policy

Beyond Kyoto

Advancing the **international effort** against **climate change**

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PEW CENTER ON Global CLIMATE CHANGE

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Prepared for the Pew Center on Global Climate Change

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Foreword *Eileen Claussen, President, Pew Center on Global Climate Change*

Our success in confronting the challenge of global climate change depends in large measure on the ability of national governments to forge an effective global strategy—one that is environmentally sound, fair, and affordable. The UN Framework Convention on Climate Change and the Kyoto Protocol represent important steps in that direction. Yet whether or not the Protocol enters into force, the same fundamental challenge remains: engaging all countries that are major emitters of greenhouse gases in a common long-term effort. We need a durable strategy that can take us beyond Kyoto.

This Pew Center report looks at core issues in crafting such a strategy. It represents the combined efforts of a dozen authors plus extensive input from policymakers, experts, and stakeholders who commented on drafts or participated in workshops in China, Germany, and Mexico. The six "think pieces" in this volume do not draw definitive conclusions about the best way forward; those can come only through further analysis and dialogue. Yet there do emerge from the papers, and from the discussions around them, some common themes and insights.

First is the realization that while the climate challenge is ultimately one of mobilizing technology, it is in the first instance one of mustering political will. This depends in part on the resourcefulness of governments in fashioning common approaches. It also means not allowing scientific and economic uncertainties to obscure the urgent need for action. Indeed the analyses here conclude that, to the contrary, uncertainty is itself a reason to act now.

Second, there is no getting around national interest. Climate change is a common challenge, but countries will engage in collective action only if they perceive it to be in their interest. A multilateral approach must therefore recognize and reflect domestic concerns such as competitiveness and development. It also must be flexible enough to accommodate different types of commitments and national strategies. Engaging actors beyond the climate circle is essential, both to build domestic support for action and to extend climate efforts to non-climate forums such as trade and development.

Finally, advancing the international effort will require new types of mitigation strategies. The approach thus far has focused principally on reducing emission "outputs." An alternative or complementary approach is to frame commitments in terms of "inputs"—the activities that generate emissions. If carefully crafted, this can help drive mitigation by focusing on the *actions* needed and by highlighting synergies between climate protection and core development concerns such as energy and transportation.

These points are neither firm principles nor prescriptions. Rather they are offered as broad themes worth considering as the dialogue on next steps moves toward a closer examination of specific options for moving forward. The Pew Center looks forward to engaging further with the many participants in this vital dialogue.

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Overview

Climate crossroads

Elliot Diringer

A decade after its launch, the international effort against global climate change stands at a critical juncture.

With well over 100 countries now committed to the Kyoto Protocol, this landmark agreement may soon enter into force. Kyoto's coming of age would be a major diplomatic accomplishment: a strong declaration of multilateral will to confront a quintessentially global challenge. But against that challenge, Kyoto would be but a first step. With the United States not joining, the Protocol would cover just 40 percent of global greenhouse gas emissions, and only through the coming decade. And that is only if the agreement does enter into force, which for the moment is hardly certain. In either case—with or without Kyoto—the international community faces the same fundamental challenge: engaging all the world's major emitters in a long-term effort that fairly and effectively mobilizes the resources and technology needed to protect the global climate.

The six "think pieces" that follow speak to that challenge. They look beyond Kyoto and consider how best to advance the international effort against climate change. The Pew Center's goal in undertaking these papers, and a series of workshops conducted alongside them, is to stimulate constructive thinking and dialogue. It is hardly too soon to begin. If the Protocol does enter into force, negotiations toward a second round of commitments are to start by 2005. If it does not enter into force, countries must be ready to consider the alternatives. Negotiations aimed at broadening and deepening the international effort will almost certainly prove more difficult than those surrounding Kyoto. Starting now to clarify core issues and explore possible approaches will, hopefully, enhance the prospects for success.

In all, more than 100 experts, officials, and stakeholders from nearly three dozen countries contributed in some fashion to this volume—as authors, as reviewers, or as participants in workshops earlier this year in China, Germany, and Mexico. This overview chapter introduces the six think pieces and highlights key themes that emerge from the papers and the workshops where they were presented and discussed.

Six Core Issues

The approach taken here is deliberately open-ended: these papers do not attempt to draw definitive conclusions about the best way forward. Nor do they set out to systematically examine a given set of alternatives. Rather, the papers are organized around six

core issues central to the design and negotiation of an effective long-term climate strategy. This inquiry is, in a sense, a return to basics. It examines questions that have loomed from the start of the international effort: how best to orient action to the ultimate objective of climate stabilization; how to manage the costs of climate action; how to arrive at agreements that are fair. The papers seek to clarify these core issues and, in a preliminary way, explore a range of approaches that might help address them. They draw on the authors' extensive negotiating experience to suggest what may be not only good policy, but politically viable as well. They aim, above all, to be pragmatic.

Briefly, the papers take up the following six issues:

A Long-Term Target: Framing the Climate Effort examines the benefits and difficulties of establishing a more concrete long-term goal to guide and motivate climate action in the near and medium term. It argues that a host of uncertainties make the negotiation of a greenhouse gas concentration target extraordinarily difficult and that alternatives—such as an "activity-based" target or a non-binding hedging strategy—may be more practical.

Climate Commitments: Assessing the Options identifies the key variables in designing mitigation commitments, offers criteria for evaluating different approaches, and discusses the merits of several leading alternatives. It argues that the wide variance in national circumstances makes a unitary approach impractical and unlikely, and that future efforts might need to allow for multiple approaches.

Equity and Climate: In Principle and Practice explores the fundamental equity concerns that suffuse the climate debate and the challenges in arriving at a fair outcome. It argues that no single equity perspective or formula can be a basis for agreement, and that the goal instead must be a political package that achieves a rough qualitative balancing of competing equity claims. The authors suggest a set of outcomes that together could meet that test.

Addressing Cost: The Political Economy of Climate Change examines the challenges of managing cost in future mitigation efforts. It identifies three critical cost dimensions that present themselves in climate negotiations—aggregate cost, relative cost, and cost certainty—and assesses how effectively alternative mitigation approaches address each.

Development and Climate: Engaging Developing Countries explores how future climate efforts can help integrate climate concerns with the core development priorities of developing countries. It argues for a fundamental reorientation of climate policy to focus less on emission "outputs" and more on the underlying activities or "inputs" that drive them.

Trade and Climate: Potential Conflicts and Synergies explores potential interactions between the international trade regime and climate policies at both the national and international levels. It identifies potential conflicts between the goals of climate protection and trade liberalization, possible measures to avert such conflicts, and ways the trade and climate regimes can be mutually supportive.

In an area of such complexity the issues are not easily segregated, so there are unavoidably overlaps among the papers. There are gaps as well—in particular, while several of the papers recognize the centrality of adaptation and technology strategies to any long-term climate effort, neither issue is treated in depth. Yet taken together, the think pieces offer a broad and, hopefully, constructive introduction to the core challenges in advancing the international climate effort.

Common Themes: Building Political Will

At the end of the day, the solution to climate change must take the form of new technology. Greenhouse gas (GHG) emissions can be dramatically reduced—and economic growth maintained—only by transforming the ways we generate and consume energy. In material terms, then, the challenge is to launch a global technological revolution. There is perhaps no historic precedent for so sweeping a technological transformation. What's more, past technological leaps have been largely ad hoc, while the need here is for deliberate, directed change. The primary medium for this revolution must be the global marketplace; only markets can mobilize capital and technological prowess on the scale needed. Yet no reasonable scenario suggests that the market alone can deliver the needed technology soon enough to avert irreversible climatic change. The direction and imperative must come from governments. How best to fashion policy to turn markets to the task of technological transformation is, then, a critical underlying question.

But the right policy answers will matter little unless there is sufficient political will to put them into action. So while the climate challenge is ultimately one of developing and mobilizing technology, it is in the first instance one of mustering political will. When and how this elusive quantity materializes will depend on a host of factors, many of them unpredictable: public awareness, media attention, electoral politics, even the weather. It depends as well, though, on the determination, flexibility, and resourcefulness of governments in fashioning common approaches.

This is, in fact, an important subtext to all six think pieces. Some consider how climate strategies can help remove obstacles to political will—by, for instance, addressing cost worries or equity concerns. Some consider ways to help drive political will—by, for instance, linking to development concerns of more immediate priority to publics and policymakers. But implicitly or explicitly, all the papers speak to the

same question: what types of international arrangements can best capture and motivate political will to achieve the broadest possible participation in an effective, long-term effort against climate change? What follows are neither prescriptions nor firm principles but rather, in broad strokes, some of the answers that begin to emerge.

Uncertainty as Cause For Action

It is by now well understood that the climate issue is rife with uncertainties—scientific, economic, and others. When faced with such uncertainties, governments by nature have difficulty launching near-term action against long-term risks. But a strong message that emerges from the analyses here is that uncertainty should not be allowed to obscure the urgent need for action. To the contrary, uncertainty is itself a reason to act now.

The scientific uncertainties are most evident in considering the case for establishing a long-term climate target. Here, the authors argue that the many uncertainties in the climate cycle make the negotiation of a quantified long-term target highly improbable, if not counter-productive. Yet they remind us that the full impacts of climate change, while quite distant, "can be averted or reduced only if action to reduce greenhouse gas emissions begins almost immediately and is sustained over the long term." And they seek other approaches that, by directing attention to the long term, could help drive action in the near term.

Similarly, the paper on cost states forthrightly that our imprecise understanding of the economics makes impossible a true analysis of the full costs and benefits of climate action. "The uncertainties over both are too great at present to allow a reliable economic rendering even with the most sophisticated modeling," the authors conclude. "The balancing must, in the end, be a political calculation." Yet the authors resist the notion that these uncertainties are cause for delay. With the potential for climate impacts that are both catastrophic and irreversible, they argue, economic reasoning favors action in the near term to preserve options in the long term. "Rather than a rationale for inaction," the paper concludes, "uncertainty is in this sense a powerful argument to begin acting now."

A Question of National Interest

Climate change is widely understood as a common challenge—in the long run it can be effectively addressed only through collective action. Yet the political reality, as the paper on commitments makes clear, is that "states are likely to address climate change only if they believe it is in their interest to do so." An international strategy can take shape and succeed only if it satisfies the domestic needs and concerns of its would-be adherents.

The danger of failing to align international climate strategy with domestic politics is perhaps best exemplified by the case of the United States. There arose a fundamental disconnect in U.S. climate policy: the Clinton administration acceded to international pressure for strong commitments without building the

domestic support, or undertaking domestic policies, to meet them. President Bush, instead of seeking a negotiated solution, chose to reject the Kyoto Protocol. The lesson is not to hold international policy hostage to the domestic whims of each and every nation—even to those of the largest GHG emitter. Rather, it is that all parties must seek to better understand their respective domestic concerns, and to build a collective framework that assists each in generating greater political will.

This is, in part, a matter of recognizing that climate is not simply an environmental issue but fundamentally one of economics and development. As one workshop participant put it, the goal for all countries—developed and developing—must be sustainable growth along a low-GHG pathway. The means of demonstrating the necessity and practicality of this goal will vary from country to country. The cost paper, for instance, addresses the concerns of those for whom uncertainty over cost or competitiveness impacts may be paramount. The development paper argues for engaging developing countries by recasting climate policy in ways that are seen as promoting, rather than obstructing, core development priorities such as energy growth and poverty reduction. "Climate-related policies," the authors state, "are most likely to draw political support within developing countries when they piggyback on and enhance more salient development priorities."

The broader point, reiterated many times in the workshop discussions, is that a multilateral approach cannot succeed by attempting solely to remold countries' behavior from the top down. It must at the same time recognize and reflect national circumstances from the bottom up.

A More Flexible Architecture

A natural corollary of this attention to domestic concerns is the need for international approaches flexible enough to accommodate different types of national strategies. The next stage of climate diplomacy must, in the words of the equity paper, construct a more "variable geometry."

The Kyoto Protocol provides a degree of flexibility. Emission targets vary from country to country, and each has considerable latitude in deciding how its target will be met. But the Protocol employs only one form of mitigation commitment: fixed targets and timetables. There was a strong consensus among the authors, as well as reviewers and workshop participants, that other approaches are needed. "In moving forward," states the commitments paper, "it is unlikely that one size will fit all: different mitigation commitments will prove more or less attractive to different countries." Different approaches are needed for developed and for developing countries, and possibly within those groupings as well. The commitments paper presents an array of possibilities—such as indexed, sectoral, or non-binding targets—and other papers consider these from perspectives of cost, equity, and development.

It was quickly evident in the workshop discussions, however, that the political necessity of greater differentiation poses an entirely new set of policy challenges. If, for instance, multiple approaches are undertaken within a single international framework, some type of metric will be needed to compare

measures so parties can assess relative levels of effort. If, on the other hand, greater differentiation is achieved through multiple frameworks—with different groupings of countries undertaking different types of commitments through parallel regimes—linkages among frameworks will be needed for each to be as cost-effective as possible. In either case, greater flexibility would come at the cost of greater complexity. Kyoto has demonstrated already the technical and institutional challenges of a system with just one type of mitigation commitment. Accommodating multiple approaches will be possible only if it can be made manageable.

Choosing the Forum and Quorum

Among the most fundamental, and most delicate, issues to emerge is how to define the universe of participation. There are two questions: the grouping of countries needed for an effective long-term effort, and the best institutional forum for this undertaking.

From the start of the climate negotiations, there has been a presumption that the best approach is a global one. The rationales are numerous and persuasive. From an environmental standpoint, the goal of climate protection can be achieved only with broad participation. From an economic standpoint, the broader the participation, the greater the opportunities for cost-effectiveness. And from the standpoint of equity, many if not most players will be reluctant to act without assurance that others will as well. Added to these rationales, at this point, is the *fact* of a global regime. Nearly every nation on earth is party to the UN Framework Convention on Climate Change. It represents a tremendous investment of political and negotiating capital and enshrines principles that most parties would not easily abandon.

Yet the failure as yet to mobilize broad, effective action suggests at least reconsidering the practicality, or even the necessity, of a fully global approach at this stage in the climate effort. A decade of tedious negotiations has led some to question the wisdom of burdening the climate effort with a decision-making structure that requires full consensus on all questions and, therefore, allows a small minority to block progress. Some developed country negotiators complain in particular that parties that have no mitigation commitments hold veto power over issues that bear exclusively or most directly on those that do. Finally, despite the existence of a globally agreed framework, the reality at the moment is one of fragmentation: even if Kyoto does come into force, the United States, Australia, and perhaps others will pursue a separate course.

One possibility, at least for the near term, is a fuller development of parallel regimes. As described in the commitments paper, these could be comprised of "like-minded states [that] are willing to undertake a certain level of commitments and have shared views about international implementation mechanisms." Such arrangements could be struck within any number of regional or multilateral forums—the OECD is frequently cited as one example—or through new bilateral or multilateral agreements.

It is also possible to envision a different grouping within the existing global framework, something akin to Annex I (listing developed countries) in the Convention but perhaps transcending the framework's present division between developed and developing countries. The idea of a "major emitters" approach surfaced more than once in the workshops. One developed country negotiator noted that just 12 parties (counting the European Union as one party) account for nearly 80 percent of global carbon dioxide emissions. But there is strong resistance within the G77 to any approach that splits this traditional developing country negotiating bloc. (One developing country negotiator said it is "politically more interesting" for G77 countries to stick together. Another suggested it may be economically more interesting not to.) Some also object to any approach that excludes the "victims"—those countries, principally the least developed, that generate the least emissions but are most vulnerable to climate impacts. Others, however, argue that the victims' interests are best served by an agreement that generates strong action, whether or not they are parties to it.

The papers and the discussion around them suggest broad consensus that, in the long run, some type of global approach is not only preferred but necessary. The question is whether at this stage insisting on a global approach is more likely to facilitate, or impede, the generation of political will.

Targeting Action, Not Only Emissions

The climate effort has sought to drive mitigation through measures mandating specific environmental outcomes. Kyoto's targets, for instance, require quantified emission reductions. Two of the papers in this set argue strongly for an alternative or complementary approach that instead frames commitments in terms of the kinds of *actions* that are required.

As noted earlier, the long-term target paper concludes that a host of scientific uncertainties make it difficult if not impossible to negotiate a quantified long-term climate target. If the international community is to purse a long-term target, the authors argue, it would be more practical to cast it in terms of the types of actions needed to move economies toward the goal of climate stabilization. They suggest, as examples, developing cost-effective technology to capture and store carbon dioxide by 2025 or, in the transport sector, replacing gasoline with hydrogen from non-carbon sources by 2050. Another option, more a cross between an emissions and an activities approach, is to aim for zero-net carbon emissions in the energy sector by 2060. A target focused on activities, rather than on variables such as GHG concentrations or global temperature, "employs as its metric the variable most amenable to human control," state the authors. "Plus, by casting the goal in terms of the practical challenges to be met, it can help define in the public mind, and build support for, the effort required."

The development paper presents a parallel argument. Particularly in the case of developing countries, the authors assert, mitigation goals should be cast not in terms of "outputs," or emission

levels, but rather in terms of "inputs," the activities that generate emissions. First, this addresses developing country concerns that, with their future emission trajectories so uncertain, a quantified emissions goal could become an economic straitjacket. Second, a goal cast in terms of energy or transport policy speaks more directly to core development priorities, and therefore is more likely to engage developing countries than would a climate-centric approach.

In both papers, then, activity-based approaches are seen as a way to overcome uncertainty and build political will. There are potential tradeoffs, depending on the type of goal chosen. A commitment to act a certain way—for instance, to adopt a given technology—may sacrifice environmental certainty: there is less assurance as to the impact on emissions. Also, a technology target may be less cost-effective than an emissions target. In allowing governments rather than markets to choose technologies, it risks locking in more costly alternatives. But these tradeoffs may be reduced if an activity-based commitment is framed differently—for instance, requiring a specified level of energy efficiency improvement. This allows greater latitude in the choice of technologies and provides stronger assurance, if not certainty, as to the environmental outcome. To the degree that such tradeoffs are in the end unavoidable, they may be the price paid for achieving broader participation and stronger action.

Reaching Beyond the Climate Circle

A theme in the papers, and a common refrain in the workshops, is the need to engage actors well beyond the ministries charged with responsibility for the climate negotiations and the experts and stakeholders who seek to influence them. A wider circle is needed both to build domestic support for action and to extend climate-related efforts to non-climate forums such as trade and development.

In many countries, environment ministries have the lead on climate policy but are often trumped by ministries of finance, trade, or industry. This shapes both the positions governments bring to the negotiations and their ability later to deliver on commitments made. The case for engaging other ministries—and their constituencies—is made most explicitly in the development paper. One of the merits of an "input-based" approach, the authors argue, is that it appeals more directly to the government agencies and private sector interests connected with politically salient development priorities. It also helps create a more "positive" agenda, casting climate action less as a constraint and more as a driver or facilitator of goals such as economic growth or energy security. The means might differ in developed countries, but the same political reality holds there as well: stronger action will require broader coalitions both in and out of government.

In the international context, widening the circle might mean extending the climate effort beyond the climate regime to other institutions. The development paper recommends enlisting aid agencies,

multilateral lenders, and export-import banks to recast development assistance and leverage private flows in ways that favor climate-friendly development. The trade paper encourages collaboration between the climate regime and the World Trade Organization both to head off potential conflicts between them and to promote synergies. It suggests a range of options—from simply building stronger institutional ties to actively pursuing climate objectives through the trade regime, for instance by negotiating a phase-out of fossil fuel subsidies. "Reducing trade barriers and greenhouse gas emissions can be complementary objectives," the paper concludes, "and the trade and climate regimes should be looking for opportunities for mutual supportiveness."

Avoiding the Minefields

The climate effort has been marked from the start by a profusion of challenging and sometimes conflicting issues and interests. As the debate has progressed the scope of issues has, if anything, broadened further.

A decade of climate negotiations suggests it will not be possible to forge a consensus that satisfactorily addresses each and every concern brought to the table. Moving forward will require somehow narrowing the field—distinguishing those issues that are necessary or productive to consider from those that are unnecessary or unproductive. These distinctions can in the end be drawn, of course, only through frank exchange and difficult negotiation. However, the papers presented here offer new perspectives on issues that have long dominated the climate debate and, in so doing, identify certain minefields that might best be avoided. In particular, the papers on equity and a long-term climate target challenge some conventional wisdom on these issues and caution against paths that might easily be dead ends.

In the case of a long-term target, the authors warn against a fixation on an ideal outcome whose pursuit could not only be fruitless but squander scarce negotiating energy. In the case of equity, the authors argue persuasively that there can be no agreement unless it is perceived to be fair—or, at the very least, not demonstrably unfair to one party or another. But they counsel against a search for the ideal equity principle or formula. To achieve equity, they suggest, it may not be necessary—or wise—to negotiate equity per se. The goal instead should be a package of specific outcomes offering each party enough to accommodate its own sense of fairness. "This is not, in the final analysis, a quantitative exercise," the authors conclude. "Rather we must look for outcomes that are robust in a qualitative sense across the many dimensions of equity at play." Such outcomes will be achieved, they advise, only by "leaving room for politics."

Next Steps

Charting a course beyond Kyoto is an immense challenge. Real movement within the climate process will not be possible without a good deal more dialogue outside the process. The thinking presented here is but a preliminary contribution to that dialogue. As the conversation deepens, and as it turns to a closer examination of specific options for moving forward, it will be important to bear in mind that no option is flawless. Each requires difficult tradeoffs among goals that may all appear critical: environmental integrity, affordability, fairness, and full participation. The equity authors' advice—to leave room for politics—might well apply across the full range of issues. Science, economics, and policy analysis can all lend essential insights. They illuminate the challenges and help define the range of solutions. But these insights can be converted to political will—and action—only through sound political judgment.

A long-term target

Framing the climate effort

Jonathan Pershing and Fernando Tudela

I. Introduction

More than most other environmental concerns, climate change is inherently a long-term challenge: its full impacts will not become obvious for decades or centuries, and an effective strategy to avert them requires sustained action over decades or longer. These long time horizons, and the scientific uncertainties they present, pose special difficulties for political systems geared to more immediate concerns, and hence, for any effort to mobilize international action against climate change.

There is broad scientific consensus that the planet is warming; that human activity is a principal cause; and that, absent prompt remedial efforts, the world will continue to warm substantially over the next several centuries, with potentially serious consequences for life-sustaining systems. While the risks may be high, most are also quite distant. Yet these far-off impacts can be averted or reduced only if action to reduce greenhouse gas (GHG) emissions begins almost immediately and is sustained over the long term. This requires transforming processes deeply rooted in our socio-economic systems: the way we produce and consume energy, transport ourselves and our goods, and build and use our infrastructure. These are systems with long life cycles, and even small changes will take time. Few governments, however, are well prepared to consider and adopt policies for long-term action to address long-term risk. Mitigating climate change thus clashes with the usual time frame of political action.

A central issue in the climate debate is whether a clear long-term target would be helpful—or perhaps even essential—in framing and motivating effective long-term action. Article 2 of the United Nations Framework Convention on Climate Change (UNFCCC), adopted in 1992, takes a step in this direction by establishing a broad long-term objective:

> *"...stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system..."* [1]

The international community has yet to better define this objective, focusing instead on nearer-term targets. The first of these, also in the Framework Convention, required that advanced industrialized countries "aim" to return their emissions to 1990 levels by 2000. The parties, recognizing that this limited goal was inadequate, soon launched a second negotiation leading to the 1997 Kyoto Protocol. Kyoto would establish new emissions reduction commitments—still short-term (for the period 2008-2012), but legally binding. It also foresees subsequent negotiations toward future commitments. At the time the

Protocol was negotiated, this iterative process was presumed to be a viable framework to address the long-term climate challenge.

With the United States now rejecting the Protocol, and its entry into force uncertain, it appears unlikely that Kyoto will achieve even its initial near-term goals. However, if Kyoto does enter into force, the international community will soon face a new round of climate negotiations: the Protocol requires that negotiations toward a second set of near-term commitments, presumably for the period 2013-2017, begin by 2005. Conversely, if Kyoto founders, parties will be forced to consider alternative approaches. Either scenario would afford an opportunity to revisit the question of a long-term target.

A long-term climate target, while typically understood as a quantitative limit on GHG concentrations in the atmosphere, might take any number of forms. It might, for instance, be cast in terms of mean global temperature or global GHG emissions, rather than atmospheric concentrations. More broadly, a target might be merely notional or aspirational, meaning its achievement is broadly desired but not obligatory; or it might in some way be binding, requiring specific actions or measures to ensure it is met. In either case, a long-term climate target is understood here as a complement to near- or medium-term goals, serving to drive or frame, not supplant, them.

Examples of different approaches to long-term target setting can be found elsewhere in the international arena. In one category are the type of non-binding medium-term goals adopted by United Nations bodies in recent years, such as the Millennium Development Goals[2] and those negotiated at the 2002 World Summit on Sustainable Development. These include, for instance, halving the population living in poverty or without access to safe drinking water by 2015. Clearer examples of long-term environmental targets are those established by the Montreal Protocol on Substances that Deplete the Ozone Layer and the Stockholm Convention on Persistent Organic Pollutants (POPS). The POPS agreement takes an approach similar to the climate convention, setting a broad long-term objective of "protecting human health and the environment from persistent organic pollutants,"[3] followed by specific restrictions on the production and use of certain compounds. The Montreal Protocol set a harder, more explicit objective—phasing out ozone-depleting substances—which was then the basis for corresponding near-term obligations. Unlike the UNFCCC, neither treaty sets a goal based on larger physical systems (e.g., for ozone, "restoring the stratospheric ozone layer").

While these examples may suggest lessons for addressing climate, the climate challenge is of an entirely different order, implicating a much broader range of human activities. This paper explores the rationale for—and practicality of—negotiating and adopting some form of long-term climate target. It begins, in section II, by setting out the case for establishing a long-term target.[4] Section III reviews the climate cycle—from human activity, through emissions, to concentrations and ultimately to climate

impacts—and considers the prospects of adopting a long-term target at each of these stages. In light of this review, section IV reassesses the case for adopting a specific long-term target. It concludes that negotiating a target may not be politically viable, and attempting to could even be counterproductive, but that if pursued, the most promising approach may be an "activity-based" target more immediately related to the concrete challenges to be met. Section V explores alternative approaches that could deliver some of the benefits of a quantified long-term target, including a hedging strategy that seeks to keep options open.

Underpinning this analysis is the strong view that the ultimate objective of the Framework Convention can be achieved only if net GHG emissions (emissions minus removals by sequestration) eventually reach zero. Implicitly or explicitly, then, a fundamental issue in considering a long-term target is whether it can motivate the actions necessary to achieve that—and, if so, by when.

II. The Case for Setting a Long-Term Target

Attaining a long-term climate target would require action across the globe. Nevertheless, individual countries and groups of countries have begun adopting targets of their own. Recent examples include: the European Union, which aims to stabilize carbon dioxide (CO_2) concentrations at no more than 550 parts per million (ppm) and limit global temperature rise to 2 degrees Celsius above pre-industrial levels; the United Kingdom, where a recommendation by the Royal Commission on Environmental Pollution to reduce CO_2 emissions 60 percent by 2050 and stabilize concentrations at 550 ppm has been endorsed by Prime Minister Tony Blair; and Sweden, which has a stabilization target of 550 ppm, but for all six GHGs covered by the Kyoto Protocol (essentially, a CO_2 target of 500 ppm).[5] None of these targets is in any sense binding.

Advocates of an internationally agreed long-term target say it is an essential functional component of the climate regime.[6] A variety of rationales have been put forth. They include:

Providing a concrete goal for current and future climate efforts A long-term target would provide the international community with a clear statement of the goal to which near- and medium-term efforts must be geared. It has been said, metaphorically, that when starting a journey it makes sense to know where you are going. A long-term target may provide a more concrete answer to the legitimate question raised by any stakeholder asked to make a sacrifice: to what end?

Increasing awareness of the long-term consequences of our actions Current emissions and concentrations trajectories represent, by default, implicit "targets." Defining a long-term target may help make those trends explicit and amenable to control.

Calibrating short-term measures and measuring progress A long-term target provides a metric to guide nearer-term measures and to gauge progress over time. At any given moment, "being on track" can only be determined if the final destination is known. A fixed endpoint also allows a determination of the total effort required, possible pathways to the objective, and the adequacy of individual steps.

Inducing technological change Effectively addressing climate change will require deep technological change. A long-term target, particularly if coupled with convincing near-term signals, could help drive the necessary research effort and investment flows. Markets would receive a stable signal as to where they should be heading, irrespective of the ups and downs of negotiations over short-term issues. In addition, a long-term signal could favor investment in technologies that can be developed and fully deployed only over a period of decades.

Limiting future risks derived from climate change An adequate long-term target may provide some assurance that specific undesirable outcomes will *not* take place; it might be an effective way of managing global risks. Furthermore, by implicitly providing information on the level of risks that are acceptable, a target can push the international community to come to terms with how it will cope with those that are not.

Mobilizing society A long-term target resulting from a multilateral negotiation would provide a degree of legitimacy to the climate mitigation effort. It could thus help mobilize society, including the private sector, individuals, and NGOs.[7] Just as many local communities build a "thermometer" to publicly track contributions toward an initiative, the international community may be sensitized with respect to climate change, keep track of advances, and step up collective efforts by monitoring progress toward a long-term target.

Promoting global participation Stabilizing GHG concentrations at any level within any reasonable timeframe is impossible without the participation of all major emitters. While at any interim step it may be argued that only the industrialized countries should act, no such latitude is available if a stringent longer-term objective is set: it is impossible to substantially reduce global emissions, atmospheric concentrations, or climate damages without global action. Broadening participation, however, will only be possible if countries can agree on equity issues.

In assessing the different forms that a long-term climate target might take, it will be important to consider how well they match these various rationales. First, however, it is helpful to introduce the key stages of the climate change cycle.

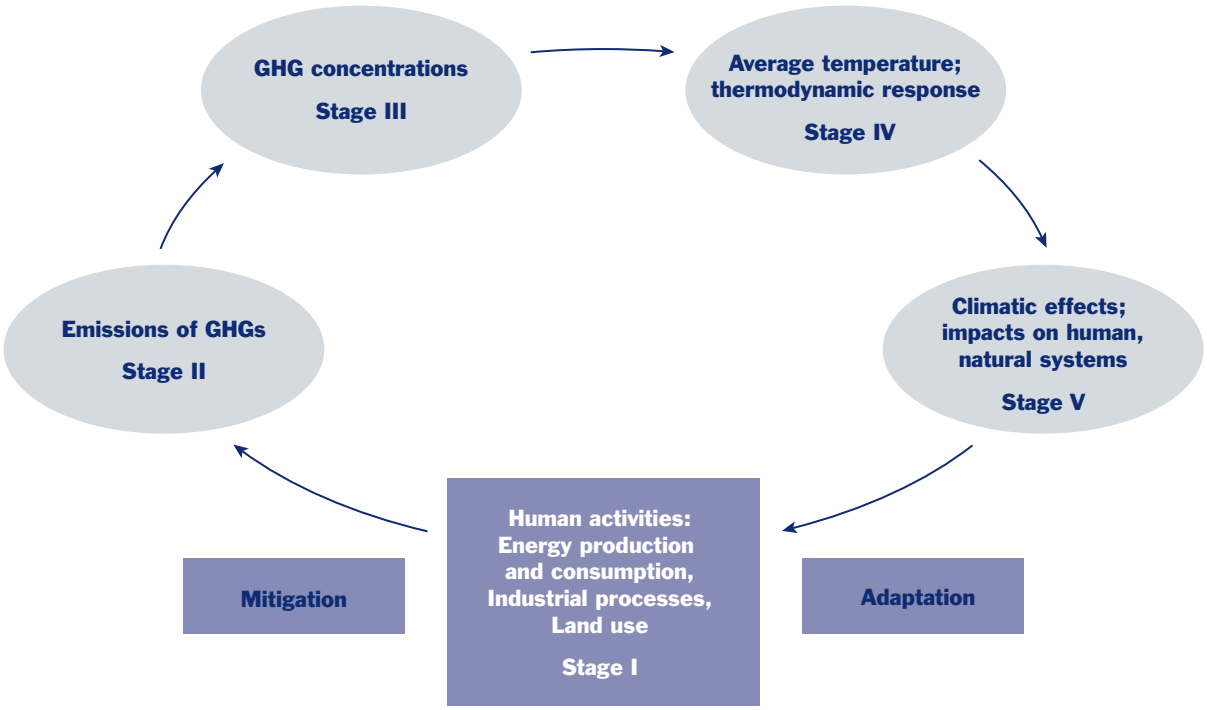
III. Human and Climate Systems

Climate change processes encompass both human affairs and the climate system in a complex interplay on time scales ranging from the instantaneous to millennia. Figure 1 represents, in simplified form, the physical processes and causal links in the climate change cycle. The cycle has five stages, beginning with human activities, then moving clockwise to emissions, to GHG concentrations, to temperature, and finally to climate impacts. Each stage has its own time frame and its own range of uncertainties.

Most *human activities* emit greenhouse gases, either directly or indirectly (stage I).[8] The principal sources of GHG emissions are fossil fuel combustion, deforestation and other land use activities, and industrial processes. The predominant, though not most potent, of the human-induced GHGs is CO_2. Others include methane (CH_4), nitrous oxide (N_2O), and a number of industrially produced gases. Many activities generate emissions years after the activity itself has ceased. For example, methane emissions from decomposing biomass may occur decades after land has been cleared.

Figure 1

The **Climate Change Cycle**



Note: This figure depicts the key stages of the climate change cycle, from human activities that generate GHGs to impacts on human and natural systems. This simplified representation emphasizes the primary causal links leading from activities to impacts. A fuller representation of the cycle would show additional physical and socio-economic feedbacks among the stages. Also, the causal links are represented at the global level. At the national level, some stages are more relevant than others. A nation may have high emissions but face low risk of climate impacts, or vice-versa.

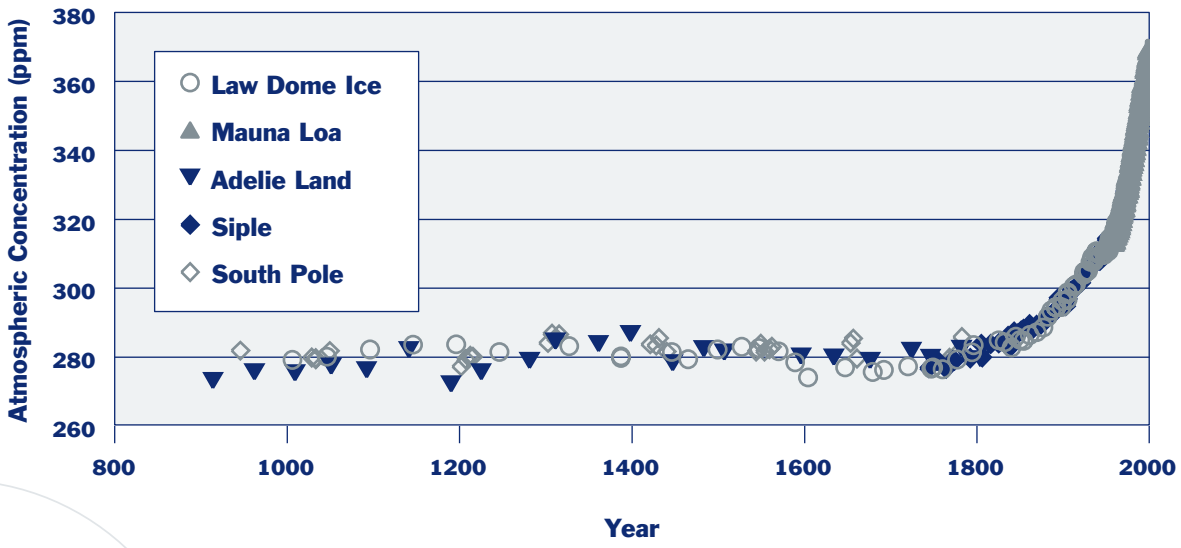
As a result of these activities, total global emissions (stage II) have increased at an essentially exponential rate since the industrial revolution. The total annual flow of CO_2 entering the global atmosphere, including that stemming from land-use changes, may have reached 8 Gigatons of Carbon (GtC) in the last decade.[9]

Rapid emissions growth has led to a rise in the *concentrations* of GHGs in the atmosphere (stage III). Carbon dioxide concentrations have been carefully measured since 1958 at the Mauna Loa Observatory in Hawaii, and measurements from ice cores and other geologic and biological features such as tree rings and coral reefs provide proxy data going back at least 400,000 years. Over the past millennium, reliable data show stable concentrations until around 1800, and an exponential increase thereafter (see Figure 2). The present CO_2 concentration is approximately 370 ppm, more than 30 percent above its pre-industrial level of 280 ppm.

Rising concentrations enhance the natural greenhouse effect that warms the planet, leading to rising average *temperatures* (stage IV). Because of the tremendous inertia in the climate system, the temperature increase occurs only gradually, and a new equilibrium temperature can be achieved only long after concentrations have again stabilized. Average global temperatures rose 0.6 ± 0.2 degrees Celsius over the 20th century. Given present emission trends, the Intergovernmental Panel on Climate Change (IPCC) projects an additional increase of +1.4 to +5.8 degrees Celsius by the end of the 21st century.

Figure 2

Evolution of **CO_2 Concentrations**



Note: Law Dome Ice, Adelie Land, Siple, and South Pole are data sets showing CO_2 concentrations in Antarctic ice cores for the past millennium. Mauna Loa represents recent atmosheric measurements.

Source: Adapted from IPCC (2001). Figure 2, p. 155.

Rising global temperatures, in turn, have *impacts* on human and natural systems (stage V). One consequence is progressive sea-level rise, due mainly to thermal expansion of the oceans and, to a lesser extent, melting of ice sheets. Other impacts include increased flooding and drought, increased frequency and severity of extreme climate events, disruption of agriculture, loss of species and ecosystems, and, potentially, sudden large-scale events such as the collapse of ice sheets. Depending on the magnitude of the temperature increase, warming may also produce localized benefits, such as increased growing seasons in northern climes, although on a global scale damages are likely to far outweigh benefits in the long term.

IV. From Activities to Impacts: Assessing the Options

It is, in theory, possible to establish a long-term target at any one of the stages of the climate change cycle. Whatever stage is chosen, however, the target-setting exercise invariably implicates all five. Any target, no matter its form, would seek ultimately to limit climate impacts (stage V) and, to be effective, must somehow influence human activities (stage I). What the target requires, then, and what it delivers can be fully understood only by working through the entire sequence. (See Appendix for a menu of possible targets and their corresponding values at each stage of the climate cycle.)

Each stage presents new uncertainties, with important implications for the ease of negotiating and implementing each given type of target. For instance, the closer a target is situated to stage V, the clearer its link to climate impacts, but the less certain its implications for mitigation policy. Conversely, a target at stage I may more readily translate into mitigation policy, but its likely contribution to reducing climate impacts is far less clear. The particular entry point could also influence the *nature* of the ensuing mitigation effort. A long-term concentration target might favor near-term goals cast as emission limits, for instance, while an activity-based target might suggest a more policies-based approach.

In physical terms, as presented above, the climate cycle quite obviously proceeds clockwise from activities to impacts. However, in assessing the practicality of target setting at each stage, we will take them up in reverse order. As the real objective of any climate change strategy is to avoid or reduce impacts, we begin the analysis there, at stage V, and work counter-clockwise back to human activities.

Stage V—Impacts

One approach to setting a long-term climate target would be to cast it in terms of the level of climate change impacts, or damages, to be avoided. Such a target could take many forms: avoiding substantial damage to coastal zones; minimizing climate-related migration of disease vectors or of natural or managed ecosystems; avoiding shifts in ocean circulation. There are compelling reasons for setting a target at this stage:

- As stated before, avoiding damages is the ultimate rationale for any action to mitigate climate change. An impacts target makes explicit the intent of the near-term effort.

- Many types of damage can be assessed in terms of cost, which can be weighed against the cost of mitigation. This allows an assessment of the value of any given level of effort.

- Many impacts are local. An impacts target with local resonance can provide a more compelling political rationale for action.

An impact-based approach is implicit in the UNFCCC's ultimate objective: avoiding "*dangerous* anthropogenic interference." However, translating "dangerous" into concrete terms is anything but clear-cut. It requires consensus on the level of acceptable risk, an inherently political determination resting on value judgments.

More broadly, any impact-based target requires an adequate understanding of the likely magnitude, timing, and distribution of future climate impacts, as well as the potential steps that might be taken to offset the damages (e.g., through adaptation). However, even assuming sufficient knowledge and consensus on acceptable risk, an impacts target can effectively drive action only if it can be reflected back through the earlier stages—temperature, concentrations, and emissions—to human activities.

Figure 3 provides a schematic view of the IPCC's assessment of potential climate impacts at varying levels of temperature increase. It reflects the very broad range of impacts—from the local to the global, the environmental to the economic, and the gradual to the sudden. Across this full range, as the IPCC readily acknowledges, there are very strong limitations on our ability to project the timing and magnitude of impacts, or to distinguish them from non-climate effects.

To begin with, even if we were able to accurately forecast future temperature rises, our understanding of the climate responses, and therefore our ability to model them, remains limited, particularly at local and regional scales. Cloud modeling, for example, stands out as one of the weakest analytical components. Another is local changes in frequency and intensity of precipitation: for any given region, one model may forecast increasing rainfall while another forecasts a decline.

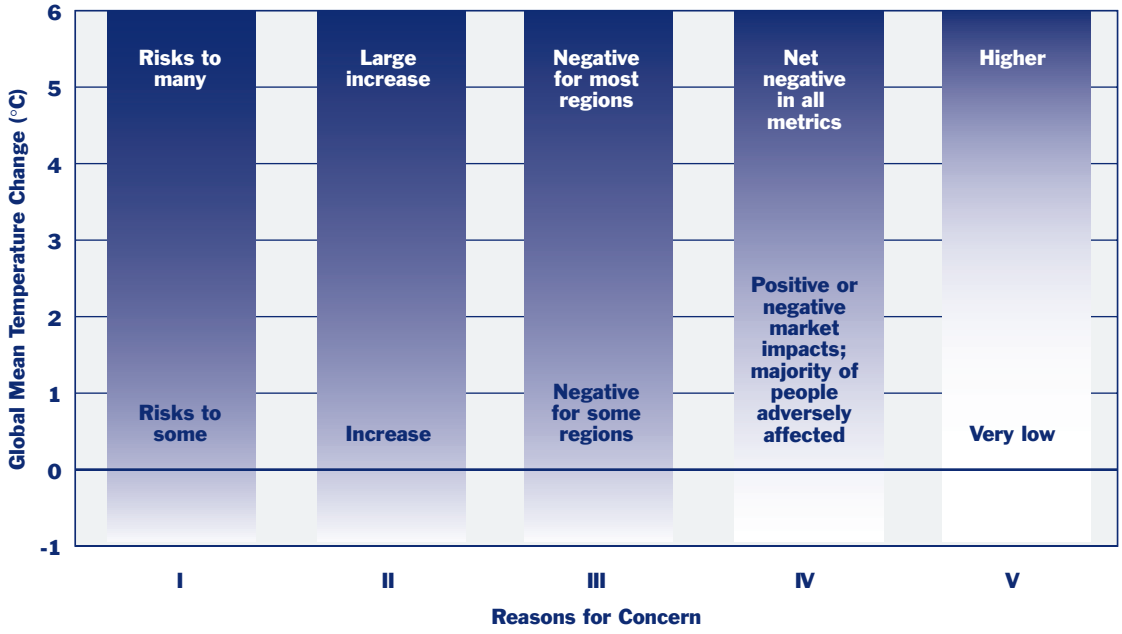
Some impacts, particularly those on ecosystems, are quite sensitive not only to the magnitude of local climatic shifts but also to the rate of change. A slow change may allow for adaptation or shifts in the spatial distribution of species, while a quick one may accelerate the rate of extinction or disrupt ecological functions in an irreversible way. Some ecosystems, such as coral reefs, are particularly sensitive to climate changes and may be irreversibly affected in a matter of a few years.

Any attempt to project climate impacts also is made difficult by the long time lags involved. Even once global temperatures re-stabilize, already a distant outcome, sea level may still keep rising for centuries, driven by the slow process of ice cap melting. In setting a target, would the appropriate time frame be a century? Ten centuries? A millennium?

The local nature of many impacts—and their sheer diversity—would further complicate a negotiation that arguably must be global in scope. Impacts will not be evenly spread throughout spatial scales, social groups, or ecosystems. Indeed, some are likely to be felt most acutely by those contributing least to their generation. Further, what is "dangerous" for one region or group might be less so or even beneficial for others.

Figure 3

Risk of **Potential Climate Impacts**



I. Unique and threatened systems (extinction of species, loss of unique habitats, bleaching and death of coral)

II. Extreme climate events (health, property, and environmental impacts from increased frequency and intensity of some climate extremes)

III. Distribution of impacts (cereal crop yield changes, decreases in water availability, greater risks to health, net market sector losses)

IV. Global aggregate impacts (globally aggregated net market sector losses, more people adversely affected than beneficially affected)

V. Large scale, high impact events (significant slowing of thermohaline circulation, melting and collapse of ice sheets)

Source: Adapted from IPCC (2001). Figure 6-3, p. 103.

One approach might be to define "dangerous" in larger structural terms—for example, irreversible or non-linear changes in ecosystems or societal systems. A long-term target may be more acceptable if it could define a threshold below which events perceived as catastrophic would be much less likely. Some have suggested that preventing the loss of "charismatic" ecosystems like coral reefs, or averting low-probability catastrophic events like the collapse of the West Antarctic Ice Sheet, could serve as powerful markers framing the long-term climate effort.[10] Yet it is in understanding the triggers for, and therefore likelihood of, such events that science and modeling are in some cases at their weakest.

Even if consensus on what constitutes "dangerous" could be reached, to be of real utility, an impacts target would have to be translated back through the other stages of the climate cycle to in some fashion redirect human activities. It is important, then, to understand the additional uncertainties that enter at each stage.

Stage IV—Temperature

The most direct consequence of rising GHG concentrations is their thermodynamic effect on the atmosphere and the planet–i.e., rising temperatures. There are strong reasons to cast a long-term climate target in terms of global mean temperature:

- Temperature and concomitant sea level rise are the primary climate change effects we are concerned with; establishing an explicit long-term target at this stage places the emphasis on those variables.
- Thermodynamic effects are global and thus are shared by all countries and individuals.
- The link between concentrations and temperatures has been well established; it thus can serve as a useful proxy.
- Temperature is an indicator that is readily understandable by the average citizen and therefore helps make an arcane debate more accessible.
- Global temperatures are now routinely monitored in a reasonably accurate fashion.

Governments and researchers have advanced several proposals that in some way employ temperature as a metric to guide action. In a 1995 proposal by the German Advisory Council on Global Change and in the "safe corridors" proposal by the Dutch government shortly before Kyoto, both absolute levels and the rate of temperature increase are considered to be critical factors.[11] The Brazilian government, in a proposal made during the Kyoto negotiations, advocated using temperature as the basis for burden-sharing criteria to establish emission targets for industrialized countries. It proposed a formula to determine each country's share of accumulated responsibility for global temperature increase.[12]

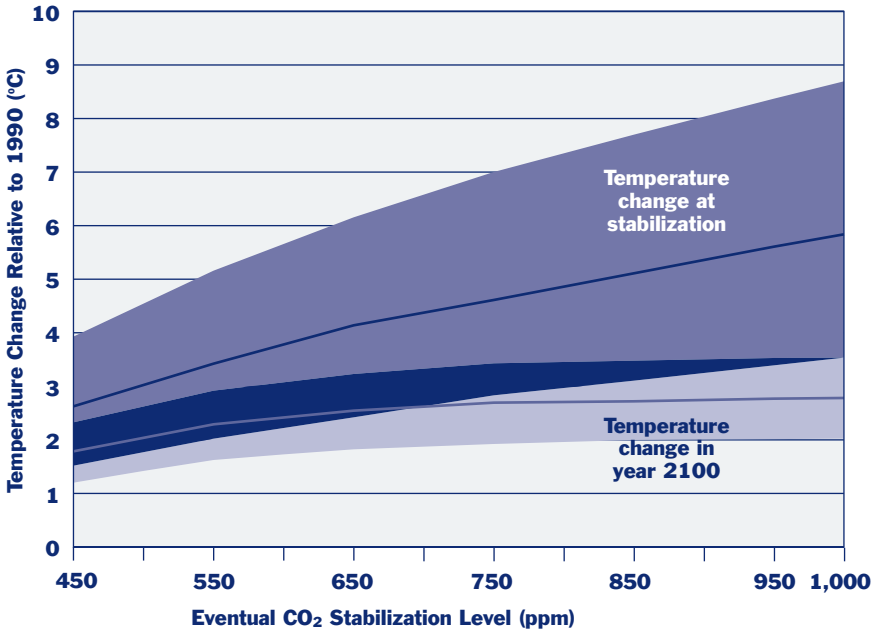
More recently, a Dutch-sponsored project called Climate Options for the Long Term (COOL) concluded that a prudent target would be a maximum temperature increase of 1.5 degrees Celsius, and a rate of maximum allowable temperature change of 0.1 degrees Celsius/decade. This proposal is based on studies assessing the consequences of such shifts to natural and human ecosystems—essentially, basing temperature targets on impacts and damages. Furthermore, concluding that a conservative path must be set to assure that the temperature targets are not exceeded, it in addition proposed a concentration target of 450 ppm.

Focusing on temperature, rather than impacts, may bypass one broad set of uncertainties: the specific impacts linked to a change in temperature. However, this stage presents its own set of uncertainties. For instance, how are we to assess the global variability in the temperature change? Temperature is projected to increase faster in the polar regions, so must we set our global target correspondingly lower, below the desired average, to ensure an acceptable level of risk at the polar extremes? Or do we set different targets for different regions? Also, while the timescales are not as open-ended as at the previous stage, we continue to face very large time lags. Do we assess the acceptability of change as a function of the long-term equilibrium effect or of the effect over the next 100 years only? And how do we know when the effects of temperature stop being linear and cross some threshold to become sudden or catastrophic?

Finally, there are uncertainties in the link between temperature and GHG concentrations, one stage back in the cycle. For any given level of stable concentrations, we can at best project a range of temperature increase, with dramatic variations in the likely impacts at the upper and lower bounds of the estimate. Figure 4 illustrates the range of uncertainty over the level of warming likely to result from different stabilized concentrations of CO_2.

Figure 4

Uncertainty in the Link Between Concentration and Warming



Source: IPCC (2001). Figure 6-2, p. 101.

Stage III—Concentrations

In both technical and political analyses of a potential long-term climate target, the metric most often employed is GHG concentrations. This is not surprising as it is the metric enshrined in the ultimate objective of the Framework Convention: "...stabilization of greenhouse gas concentrations in the atmosphere...." This alone may suggest to some that this is the appropriate form for a long-term climate target and could impede any effort to negotiate a target of a different type. There are a number of persuasive rationales for setting a target at this stage of the cycle:

- Increased GHG concentrations in the global atmosphere are the most direct cause of climate change.
- Even more accurately than global temperatures, global GHG concentrations are now routinely monitored.
- The dynamics of GHG concentrations are commensurate with the long-term time frame of mitigation action, reflecting, as it does, not marginal change, but the cumulative total of all global activities.
- Finally, the UNFCCC reflects a political consensus that was difficult to achieve and, as it casts its ultimate objective in terms of stabilizing concentrations, politically this may be the easiest path to a specific long-term target.

As noted earlier, several countries already have adopted non-binding concentration targets. The implications of stabilizing concentrations at given levels—for both the climate impacts that might result and the emission reductions that would be necessary—have been closely analyzed. Some of those implications are described in the box on the next page.

Stage III—concentrations—is at the midpoint in the climate cycle, halfway between stage I (human activities) and stage V (climate impacts). From the target-setting perspective, this presents both virtues and drawbacks. This stage provides a good vantage point to look in both directions—to original cause (human activities) and to ultimate effect (climate impacts)—and might therefore provide a convenient metric between them. Concentrations would thus become the nexus between damages to be avoided and effort to be undertaken. However, such an exercise is confounded by uncertainties in both directions. The difficulties in relating a given GHG concentration to global temperature and, in turn, to impacts, have already been discussed. Moving in the other direction, the most obvious difficulties are

Possible CO_2 Concentration Targets

Stabilizing at 450 ppm

As perhaps the most stringent long-term target that might likely be achieved under current circumstances, stabilization of CO_2 concentration at 450 ppm in 2100 has received particular attention.[13] It was, for example, extensively discussed in the COOL project, funded by the Dutch government.[14] According to the IPCC's Third Assessment Report, stabilizing at 450 ppm would virtually exclude the possibility of changes in mean surface temperature[15] exceeding 4 degrees Celsius (range: 1.4-4.0 degrees Celsius). As of 2100, temperature increase would range between 1.2 and 2.4 degrees Celsius. Large-scale discontinuities, such as the disruption of thermohaline ocean circulation, would be unlikely. The IPCC analysis suggests that meeting a 450 ppm target would require a reduction in *global* CO_2 emissions of about 15-25 percent below 1990 levels by 2050. A 450 ppm target might be met with already known technologies but would likely entail deep social and political transformations.

Stabilizing at 550 ppm

Stabilizing CO_2 concentrations at 550 ppm has attracted even greater analytical attention, as it roughly coincides with a doubling of CO_2 concentrations above pre-industrial levels[16] and is frequently used as a baseline hypothesis for models examining climate sensitivity. Such a level would imply changes in mean surface temperature of between 1.6 and 2.9 degrees Celsius by 2100. Eventually, temperature changes would reach equilibrium at a range of 1.5-4.5 degrees Celsius.

Only under the most favorable of the emission scenarios examined by the IPCC (see Figure 6 below) would CO_2 concentrations eventually stabilize at 550 ppm without specific mitigation efforts; most probably, significant action would be required to meet this target. Other modeling suggests that under a least-cost pathway, emissions would have to peak no later than 2030 at no more than 11 GtC and then decline, reaching 6 GtC by 2100.[17] This would call for developed countries to reduce their emissions 60 percent by 2050 relative to 2000, and for developing countries to control their own emissions starting around 2030. Stabilization at any level below 600 ppm would require reductions in energy and carbon intensities far greater than any achieved historically.

Stabilizing at higher levels (650-1,000 ppm)

For a number of the IPCC scenarios, targets in this upper range of concentrations may be achieved even without specific climate change policies. Thus, setting a high level as a target generates little if any action. Stabilizing concentrations within this range may still limit the impacts of warming to less than 4 degrees Celsius, especially if climate sensitivity turns out to be low. However, stabilizing at 1,000 ppm is likely to result in catastrophic long-term consequences. According to the Third Assessment Report, stabilizing at 1,000 ppm would not require global emissions to peak until as late as 2090, limiting the need for much near-term action.

in determining what level of concentrations can actually be achieved—and, conversely, how a given concentration target would be translated into effort required.

The achievability of a given concentration target rests in part on assumptions about future GHG emissions, which, as will be discussed below, are highly uncertain. Based on current emission trends, the IPCC projects that GHG concentrations could range anywhere between 540 and 970 ppm in 2100.[18] These and other uncertainties are reflected as well in the wide range of cost estimates for achieving

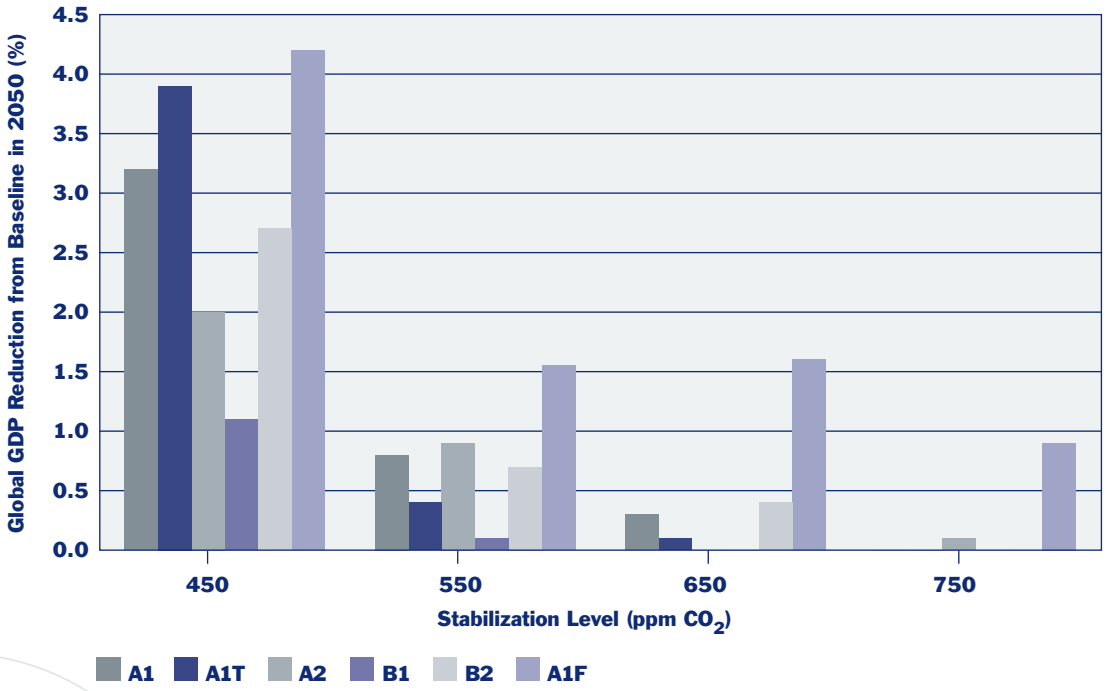
stabilization at different concentration levels. As seen in Figure 5, these range from less than 0.5 percent to as much as 4 percent of global GDP in 2050.[19]

A concentration target effectively sets an upper bound on allowable cumulative emissions over a given period. But it leaves open the question of the most feasible or cost-effective emission trajectories consistent with that target. The higher the near-term emissions, the sharper and greater the magnitude of the future decrease that will be required if any given concentration level is to be met. Analysts have run the models "backwards" to define possible emission pathways that would lead to stabilized CO_2 concentrations at levels ranging from 450 ppm to 1,000 ppm. They conclude that any given level of stabilization would require emissions to peak and then fall well below current levels. These analyses lead to a further inescapable conclusion: in the long run, regardless of what concentration level is set, it can be achieved only when net emissions (emissions minus removals by sequestration) effectively are reduced to zero.

Moving one more stage back in the climate cycle—to emissions—allows a closer look at likely, and possible, emission trajectories.

Figure 5

Estimated **Costs of Stabilization** Under Different Emmissions Scenarios



Source: IPCC (2001). Figure 7-4, p. 120.

Stage II—Emissions

There are several compelling rationales for casting a long-term target in terms of emissions:

- Excess GHG emissions are readily understood as the cause of climate change; an emissions target is readily understood as an effort against an undesirable effluent.
- GHG emissions are frequently associated with other pollutants whose elimination is sought anyway for public health reasons.
- Every government has the authority to fully control domestic GHG emissions. As a consequence, it may adopt commitments related to these emissions and be held accountable in case of non-compliance.
- Based upon the work of the IPCC, clear methodologies, procedures, and formats exist to monitor, review, and report emissions in national inventories.

Essentially, the UNFCCC and the Kyoto Protocol have sought to intervene at this stage, establishing near-term targets in terms of allowable emissions for industrialized countries. Longer-term targets have also been proposed for this stage. For example, as noted earlier, the UK government has set an aspirational goal of reducing emissions 60 percent by 2050 and advocated the same target for all industrialized countries.

At the emissions stage of the cycle, however, we are yet further removed from climate impacts. Setting a target at this stage thus injects another layer of uncertainty in the correlation between the chosen metric and the ultimate goal of impacts avoided. The flip side, however, is that the metric is now more closely related to the underlying causes of climate change—human activities amenable to human control. This allows a more direct assessment of the kinds of actions that would be required and the costs they might entail.

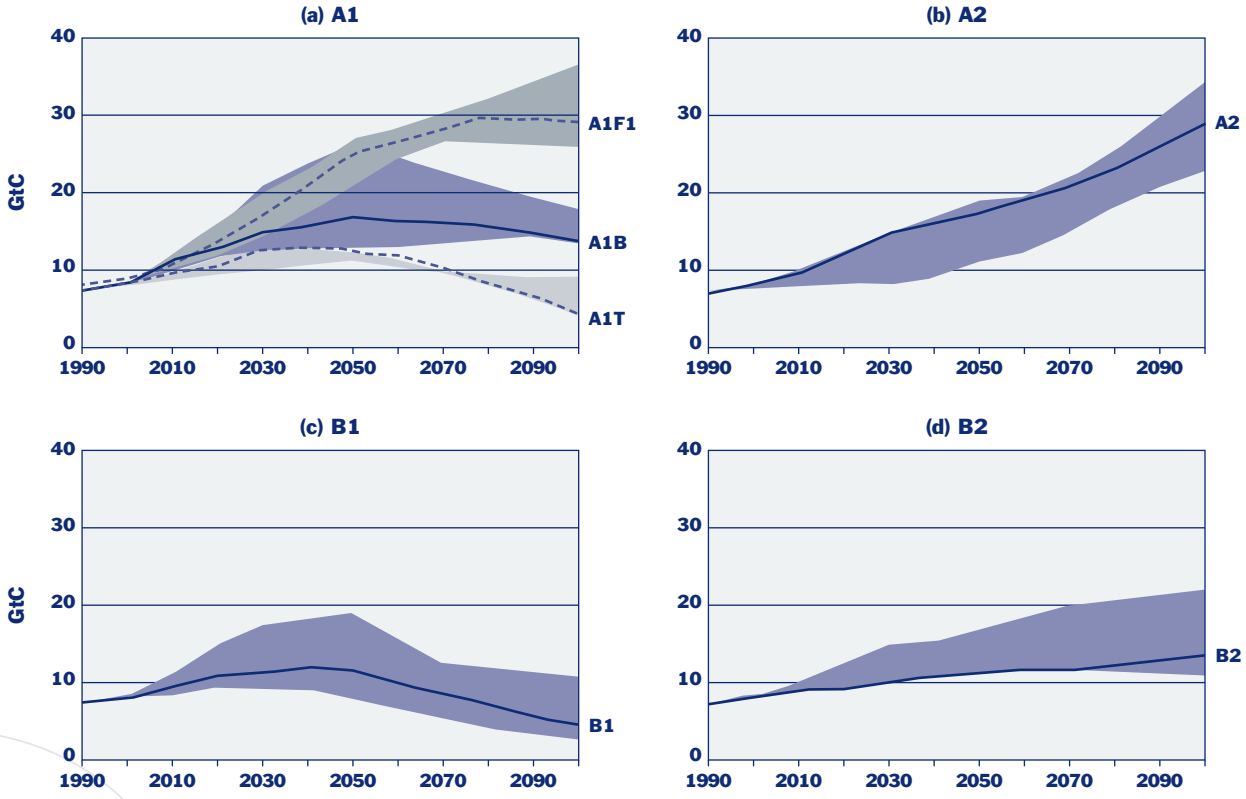
As we have already seen, such assessments rest in part on assumptions about future emission trends. These, in turn, rest on assumptions about a host of variables, including economic growth, population growth, and the rate of technological change. As no one set of assumptions can be deemed reliable, the IPCC has developed a set of scenarios illustrating potential alternative futures and their associated emission trajectories, all in the absence of specific climate initiatives. As can be seen in Figure 6, the potential emission paths vary enormously. In some cases, CO_2 emissions peak around 2040-2050 and then decline; in others, these emissions keep growing throughout the 21st century and beyond. As of 2100, the projected levels of CO_2 emissions range from below 5 GtC to above 20 GtC. This enormous variability in emission forecasts provides considerable room for conflicting assessments of the effort required to meet a given emissions target.

The calculation of effort, in turn, defines the parameters for a closely related and inherently political calculation—the *distribution* of effort. To the degree that an emissions target establishes not only an allowable level of cumulative emissions over a given time period, but also the preferred timing of the necessary emission reductions, it effectively defines allowable emissions at any given moment during that period. In that sense, it creates a finite resource—the right to emit—and quantifies it. On one hand, this can facilitate a precise apportionment of responsibility for meeting the target. On the other hand, it imbues the target itself with enormous political and economic implications. The target-setting exercise is thus implicitly laden with all the stakes of the burden-sharing exercise that would follow.

Focusing on emissions invites a more vivid and direct examination of the effort required to meet a target, the associated costs, and their distribution. At the same time, however, the emissions metric makes it yet more difficult to characterize the target as ensuring any given level of protection against climate impacts. As a political matter, the exercise may easily become one pitting large, concrete, collective costs against benefits that would be difficult to establish.

Figure 6

IPCC **Emissions Scenarios**



Note: Six scenario groups were developed by the IPCC, organized into four families. The A1 and A2 families emphasize economic development but differ with respect to the degree of economic and social convergence. The B1 and B2 families emphasize sustainable development, and also differ in convergence. Three scenarios were defined within the A1 family to describe alternative technology developments.

Source: IPCC (2000). Figure SPM-3, p. 7.

Stage I—Human Activities

Arriving finally at the first stage of the climate cycle places the focus squarely on the human activities at the root of climate change. There are strong rationales for establishing a long-term target at this stage:

- Ultimately, human activities are the proximate cause of climate change; changing these activities will change the climate system.
- We—individually and through government policies—have the capacity to change behavior and technology to curb emissions and climate impacts. Few other points in the cycle can be so directly affected.
- Long-term goals set at this stage in the cycle may have ancillary benefits (e.g., local pollution reduction and improvements in trade competitiveness) and thus bring additional political support.
- Characterizing the challenge as technological, rather than exclusively environmental, may also help broaden political support.

What might an activities-based target look like? One option is to focus on outcomes—for instance, fully decarbonizing the energy sector by 2100. Another option is to set a particular technology goal—for instance, replacing internal combustion engines with fuel cell vehicles by 2030. Both approaches define the goal in concrete terms that, in theory at least, can be readily translated into a detailed program of action. The effects these targets have for subsequent stages in the climate cycle, while not easily quantified, are nonetheless obvious.

At the first stage evaluated above—stage V, impacts—the focus is primarily on damages to be avoided and, only secondarily, on the implications for other stages, from temperature to concentrations, emissions and, ultimately, human activity. The middle stage—concentrations—allows a more balanced view extending in both directions around the climate cycle. The present stage is the furthest removed from impacts; any attempt to calculate the benefits of an activities-based target in terms of impacts avoided is thus subject to all the uncertainties introduced at each intervening stage. Such a target can be correlated to the ultimate goal of avoiding impacts only in the most general sense.

Conversely, an activities-based target minimizes uncertainties about what effort will be required. The metric employed is the variable over which we have the greatest control. We cannot change the physical behavior of the atmosphere, nor the impacts such changes will have on the climate system (although geo-engineering solutions have been proposed, none are yet considered remotely feasible). Even our ability to transform emission trajectories is only indirect, subject to vagaries such as economic growth, weather, and technological change. Our influence is most direct at the stage of human activity: we can discourage activities that generate emissions, encourage activities that emit less or that capture emissions from the

atmosphere, or live with the consequences and try to adapt. A long-term target set at any stage of the climate change cycle would, in any event, have to be translated into policies reshaping human behavior.

There are, of course, drawbacks. Unless the goal is sufficiently broad or stringent (e.g., full energy decarbonization), there is no assurance that it will in fact deliver the desired outcome of reduced climate change impacts. As with an emission target, the benefits are thus far more opaque than the costs of whatever action is required. At the same time, the costs are less diffuse here than they would be at other stages in the cycle. A focus on major emissions-generating activities places the burden much more immediately on specific sectors with significant political influence. Finally, a target cast in terms of a particular technology runs the risk of locking in a less-than-ideal technology and discouraging investment and innovation that could produce a better one. From a narrow economic standpoint, it may also be less cost-effective than a target that sets a desired environmental outcome and allows the market to choose the means of achieving it.

IV. Reconsidering the Case for a Long-Term Target

At the outset, this paper presented several strong rationales for a long-term target to drive and frame the international effort against climate change. However, an analysis of the prospects for target setting at various stages of the climate cycle uncovers a host of obstacles. Some are technical; others are political.

The technical complications stem primarily from incomplete knowledge or understanding, and they are compounded at each successive stage of the cycle. Uncertain about the future of key drivers such as technological and economic change, we cannot with any confidence predict emissions pathways—and hence, extrapolate accurately to concentration levels. Even if these were clear, we do not currently have the capacity to plausibly link the resulting global thermodynamic changes with specific local damages.

The political obstacles are no less daunting. Even assuming an adequate base of scientific knowledge, the establishment of a long-term target is implicitly an exercise in defining "acceptable risk," which is a matter of judgment, not fact. With the potential impacts of climate change so unevenly distributed, countries have widely divergent views on the level of global risk that is acceptable—or, put another way, the types of climate impacts that can be ignored. Is it possible to convince small island developing states that some sea level rise—say, enough to inundate their territory—is acceptable? How much might other countries be willing to offer to compensate for such losses?

Assuming consensus on the level of acceptable risk could be reached, target setting encounters a second set of political obstacles. It implies the need to apportion effort—to allocate emission allowances or other burdens or responsibilities. The enormous difficulty in the debate over differentiating emission targets in the Kyoto Protocol, when the commitment was only short-term, merely hints at the difficulties

that might be anticipated in attempting to allocate rights and obligations over the long term. Setting the target and allocating burdens are, of course, separate exercises. But insofar as the target defines the total burden or rights to be allocated, its establishment becomes weighted with all the attendant political and economic stakes. The target is in this sense seen as a proxy for a multitude of politically charged decisions.

These political complexities beg the question of whether it might ever be possible to set a long-term target that actually serves the purpose of driving action. The more stringent the target, the more effective it is in driving action, but the more costly it is as well. (Too stringent a target can set back action, though, if its high costs elicit strong political resistance.) This suggests the negotiation is likely to yield a target less stringent than might be environmentally desirable. However, an "easy" target will drive little—if any—action. For example, unless a concentration target is set below 600 ppm, meeting it might require no action at all in the near term.[20] Thus, target setting could serve as much an excuse for delay as a goad to action. If the negotiation reaches an agreement, the target may well be ineffective. Should the proposed target be stringent enough, the negotiation may well fail.

Over time, scientific advances may overcome many of the technical obstacles and narrow the range of uncertainties. But the basic political dilemmas will always remain. There is a risk that, by diverting a limited pool of "negotiating energy," any effort to establish a long-term target could in fact be detrimental to the cause of combating climate change. It seems unlikely that any such negotiation could succeed in a period of less than five to ten years. Unless there are parallel short-term commitments, countries and industries may undertake little real emissions reduction during that period, citing uncertainty over the long-term target as a pretext. In the final analysis, the hurdles of negotiating a long-term target are such that the possibility of failure is quite real. This could seriously undermine confidence in the process and diminish the prospects for effective international action, as failing to achieve a successful outcome in a negotiation may jeopardize the morale needed to undertake subsequent ones.

If, however, the international community does resolve to undertake the negotiation of a formal long-term target, the stage-by-stage analysis above offers strong arguments for devising it at the stage of human activities. This stage is far removed from impacts; an activity target does not ensure a given level of protection, nor does it invoke the goal of avoided impacts as a driver for change. But a target focused directly on activities is spared the many layers of uncertainty and the enormous time lags encountered in trying to translate impacts avoided into action required. It employs as its metric the variable most amenable to human control. Plus, by casting the goal in terms of the practical challenges to be met, it can help define in the public mind, and build support for, the effort required.

An activity target more closely matches the approaches taken in the Montreal Protocol and the POPS Convention, as cited earlier. In the case of the Montreal Protocol, the long-term objective of phasing out ozone-depleting substances is readily translated into near-term goals identical in form. In the case of POPS, the long-term objective of protecting human health and the environment from persistent organic

pollutants serves only as a guiding force. But in both cases, the operative target or commitment is set in terms of a variable over which states have control: the production, sale, and use of given compounds.

Climate goals could be formulated as:

- Achieving specific high levels of efficiency (measured as an output per unit of energy) in home or industrial appliances, transportation systems, utilities or productive processes;
- Eliminating the use of sulfur hexafluoride (SF_6) or perfluorocarbons (PFCs) in the industrial sector;
- Developing the technology for cost-effective capture and storage of CO_2 by 2025;
- Replacing gasoline in the transport sector with hydrogen produced by non-carbon emitting sources by 2050;
- Eliminating carbon emissions from the energy sector by 2060.

Such goals are within the control of political processes and may also allow fundamental shifts in the structure of the international process. For example it may be unnecessary to have a global, multilateral system in place if the intent is to develop the technology to replace fossil fuel-based electricity production. A smaller group of countries (and companies) acting in concert might generate such a technology, leaving a larger multilateral process to promote and facilitate its penetration into the global market. Such processes could, in fact, be of a more regional nature as well: countries with significant wind or solar resources may choose a different technology focus than those wishing to exploit nuclear power or biomass.

To meet any level of long-term climate stabilization, an activity target must engender a level of effort that is very robust—delivering in the long term nothing less than zero net emissions. Yet even a target or group of targets falling short of that objective will, at the very least, be moving the system in the right direction.

V. Alternative Approaches

If, for the time being, no negotiation toward a long-term target is undertaken, are there alternative approaches that might provide at least some of the benefits of a long-term climate target? Are there practical options that may help narrow the gap between short-term measures and goals that may be many decades away?

Two alternatives suggest themselves: a hedging strategy, which promotes near-term actions that leave open a range of future "targets" without committing to any one of them; and a gradual move toward consensus on an informal target that can be a general guide for action.

Hedging Strategies

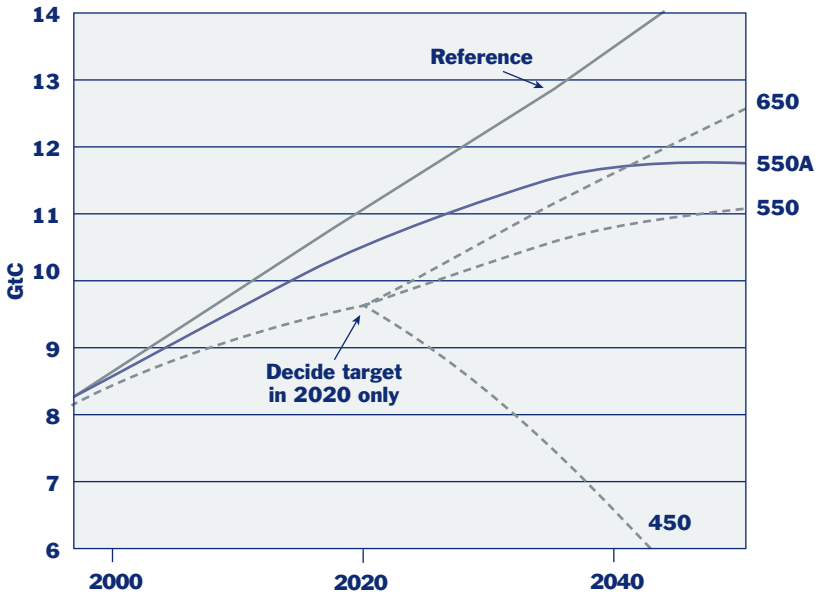
A hedging strategy acknowledges the many uncertainties in setting a long-term target and, rather than establishing one, seeks a path that keeps all reasonable options open. Such a strategy would use a notional, non-binding target—or more likely, a range of potential outcomes—and favor near-term actions that are consistent with all of them. Hedging is an iterative process that uses new knowledge as it becomes available to better weigh long-term options and the adequacy of near-term actions.

Figure 7 illustrates what a hedging strategy might imply for emission trajectories. In this case, it is suggested that an optimal goal—with perfect foresight—is a concentration of 550 ppm, and the optimal path to it is the one represented by "550A." But, in the absence of such foresight, and not knowing if a 450 ppm target might ultimately prove warranted, the strategy aims to keep that option open. It requires near- and medium-term actions that preserve the option of 450 ppm, but does not commit to that as a firm target.

As better information becomes available, efforts may be strengthened (should a more aggressive target be agreed) or relaxed (should the problem prove less severe than anticipated). By deferring any binding decision on a long-term target, and leaving open the possibility that a less aggressive target may ultimately suffice, a hedging strategy may fare better politically than any effort to negotiate a fixed long-term target. However, it presents political difficulties of its own. In order to keep options open, it effectively compels prompt, aggressive action consistent with the more stringent end of the potential target spectrum. In the illustration above, the emissions trajectory necessary to preserve the option of 450 ppm is lower than would be required if 550 ppm were ultimately deemed acceptable (although higher than the optimal 450 ppm path). This requires a significant commitment of near-term effort, in the absence of agreement on the long-term goal.

Figure 7

A **Hedging** Strategy



Source: IPCC (2001). Figure TS.10a, p. 67.

Once launched, a hedging strategy can create a dynamic for periodically revisiting and adjusting objectives and actions. The goal of avoided impacts would suggest preserving the option of 450 ppm, which in turn might require keeping emissions as close as possible to present-day levels. However, if the cost of the near-term actions required were too high for the political process to bear, only those actions that fall at an acceptable cost would be entertained. As long as the most stringent target is kept within the range of possible outcomes, the iterative process of continually revising the cost and damage estimates could provide adequate tension in the system to ensure long-term progress in the proper direction.[21]

As any "target" under a hedging strategy would provide guidance only, it need not be the product of a formal negotiating process. It may equally be the sum of current scientific understanding, as reflected, for instance, in discussions within the IPCC.

Alternatives to Negotiated Targets

Of course, it may be impossible to set goals that are broadly enough agreed to make the effort worth the negotiating cost. In this case, some alternative drivers may help push climate mitigation activity.

One possibility is better understanding and widespread dissemination of "good" science and information. Even if we cannot define a desirable long-term goal, we do know that continuing the present trends is not acceptable if future generations are to end up with a livable system. As long as we know that we must continue to change, this by itself constitutes a long-term goal. The clearer our understanding of the effects of climate change, and of the effectiveness of our mitigation actions, the more likely we will be to act. In this case the information provides a directional goad rather than a target with a specific magnitude.

In most of the discussion above, the target is assumed to be negotiated and accepted by most or all nations. However, two alternatives may also generate significant levels of effort without being globally agreed: a target set by one (or a few) countries, or a target that becomes the implicit basis for analysis and policy making but never becomes the basis for any negotiated agreement.

In the first case, countries may use the target to drive their own domestic agendas. Then, while never signing on to the target itself, others may begin to compete on global markets using the technologies and drivers that are promoted by the target-setting countries. We are already seeing some movement in this direction: with the Kyoto Protocol's entry into force multinational companies would be required to meet emission standards in countries with targets—even if they are based in countries with no targets at all. Should long-term goals such as those advocated by the UK become widely agreed, a similar process could ultimately unfold at this more stringent level. The world will thus be pushed to accept the goal—if not the specific strategies—of a small and determined group of standard-setting players.

Perhaps the best example is California, with its standards for vehicle emissions. Because auto companies are unwilling to forego the California market, the world has seen an increasing number of vehicles meeting its emission requirements—even though virtually no other state or country has adopted similarly stringent levels.

Alternatively, some metric broadly accepted in the scientific community as a common basis for analysis could begin to take on characteristics of a goal. For example, most efforts to model emission trajectories and potential climate impacts assume a CO_2 concentration of 550 ppm—or approximately doubling pre-industrial levels. The science community began using 550 ppm as its standard value in the IPCC's First Assessment Report. Soon, the vast majority of models and analyses were run with this value. It is not likely a coincidence that the international target most often proposed is at a similar level

VI. Conclusions

For all the uncertainties in our scientific understanding of climate change, this much is clear: the steady buildup of GHGs in the atmosphere poses significant long-term risks, both environmental and economic; and mitigating those risks requires action that is both global and sustained. It is in driving and framing this action that a long-term target would have its greatest value. A target would help define the scope and nature of the action required, and would serve as a constant prod, or lever, to ensure that action is taken.

The search for a long-term target encounters uncertainties at each turn. The greater the uncertainties are, the greater the opportunities for discord and delay. An activity target shortcuts the analysis; it bypasses several layers of uncertainty to focus attention on the factors most responsive to human intervention. As a consequence, it is substantially removed from the primary motivating force—the avoidance of impacts—and it starkly reveals the costs of any proposed undertaking.

A hedging strategy essentially declares the uncertainties too great to allow a firm or binding consensus on a target right now. It tries to buy time—keeping options open until better information narrows the range of uncertainty and consensus can be reached.

A long-term target is a tool, one of many that could be employed in the effort against climate change. Ultimately, though, the vigor and success of any such effort rests less on our choice of tools than on our willingness to act. Climate change will be effectively addressed only if there is sufficient political will. If the process of developing a long-term target helps to generate political will—if it indeed serves as a catalyst for action—then it may be worth undertaking even if in the end there is no agreed outcome. If, on the other hand, the search for a long-term target diverts what political will exists into a fractious and fruitless exercise, it winds up serving not as a lever for action, but an excuse for inaction.

Appendix

Correlating Concentrations, Temperature, Impacts, Emissions, and Cost

The table below shows how a long-term target set at a given stage of the climate change cycle—e.g., concentrations or temperature—would correspond to values at other stages of the cycle or to other parameters within a given stage.

Eventual CO_2 Stabilization Level†	Time of Stabilization*	Mean Surface Temperature Change by 2100**	Mean Surface Temperature Change (at Equilibrium)**	Cumulative Carbon Emissions 1990-2100 (GtC)	Possible Pathway (Global Emissions Peaking at... GtC/Year, by Year...)	Cost: Global Average GDP Reduction in Year 2050
450 ppm	2100	1.2-2.3°C	1.5-3.9°C	630-650	9 GtC by 2020	1.0-4.1%
550 ppm	2150	1.6-2.9°C	2.0-5.0°C	870-990	11 GtC no later than 2030	0.1-1.7%
650 ppm	2200	1.8-3.1°C	2.4-6.1°C	1030-1190	___	0-1.5%
750 ppm	2250	1.9-3.4°C	2.8-7.0°C	1200-1300	13 GtC by 2070	0-1.0%
1,000 ppm	2375	2.0-3.5°C	3.5-8.7°C	____	____	___

† Concentrations here refer only to CO_2. Adding the effect of non-CO_2 gases would entail a substantial increase in total CO_2-equivalent concentrations. For instance, a CO_2 stabilization target at 450 ppm would imply 550 ppm CO_2-equivalent when the other GHGs are taken into account.

* According to the scenarios in Wigely et al. (1996). Concentrations have to be close to stabilization level some decades before the final time of stabilization.

** Low and high estimates (for climate sensitivities of 1.7 and 4.2 degrees Celsius respectively).

Source: IPCC (2001).

Endnotes

1. UNFCCC, Article 2; http://unfccc.int/resource/docs/convkp/conveng.pdf. Article 2 further states: "Such a level should be achieved within a timeframe sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner."

2. The Millennium Development Goals are an agenda for reducing poverty and improving lives that world leaders agreed on at the Millennium Summit in September 2000. For each goal one or more targets have been set, most for 2015, using 1990 as a benchmark. They include goals for poverty and hunger eradication, universal primary education, gender equality, reduction in child mortality, improvement in maternal health, combating AIDS and other diseases, ensuring environmental sustainability, and promoting global partnerships for development. For details see http://www.undp.org/mdg/.

3. See http://www.pops.int/documents/convtext/convtext_en.pdf.

4. In this paper, long-term is defined as a time frame extending from 2050 to the end of the 21st century and beyond. A target is defined as an outcome that the international community seeks. A target can take a weak, notional form (where the desirability of the outcome is broadly recognized but the outcome is not obligatory) or a strong form (one that would require specific decisions to guarantee the timely occurrence of the outcome itself). The short-term leverage provided would vary accordingly.

5. Klimatkommittén (2000).

6. The New Economics Foundation (2002), for example, advocates a formal, binding, internationally agreed concentration target as absolutely necessary in the context of the UNFCCC.

7. Perhaps the most famous such target was the pledge made by U.S. President John F. Kennedy that the U.S. would "put a man on the moon by the end of the decade." This target mobilized society and induced technological changes—in some cases leading to the development of entirely new technologies.

8. Human activities may also determine changes in the atmospheric presence of aerosols or very light airborne particles. Most of them (e.g., sulfates deriving from sulfur dioxide emissions) result in a negative radiative forcing, that is, they would induce a global cooling effect. Other aerosols (e.g., soot) have the opposite effect. Their presence must be taken into account, along with natural effects such as the dynamics of solar radiation output, to adjust climate change models. Aerosols are not considered in this paper.

9. See IPCC (2000a), Table 2, p. 5. Average annual budget of CO_2 for 1989-1998. Emissions from fossil fuel combustion and cement production: 6.3 ± 0.6 GtC yr^{-1}; emissions from land-use change: 1.6 ± 0.8 GtC yr^{-1}.

10. O'Neill and Oppenheimer (2002).

11. German Advisory Council on Global Change (1995); Kreileman and Berk (1997).

12. For a copy of the Brazilian Proposal, see: http://unfccc.int/resource/docs/1997/agbm/misc01a3.pdf.

13. If the concentration target refers only to CO_2, the presence of non-CO_2 GHGs will represent nearly an additional 100 ppm of CO_2 equivalent. For a discussion of the relative warming potential of the major greenhouse gases, and the uncertainties associated with each, see Reilly et al. (2003).

14. Berk et al. (2001).

15. Reference year is 1990.

16. For an analysis of the rationale for adopting 550 ppm as a stabilization target, see UK government (2003).

17. Wigely et al. (1996).

18. The IPCC scenarios project concentration levels in 2100, but these do not represent ultimate stabilization levels, as concentrations will continue to rise over several centuries due to the slow decay of GHGs in the atmosphere.

19. The costs estimated in this figure are, at best indicative. Costs depend on a variety of factors, including the baseline (i.e., what the trend would have been without a mitigation policy); burden-sharing arrangements and access to market flexibility mechanisms; how transaction costs, information availability, and market clearing are accommodated; questions related to net present value of future costs, discount rates, future technological innovations, and induced technological change, and possible learning curves. Many models do not include ancillary benefits of mitigation action (benefits to public health and local pollution may be significant—and difficult to measure), or rates of natural uptake of carbon. Finally, for perspective, it is important to bear in mind that global GDP in 2050, the baseline for the cost figures presented, is projected to be 4 to 9 times higher than in 1990.

20. It is true that, even for more stringent targets, trajectories can be proposed that require little near-term action and shift the burden instead to later years. However, given the required magnitude of such out-year reductions, it seems unlikely that the technical or political capacity would exist to implement such rapid changes.

21. Such an idea underpins the work of Pizer (1997) and the IEA (2002).

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Climate commitments

Assessing the options

Daniel Bodansky

I. Introduction

The question of commitments lies at the heart of the climate change debate. Ever since climate change first emerged as a political issue in the late 1980s, attention has focused on quantified "targets and timetables" as the principal type of commitment—the model used with great success in the 1987 Montreal Ozone Protocol. Although legally binding targets and timetables for greenhouse gas mitigation could not be agreed in the 1992 UN Framework Convention on Climate Change (due primarily to opposition by the United States), they became the centerpiece of the Kyoto Protocol—and the lightning rod for its opponents.

In considering the way forward—either under Kyoto or beyond it—a central question will be the type (or types) of mitigation commitments to employ. Should quantified emission limitation targets continue to be the principal type of climate commitment and, if so, should these targets be of the kind found in Kyoto—that is, fixed targets, pegged to historical emission levels? Or should international climate policy strike out in a different direction by adopting different types of targets, for instance, or by focusing on technology standards or commitments on research and development? The often-tortuous history of the climate change negotiations demonstrates that politics more than policy will determine the answer to these questions.

This paper examines the structure of future climate mitigation commitments—that is, the different forms future commitments might take.[1] Part II addresses the function and importance of mitigation commitments. Part III identifies the range of options with respect to three key variables: what types of commitments, when, and by whom? Part IV then proposes criteria for assessing these options. Part V evaluates some of the leading proposals for future commitments.

II. Why Commitments?

The importance of commitments may seem self-evident. However, the rejection of the Kyoto Protocol by the United States, and the reluctance of developing countries to assume binding emission limitation targets (at least until industrialized countries have taken action), make it useful to consider at the outset: What is the function of commitments? Are they essential, or could the climate change problem be addressed either through the application of pre-existing legal obligations, or through voluntary measures as the Bush Administration has proposed?

The nature of the climate change problem, as well as the history of international environmental cooperation more generally, suggest the need for commitments. The existence and implications of purported legal obligations, such as the duty to prevent transboundary pollution and the polluter pays principle, are the subject of endless debate among scholars and states. Although these principles reflect strong moral imperatives—and may even have the status of international law—in the absence of courts that could apply and enforce them, they are unlikely to be of significant use in changing states' behavior. Instead, states are likely to address climate change only if they believe it is in their interest to do so. That is why climate change negotiations have focused on "commitments," requirements that a state itself assumes, rather than on "obligations," a broader term that includes norms externally imposed.

The role of commitments derives from the "collective action" nature of the climate change problem. Like other collective action problems, climate change mitigation poses a fundamental dilemma. Because most of the benefits of climate change mitigation do not accrue to the country taking action, but are instead shared by the international community as a whole, individual countries have little incentive to do anything on their own.[2] Even when the global benefits justify the costs, the country engaging in mitigation usually receives only a fraction of the total benefits. So, from its individual perspective, the costs of mitigation are likely to exceed the benefits. Of course, if the costs of reducing emissions are sufficiently low, countries might be willing to go ahead anyway, for example, to show leadership or for public relations purposes. But significant investments to reduce greenhouse gas (GHG) emissions will be in a country's individual self-interest only if they are reciprocated by other states—only if a country's actions are part of a bargain involving significant action by others to address climate change.

International commitments serve as the glue that helps hold a cooperative regime together. Before taking potentially costly actions to address climate change, states need to be confident that others will do their part as well. International commitments are the means by which countries bind themselves to one another to take mutual action.

What does it mean to say that a country "commits" itself to undertake mitigation actions? In one sense, virtually all international commitments are voluntary. Given the absence of an international legislature that can impose obligations on states, international obligations in general depend on a state's consent. But, by making a commitment (for example, to reduce GHG emissions), a state agrees to limit its future freedom of action; it promises to behave in a certain way or to achieve a certain result. While its acceptance of a commitment is voluntary, its fulfillment of the commitment is not.

International commitments fall along a spectrum. Some are political, such as the aim in the UN Framework Convention on Climate Change (UNFCCC) to return developed country emissions to 1990 levels by the year 2000; others are legal, such as the reporting requirements in the UNFCCC and the targets and timetables in the Kyoto Protocol and the Montreal Ozone Protocol. In the absence of effective

institutions to interpret and enforce international law, the distinction between political and legal commitments can often seem illusory. Most international commitments—even "legally-binding" ones—depend on the good faith of states and on the diffuse costs of developing a reputation for breaking one's promises, which makes it more difficult to enter into mutually-advantageous deals in the future. But, in general, casting a commitment in "legal" form signals a greater level of seriousness by states, raises the costs of violation, and sets in motion domestic legal implementation mechanisms. That is why, even in the absence of any realistic prospect of being sanctioned for non-compliance, countries are usually reluctant to accept legally binding commitments and why the decision to do so in the Kyoto Protocol was so controversial and difficult.

Of course, no level of commitment can fully assure that a country will uphold its end of the bargain. Some countries may view their treaty commitments as aspirational rather than absolutely binding. But, compared to a strictly voluntary system, commitments provide states with greater confidence that other states will not simply say one thing and then do another. This not only promotes action by states, but provides a signal to the market that helps drive changes in private behavior. Moreover, if mechanisms can be agreed to impose specific sanctions for violations, this further raises the costs of non-compliance and thus provides additional assurance to states that others will comply with their commitments. Indeed, given the potentially high short-term costs of mitigating climate change, many analysts believe that both legally binding commitments (in contrast to voluntary actions), and a strong compliance system (with strict penalties to deter free riders) are essential.[3]

III. Key Variables

The problem of developing climate change commitments can be expressed by the following question: who *will have* what *commitments* when*?*

All three of these variables—who, what, and when—raise important, interdependent issues.

What Types of Commitments?

Specifying the content of a commitment has both formal and substantive dimensions:

Binding vs. Non-Binding

To begin with, there is the issue of the legal form of a commitment—in particular, whether it will be legally binding or political. This is not simply an either-or choice; a range of options present themselves:

Non-binding "commitments" Although perhaps strictly speaking a misnomer, a "commitment" can be expressed in non-legally binding language, as a recommendation ("should" rather than "shall") or an aim. The emissions target for developed countries in the UNFCCC (to return emissions to 1990 levels by the year 2000) was contained in the commitments section of the treaty, but was stated as an "aim" rather than a legal requirement.

One-way ("no-lose") commitments This is a variant of the previous option. An aim, although non-binding, could have legal consequences in the sense that, if bettered, it can provide a country with certain legal benefits. For example, if a country reduced its emissions by more than its non-binding target, then it could sell the surplus emissions to other countries.[4] Project baselines established under Kyoto's Clean Development Mechanism (CDM) are, in essence, one-way "commitments," since a country (or firm) faces no penalty if its project exceeds a baseline, but receives certified emission reduction credits if the project reduces emissions below the baseline.

Legally binding commitments A commitment can also be expressed in binding language ("shall"), like the targets and timetables in the Kyoto Protocol. It is important to note that this is a separate question from whether the commitment is subject to enforcement through a compliance system (considered below). Most international commitments do not have any specific compliance mechanisms.[5] Nonetheless, they are legally binding and must be complied with by those states that accept the commitment (in much the same way that one is bound by one's solemn promises, whether or not enforcement machinery exists).

Enforceable commitments A binding commitment can be subject to a mandatory compliance system, with authority to respond to violations, such as the dispute settlement system adopted under the World Trade Organization. This would provide the greatest assurance of compliance but would also present the greatest worry for states that are on the fence about whether to undertake mitigation commitments. The Marrakech Accords, which set forth detailed rules to operationalize Kyoto, establish a compliance procedure, including consequences for non-compliance. But the binding character of these consequences remains an open question.

Choice of Policy Instrument

The substantive content of commitments can involve an equally wide variety of policy instruments:

Emission targets An emission target is an obligation of result: it requires regulated entities (for example, countries or firms) to achieve a particular level or rate of emissions, but allows them flexibility as to how they will achieve that result.[6] Emissions targets can be specified in various ways: fixed or indexed, absolute or conditional, and economy-wide or sectoral.

> *Absolute targets*—Until recently, most of the attention in the climate change regime has focused on fixed, countrywide emissions targets, pegged to an historical base-year emissions level (generally, 1990 emissions). The Kyoto Protocol, for example, requires industrialized countries to achieve predetermined, fixed levels of emissions for the 2008-2012 commitment period.[7] In this respect, the climate change regime has followed the approach used in several other international environmental regimes, including those addressing acid rain and stratospheric ozone depletion.

Indexed targets—Because emissions depend on a wide range of variables that are difficult to anticipate in advance (economic growth, weather, technological change, etc.), an emission target can be pegged to one or more of these variables, rather than defined in fixed terms, like the Kyoto targets.[8] Thus far, most of the literature has focused on tying emissions targets to a country's GDP so that the permitted level of emissions would be larger or smaller, depending on whether the economy grows or shrinks. The Bush Administration's carbon intensity target[9] and the proposed Argentine target[10] are both examples of indexed GDP-based targets.

Conditional targets—In contrast to the Kyoto targets, which apply come what may, a target could be formulated in conditional terms: if the specified conditions are not satisfied, then the target either would not apply at all or would be modified in some fashion. One option is to make commitments conditional on a state's achievement of a minimum level of wealth. (For example, per capita GDP could be used as a "graduation criterion" for the assumption of commitments by developing countries.) In addition, conditional targets—like indexed targets—could help alleviate fears that a fixed emission target might become an economic straitjacket. A conditional target that has received particular attention in this regard is the so-called "safety valve" approach.[11] In essence, a safety valve defines a conditional target in negative terms: the target applies unless the cost of compliance exceeds a specified level, in which case the target is relaxed through the issuance of additional emission allowances.[12]

Sectoral targets—A target can also be specified on a narrower basis than total national emissions. For example, targets could be specified for particular sectors or industries that are particularly important, politically easier to address, or comparatively insulated from international competition. Sectoral targets could be binding or "no lose," fixed or indexed. In essence, proposals to expand the CDM to apply to entire sectors rather than particular projects[13] would involve setting no-lose, sectoral emission targets: if a developing country failed to meet its sectoral target, it would face no consequences; but reducing emissions below its target would generate emission reduction credits that the country could sell.

Financial targets Rather than focus on emissions, a target can be specified in financial terms, as an amount to be devoted to climate change mitigation, either domestically or internationally. Both the UNFCCC and the Marrakech Accords set forth collective financial commitments that apply to Annex II countries as a whole, rather than individual targets for each state.

Policies and measures In contrast to a target-based approach, a commitment regarding policies and measures (PAMs) is an obligation of conduct rather than an obligation of result: it requires

countries to act in certain ways, but does not require them to achieve any particular level of emissions or financial contribution. During the negotiation of the Kyoto Protocol, the European Union pushed for the inclusion of commitments related to policies and measures, but due to strong resistance from the United States, the Protocol includes only an illustrative list of possible PAMs, without requiring states to adopt them.[14] Examples of PAMs include:

Technology and performance standards—An international commitment can address the use of emission-reduction technologies. For example, it could specify mandatory standards relating to appliance efficiency, residential insulation, or the use of renewable or other non-emitting energy sources.[15] The international commitment can either require the use of particular technologies (which would tend to lock in those technologies) or set forth a performance standard (for example, relating to energy efficiency) that allows private entities flexibility as to the choice of particular technologies. Among the relatively few examples of international technology standards are the construction, design, and equipment standards for oil tankers set forth in the Marine Convention (MARPOL) including, for example, segregated ballast tanks.[16]

Taxes—An international commitment can provide for a common or harmonized tax on GHG emissions. So long as a country had the required tax in place, it would satisfy its international commitment, regardless of the actual level of emissions reduction achieved.[17]

Subsidy removal—An international commitment can require countries to remove specified subsidies, for example, on energy production or consumption. The Kyoto Protocol includes in its illustrative list of PAMs for developed countries "the progressive reduction and phasing out of subsidies."[18] Subsidies are a problem not only in industrialized countries: the International Energy Agency estimates that removing energy subsidies in just eight developing and transition countries would reduce their CO_2 emissions by 17 percent and global emissions by 4.6 percent.[19]

Emissions trading—An emissions commitment can be coupled with a PAM requiring countries to implement a domestic emissions trading program with specified features (including possible linkages with other national programs and with an international emissions trading system, or a safety-valve device).[20] The European Union directive on emissions trading represents an effort of this kind: it sets forth the parameters of a required emissions trading system for EU member states.

Technology R & D and incentives—To address the low rates of investment in research and development concerning emission-reducing technologies,[21] a commitment might require states to devote additional resources for R & D, as well as for deployment of existing and new technologies.[22] For example, countries could commit to various forms of participation in an international hydrogen initiative. The agreement on the international space station is one illustration of an international agreement focusing on cooperative research, development, and deployment.

Since a targets-based approach and a PAM-based approach are often seen as competitors, it is worth emphasizing that they could complement one another: a target could be used to specify the overall result to be achieved, while PAMs could specify the means for reaching that result. Indeed, in some cases the relationship could be even stronger. As some commentators have noted,[23] an international target-and-trading approach would be most cost-effective if combined with national PAMs ensuring that domestic trading systems are complementary.

When Will Commitments Apply?

Another critical question is the timing of commitments. The international negotiations thus far envision a dynamic process beginning with the relatively modest but important reporting requirements in the UNFCCC, to be followed by specific mitigation commitments in subsequent protocols. A future agreement could set forth a more detailed road map for the evolution of commitments over time.

There are two important elements to timing: first, when will a commitment take effect, and second, how long will it last?

When Does the Commitment Begin?

In contrast to most treaties, which set forth commitments that take effect immediately upon the agreement's entry into force, the Kyoto Protocol establishes a commitment period beginning more than ten years after its adoption. The intent was to avoid economic disruption by giving countries and firms time to adjust to the Kyoto targets. Even so, many economists argue that, if the United States had stayed in the Kyoto system, the Kyoto targets would have cost more than necessary by requiring premature capital retirement.[24] According to this view, an even longer-term target, timed to coincide with ordinary patterns of capital turnover, would have been more economically efficient. If a commitment is too far off in the future, however, it may lack credibility; it may raise concerns that, given the lack of stability in international politics, the commitment is likely to be changed before it ever takes effect. An intermediate approach is suggested by the Montreal Ozone Protocol, which provides for the gradual phasing-in of commitments, so that the commitments start relatively soon, but do not reach their full stringency until later, in order to give individuals and industry time to adjust.

What is the Duration of a Commitment?

In most international environmental regimes, commitments have an indefinite duration; they continue in effect until the parties modify or terminate them. The Kyoto Protocol, in contrast, defines an emission target for only a five-year period, ending in 2012. This is sometimes justified as providing necessary flexibility. The rationale is that, given the significant uncertainties relating to climate change, the international regime should consist of a series of rolling commitment periods, which allow commitments to be continually redefined to take account of improved scientific and economic understanding. But indefinite commitments also could build in flexibility (for example, a carbon intensity target that increases in stringency over time) or could provide for periodical review with a view to possible adjustments. Most international environmental agreements have flexible amendment procedures, so that commitments can be periodically updated in response to new problems and new information. Similarly, the international trade rules and tariff rates set forth in the GATT/WTO regime are not time-limited. But this has not meant that they are carved in stone; instead, the trade regime has undergone major changes through periodic negotiating rounds. The real effect of making commitments with a limited duration is to reverse the ordinary presumption of continuity. In other regimes, commitments continue until they are changed; in the Kyoto Protocol, they lapse unless they are renewed. This allows states to preserve much more freedom, but at the cost of making the regime less predictable, and necessitating repeated negotiations, each of which could prove politically difficult.

Who Will Be Subject to Commitments?

Individuals/Private Entities

Although the climate change regime has, thus far, sought to establish obligations only for states—for example, relating to emissions targets, financial contributions, and reporting—an international commitment could conceivably apply directly to individuals, private entities, or sub-national entities such as cities. International criminal law, for example, establishes basic duties on individuals (for example, not to commit torture or genocide), the violation of which results in international criminal liability.[25] Although individual criminal responsibility seems clearly inappropriate for climate-related activities, other forms of individual liability are possible. For example, an international emissions tax could apply directly to producers or consumers of fossil fuels. Similarly, some have suggested that, given the withdrawal of key countries such as the United States from the Kyoto Protocol, the international climate regime should establish emission reduction obligations for multinational corporations.

It should be emphasized, however, that attempting to impose obligations directly on individuals or private entities would pose very difficult issues of implementation and enforcement—particularly with respect to individuals and firms located in countries that do not participate in the international regime

and that therefore could not be enlisted for enforcement purposes.[26] There are, at present, no examples of international environmental regimes that apply directly to individuals.

States

Given the difficulties of imposing obligations directly on individuals, most international regimes define commitments for states and rely on them to translate these into obligations for individuals and firms under their jurisdiction.

Because of the global nature of the climate change problem, the natural tendency is to include all countries in an international climate change regime. All countries have a duty to participate because of their contribution to climate change, and they all have a right to participate because they will all be affected by it. The UNFCCC takes this approach: it is open to any state and defines at least minimal obligations for all participants. At the same time, it recognizes that the same level of commitment is not appropriate for all states. It therefore sets forth differentiated obligations, based on the principle of common but differentiated responsibilities and respective capabilities.[27]

In establishing new commitments, a key question will be whether they apply equally to all states, or whether differentiation is appropriate. Kyoto's mitigation commitments all take the same form, for instance, but apply only to developed countries and vary in stringency among them. Commitments could also be differentiated by form (some countries have absolute or binding targets, while others have indexed or no-lose targets); by timeframe (as in the Montreal Protocol, which gave developing countries an additional 10 years to phase out ozone-depleting substances);[28] or by conditionality (applying when a country has met a criterion such as a specific level of per capita GDP or emissions).

The criteria that might be used to determine who should participate in a climate regime, or to differentiate commitments among the participants, include the following:

Big current emitters Relatively few countries contribute significantly to climate change—15 countries, for example, account for 75 percent of global CO_2 emissions.[29] Mitigation commitments by these big emitters could largely address the climate change problem. Moreover, limiting membership in the regime to countries with mitigation commitments could simplify the negotiating dynamic significantly.

Big historical emitters Alternatively, commitments might vary depending on a country's historical contribution to the climate change problem. Here, the rationale for differentiation would be the idea that countries with high historical emissions are responsible for the current problem and have a duty to fix it—including through reductions in their current emissions. This is the essence of the so-called "Brazilian proposal" for allocating the burdens of addressing climate change.[30]

Rich countries Commitments could vary depending on a country's wealth and therefore its capacity to respond to the climate change problem.

Like-minded states A future climate regime could be limited to like-minded states, which are willing to undertake a certain level of commitments and have shared views about international implementation mechanisms such as emissions trading. Again, the idea would be to create a more favorable negotiating dynamic by conducting negotiations initially among countries with shared goals, bringing other countries in later.

IV. Assessment Criteria

Potential commitments need to be evaluated from both a policy and a political perspective. In some cases, synergies may exist between different assessment criteria: a climate policy that is equitable or cost-effective may in the long run be more environmentally effective. But, often, different assessment criteria will be in tension. Ensuring predictability in the costs of mitigation measures, for example, comes at the expense of predictability concerning environmental effects. More broadly, there are strong tensions between the basic goals of policy optimization and political feasibility. Formulating a sound climate change policy is not so difficult; nor is formulating a politically acceptable one. The challenge is to devise a policy that is both sound and acceptable.

Policy Criteria

What commitments are optimal from a policy perspective? There are five key criteria: environmental effectiveness, cost-effectiveness, equity, dynamic flexibility, and complementarity.

Environmental Effectiveness

Ultimately, the purpose of mitigation commitments is to reduce dangerous climate change. The bottom-line test of commitments is their effectiveness, over the long run, in preventing (or at least limiting) climate change.

An important contributor to environmental effectiveness is, of course, stringency—all other things being equal, a stronger commitment should produce a greater environmental result than a weaker one. But all other things are rarely equal and, as a result, environmental effectiveness is not solely a function of stringency. Other important factors include:

Leakage To the extent that the climate change regime is not global, private entities can avoid the impacts of commitments by shifting their operations to a non-party state. As a result, more stringent targets could actually be counterproductive, both by discouraging countries from joining and by causing emitting activities to shift to states without commitments.[31]

Stimulating technological change Some types of commitments may be more effective, over the long run, in inducing technological change. For example, many policy analysts argue that market-based approaches, such as "cap-and-trade" or taxes, are more effective in promoting ongoing technological change than technology standards, which lock in a particular technology and fail to provide incentives for further change.[32]

Changes in public attitudes, awareness, and learning Over the long run, addressing climate change will likely require changes in public attitudes and behaviors. To the extent a commitment can help do so—for example, by raising public awareness—this would be an extra benefit.

Enforceability Given the nature of the climate change problem, countries will be tempted to violate their commitments, since the near-term economic benefits of violation (reduced compliance costs) will typically outweigh the near-term environmental costs (greater climate change). For this reason, climate change commitments may be effective in changing behavior only if they can be adequately monitored and enforced.[33]

Cost-Effectiveness

Since countries have only a finite level of resources to devote to climate change and other competing needs, commitments need to get the most "bang for their buck"; they need to reduce each unit of emissions at the lowest possible cost. Most economists agree that market-based approaches—such as emissions trading and taxes—are best from this perspective.[34] The more flexibility market participants have to seek out and utilize low-cost reduction options, the greater the economic effectiveness. That is why the Kyoto Protocol provides not only "where" flexibility (countries may receive credit for emission reductions in another country where the reductions can be made more cheaply), but also "what" flexibility (countries can choose the domestic policies and measures that make most sense for them) and "when" flexibility (countries can time their reductions over a five-year commitment period, and can bank surplus reductions for use in future commitment periods). As discussed above, many economists argue that even longer commitment periods would be desirable, to give companies more flexibility in timing their emission reductions to take advantage of regular capital replacement cycles and additional R & D.[35]

Equity

Commitments should treat participants fairly. As discussed in the equity paper in this report, this is important not only in determining which commitments are politically acceptable; it is also an important end in itself. Whereas environmental and economic effectiveness can both be judged in absolute (objective) terms, equity is by its nature relational. The question is whether a commitment (or set of commitments) is sufficiently equitable to be perceived as such by all participants.[36]

Dynamic Flexibility

Given the likelihood that commitments will periodically need to be revised in light of new scientific and economic information, a commitment would ideally be formulated in a manner that allows revisions as needed. For example, both targets and taxes have a form that can be scaled up or down, becoming more stringent or lax as the circumstances warrant.

Complementarity

The withdrawal of the United States from the Kyoto Protocol opens up the possibility of a fragmented climate regime, with different country groupings adopting different types of commitments. In that case, an important factor in assessing possible commitments would be the feedbacks, complementarities, and potential linkages between commitments in different regimes. For example, if one group of countries adopted commitments involving policies and measures and another group adopted binding emissions targets, it could be difficult for the two regimes to interact. Similarly, if the two groups both adopted "cap and trade" regimes—one based on absolute, fixed targets and the other on indexed targets—trades between the regimes, although possible, might be difficult, and need to wait until emission reductions had been achieved and verified.[37]

Political Criteria

From a political perspective, there are two key criteria: whether a particular type of commitment can be negotiated, and whether it can be implemented.

What Commitments Can Be Negotiated?

In considering future commitments, the question is not simply which commitments are optimal, but which are negotiable. Most of the options for mitigation commitments discussed above have been proposed at one time or another. But none has been able to command a stable consensus.

In some cases, an option may not be negotiable due to domestic political factors in particular countries. For example, carbon taxes are likely to be unacceptable to the United States in the foreseeable future, regardless of which party is in power.

But several more general considerations also affect the negotiability of mitigation commitments, including the following:

Continuity with Kyoto A commitment's continuity with Kyoto could cut both ways in terms of political acceptability. On the one hand, most countries now have a substantial investment in the Kyoto process, so a commitment's continuity with that process would be a point in its favor.

At the same, Kyoto has become a negative icon for many in the United States, and is likely to remain a non-starter even once a new administration takes office. In terms of this particular criterion, indexed or conditional targets could conceivably square the circle: they are compatible with the architecture established by Kyoto, including the emissions trading mechanism;[38] but they are more flexible than the fixed, absolute targets in Kyoto, and thus could credibly be characterized as a different approach from Kyoto.

Economic predictability For countries as widely different as the United States and China, a primary concern with Kyoto-style commitments has been the possibility of high compliance costs. Although some economists estimate that the costs of compliance would be low—and that an emissions target for China could even be economically advantageous, given its potential to reduce emissions cheaply and to sell surplus credits to countries with higher mitigation costs—compliance costs depend on many unpredictable variables such as rates of economic and population growth and of technological change, which make economic estimates highly uncertain.[39] From a political standpoint, economic predictability may be as or more important than economic efficiency. Countries want to know in advance what they are undertaking and whether it makes political and economic sense.

Compatibility with sustainable development priorities Most developing countries perceive climate change mitigation and economic development to be in competition with one another: money invested in mitigation is money diverted from economic development. In the long run, developing countries will undertake climate change mitigation only if they see synergies with sustainable development goals, for example, through the promotion of energy efficiency, renewable energy, and sustainable land use.[40] So, to the extent that they can be crafted in a manner that advances a country's development goals, climate change commitments will be more attractive.[41]

What Commitments Can Be Implemented?

To be effective over the long run, commitments need to take into account the capabilities and limitations of the institutions on which implementation and compliance will depend. The importance of institutional capacity is by now well understood in the context of technology transfer: the "best" available technology is not necessarily best for a country lacking the capacity required to use the technology effectively. Instead, technologies that better fit a country's capacities may be more appropriate.
At the international level, where institutions are notoriously weak, the issues of implementation and enforcement deserve particular attention. A commitment may make perfect policy sense in the abstract, but, unless it takes account of the practical realities of implementation, a gap is likely to emerge between promise and performance.

Factors relevant to implementation include the following:

Ease of monitoring Different types of commitments vary widely in terms of the ease with which they can be monitored and verified. Some analysts attribute the success of the international oil pollution regime to its reliance on construction and design commitments that are easy to verify (by direct inspection of ships when they are in port),[42] rather than on discharge standards. In the climate change context, national emissions of carbon dioxide can be estimated with a high degree of confidence, but emissions of other gases and removals by sinks are considerably more uncertain. Indexed targets introduce additional complexities, since they require monitoring not only of emission levels but also the variable to which emission allowances are pegged.[43]

Predictability of compliance Most implementation of international commitments takes place at the national level, through national law, so commitments adopted internationally need to be capable of domestic legal application. One criticism of obligations of result, such as targets and timetables, is that, because compliance depends on changes in behavior by firms and individuals (as is the case with climate change), it is difficult for a country to predict accurately whether it will achieve the required result. By contrast, obligations of conduct, such as equipment standards, tend to be easier to implement at the national level: if a country engages in the required conduct (for example, by requiring firms to install the specified equipment), then it is in compliance.

V. Options for Future Commitments

The following represent some of the most frequently discussed options for future climate change mitigation commitments. Three caveats are in order. First, these options are, of course, not the only possibilities. Instead, they represent a range of approaches chosen to illustrate many of the general issues regarding mitigation commitments. Second, the assessments of the various options identify the most prominent advantages and disadvantages of each approach, rather than applying the assessment criteria discussed above in a systematic manner. Finally, these options could be combined in various ways; they are not mutually exclusive. For example, an agreement might commit states not only to an emissions target, but also to efficiency standards and funding for research and development. Or it might set forth different types of commitments for different categories of countries—a binding emissions target, say, for industrialized countries, and a non-binding one for developing countries. Or it might set forth an evolutionary pathway, with different types of commitments kicking in at different times.[44]

Absolute, Sequentially-Negotiated National Emissions Targets

The Kyoto Protocol sets forth fixed national emission targets for the 2008-2012 period. The idea is that the first five-year commitment period will be followed by other commitment periods, to be negotiated on a rolling basis. Kyoto-style targets, if applied to all significant emitters, would have several benefits:

- *Environmental effectiveness* Fixed targets, if complied with, provide the greatest environmental certainty.

- *Cost-effectiveness* Fixed targets can be cost-effective if combined with emissions trading (as in the Kyoto Protocol) and with "when flexibility" (either through a longer commitment period or through provisions for banking and borrowing).

- *Equity* Fixed targets (like targets generally) can be differentiated among countries to meet equity concerns.

- *Dynamic flexibility/scalability* Fixed targets (like targets generally) can be adjusted up or down to take account of new information.

- *Continuity with Kyoto* For countries that support Kyoto, fixed targets would provide the greatest continuity.

At the same time, absolute targets also have several significant drawbacks:

- *Difficulties of negotiating* The costs of achieving a fixed national emissions target are uncertain, and depend on many factors (such as rates of economic growth and technology change) that are difficult to predict. Although absolute targets can allow considerable flexibility in implementation (as illustrated by the Kyoto mechanisms), they represent a legal straitjacket in the sense that, once agreed, they do not provide for changing circumstances. This rigidity could make iterative negotiation of fixed short-term targets difficult.

- *Perceived incompatibility with development priorities* Absolute targets are particularly problematic for developing countries and countries with rapidly growing economies, since they are seen as representing a potential constraint on economic growth. Of course, targets could build in "headroom" to allow developing country emissions to grow. Unless economic and emissions growth can be predicted reliably, however, setting fixed targets for developing countries involves a difficult balance between targets that are too loose (and possibly create surplus allowances, above business-as-usual emissions, often referred to as "hot air"), and targets that are too strict and inhibit development.

Indexed National Targets

Indexed targets have some of the same advantages and disadvantages as fixed targets. On the positive side, they are cost-effective if coupled with trading, which appears difficult but not impossible; they can be differentiated between countries[45] and made more or less stringent as the circumstances warrant; and they could provide continuity with Kyoto. In addition, they provide greater flexibility than fixed targets by allowing emissions to vary depending on whether the economy (or whatever variable emissions are pegged to) grows or shrinks. This can prevent the creation of "hot air" due to an economic downturn, but comes at the expense of environmental certainty. Indeed, if economic growth is sufficiently high, permitted emissions may even go up rather than down. And although the increased flexibility of indexed targets mitigates the problem of economic uncertainty, it does not eliminate it altogether.

Sectoral Targets

Sectoral targets (either fixed or indexed) have the benefit over economy-wide targets of allowing states to proceed incrementally. Rather than attempt to develop a target that makes sense for the entire economy, states can address emissions in a step-by-step manner, starting with a more limited set of activities in sectors such as energy or transportation. That is why many national strategies for addressing GHG emissions take a sectoral approach. Moreover, in some cases, more is known about emissions in one sector than another, so sectoral targets may help ease monitoring concerns. Finally, sectoral targets would make it more difficult for countries to give preferential treatment to particular sectors and, in that respect, could help ease competitiveness concerns.

But addressing emissions on a sectoral basis comes at a price. If states are restricted as to which types of emission reductions "count" internationally, they may be unable to take advantage of the most cost-effective options. Even if targets are developed for all sectors with significant GHG emissions, separate sectoral targets prevent countries and firms from making tradeoffs across sectors, doing more in a sector where emissions can be reduced more cheaply and less in another sector where reductions are more expensive.[46] Allowing such tradeoffs not only makes economic sense; it may also make targets more negotiable by giving countries flexibility to focus on those sectors where they can reduce emissions with the least economic and political pain. Sectoral targets also could distort competitiveness and give rise to complex equity issues if different circumstances prevail in the same sector in different countries.

Hybrid Targets (Safety Valve)

Hybrid targets, advocated primarily by economists,[47] were put on the table informally by Brazil in 2000, during the negotiations that culminated in the Bonn/Marrakech Accords. Hybrid targets have a number of desirable features:

- *Economic predictability and negotiability* By ensuring that the costs of mitigation commitments cannot rise above a predetermined level, hybrid targets remove one of the principal obstacles to the negotiation and acceptance of emission reduction targets.[48]

- *Equity* Although the safety valve level would need to be the same globally (otherwise the country with the lowest safety valve price could continue selling permits until the global trading price equilibrated at its safety valve level), commitments could still be differentiated through the emission reductions targets. (With a hybrid target, a country's costs are a function of both the safety valve price and the stringency of its emission target.) Thus, the safety valve, like fixed targets, is compatible with the application of equity criteria.

- *Scalability* A hybrid target could be scalable through its safety valve price as well as its emission reduction targets. To facilitate planning by business (which is currently difficult due to uncertainty about the stringency of targets after Kyoto's first commitment period), the safety valve price could have an automatic escalator, which would apply unless the parties decided otherwise.

Of course, the economic predictability of hybrid targets comes at the expense of environmental predictability—the principal strength of fixed emission reduction targets. This has an obvious downside: if mitigation costs prove high and the safety valve kicks in, then the level of actual emission reductions would be less than under a fixed target. But there are risks either way. Just as we have no assurance what level of reductions a given price will buy, we have no assurance how much a particular emissions reduction will cost. The difference is, the economic risks of excessive costs are near-term, while the environmental risks of insufficient reductions in emissions are longer-term and may be correctable through stronger measures later. Moreover, economic predictability could even provide an environmental benefit: with a guaranteed ceiling on costs, countries might be willing to accept more ambitious targets, leading to greater emissions reductions if costs prove low.

In addition to environmental uncertainty, a hybrid target would be likely to face issues of political acceptability in countries opposed to the introduction of new taxes, since the safety valve would operate, in effect, like a tax. Agreement could also prove difficult on a safety valve price as well as on what to do with any money raised from the sale of additional permits. (Would the money go to an international fund and, if so, who would control the fund, or would it be spent domestically?) In addition, if the safety valve price were set relatively low, it could limit incentives for technological research and innovation, by giving companies an easy way out if costs prove high.

Non-Binding ("No-Lose") Targets For Developing Countries With Graduation Criteria

No-lose targets have been proposed primarily as a means of providing incentives for developing countries to accept emission targets.[49] Over the long run, developing countries may need to accept binding targets as their economies develop. No-lose targets could serve as a useful transitional device, possibly in conjunction with criteria that define when a developing country would graduate from a non-binding to a binding target. During the transitional period, no-lose targets could be combined with legally binding commitments in various ways. For example, under a "dual commitment" approach, a relatively weak but legally binding commitment could be combined with a stricter one-way commitment that, if surpassed, would allow a country to engage in emissions trading.[50] Given the high variability of economic growth rates in developing countries, an indexed rather than fixed target could be used to prevent the target from becoming too easy or too hard.

Efficiency/Technology Standards

The difficulties involved in negotiating, monitoring, and enforcing emission targets have made technology standards more attractive, even to some economists who, as a rule, criticize such standards as inefficient.[51] Technology standards—for example, relating to energy efficiency—could be negotiated by governments or through public-private partnerships. One advantage is that they could have a significant environmental impact, even in the absence of universal acceptance, through tipping effects. As Scott Barrett explains: "If enough countries adopt a [technology] standard, it may become irresistible for others to follow, whether because of network effects, cost considerations...or lock-in."[52] If so, technology standards would be essentially self-enforcing, and would not involve the compliance issues raised by emission targets. Moreover, trade rules may allow countries that accept a technology standard to exclude from their markets products that fail to meet the standard, putting additional pressure on non-participants to join the technology regime.[53] Finally, technology standards are comparatively easy to monitor, since in most cases they simply require inspection to make sure that the proper equipment is being used.

At the same time, technology standards have a number of significant drawbacks that have limited their appeal in the climate change negotiations thus far. They depend on governments being able and willing to pick technologies based on sound technical considerations (rather than on the basis of which technologies are produced domestically or are backed by a politically powerful lobby). They lock in technologies and do not provide an incentive for further innovation. They limit flexibility by prescribing not just a result, but how countries must achieve it. For these reasons, among others, over the last decade, environmental policy has tended to move away from command-and-control regulation towards market-based approaches.

R & D Commitments

If emission reduction technologies such as hydrogen fuel cells or carbon capture and storage became practicable and economic, this could go a long way towards overcoming the existing barriers to climate change mitigation. But recent studies indicate that, despite the high profile of the climate change issue, investments are going down overall in mitigation-related research and development.[54]

International commitments by states to provide funding for research and development are not unprecedented. For example, the international space station is the product of an agreement providing for multilateral cooperation and funding.[55] Voluntary approaches have also sometimes proven successful. Twenty-one countries including the United States currently contribute to the Consultative Group on International Agricultural Research, which funds research centers around the world.[56] So, while some countries such as the United States may be wary of any new financial obligations, financing of R & D might prove attractive, either as an alternative to more stringent types of mitigation commitments or, at a minimum, as an add-on.

VI. Conclusions

In developing new mitigation commitments, the toolbox available to policymakers contains a wide range of options. In this respect, the climate change debate has grown considerably more sophisticated over the past decade.

In moving forward, it is unlikely that one size will fit all: different mitigation commitments will prove more or less attractive to different countries. The question will be whether to undertake the extremely difficult political task of negotiating a unitary system or to accept—at least for the short- to medium-term—a more variegated set of commitments, under either a single regime based in the UNFCCC or multiple regimes at the bilateral, regional, and global levels.

In general, the various types of possible commitments are complementary to one another rather than mutually exclusive, both within and between countries. National and international climate policy could consist of a mix of different types of emission targets for different countries and sectors, as well as technology standards and R & D commitments.

But to the extent that commitments vary between countries, international climate change policy will face several important challenges: first, to ensure that the various commitments add up to a sufficient level of effort overall; second, to ensure that the mix of commitments across countries is, broadly speaking, equitable; and third, to promote linkages between different national programs and, if there are multiple international regimes, between those regimes. None of these tasks is insuperable, and careful policy analysis can help elucidate the possible solutions. But, in the end, the successful resolution of these issues will depend on mustering greater political will among states to address climate change.

Endnotes

1. For a discussion of two related issues—first, how to distribute the burden of mitigation commitments (based on wealth, historical emissions, per capita entitlements, or some other criteria), and, second, what the trajectory or end point of commitments should be—see Ashton and Wang (2003) and Pershing and Tudela (2003), respectively. This paper focuses on mitigation commitments and does not address the equally important issue of adaptation commitments.

2. In this respect, mitigation differs from adaptation. Most of the benefits of adaptation accrue directly to the country undertaking the adaptation measures. (They are, in this respect, what economists refer to as "private" rather than "public" goods.) Thus, so long as the benefits outweigh the costs, countries have an incentive to undertake adaptation measures regardless of what other states do.

3. Barrett (2002); Victor (1999).

4. Philibert and Pershing (2001).

5. The World Trade Organization dispute settlement system is one important exception.

6. Another way to say this is that approaches using emissions targets flow from outputs (i.e., emissions) to inputs (i.e., the activities that cause emissions), rather than vice versa. See Heller and Shukla (2003).

7. Although the provisions on sinks in the Marrakech Accords have modified these targets, and Kyoto's flexibility mechanisms allow countries considerable leeway in how they meet their targets.

8. The non-binding target in article 4.2(a) of the UNFCCC implicitly acknowledged a wide variety of circumstances that may cause emissions to vary.

9. U.S. Global Climate Change Policy: A New Approach, Feb. 14, 2002, available at http://www.usgcrp.gov/usgcrp/Library/gcinitiative2002/gccstorybook.htm.

10. Bouille and Girardin (2002).

11. Kopp et al. (1997); McKibben and Wilkoxen (1997).

12. The safety valve has been characterized as a "hybrid" approach because it mixes a quantity-based instrument (if the safety valve price is not exceeded, then the quantitative target must be met) with a price-based instrument (if the safety-valve price is reached, then additional emissions are allowed at that price). IEA (2002).

13. Samaniego and Figueres (2002).

14. Kyoto Protocol, art. 2.1.

15. Barrett (2002).

16. Mitchell (1994).

17. Cooper (1998); Nordhaus (2001).

18. Kyoto Protocol art. 2.1(a)(v).

19. China, India, Indonesia, Iran, Kazakhstan, Russia, South Africa, and Venezuela.

20. McKibben and Wilkoxen (1997).

21. Margolis and Kammen (1999).

22. Barrett (2002).

23. Hahn and Stavins (1999).

24. Aldy et al. (2001). For a discussion of rates of capital turnover, see Lempert et al. (2002).

25. The Genocide and Torture Conventions—in which the United States participates—both define crimes for which individuals can be held responsible. The newly created International Criminal Court will have jurisdiction to prosecute individuals directly for commission of crimes against humanity.

26. International criminal law is generally based on the idea of universal jurisdiction: any state can proscribe and punish violations, regardless of where they occur. A similar approach could be used for climate change, although it would be sure to draw objections from non-participating states, such as the United States, which have objected to the new International Criminal Court on similar grounds.

27. UNFCCC, art. 3.1.

28. The timetable specified in the Montreal Protocol for industrialized countries to phase out their use of ozone-depleting substances applies conditionally to developing countries, if their per capita consumption of ozone-depleting substances exceeds a specified level.

29. IPCC (2001), sec. 10.1.2.1.

30. UNFCCC (2002).

31. For more on leakage, see Aldy et al. (2003).

32. Wiener (2001).

33. Barrett (2002).

34. Aldy et al. (2003).

35. Lempert et al. (2002).

36. Ashton and Wang (2003).

37. Trading between systems using absolute and relative targets might also be possible through use of a gateway as in the United Kingdom trading system or a commitment period reserve. For a discussion of the possibility of trading between systems using absolute and relative targets, see Haites (2002); IEA (2002).

38. See supra note 37.

39. Estimates of U.S. compliance costs, for example, differed by more than an order of magnitude, from about $5 billion to over $400 billion per year. See Weyant and Hill (1999); EIA (1998).

40. Heller and Shukla (2003).

41. Winkler et al. (2002).

42. Mitchell (1994).

43. IEA (2002), at 139 (GDP measurement is relatively inaccurate in many developing countries).

44. For example, as the text discusses, developing countries might start with non-binding emissions targets and more towards more binding targets over time, as they satisfy specified graduation criteria.

45. Differentiation would be possible on the basis of not only the stringency of the target, as with fixed targets, but also the variable to which targets are indexed.

46. Although trading across sectors could mitigate this concern, if trading were fully allowed, then the sectoral targets would, together, amount to an overall national target.

47. Kopp, Morgenstern, and Pizer (1997); McKibbin and Wilkoxen (1997).

48. In rejecting the Kyoto Protocol, for example, the Bush Administration identified potential harm to the U.S. economy as one of Kyoto's two fatal flaws.

49. Philibert and Pershing (2001).

50. Kim and Baumert (2002); Philibert and Pershing (2001).

51. Barrett (2002), at 398.

52. Id., at 395.

53. Charnovitz (2003).

54. Margolis and Kammen (1999).

55. Barrett (2002), at 394.

56. See http://www.cgiar.org/index.html.

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Equity and climate

In principle and practice

John Ashton and Xueman Wang

I. Why Equity Matters[1]

In a recent experiment with pairs of five-year-olds, one in each pair was given ten chocolate coins and invited to share them with the other, who could choose either to accept or reject the allocation offered.[2] In the case of rejection neither child got to keep any of the coins. Most spurned any offer of fewer than four of the ten coins. A fair distribution of reward was seen as more important than the reward itself. Whether this strong sense of equity is a basic instinct, as the coin experiment suggests, or a social construct—whether it emerges from our genes or from culture—it looms large across a wide range of human affairs. The notion of equity has a universal appeal.

In most societies some idea of equity lies at the heart of politics: the art of "sharing coins" across a community. Political movements often start as protests by groups of people who feel unfairly treated. Successful politicians broker solutions that people with different interests can all regard as fair—or, at the very least, not demonstrably unfair to one group or another. The results have come to be reflected in our institutions. Many legal systems give judicial meaning to the notion of fairness. The quest for equity pervades international discourse. It inspires the United Nations Charter, with its assertion that all humans equally are entitled to live in freedom from want and fear. It animates the current debate about globalization.

Equity is a familiar theme in environmental negotiations. At the Rio Earth Summit in 1992, the international community agreed that "the right to development must be fulfilled so as to equitably meet developmental and environmental needs of present and future generations." Polluting states were to be accountable for the transboundary consequences of their pollution (the "polluter pays" principle). The effort states should make in responding to common environmental challenges was to reflect the extent to which they had contributed to the problem and their capacity to address it (the principle of "common but differentiated responsibilities").[3]

Climate change poses a serious challenge to our ability to construct equitable global responses to shared problems. Emissions of greenhouse gases (GHGs) come disproportionately from industrialized countries. Some countries—again predominantly in the industrialized world—are better placed than others to pioneer the technologies, processes, and behavioral changes that will be necessary to mitigate their emissions. Moreover, the most harmful consequences of climate change are likely to befall the

poorest countries: in many cases, not only those least responsible for unleashing them, but also those least equipped to deal with them. Furthermore, in the climate negotiations, the same countries tend to be the least able to make their voices heard or to assess the implications of any proposed outcome in light of their own interests.[4]

So it is not surprising that the language of equity has permeated the international negotiations on climate change since they began in 1991. Different nations and groups of nations have offered different, and often conflicting, visions of what is fair and what is not. Not surprisingly, these visions tend to coincide in most cases with perceived material interest. The two major agreements so far achieved—the United Nations Framework Convention on Climate Change (UNFCCC), and the Kyoto Protocol—each convey a palpable sense of the extent to which those who negotiated them bent over backwards to find a package of outcomes that all could consider fair. There is something for everyone.

These agreements reflect a rough calculus of equity at the early stages of the international climate effort. Both put the onus for early action on industrialized countries, citing common but differentiated responsibilities. They make clear that measures to deal with climate change should not limit the ability of developing countries to develop and pay special attention to the needs of the poorest and most vulnerable countries. They include provisions for the transfer of technology and financial resources and help in dealing with the impacts of climate change. The Convention commits parties to "protect the climate...on the basis of equity." It makes the fulfillment of obligations by developing countries conditional on assistance from the developed countries. The Kyoto emissions constraints apply only to the latter.[5]

But the Convention and the Protocol are only first steps towards an international regime capable of neutralizing the impact of human activity on the climate. The withdrawal of the United States from Kyoto has made them yet more tentative. A successor agreement will need to deliver stronger commitments further into the future. That will demand more effort and inevitably throw into sharper relief the links between climate change and equity. A deeper and more universal understanding of the equity considerations inherent in the climate problem will be needed. So will more powerful tools to resolve the conflicts and tradeoffs between competing views of fair outcomes. In short, the success of the negotiation will hinge in large measure on the ability of parties to come to terms with the equity dilemmas they will face.

This paper offers a set of tools for thinking about these dilemmas. Section II identifies the dimensions of equity that arise in the context of climate change. Section III examines how these present themselves in practice, in different domains of choice. We argue, on the basis of this analysis, that parties are unlikely to agree on any unitary approach to equity, based on a single, objective yardstick, as a foundation for a long-term climate agreement. Any search for such an approach is bound to fail and risks diverting negotiating capital away from more productive terrain. Rather, a fair agreement will be one that is qualitatively robust across competing equity claims.

The equity calculations underlying any eventual agreement will thus rest on political judgment and compromise. It will be important in the negotiation to leave space for that judgment, and for the balancing of competing conceptions of equity. From this perspective, section IV suggests some minimum equity conditions that a post-Kyoto climate agreement must meet in order to stand a chance of being considered fair by most if not all parties. Finally, section V assesses the extent to which various approaches to emissions mitigation might help construct an agreement that meets these conditions.

II. Equity in Five Dimensions

Before introducing the specific notions of equity that bear most directly on the climate debate, it is important first to distinguish more broadly between equity and the related but distinct question of interest.

Equity—whether grounded in philosophy, morality, or human nature—is an ideal that shapes our view of what is right or just. It is predicated on the notion of common good and, at times, calls on some to sacrifice for the sake of others. Interest, on the other hand, represents what is best for the individual (or, in the international context, the individual nation) as determined by that individual. Equity may be one factor in assessing interest. But it is rarely the overriding one. The others usually boil down to some assessment of costs and benefits.

Equity and interest may coincide. When they do not, interest often exerts a stronger influence on the chosen course of action. Inequities persist because rectifying them would diminish the self-perceived interests of those in the stronger position to control the state of affairs. History, however, offers examples of equity prevailing over established interests—for instance, the extension of voting rights to women and minorities. What is required in these cases is the mustering of sufficient political will.

Both equity and interest are reflected, then, in a common currency—effort. How much effort must, or will, a party undertake to meet a given set of obligations? Effort ordinarily is assessed in relation to the benefits to be gained. It is partly a function of perceived economic cost, to the economy as a whole or to groups within it. It has a relational aspect as well: a given obligation can feel easier if others are doing it too (by the same logic as the chocolate coin experiment). But effort is ultimately a political quantity. It depends on the amount of political capital a government is willing to invest in the attempt to stabilize the climate in relation to other priorities, on the leadership qualities of individual politicians, and on the relative political weights of the domestic constituencies that stand to win or lose. In the end, no government will accept an agreement that conflicts directly with its interests as it sees them, to whatever extent those interests reflect considerations of equity. So it is here, in the political judgment about how much effort to invest, that equity and interests must be balanced or aligned.

It can be hard to disentangle equity and interests. Governments often cloak their interests in the guise of equity. Competing parties champion different notions of equity, not surprisingly those coinciding most closely with their interests. Nonetheless, it is possible and perhaps essential to isolate and understand the essence of equity, uncluttered by other self-interested considerations. Only then can we begin to identify the contours of a "fair" outcome. If equity is to be served, the challenge is to fashion an outcome that is both fair and reasonably satisfies the interests of most or all concerned. In this examination, we do not ignore interest but rather put it aside to focus more directly on equity in order, hopefully, to contribute to such an outcome.

How Do We Decide What is Fair?

Many different equity notions or claims have been put forward in the climate debate. Most can be encompassed within what are here described as five dimensions of equity. Not all are universally held principles, but each has sufficiently broad appeal to have attained legitimacy in the eyes of many. Together, they define a notional "equity space." Any proposition in the negotiations locates uniquely in this space according to its projection in each dimension. Of course, equity space does not exist in any objective or physical sense. As we have seen, it looks different according to the interests of each party. But it is a useful notion in that each dimension is distinct from the others, and each must be considered for a full account of the equity content of any proposition. It enables us, in a sense, to deconstruct equity in the context of climate change.

Responsibility

In many circumstances, equity boils down to an allocation of responsibility. When our interests are harmed, the question of who is to blame is usually among the first to arise.

In the realm of the environment, the polluter pays principle illustrates this. It requires the party responsible for the harm to bear the costs of repairing it.[6] As a broad political concept, this is easy to comprehend and few would challenge its intrinsic fairness. But as a precise legal instrument, it is harder to apply. Even in simple cases, there is often room for dispute about how negligent the polluter might actually have been or how much damage has actually been incurred. A polluter who is conscious of the damage being caused should arguably bear more responsibility than one who is not.

Moreover, the notion of responsibility is hard to apply when the chain of cause and effect linking the initial action to the harm is long and uncertain; when the extent or distribution of the damage is difficult to quantify; when compensation for damage does not by itself solve the problem; or when the benefit arising from the harmful behavior is spread beyond the party responsible for the harm, for example through trade in carbon-intensive goods. As we shall see, all these difficulties apply in the case of climate change.

Nevertheless, a fair agreement on climate would need somehow to reflect the relative degrees of responsibility for the problem arising in the first place.

Equal Entitlements

Another approach to equity is based on the idea of rights or entitlements to certain goods or benefits. Equity becomes a question of how these entitlements should be distributed. In many cases the proposition is that all humans should enjoy equal entitlements to a given public good.

This egalitarian argument is most familiar in the case of abstract public goods like liberty, security, access to impartial justice, and opportunity. Entitlements of this kind are well established in international law, not least in the United Nations Charter and the two international covenants covering civil, political, economic, social, and cultural rights.[7] In principle, if unfortunately not always in practice, every citizen of whatever station in life has an equal right to enjoy them.

The principle is harder to invoke when it comes to more material goods. Some political systems apply egalitarian principles to some environmental resources such as access to land, water, or fisheries, usually by seeking to establish some form of public ownership. But these approaches often fail to deliver equal access in practice, even when so intended. In any case, they are a matter of political choice rather than universal agreement. No state, for example, shares equally among its citizens the benefits accruing from the extraction of its minerals (perhaps because these relate less directly than, say, water, to basic human needs). Most goods are allocated through property rights according to ability or willingness to pay, not provided equally to all.

Nevertheless, it is sometimes argued that entitlements should be applied to the atmosphere. Climatic stability is a global commons attribute. No one can own the atmosphere. Surely, runs the argument, every human has an equal stake in it: an equal share of the total "carbon space" available for human activity. On that basis, equity in any new climate agreement would be judged by the extent to which it carries us towards such an equal entitlements world.

Capacity

Another basic notion of equity relates to the capacity to act. The idea that the most able should contribute the most to the provision of a public good is well established in most national polities and in the international system. It is one of the principles behind progressive taxation. It is particularly relevant to the family of global pollution problems to which climate change belongs, in which industrialization goes hand in hand with damaging behavior.

Industrialized countries have more access to the technologies necessary to address such problems, and to the capital necessary to develop them and bring them to market. They are better able to put in

place the necessary policies, including those linking domestic measures to international commitments, and to innovate in pursuit of national goals. An equitable approach to climate would thus demand more from those most equipped to respond.

Basic Needs

Another component of fairness is the idea that the strong and well endowed should help the weak and less well endowed in meeting their most basic needs. Most countries at least aspire to offer a safety net to the helpless.

Internationally, this is one impulse behind the effort to eradicate poverty. The Millennium Development Goals define a set of basic human requirements to be met through shared action and support from those rich enough to provide it. Many developing countries insist on the right to accord a higher priority to fighting poverty at home than to contributing to global efforts that might conflict with this. This is essentially an appeal to the primacy of basic needs. Thus a fair climate change agreement would if possible help, and certainly not undermine, the efforts of the poorest countries to meet the basic needs of their people.

Comparability of Effort

In assessing whether an outcome is equitable, parties will invariably compare the effort they are being asked to make with that required of other parties. A proposal may satisfy the requirements of responsibility, entitlements, capacity, and basic needs. But if some seem to be getting a better deal than others—if their commitments are, in some sense, disproportionately easy—the deal may still seem unfair.

The idea that those with similar circumstances should undertake a similar degree of effort clearly has links to the other dimensions already described, particularly to capacity. It also lies at the intersection between equity and interests, since effort in this context is synonymous with the political and economic cost to a party of taking on a given set of obligations. But the essence of this dimension lies in its *relational* quality: the effort demanded of a party not only has to seem fair as an absolute expression of its record and circumstances but also in light of the deals secured by others.

What About Future Generations?

So far we have focused on equity between people living now. But climate change will restrict the choices of generations to come. We might therefore ask how we can ensure that our approach to it is also fair to them.

This is not an additional dimension of equity in the sense of the five we have just described. Instead, it cuts across each of them. Future generations will have no responsibility for the problem that is handed down to them. They too are entitled to a fair share of carbon space. Their capacity to act in response to climate change is, by definition, unpredictable at least in the long term. From their perspective, their basic needs will be no less important than ours; nor would they be likely if asked to accept a disproportionate share of the burden of effort.

The problem is how to reflect interests of this kind—interests that we hold in trust—in a present-day negotiation. Future generations do not have a seat at the table or a capacity to articulate a position. Poor countries can argue on basic needs grounds that when the survival of those alive now is at stake, their descendants must be left to look after themselves. But it is precisely because of our tendency to borrow destructively and unaccountably from the future that making the transition to sustainable development has become such a momentous challenge.

Few would dispute that the next climate agreement should in some sense be fair to future generations. A crude way to assess this would be in terms of its overall impact on emissions. The faster we can bring climate change under control, the less we damage the interests of successor generations. Accordingly, the analysis that follows does not explicitly address these interests. Rather, it assumes that an agreement that satisfies present-day equity considerations, thereby facilitating the strongest possible climate action, will also represent the best available deal for future generations.

III. Equity in Practice[8]

The five equity dimensions together capture the predominant ways in which equity is invoked in the context of climate change. But outcomes in the real world reflect the practical choices of governments, politicians, and others who shape opinion. For a clearer view of how our equity dimensions may constrain outcomes in the next phase of climate diplomacy, we must look at their implications in the different areas of decision-making, or *domains of choice*, within which parties will negotiate. Each domain has its own potential winners and losers, and each contributes to the multiple political judgments that must be made about whether an outcome looks fair.

There are, in essence, four separate but connected domains to consider. The first concerns what action should be taken, if any, to constrain *emissions* of greenhouse gases. The second concerns the *consequences* of climate change, and the steps necessary to deal with them. The third concerns the help given to, or received from, others through *transfers* of resources. The fourth concerns the *process* of negotiation on climate change.

Equity and Emissions

What obligations should a state in a given set of circumstances be expected to undertake to constrain its GHG emissions?

The notion of responsibility offers one type of response. As we have seen, responsibility for human interference with the climate is distributed unevenly. So it might seem reasonable to assess how much different countries have contributed to the problem, and to apportion accordingly the responsibility for solving it. Profligate emitters would be expected to do most to bring their emissions under control. As the largest emitters (in per capita, if not always absolute, terms) are generally also the wealthiest, such an approach would make sense as well from the perspectives of capacity and basic needs.

But in practice, the assignment of responsibility is hardly straightforward. There is uncertainty over the detailed connections between emissions at one time and climatic variation at another. Nor is it obvious exactly which emissions should be included in the "climate account." One approach would be to distribute emissions according to the relative *historic responsibility* of different countries for the extent of the problem so far. Methodologies for doing this have been under discussion for several years, based on a proposal originally made by Brazil.[9]

But from what date should the accounting of responsibility begin? Should the clock start with industrialization, with scientific speculation about the link between human activity and climate change, or at some later date? Should the account include only direct GHG emissions, or should it also cover emissions and withdrawals as a result of changes in land use? Should it be based on total emissions over the chosen period, on the resulting changes in GHG concentrations in the atmosphere, or on the degree of climate change likely to have been caused or committed to as a result of the changed concentrations?

And why in any case should parties be held responsible for what they did before the international community understood that human activity affects the climate? Perhaps it would be fairer to allocate responsibility according to *current emissions*. Furthermore, should not those whose *future emissions* are likely to grow most rapidly assume some responsibility for the climate consequences of their chosen development path?

In assessing responsibility, it is also reasonable to ask who benefits from the emissions caused by a particular activity. The Kyoto Protocol penalizes emissions at the point of production. But we live in a world with a high and growing volume of international trade. Thus some countries, such as producers of metals or large volumes of manufactured goods, generate emissions to make products that are used elsewhere in the world. There are equity grounds for the proposition that those who receive the benefits from the emissions (or "embedded carbon") associated with the production of such goods should carry the cost. Emissions might then be assessed and penalized at the point of consumption. Otherwise a steel exporter would be carrying a carbon burden for those who use the steel.[10]

The entitlements approach circumvents these complexities by choosing a different starting point. Rather than responsibility, it assigns rights, in the form of equal entitlements to the atmosphere. If everyone has an equal right to account for emissions, the next stage of the climate regime should bring per capita emissions closer together. So countries with high per capita emissions should reduce them; but those with low ones should have headroom within which to increase them. This is the basis of the proposal known as "Contraction and Convergence."[11] Such an approach has intuitive appeal. Indeed it is hard to see how any successful response to climate change could follow a radically different path to the one it maps out. But as a practical framework for the next stage of the international negotiations, it faces serious obstacles, not least in addressing concerns about the scale of resource transfers and domestic dislocation it might require of high emitters (see box below).

Some proponents of equal entitlements argue that the Kyoto mechanism of tradable emissions permits, applied without an agreed long-term regime based on equal entitlements, gives the industrialized

Contraction and Convergence

The "Contraction and Convergence" proposal, developed by Aubrey Meyer, assigns every human being an equal entitlement to GHG emissions. All countries should thus move towards the same per capita emissions. Total emissions should *contract* over time, and per capita emissions should *converge* on a single figure. The actual convergence value, the path towards convergence, and the time when it is to be reached would all be negotiable. The proposal allows for the trading of emissions entitlements using mechanisms of the kind permitted under the Kyoto Protocol.

At one level, this is compelling. It offers a long-term architecture for an international emissions regime, potentially robust across several of the equity dimensions identified in this paper. It would not require developing countries to shift their immediate focus away from their basic needs: their emissions constraints would bite gradually as per capita emissions increased. And by emphasizing entitlements as well as commitments, it could help address the sense of inequity that arises from the unrequited "carbon debt" of past emissions by industrialized countries.

But on closer inspection, there is no fundamental reason why the right to emit should be equally shared when access to other public goods is not: at the heart of the proposal lurks a contestable ideological choice to that effect. Moreover, perhaps it is not GHG emissions that should be equally distributed, but the welfare costs to which emissions give rise. Should not those living in cold countries (with high heating needs) or large countries with dispersed populations (high transport needs) be allowed higher per capita emissions? The large resource transfers from currently high per capita countries to low ones implied by the scheme may be equitable; but it is probably unrealistic to expect such commitments at this stage.

Ultimately, almost any conceivable long-term solution to the climate problem will embody, at least in crude form, a high degree of contraction and convergence. Atmospheric concentrations of GHGs cannot stabilize unless total emissions contract; and emissions cannot contract unless per capita emissions converge. The practical question is not whether this is a reasonable scheme, but whether the quickest way to realize it is to base the next stage of the negotiations explicitly on it.

Nevertheless, the contraction and convergence proposal plays an important role in the climate process. It focuses attention on the ethical questions at the heart of the climate problem, which no long-term solution can afford to ignore. If supported by a critical mass of countries, it would become an important force in the negotiation. The ideas behind the proposal will remain relevant to any discussion of climate and equity for as long as the search continues for a global response to climate change.

world permanent and disproportionate ownership rights over the atmosphere and should therefore be rejected. From a pure entitlements perspective, this position cannot be dismissed out of hand. Certainly, emissions permits have many of the attributes of other forms of property (and not least of a currency). But the permanence of the right concerned is open to question. Furthermore, emissions trading can be justified on other equity grounds, particularly capacity and comparable effort. The abandonment of this key piece of the Kyoto architecture would take the climate process backwards, not forwards. This illustrates the danger of pressing too far along a single dimension of equity to the exclusion of others.

Whether or not equal entitlements can be a basis for moving the climate effort forward, the notion of *per capita emissions* remains central to any discussion of climate and equity. As a simple yet powerful metric for encapsulating and comparing parties' emissions and economic profiles, it lends perspective on other equity dimensions, not least responsibility, capacity, and basic needs. It is easy to communicate to publics and is likely to feature increasingly in the climate negotiations. It is perhaps most useful, however, when coupled with other indicators such as per capita income and emissions per GDP to provide a fuller picture of countries' relative circumstances.

Any allocation of mitigation burden—whether through rights or responsibility—is further complicated if comparability of effort is to be an objective. This concern is often expressed in terms of competitiveness. Any regime that puts some countries under tighter carbon constraints than others alters the terms of trade and conditions for investment between them. This can also be the case among countries with the same carbon constraints. Two countries might have identical emission, population, and income levels, but differences in other circumstances—such as natural endowment, energy mix, or energy efficiency—will translate into greater marginal abatement costs for one than for the other.

It is unlikely that the Kyoto commitments will dramatically distort existing patterns of trade and investment, especially as the U.S. withdrawal will keep the price of carbon relatively low. Nevertheless, both Canada and Japan have argued that, particularly with the United States out, their targets put them at a distinct competitive disadvantage. Canada has even proposed that it receive emissions credits for its exports of clean energy to the United States, its largest trading partner. Arguments about unfair competition from unconstrained economies are likely to intensify as the regime becomes more ambitious.

Taking all these arguments together, an equity perspective on emissions suggests that the more prosperous a country is, and the higher its total and per capita emissions, the stronger should be its obligations. That points in the near term to more vigorous action by industrialized than developing countries. It also suggests the need for differentiation of commitments and a mechanism for minimizing competitive stresses, perhaps linked to international frameworks for trade and investment. But it also follows that as the more advanced developing countries achieve a higher level of development, and as their emissions and income grow, they will over time have to assume an appropriate share of the responsibility for limiting and ultimately reducing global emissions.

Equity and the Consequences of Climate Change

For many countries, particularly the poorest, the most pressing requirement in any new agreement will be for help in dealing with the harmful consequences of climate change. Equity is no less important here than in the context of emissions.

Harmful climate-related impacts are projected to arise from rising sea level; changes in patterns of temperature, winds, cloudiness, precipitation, ocean chemistry, and perhaps ocean currents; more frequent and possibly more violent storms; and destabilization of natural biomes. The human consequences are expected to include displacement of people, disruption of agriculture and fisheries, more intense competition for water, enhanced threats from agricultural pests and human diseases, and possibly enhanced risks of conflict arising from the interplay between these and other stresses.[12]

Countries will need to invest in measures that will make them less vulnerable to future impacts. How will equity considerations affect their responses?

Once again, the responsibility perspective is important. Those who suffer harmful climate change impacts will wish to hold accountable in some way those whose emissions are largely responsible. But even more than in the case of emissions there is a practical difficulty in translating responsibility in principle into a quantitative allocation of obligations. It is extremely hard if not impossible either to establish the precise causal connections between one country's emissions and the climatic impacts of those emissions on another, or to establish the exact additional costs of making an economy resilient to those impacts.

Considerations of capacity and basic needs reinforce the responsibility case. Prosperous countries have more options for dealing with the impacts of climate change. Households with more disposable income are better placed to relocate away from coastal areas threatened with inundation, or to seek livelihoods less dependent on the climate. Governments with more resources to deploy are better able to make their economies less vulnerable to climatic damage.

Poorer countries are not only less responsible for the problem. They are also, by and large, less equipped to deal with its results, and more vulnerable to disruption of their ability to meet the basic needs of their people. They can be expected to press for assistance commensurate with the scale of the damage they are likely to suffer. They will seek this both through the climate negotiations and in other contexts. For example, if weather-related natural disasters continue to become more frequent, their victims can be expected to call not only for emergency humanitarian relief but also for more systematic compensation in the context of climate change.

This kind of thinking could introduce strong currents of resentment into the climate debate, possibly flowing back into the wider dynamic of international affairs. One mechanism for this might be attempts to bring "class action" lawsuits for compensation against governments or energy companies.[13]

Consequences may also arise from the impacts not of climate change itself, but of the measures taken in response to it. Climate policies can affect the interests of different countries to different degrees. Some oil exporting countries press stridently for compensation for the economic costs of any decline in demand for oil. The impact of the Kyoto targets on their economies will likely be small alongside market fluctuations. But the general argument will attract more attention as the impacts of climate policy grow. A poor country whose economy depends heavily on the price of a commodity, especially coal, for which demand might decline as a result of a stronger climate agreement could legitimately appeal for help on grounds of responsibility and perhaps basic needs.

So in the domain of consequences, as with emissions, the considerations we have identified offer general guidance only. Equity arguments suggest that a new agreement will need to embody enhanced support for those countries facing harmful impacts of climate change. But they do not offer a detailed prescription for the scale of that support, for how the burden of providing it should be equitably distributed, nor for how it should be shared among recipients.

Equity and Resource Transfers[14]

The existing instruments set up various mechanisms for the provision by industrialized countries of funds, technology, and knowledge to developing countries. The Bonn and Marrakech Accords that clarify the operation of the Kyoto Protocol establish designated funds to help vulnerable countries adapt to climate change and to meet the special needs of the least developed countries. There are three separate funds: a Special Climate Change Fund, a Least Developed Countries Fund, and an Adaptation Fund. Developed countries have pledged new support in part through these funds amounting to 450 million Euro annually by 2005.[15] There are other commitments, under the Protocol and the Convention, to transfer technology and to help countries develop the capacity to engage on climate change.

Stronger assistance to developing countries for both mitigation and adaptation is an important component of equity, in particular the dimensions of responsibility and capacity. But as a practical matter, transfers of public funds are unlikely ever to meet the full needs of developing countries. Kyoto establishes a model, through the Clean Development Mechanism (CDM), for channeling private investment towards climate goals. It will be important in the next phase to explore further the potential scope of private sector finance in strengthening the capacity both to mitigate emissions and to deal with the consequences of climate change.

It can be hard to separate transfers driven by the climate regime from those that would take place anyway. Likewise, if funding for an activity with a climate benefit is provided through bilateral development assistance rather than a channel established under the climate regime, should that be reflected in the equity calculation? Furthermore, where do climate benefits end and others begin? Arguably, well-governed countries will be better able to implement successful policies to adapt to climate change. Does that mean that assistance outside the climate regime for general good governance should appear in the "equity account"?

Whatever the problems of definition, resource transfers will play a big part in the post-Kyoto negotiation. They are a tangible expression of the extent to which the notions of responsibility, capacity, and basic needs inform any outcome. They bring into the political equation their own groups of policy-makers, commentators and vested interests. As we have seen in the previous section, much of the attention will focus on assistance in dealing with climate change impacts. It will extend as well to other forms of support for developing countries, including the transfer of climate-friendly technology, and help in building domestic capacity to put climate policies in place. Yet, as in the two previous domains of choice, our equity dimensions serve better to justify these broad needs than to validate particular means, or apportion the costs, of meeting them.

Equity and Process

Equity relates not only to the substance of an agreement but also the process by which it is reached. There is no surer way to push an agreement out of reach than for a group of parties to conclude that the negotiating process is biased against them. Trade negotiations broke down in Seattle partly because developing countries saw the real deals being done behind closed doors among small groups of countries (the so-called "green room" process). In the climate negotiations, the disastrous meeting in The Hague in 2000 of the Sixth Conference of Parties (COP6) collapsed partly because developing countries would not accept as a fait accompli any last-minute agreement between the European Union and the United States.[16]

The Kyoto Protocol itself illustrates the importance of a fair process. There were no agreed criteria for assigning obligations. Some commitments were imposed by muscular chairmanship or gaveled through without reaction from exhausted negotiators. Developing countries were on that occasion pressed into accepting a deal made in their absence among their industrialized partners, fuelling their suspicions ever since about faits accomplis. The Kyoto Protocol might not have been agreed without such methods; but it has been fragile in part because of them. As the process becomes more demanding on more countries, it will become ever more important for all to feel that their voice in it will be heard.

This imperative derives, in a sense, from the equity dimension of entitlements: all who believe they have interests at stake in any aspect of the negotiation are entitled to equal access to the process. And there should be room for any party to press its concerns. The negotiation—and, hence, its outcome—stand a better chance of being accepted as fair if the process is transparent and open to all parties.

In a negotiation with 168 parties clustered into disparate groups, each incorporating a range of conflicting interests, it is a challenge to establish these conditions. There will always be tension between the need to create the time pressure without which parties cannot be brought to compromise and the desire of each party to be allowed enough time to assess its interests. Any deal reached behind closed doors between some parties without consulting others will always be vulnerable, even if it only touches directly on the interests of the parties in the room. Yet in any large negotiation the core political deals are always struck informally between those with most at stake. Those willing to take on commitments resent vetoes from those not being asked to do so. It can be destabilizing to demand, as some often do, that no deal is acceptable without parallel progress on all issues, so that emissions cuts offered by industrialized countries become contingent upon specific kinds of resource transfer, however desirable. So transparency and inclusion can only work if all parties show sensitivity to each other's process concerns and nurture a sense of responsibility to the process as a whole.

Another equity dimension at play here is capacity. The climate negotiations are among the most complex ever attempted, and some parties have far greater capacity to participate effectively in them. During any session, several dozen highly technical negotiations proceed simultaneously, covering issues as diverse as the rules of procedure and feedbacks between climate change and ozone depletion. Parties with enough skilled negotiators to engage effectively on each issue, and make the linkages between them, are at an advantage. The larger industrialized countries typically bring teams of several dozen—in some cases over a hundred—officials to a major negotiating session. Many of the poorest countries manage only to send a single representative.

This is not just a question of the size or skills of the team a country can deploy in a negotiating session. To participate with confidence in the process as a whole, a government needs to be able to maintain an up-to-date assessment of its national interest in each of the many areas under discussion. It must understand the implications of the positions and underlying policies of others. It must maintain domestic systems to set climate goals, integrate them with other areas of policy, monitor performance against them, and anticipate future developments. This requires a large investment in people and institutions. Many countries simply lack this capacity. The process has coped with this so far. The most pressing commitments have up to now largely been required from countries able to participate fully. But it may not be possible to broaden participation in the next phase without a major effort to broaden the capacity to participate.

Various means are available. Training can be provided to negotiators and policymakers. Advice and financial support can be given to strengthen domestic institutions. Investment could be made in shared regional capacity among groups of countries with similar circumstances. Following Seattle, for example, developed countries wisely stepped up this kind of support for developing countries to take part effectively in trade negotiations.

Most debate about the future of the climate regime takes place among scholars, officials, activists, and others from the North. It might be worthwhile to provide opportunities for representatives of developing countries to play a fuller part in such dialogue, off line from the formal negotiations. Participation in such initiatives would help build confidence and shared perspectives on key issues before they arise in the more highly charged setting of the negotiations.

Leaving Room for Politics

The multiple dimensions of equity—some competing, others mutually reinforcing—inform and constrain each of the major domains of choice confronting governments. As we have seen, none of these dimensions can by itself offer a realistic path towards a detailed, quantitative allocation of effort country by country. What is striking about the attempts that have been made to construct such a path is that they lead in different directions. Still less is there a uniquely reasonable way to combine the different approaches into a single, all-purpose yardstick. Different choices about how much weight to assign to each lead to different outcomes. There is no single objective way to reconcile them or to calculate tradeoffs between them—no algorithm with which to construct an inherently equitable agreement.

Yet unless an agreement is seen as equitable it will neither win adherents nor mobilize real action—it will not be effective. How then do we arrive at an equitable outcome? The construction of an equitable agreement—indeed the very perception of what is equitable—is bound at each stage to be a matter of political judgment, vision, and leadership. We need to allow space for the politics to arrive at a rough balancing of competing equity demands. This is not, in the final analysis, a quantitative exercise. Rather we must look for outcomes that are robust in a qualitative sense across the many dimensions of equity at play.

IV. Equity and the Next Climate Agreement

Our aim in the next phase of climate negotiations must be an international strategy that will take humanity substantially further towards a restored climate. This will require far stronger mitigation of emissions than provided for under Kyoto: both deeper cuts by industrialized countries and, in time, an extension of commitments beyond

those countries. With respect to emissions, in other words, we need both to *deepen* and *broaden* the effort. We must at the same time address the needs of those who, despite such efforts, will bear the consequences of a changing climate.

One way to begin mapping a way forward is to suggest a set of conditions that a new global climate agreement must meet, or elements it must contain, for it to be robust across the key equity dimensions. Those conditions would, in effect, form a gateway through which the negotiations would need to steer. Through it lies the space in which the final political deals could be cut.

The conditions must reflect both the broad equity considerations that run through the climate debate and the particularities of this moment in climate diplomacy. Taking the present, tenuous state of affairs as a starting point, they must define the rough contours of a fair approach capable of mobilizing an effective, long-term global response to climate change. The conditions outlined below are, in essence, a set of minimum attributes by which an equitable agreement can be recognized.

First Equity Condition: Action by the United States

In the long term, no effort against climate change can succeed unless the United States is engaged. Only limited progress, then, can be envisioned until the United States initiates meaningful efforts to reduce its emissions. U.S. action will contribute much more to the global effort if undertaken as a party to a multilateral agreement rather than unilaterally. Either way, it is important that in the eyes of other parties these efforts are commensurate with the United States' responsibility for past and current emissions and its capacity to act. The United States is the world's most prolific emitter and, among the major economies, the largest per capita emitter. It is also one of the major potential sources of climate-friendly innovation and capital, and of demand for emissions credits.

Progress towards the overall climate stabilization goal would be much harder if the economy that accounts for some 25 percent of global emissions takes on no climate commitment, even if others are still willing to play their part. But continued U.S. absence would also put a brake on what other industrialized countries would be able to do. They would be under pressure from sectoral interests not to cede further competitive advantage to the United States. Developing countries might see no point in taking on new obligations, for which in any case the equity arguments would be very weak without action by the United States.

The climate process in its current form would in these circumstances stall or disintegrate. At best it might fragment into competing geographical blocs. The European Union might press ahead in the conviction that the longer-term innovation benefits of climate action outweigh the shorter-term costs. Germany, Sweden, and the UK have recently set long-term goals designed to deliver much deeper cuts over the next few decades. But even if others were to join them, it would be impossible to build up the momentum that would be available from a concerted global effort.

That is not to say that other parties should simply agree to whatever it takes to get the United State back into the international regime. A period of fragmentation, perhaps involving regional agreements, could still be better than a global agreement built on inadequate foundations.

Second Equity Condition: Continued Leadership by Industrialized Countries

Apart from U.S. action, industrialized countries must as a group continue to lead the effort, as the Framework Convention obliges them to do. Collectively, industrialized countries account for some 85 percent of historic and 65 percent of current emissions.[17] They have higher per capita emissions, greater capacity to act, and are less vulnerable to the consequences of climate change. So they will need to accept deeper cuts in emissions.

Third Equity Condition: Some Developing Countries Constrain Emissions

This is the most sensitive and complex equity condition. Developing countries have consistently argued that it would be unfair to impose carbon constraints at this stage on their economies. They believe that this would unreasonably restrict their ability to address their more urgent priorities, particularly to fight poverty. They fear that the obligation to limit emissions would make it harder for them to deliver sustainable livelihoods, housing, education, health, and other essential public goods. They argue that they should not be hampered in this way because these are moral imperatives, and because industrialized countries were able to reach their current levels of development without carbon constraints.

These are legitimate concerns. No climate regime should undermine the ability of parties to meet the basic needs of their people. However, as future emissions from some of the more populous and most rapidly developing countries loom larger over time, there will increasingly be a case for such countries to accept some responsibility for the contribution they are making to climate change. Further, there is growing recognition that strategies to reduce emissions growth can at the same time address the overriding economic priorities of developing (as well as industrialized) countries.[18] Improved energy efficiency, for instance, contributes both to climate mitigation and to economic growth. Approached from this perspective, deeper engagement in the climate regime can be seen more as an opportunity than a burden for developing countries.[19]

One complexity is the enormous variation among the circumstances of the 145 nations with developing country status in the climate process. There is no case for the 48 countries in the "Least Developed Countries" group to take on binding commitments, though that should not exclude them from sustainable development benefits arising from other forms of participation in the next stage. For other developing countries, any path towards commitments may need to include criteria to decide which countries should join the commitments regime at what point.

As we have seen, developing countries are particularly vulnerable to the impacts of climate change. They have an interest in an effective regime that moves as rapidly as possible towards the lowest possible level of stabilization. Otherwise, climate change itself will constrain their economic choices and undermine their efforts to fight poverty. To the extent that stabilization cannot be achieved without them, they have some interest in participating sooner rather than later.

Fourth Equity Condition: More Help in Dealing with Climate Impacts

At the same time, developing countries are unlikely to offer what will seem to them a large concession by accepting the possibility of commitments without a deeper shift in the way industrialized countries respond to their equity arguments. This will, in part, require a willingness to do substantially more to help vulnerable countries deal with climate change impacts. This is not only a matter of financial support but also the investment of imagination into more effective approaches to building the capacity to deal with climate impacts, and within that to the rapid diffusion of technologies and governance systems that can support this. Avenues to explore might include linking assistance to some measure of responsibility, assistance for certain kinds of weather-related disaster, and the resettlement of people displaced by climatic factors. One proposal calls for reforming disaster relief funding by creating a Climate Impact Relief Fund under the UNFCCC.[20] Developed countries are likely to be reluctant to move in any of these directions. But such steps may be necessary to persuade developing countries to take on emission commitments.

Fifth Equity Condition: Other Kinds of Help

The North must also invest in the capacity of developing countries to participate in the climate process. This goes beyond the provision of training and other human resource assistance to enable countries to engage with confidence in the negotiations themselves. It will also include help in linking the international process with domestic policy; and the application of technologies, processes, and development alternatives that can deliver benefits both for local sustainable development and for the climate. A key area will be the development of affordable clean energy and transport options. Some of this support might be geared particularly towards the capacity to take on, and derive maximum benefit from, emissions targets.

These five conditions form the outline of a mutually reinforcing climate package. The more confidence developing countries have that the North will shoulder its responsibilities, the easier it will be for them to take on new obligations of their own. And the more willing they are to do so, thereby broadening the regime, the further the North should be able to go in deepening it.

V. Mitigation Options

Having suggested conditions that a future climate agreement must meet to be viewed as equitable, we can now assess how helpful different approaches might be in delivering them. The conditions fall into two categories. The first three relate to mitigation of emissions through a deeper and broader regime. The other two concern help from the North to the South. Both categories are crucial, but mitigation of emissions is the more complex. In addition to political will, it will require great ingenuity to design a suitable regime. This section will assess from an equity perspective some of the options available, most of which are set out in more detail in other papers in this volume.[21]

First, however, it is worth highlighting two features of the Kyoto model that could, if extended, make an indirect yet critical contribution to resolving the equity dilemma.

The first is the flexibility that Kyoto allows to parties in meeting their commitments: through action on different GHGs, through the sequestration of carbon in soil and vegetation, through projects to mitigate emissions elsewhere, and through trading in emissions permits. The aim of this flexibility is to enable parties to meet their commitments at the lowest possible cost, thereby delivering more mitigation for a given effort. Yet there are implications for equity as well. The lower the cost or burden, the less pitched will be the battle over allocating it. Looking forward, economic costs will loom only larger. Certain areas of flexibility, for instance over multiple types of commitments, might help to reduce political burdens. The basic point is that in pursuit of an equitable outcome, regime flexibility is an ally.

The second pertinent feature of the Kyoto architecture is the way it enshrines different treatment for different countries and groups of countries. Industrialized countries have individually negotiated emissions targets. Among them the economies in transition can choose the baseline year against which their targets are defined. Developing countries have no emissions commitments, and access to certain kinds of assistance, with further help available for the poorest. This differentiation is in some respects arbitrary. But it also opens up many possibilities to take account of equity considerations. In all likelihood, further differentiation will be critical to achieving an equitable outcome in the next phase.

Fixed Kyoto-like Targets

Fixed targets expressed in total national net emissions—or possibly limited to specific sectors—over a given period could embody all the necessary equity considerations. Emissions could be allocated in light of a country's responsibility for current and past emissions as well as its per capita emissions, its capacity to act and the implications of its commitment for basic needs. Standard indicators could be developed to inform the assessment of each factor.

Of course, their relative weights in fixing any country's commitment cannot be determined on the basis of equity alone. To some extent this would need to emerge from the politics of the process, though even here equity considerations can narrow the range of choices.

With targets of this kind, however, parties cannot accurately forecast the cost of meeting their commitment. Certainty in environmental impact dictates uncertainty in cost (since the market will set the price of each ton of carbon abated). This is unattractive for economies that are fast-growing or otherwise subject to wide fluctuations: a growth spurt would push up emissions and thus increase the effort required to meet a given commitment. Uncertainty about the effort implied may limit the maximum target that any country can regard as fair. Targets with a built-in buffer against unforeseen economic developments might persuade some governments to commit to a more ambitious obligation than they could accept in the form of a fixed target.[22]

Indexed Targets

One approach would be to express commitments not in terms of absolute emissions, but as an "indexed" or "relative" target set as a ratio between emissions and some indicator of economic performance. Options include emissions per unit of gross domestic product (GDP) (the "carbon intensity" of the economy), energy consumption per unit GDP, or analogous sector-specific indices. An alternative form of relative target could be expressed in terms of per capita emissions. This would build the entitlements approach into the regime. Many developing countries would see this as a step forward for equity.

These approaches focus more directly on decoupling economic growth from emissions and dampen the effect of economic fluctuations. By reducing the corresponding uncertainty, they would expand the realm of what some governments might see as fair. They could be made to fit the existing architecture, to allow access for example to emissions trading (though trades would need to take place at the end of the accounting period, since the total emissions allowed under the target could only be calculated when GDP at that point was known).

A Safety Valve

Another means of providing certainty about cost—again at the expense of clarity about expected emissions—would be to set a maximum price for emissions permits. If the marginal cost of abatement rose above that price, parties would not have to pay more for additional emissions permits. The net effect would be less mitigation than would have been required without the price cap. Again this would give parties confidence that they would not be risking a degree of effort that they judged unfair. They might therefore be willing to take on more demanding commitments than they would in a regime without such a mechanism. This approach could appeal particularly to countries, like the United States, under pressure on equity grounds to take on tough obligations, and concerned about cost, competitiveness, and comparability

of effort. It is not, of course, a category of target in its own right, but rather a "safety valve" that can be applied to many types of target. All targets that can be expressed in terms of tons of carbon, and give rise to a market price for carbon offsets, could in principle be modified in this way.

"No-Lose" Targets and Graduation Thresholds

This option has been proposed primarily as a potentially attractive means of entry for developing countries into a regime of emissions commitments. They could enter in stages, first taking on softer, non-binding obligations. It might be possible to devise these to allow at least partial access to emissions trading and project investment beyond the CDM. New opportunities might be devised, building on the experience of the CDM, to attract investments that would provide benefits both for the global climate and for local sustainable development needs. These might include innovative forms of finance, mixing public and private capital. The aim in each case would be to offer the prospect of economic as well as climate benefit at low or zero risk.

From an equity perspective, such approaches offer a constructive response to the arguments put forward by developing countries. They could open the way for evolutionary progress towards more demanding commitments, linked to economic and social progress. But there would need to be criteria for determining who should enter the commitments regime in the first place and when they should do so: conditions, in effect, for graduating from the group of developing (or "non-Annex I") countries in its current form. This is among the most sensitive of all equity questions. The attractions of graduation would need to overcome the strong resistance, going well beyond the climate process, to any erosion of the principle that developing countries should wherever possible act as a single group.

Developing countries have argued that emissions commitments should in fairness only apply to countries beyond a certain level of development. There are anomalies under Kyoto: a few countries without commitments have higher per capita GDP than some with commitments. But overall it is implicit in the Kyoto regime that the threshold lies somewhere between the economic and social circumstances of developed and developing countries. In a more flexible and varied system of commitments, there would be more room on equity grounds for an initial threshold that would allow some developing countries at least to take on "no-lose" commitments at an early stage.

One way to approach this would be to design a threshold based on objective indicators. No single metric would be acceptable to all countries. The correct mix would be difficult to negotiate. It could be based at least partly on a per capita description of a country's circumstances, so as to relate development to the needs of individuals. If a graduation criterion of this kind could be agreed, it would streamline the process by avoiding the need to negotiate all new commitments on a case-by-case basis. It would also contribute to confidence that those who achieve the capacity to act in line with their growing responsibility will do so.

An alternative approach would simply be to create a mechanism whereby countries that felt comfortable about taking on commitments could have them recognized within the framework of the new regime. They would in effect decide to graduate, on the basis of their own assessment of where a reasonable threshold lies. Such a mechanism was under negotiation at Kyoto, but fell out of the final package.[23]

Variable Geometry

Many of the elements described above are compatible with each other and with the essential features of Kyoto, such as project mechanisms, carbon trading, and standardized procedures for maintaining and reporting emissions inventories. Most of them are not alternatives to each other, but potential components of a more sophisticated climate regime. Countries could choose from a menu of possible options those about which they felt most comfortable. This would extend the flexibility and differentiation reflected in Kyoto, which as we have seen would have equity attractions. There would be a price in terms of greater complexity and therefore higher transaction costs. But we have learned to live with complex regimes in other areas, and this may be an acceptable price for a regime that delivers more mitigation on a fairer basis.

VI. Conclusions

There is no "single truth" about equity—no unique mathematical solution to the equity equation. Room must be left for politics and interests. After all, the world is not fair. Natural resources are distributed as if by a roll of the dice, with regard neither to equity nor virtue. So are earthquakes. To demand more rigorous levels of equity in dealing with climate change than we do in other contexts would penalize everyone, by reducing the political space in which to find solutions. The least fair outcome for everyone would be failure to get to grips with climate change.

That said, we can now identify some of the features a new agreement will need if it is to be seen as equitable, and thus be negotiable. A successful agreement will form a complex tapestry of obligations in different areas. Taken together these will need to pass muster in each of our equity dimensions. This will require far more political will than has so far been available. A failure of political will, however, must be set against the consequences of failure to act in the face of a momentous global challenge.

The above picture is based on the assumption that, by and large, this is a self-standing negotiation—that it does not depend critically on what happens elsewhere on the international stage. Can we take this for granted? Or could friction in other areas, or a general loss of confidence in multilateralism, undermine the prospect of agreement on climate? These questions cannot yet be answered. But climate change raises profound questions of prosperity and security as well as equity. After all, to those facing it, the rising sea is a weapon of mass destruction. The need for an agreed global response to the climate threat is a very powerful reason for all nations to invest in an equitable and effective multilateral system.

Endnotes

The opinions expressed in this paper are the authors' own and do not necessarily reflect official views or policies.

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1. This paper treats the concepts of equity and fairness as interchangeable, reflecting their usage in much public discourse. The authors hope this treatment will make their argument more accessible. Subtle distinctions can be made between the connotations of the two words, but these are not central to the case the authors seek to make.

2. Harbaugh et al.

3. UNCED (1992).

4. Similar considerations apply within countries, and across different sectoral interests, but this paper will focus on equity between states.

5. It is beyond the scope of this paper to offer a detailed analysis of the many equity-related provisions of the UNFCCC and the Kyoto Protocol.

6. "Polluter pays" can be understood also as an efficiency principle: holding the polluter responsible for resulting economic damages leads to a more efficient allocation of societal resources.

7. The International Covenant on Economic, Social and Cultural Rights, and the International Covenant on Civil and Political Rights.

8. The analysis in this chapter reflects the way in which climate change is generally debated, and the conceptual framework around which the negotiating process has been built. That framework contains hidden assumptions that deserve to be examined from an equity perspective. For example, the framework encourages parties to see the response to climate change, in essence, as a set of costs, and the negotiations as a process for allocating those costs fairly. But the response to climate change can bring gain as well as pain. It is not obvious that for all countries and all timescales the costs outweigh the benefits. Likewise, the framework encourages parties to see climate policies as alternatives to other types of policy, implying that there is bound to be a tradeoff between climate goals and other objectives. In reality, all policies have multiple consequences. Policies designed to cut GHG emissions can sometimes also reduce particulate emissions, with major gains for public health. A conceptual framework based on the idea of convergent policies (i.e., policies and policy processes designed to achieve multiple aims) put forward by UK Minister of State Peter Hain would make possible more accurate equity calculations by including the ancillary benefits that climate policies can offer and the climate consequences of policies adopted for other reasons.

9. UNFCCC (1997).

10. One possible approach to this, developed by former UK government adviser Tom Burke and others but not hitherto discussed in the literature, would adjust emissions inventories to take account of trade in carbon-intensive goods. If one country buys aluminum from another, the emissions associated with its production would be cancelled from the inventory of the exporting country and added to that of the importer. As countries trade goods in and out of their economies, they would thus also transfer responsibility for the emissions associated with those goods. This would supplement, not replace, a target-based approach. But by smoothing out trade-related inequities in real time it would help address concerns about competitiveness and comparabiity of effort. Of course, a scheme of this kind would be enormously complex to operate. The technical obstacles could prove insurmountable.

11. See the Global Commons Institute "Contraction and Convergence" proposal at http://www.gci.org.uk.

12. IPCC (1997).

13. Grossman (2003).

14. See also Heller and Shukla (2003).

15. The European Community and its member states, Canada, Iceland, New Zealand, Norway, and Switzerland jointly announced their preparedness to contribute collectively 450 million Euro annually by 2005. UNFCCC (2001).

16. Personal communication with G77 and China delegate at COP6 in The Hague reflected this view. The delegate expressed the intent to reject any final agreement reached between the European Union and the United States that developing country delegates did not participate in negotiating.

17. IPCC (2001).

18. Chandler et al. (2002).

19. See also Heller and Shukla (2003).

20. Müller (2002).

21. See Aldy et al. (2003); Bodansky (2003); and Heller and Shukla (2003).

22. See also Aldy et al. (2003).

23. See UNFCCC (1997a). Footnote 7 states, "The Group of G77 and China have requested the deletion of this Article." See http://unfccc.int/resource/docs/cop3/crp02.pdf. See also Oberthür and Ott (Eds).

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Addressing cost

The political economy of climate change

Joseph E. Aldy, Richard Baron, and Laurence Tubiana

I. Introduction

Addressing cost—and the perception of cost—is a central issue in fashioning an effective international response to climate change. Greenhouse gas emissions occur as a by-product of virtually every type of economic activity, from driving a car to using a computer, operating a steel mill, or growing rice. Any effort to mitigate greenhouse gas (GHG) emissions will require investments in new technology and probably changes in behavior—in short, modifications to economic activity that entail costs to society. These costs could be substantial for some activities and could vary significantly across countries. Strictly from an economic vantage point, it is important that any international strategy against climate change include measures to manage cost. Perhaps more importantly, though, addressing cost concerns is key to securing the broadest possible participation in a climate agreement, and to ensuring that parties ultimately fulfill their commitments. Successfully addressing cost, in other words, is essential to achieving the goal of climate protection.

The question of cost is only partly an economic one. Even if economists were able to accurately forecast the full costs and benefits of climate action, their calculations would be received differently from individual to individual and from country to country. Some may consider cost considerations paramount while others will assign them a lower priority. The same costs, then, are perceived differently, and the willingness to bear costs is ultimately more a matter of politics than economics. The scope for differing perceptions is all the greater when the economic realities are themselves highly uncertain, as is the case with climate change. Widely divergent estimates of the potential costs and benefits leave those with a stake in the debate freer to characterize costs as best suits their interests. These characterizations, more than the underlying economics, may determine the ultimate policy outcome. A cost-conscious climate strategy, then, may need to concern itself as much with the perception of cost as the reality.

Cost concerns have figured prominently since the start of international climate negotiations more than a decade ago. To promote compliance at least cost, the 1992 UN Framework Convention on Climate Change allowed for joint implementation among industrialized countries to meet their voluntary goal of returning emissions to 1990 levels by 2000.[1] Cost minimization is integral to the very architecture of the subsequent Kyoto Protocol. Its market-based mechanisms—international emissions trading, joint implementation (JI), and the Clean Development Mechanism (CDM)—are designed to promote cost-effective mitigation among developed countries and investment in low-cost mitigation in developing and

transition economy countries.[2] In negotiations over Kyoto's implementation rules, further cost concessions were granted to some parties through credit for GHGs sequestered through forestry and other sinks activities. Yet despite these efforts to manage or minimize costs, the United States has flatly rejected the Protocol, and Australia has declared it will not ratify at this time, both citing cost as a principal concern.

Cost concerns will become even more critical in the next stage of climate diplomacy. Whether through a single, global framework, or through parallel regimes, any effort to deepen and broaden mitigation commitments will present larger cost issues than those encountered thus far. For developed countries, stronger commitments will push efforts past "no-regrets" measures like improved energy efficiency and force deeper shifts in capital investment. Developing countries, if they are to take on commitments, must be assured that they are compatible with their broader economic and development strategies. Effectively addressing these challenges is key to advancing the international climate effort. Even a well-designed and functioning international framework can go only so far in meeting countries' cost concerns; the economic impact of a mitigation commitment will depend also on the domestic measures chosen to implement it. These domestic choices, however, are beyond the scope of this paper. Similarly, while a full accounting of climate economics would include the costs of adapting to climate change impacts and the potential local benefits brought about by GHG mitigation, these two sets of issues are not explored here in depth. The focus of this paper, rather, is how mitigation cost concerns present themselves in climate negotiations and how they can best be addressed in the design of international climate measures.

Section II of the paper discusses two overarching issues key to understanding cost in the climate context: timing and uncertainty. Section III explores three critical dimensions of cost: aggregate cost, relative or distributional cost, and cost certainty. Section IV then applies those dimensions in an evaluation of various international policy options for managing mitigation costs. Section V summarizes the options and how well they address the three cost dimensions. The paper concludes with an assessment of the implications of cost for the viability and stability of a long-term climate change agreement.

II. Overarching Issues

Broadly speaking, economics looks at cost through two different, interdependent lenses: efficiency and cost-effectiveness.

An activity is *efficient* in economic terms if in the long run the costs to society are justified by the resulting benefits. In the climate context, efficiency pertains most directly to the choice of a long-term goal—for instance, the level at which GHG concentrations in the atmosphere are to be stabilized—and the emissions path to achieve it. An efficient climate change policy would ideally result in the last unit of investment in climate protection, or marginal cost, yielding an identical unit of avoided climate

damage, or marginal benefit. As long as the benefit of incremental investment exceeds the cost, it should be undertaken. At the point when the marginal benefit of an additional unit of investment falls below the marginal cost, it is more efficient to reallocate investment resources from climate protection to other socially beneficial purposes.

An activity is *cost-effective* if its goal is achieved at the lowest possible cost. In the climate context, the focus is ensuring the greatest possible GHG mitigation for every dollar, euro, yen, or yuan invested. A cost-effective climate policy would ideally result in each GHG emitter investing the same amount for the last ton of emissions abatement it is required to undertake. If a policy requires two power plants to reduce emissions by an identical amount—even though the marginal cost is $10 per ton for one, and $100 per ton for the other—it is not cost-effective: the total cost is more than necessary to achieve the desired GHG reduction. It is important to recognize that cost-effective implementation is a prerequisite for a policy to be efficient. Yet even if a chosen goal cannot be fully justified on efficiency grounds it makes economic sense to achieve it as cost-effectively as possible.

While these core economic principles may be reasonably straightforward, their application is not. Calculating the efficiency or cost-effectiveness of a given climate strategy is complicated by a host of factors. Two of the most critical are timing and uncertainty.

Timing

The long-term nature of climate change confounds both the economic and political calculus of how best to address it. While environmental policies usually entail up-front costs (such as investment in emission control technology) to deliver benefits spread out over the future (such as reduced ambient particulate matter), few environmental risks exhibit such a stark divergence in the timing of costs and benefits as climate change. Greenhouse gas emissions can reside in the atmosphere for decades, e.g., methane (CH_4); centuries, e.g., carbon dioxide (CO_2); and even millennia, e.g., perfluorocarbons (PFCs). These long atmospheric residence times imply that today's emissions may impact the global climate for hundreds of years. While past and current anthropogenic emissions currently influence the global climate, the more substantial impacts will occur much later in this century and beyond.[3] To effectively address the risks of climate change, then, requires emission abatement efforts in the near term that will deliver benefits in the long term. The substantial lag time between costs and benefits poses a political dilemma: policymakers do not like to impose costs on their publics if the benefits are so distant and uncertain.

In weighing potential investments, consumers and businesses ordinarily apply a discount rate to compare present and future costs and benefits. The discount rate assigns a reduced, or discounted, present-day value to a cost or benefit that will not be realized until some time in the future. For example, a return of $100 anticipated in 10 years is worth about $50 today if a discount rate of 7 percent is used.

With potential benefits from avoided climate change decades to centuries away, the efficiency calculation turns heavily on how they are expressed in today's value. Benefits accruing 100 years from now will be worth 45 times more in present value terms with a 3 percent discount rate in lieu of a 7 percent discount rate. Yet there is no consensus among economists or policymakers on how to discount the far-distant future.[4]

Timing also strongly influences the cost of meeting whatever emissions target is chosen. A priori, reducing emissions 10 percent from current levels by the end of the decade is more costly than undertaking the same amount of abatement by 2020. The first scenario imposes a significant departure from the current trend: the early retirement of physical capital that could be operated for another decade. The second approach provides firms with more opportunities to make mitigation investments consistent with the turnover of their capital stock, resulting in a lower-cost adjustment. It also gives time for the development of more effective and lower-cost abatement technologies. However, the cost savings will be achieved only if the delayed target is firm enough to send a credible signal to investors, firms, and consumers. If pushing the commitment out by a decade implies postponing action *altogether*, this additional lead-time could instead mean higher cost as GHG-intensive technologies and behaviors become more deeply embedded and therefore more costly to change. Society's ability to control GHG emissions at a reasonable cost in the future depends heavily on the path chosen in the short run.[5] No matter how distant the goal, near-term action is needed to promote the development of technologies to achieve it most cost-effectively.[6]

Uncertainty

A second, and related, issue that complicates the choice of global climate change policy is uncertainty. There are significant limits to our understanding of both the physical and social phenomena at play—from climate processes and their localized impacts to future trends in economic and population growth. These uncertainties confound any assessment of the benefits and costs—i.e., the efficiency—of any climate strategy. Economic models rely heavily on assumptions—some simple, others quite sophisticated—to overcome key uncertainties. However, while helpful in comparing the relative cost of alternative policies and in identifying cost-effective policies, modeling thus far is able to provide only crude estimates of the potential costs and benefits of climate action.

The ultimate goal of climate action—in other words, the anticipated *benefit*—is to avoid the deleterious impacts of climate change. Yet any projection of impacts rests on projections of atmospheric GHG concentrations, which in turn rest on projections of emission trajectories. There are significant uncertainties at each stage. Long-term emission forecasts reflect uncertainties regarding population growth, economic output, energy endowments and energy prices, technological change, and land use activities—not to mention geopolitical changes. An effort by the Intergovernmental Panel on Climate Change (IPCC) to project long-term emission trends yielded six illustrative scenarios based on different

story lines, with global CO_2 emissions in 2100 varying by a factor of six and concentration levels varying by a factor of two.[7]

For any given atmospheric concentration of GHGs, there is substantial uncertainty as well about the magnitudes, variability, and geography of impacts such as changes in temperature and precipitation, sea-level rise, disease incidence, etc. For the range of projected concentrations, projections of global average temperature increase by 2100 range from 1.4 to 5.8 degrees Celsius,[8] and this masks additional variability in temperatures at regional and local scales. Substantial challenges also plague assessments of low-probability, large-impact events such as the collapse of the Gulf Stream or the melting of the West Antarctic Ice Sheet. Even if these biophysical impacts could be accurately forecast, assigning economic values to them is by no means straightforward. Estimating the present value of non-market goods and services such as endangered species habitat, watershed protection, or reducing mortality risk involves substantial uncertainty. Extending these valuations hundreds of years into the future introduces yet more layers of uncertainty—if only because future generations cannot express preferences at present.[9]

Projecting the *cost* of climate action likewise entails substantial ambiguity. Uncertainties over future emission trends are important because the level of effort required to meet a given target must be measured from a presumed baseline of "business-as-usual" emissions growth. There are significant uncertainties as well over the likely social and economic responses to a given GHG mitigation policy. For instance, the costs will depend in large part on how easily consumers and producers can substitute away from carbon-intensive activities towards carbon-lean ones.[10] The more flexible and responsive firms and consumers are, the lower the costs. The rates of technological change and diffusion are also critical and also hard to predict. Most models treat technological change as exogenous (they assume that assigning a price to GHG emissions stimulates the deployment of lower-carbon technologies, but not additional innovation) although in reality higher costs will almost certainly drive investment toward new technology. The models also are not adept at portraying different types of policy approaches. They typically project cost impacts by assigning a price to GHG emissions—in effect, modeling every policy as if it were an efficient emissions tax or emissions trading program.

These layers of uncertainty, and the widely varying assumptions used to overcome them, are reflected in the wide range of cost estimates in the economic modeling literature. For example, 13 models participating in the Stanford Energy Modeling Forum estimated the marginal cost of GHG reductions under the Kyoto Protocol (the cost of removing the last ton to achieve the Protocol's goal) from less than $20 to more than $200 per ton of carbon.[11]

Uncertainty over potential climate damage and the cost of mitigating it is all the more critical to the degree that they are irreversible: once elevated, atmospheric GHG concentrations will remain so for centuries if not millennia; and once expended, resources invested in mitigation are largely irrecoverable

and no longer available for other private or social priorities.[12] On the cost side, uncertainty coupled with irreversibility tends to favor a less ambitious environmental objective. Firms would prefer to delay investment and gain new information that can allow for a better-informed decision in the future.[13] From this perspective, there is value to postponing the investment and maintaining as much flexibility as possible about the appropriate type of investment until some of the uncertainty about costs can be resolved.[14]

From the perspective of climate damages, however, uncertainty coupled with irreversibility favors a stronger environmental objective.[15] If new information shows that the risks to the climate are not as serious as now believed, easing or removing emission limitations remains an option. If, on the other hand, new information shows the risks are greater, but little or no abatement action has been taken, society may have foreclosed the option of stabilizing GHG concentrations at the optimal level.[16] The potential for climate change damages to increase at an accelerating rate—faster than the rate of warming—reinforces the case for acting sooner.[17] Rather than a rationale for inaction, uncertainty is in this sense a powerful argument to begin acting now to avoid an irreversible change in the global climate.[18]

III. Three Key Dimensions of Cost

Three critical dimensions of cost confront nations as they attempt to negotiate an effective international response to climate change. Each nation, of course, must consider the cost implications of a potential commitment for its economy as a whole. In fact, much of the economic analysis of climate change policy has taken a macro-economic perspective with results expressed in terms of losses or gains in gross domestic product (GDP) for countries or regions.[19] This *aggregate* measure of cost, however, is only of limited value without some measure of the distribution of cost—or possibly gain[20]—both between and within countries. The *relative* cost for various actors is therefore another essential dimension of the cost issue. Finally, the willingness of a country to take on a commitment depends in part on the how confidently it can anticipate the resulting costs. We refer to this third dimension as cost *certainty*. Each of these dimensions rests on economic realities but how they affect decision making is heavily shaped by perceptions.

The attractiveness of an international agreement will hinge in part on its capacity to alleviate—or, at least, not exacerbate—concerns about these three critical dimensions: aggregate cost, relative cost, and cost certainty. As noted earlier, for any given level of commitment, how a country chooses to meet it will have significant bearing on cost. This paper, however, focuses primarily on the international architecture and how its design opens or constrains the choices available to parties.

Aggregate Cost

The overall cost of GHG mitigation hinges largely on the stringency of the goal—which, as we have seen, is a function of both its magnitude and timing—and the cost-effectiveness of the measures chosen to meet it. At the global and country level, the projected cost is most often analyzed and expressed as a reduction in GDP, or the economy's ability to generate value added through various activities. For example, the IPCC estimates that a goal of stabilizing atmospheric GHG concentrations at 450 parts per million would reduce global GDP 1-4 percent from the forecast business-as-usual level in 2050.[21] (Global GDP is projected to be 4 to 9 times higher in 2050 than in 1990.[22]) While the change in GDP may be the most accessible aggregate cost concept within the policy arena, it is important to recognize that it does not fully reflect the welfare effects of a climate change mitigation policy. Other measures of the reduction in welfare, such as household consumption or employment, by illustrating potential losses more concretely, can strongly influence perceptions of cost and, in turn, the political viability of alternative approaches. On the other hand, such estimates generally omit the positive side-benefits of climate policy such as reduced local pollution.[23] These may play a role in building public support for GHG mitigation.

The cost of mitigation arises when companies and individuals undertake actions they would not have otherwise taken had they not been subject to a constraint on their emissions. Whether through a tax, an emissions quota, or regulatory action, the choices of technologies and behaviors that depart from business-as-usual are viewed as more costly. Either because less is spent on more productive activities or more is spent for the same economic outcome, reducing emissions entails reduction in value-added and losses in GDP. These are the basic assumptions of computable general equilibrium models that have looked into the economic effects of various emission targets.[24]

The nature of the climate challenge suggests that aggregate cost is best minimized by allowing flexibility as to *where*, *when*, and *what* type of mitigation action is taken. Greenhouse gas emissions fully mix in the atmosphere, so a ton of CO_2 abated in Boston yields the same benefit to the climate as a ton abated in Berlin or Beijing. To minimize costs, abatement should occur where it is cheapest. Since changes in the climate reflect GHG concentrations (the long-term accumulation of emissions), the exact timing of emissions abatement does not matter. The climate is not sensitive to annual variations in GHG emissions, so some flexibility in the timing of emissions abatement can result in lower costs with no adverse climate impact.[25] Several gases contribute significantly to warming—CO_2, CH_4, nitrous oxide (N_2O), PFCs, hydrofluorocarbons (HFCs), and sulfur hexafluoride (SF_6)—arguing for a policy that provides incentive to focus on those whose reduction yields the greatest climate bang for the buck.[26] In addition, a ton of CO_2 permanently sequestered yields the same climate benefit as abating a ton of CO_2 emissions, so a cost-minimizing policy should include sequestration as well as abatement measures.[27]

The international architecture of the Kyoto Protocol provides all three elements of flexibility: its trading mechanisms exploit *where* flexibility; the five-year commitment period and the possibility to bank reductions for use in the future reflect *when* flexibility; and the so-called basket approach (covering six gases, not only CO_2) and inclusion of carbon sinks address *what* flexibility. In theory at least, these three forms of flexibility should lower the cost of meeting any given emissions objectives by ensuring that no economic agent or sector spends more than necessary to abate emissions.

Relative Cost

In assessing the political acceptability of a climate agreement, aggregate cost may ultimately be less critical for some parties than relative cost—the distribution of costs both among and within countries. While the issue of relative cost is often portrayed as one of countries' competitiveness, it operates principally at the sectoral level. It arises when a sector competing in the international marketplace faces climate-related costs different from those of its competitors in other countries. Even if a country's aggregate cost or the impact on national competitiveness overall is minimal, the concentration of cost in discrete sectors concerned about competitive disadvantage can be a powerful domestic obstacle to an international climate commitment.

The potential competitiveness impact of a climate policy is a function of two factors: the total amount of reductions being asked from sources, and their marginal cost to achieve these reductions. The first is a function of the country's total abatement commitment and of the allocation of effort among domestic sources. The second is a function of available technology but also of domestic and international policy, as some policy options allow participants to equalize marginal costs of mitigation.

Relative cost issues arise across different international dimensions. First, there are concerns among parties to an agreement with mitigation commitments—for instance, those developed countries ratifying the Kyoto Protocol. Even if two countries have comparable commitments, variations in their underlying economic and energy structures and implementation strategies may yield significant differences in energy price increases and, thus, the relative cost of compliance. A second set of concerns arises between those parties to an agreement that have mitigation commitments and those that do not—in the case of Kyoto, between developed and developing countries. A third set of issues may arise between parties and non-parties—for instance, between the developed countries participating in Kyoto and the United States, which has not taken on a comparable commitment.

Relative cost differences influence not only the political viability of a climate agreement, but also its environmental effectiveness. This is usually illustrated by the notion of emissions leakage: emission reductions in one place are partly offset by emission increases elsewhere that otherwise would not have taken place. As an illustration, the implementation of GHG reductions would likely increase the cost of using energy. Some energy-intensive industries may attempt to avoid this increase by relocating plants or

shifting production to countries with lower costs.[28] Another form of leakage may occur if GHG reductions in industrialized countries lower international fuel prices, triggering higher fossil fuel use and emissions in other countries.[29] (From a competitiveness standpoint, OPEC countries could take measures to maintain export revenues.[30]) In all, estimates of leakage under Kyoto (assuming U.S. participation) ranged from 5 to 20 percent.[31] The magnitude of potential leakage would of course be reduced if commitments covered a wider group of countries.

Finally, the distribution of costs *within* a country can significantly influence its willingness to participate in an international policy regime. Fossil fuel energy producers, energy-intensive industries, consumers, and workers in these industries are likely to bear a larger share of the burden of an emissions mitigation policy. In contrast, suppliers of energy-efficient and renewable energy technology or forestry and agricultural firms that engage in carbon sequestration may benefit from such a policy. These constituencies can strongly influence the position a country takes to international negotiations and its willingness to accept an agreement.

The design of an international agreement can ease or exacerbate each of these facets of relative cost. It would be a fallacy, however, to assume that there exists an approach that would preserve the current status of international competitiveness in carbon-exposed industry. The changes required to effectively address climate change are too far-reaching and involve substantial differences in impacts on the owners and users of various types of fossil fuel resources.[32] However well an international agreement can minimize differences in relative costs across countries, it ultimately falls to national policy to redistribute the burden domestically in order to allay competitiveness concerns and perhaps compensate those activities that stand to lose the most.

Cost Certainty

Another critical cost dimension influencing a country's willingness to accept and meet a climate commitment is the predictability—or certainty—of the costs it entails. A regime that provides greater certainty may promote stronger participation and compliance.

In entering into a climate agreement, national governments must secure the support of their constituents based on an expectation of the resulting costs and domestic policy implications. If realized costs vastly exceed projected costs, the probability of non-compliance would increase. Further, some countries may use unexpectedly high costs as a rationale to opt out of the agreement. This could undermine the credibility of the international policy regime and the prospects for stronger commitments and broader participation in subsequent rounds. Conversely, increased cost certainty may enable a country to take on a more ambitious commitment than it otherwise could, facilitating a stronger agreement and greater net climate benefits.[33]

Certainty is also critical to the firms that in the end must deliver on a government's commitment. Businesses have a well-known aversion to regulatory uncertainty: new regulations (including environmental rules) can affect the profitability or sometimes the viability of industrial activities. Greater cost certainty can facilitate better investment strategies, allowing firms to adjust their behavior over time to mitigate the costs of the policy change. For example, an unexpected 25 percent increase in the price of energy in 2010 would have a much more negative impact on firms and the economy than the same price increase anticipated ten years in advance. The former case may resemble an oil price shock while the latter allows time to reduce the energy intensity of the economy in response to the expected price change.

Firms have no substantial interest in the aggregate cost of climate change policy, unless it requires responses in macroeconomic policies (e.g., monetary policy) that affect their competitiveness. Their interest is primarily in the direct costs they will face. A policy that provides greater certainty about marginal cost may therefore address the firms' concern even if it reduces uncertainty over their total cost only marginally if at all. Still, such a policy can help overcome political opposition to a climate agreement and increase the probability that a country will comply with it.

IV. Shaping the Long-Term Climate Regime

Economists and others have advanced many ideas for addressing cost concerns in an international climate regime.[34] This section assesses how several of the more prominent proposals would perform vis-à-vis the three dimensions of cost described above. They include both quota–based approaches (international emissions trading, a safety valve, indexed targets, sectoral targets, and non-binding targets) and non-quota-based approaches (harmonized taxes and technology standards). Some of these instruments can complement each other. For instance, developed countries could pursue binding economy-wide emission targets while developing countries adopt sectoral or non-binding targets, all linked to international emissions trading. Similarly, commitments could progress from one form to another as the regime evolves. This analysis, however, looks at these approaches individually and not sequenced or in combination.

International Emissions Trading

Governments can promote cost-effective achievement of a given level of GHG mitigation through policies that ensure that all emissions sources face the same marginal cost of reduction. While either an emissions tax or a tradable emissions allowance program can result in this equalization of marginal costs, the international negotiations have favored trading. This in part reflects a reluctance to subject domestic economies to an international taxing authority. Trading, however, also has the advantage of allowing a negotiation over the distribution of cost, via the setting of country targets.

An abundant literature supports the cost-minimization advantage of international GHG emissions trading.[35] While economic models offer a rather large range of marginal cost estimates for implementing the Kyoto Protocol, they support the robust conclusion that trading can reduce overall costs.[36] In the case of Kyoto, cost reduction hinges partly on the availability of excess allowances in countries in transition (especially Russia and Ukraine). But the main factor is the efficiency gain achieved by not requiring countries to meet their obligations exclusively through domestic measures: a country with a high marginal cost of abatement has a direct interest in paying a country with a lower cost to make the necessary reductions.[37]

These remain, nevertheless, modeling results assuming that all sources in all countries with commitments effectively participate in a perfectly efficient international emissions trading regime.[38] In practice, however, while some governments may allocate some of their emissions commitments to large industrial sources and allow them to trade on that basis (e.g., as currently envisioned in the European Union), they may regulate emissions from other sources and sectors through alternative approaches. Some governments, attempting to come closest to the ideal reflected in economic models, may address all emissions from all sectors through "upstream" trading regimes (where the introduction of carbon into the economy is subject to an aggregate quota, and upstream firms such as coal mine operators and crude oil suppliers would trade among themselves). Still other governments may decide to implement domestic policies that involve no devolution of emissions allowances and no direct role for their private sector in an international emissions market. In contrast to the modeling picture, the international market may be characterized by transactions among large industrial sources and governments of those countries with commitments.[39] There may also be barriers to international transactions or biases introduced by different regulatory regimes, such as domestic commitment periods of different durations, different penalty levels, and limited access to the international regime.[40] Despite these limitations, it is widely agreed that emissions trading is among the most effective means of minimizing the aggregate cost of GHG reduction.

Emissions trading also helps address relative cost issues. By allowing sources access to the same least-cost potential to comply with their objectives, trading reduces the competitive differentials that may exist when sources in different countries face various marginal costs of abatement. This also reduces leakage by lowering incentives to relocate. In addition, a domestic trading system linked to the international system can help address relative costs within a country. A government could auction emission allowances and use some of the proceeds to finance transition assistance for workers in energy-production and energy-intensive industries whose jobs may be jeopardized. A government also could return some of the auction proceeds to adversely impacted industries and leave them no worse off. Similarly, a free allocation of some or all allowances would compensate sources for the negative effects of an emissions constraint.[41]

International emissions trading also can reduce some of the uncertainty about costs. A well-functioning international emissions market can help absorb country-level spikes in emissions (e.g., weather-related) and limit their impact on compliance costs. Instead of undertaking costly domestic abatement to

offset the effects of the weather, a country could purchase allowances from other countries at a more reasonable cost. The likelihood that trading will reduce cost uncertainty depends on how the institution evolves over the next decade and countries' participation decisions. An emissions market that is not liquid and efficient may not offer many cost-saving opportunities or insurance against unexpectedly high abatement costs. The actions of countries likely to be large buyers or sellers will influence the expected price of allowances in the international market. How they implement reductions domestically—with or without domestic emissions trading—will influence how reliable and competitive the international market will be.

Quantitative Targets with Safety Valve

The emissions commitments in the Framework Convention and the Kyoto Protocol take the form of fixed quantitative targets. A variant that may offer greater cost certainty would maintain quantitative targets but incorporate a "safety valve" mechanism to insure against unexpectedly high costs. Countries would have initial emission allocations but would have the option of buying additional allowances at a predetermined price.[42] This would effectively put a ceiling on the price of nationally or internationally traded allowances and thus provide an upper limit on the *marginal* cost of compliance.

To function as insurance against unexpectedly high mitigation costs, the safety valve price must be set above the forecast marginal cost of meeting the agreed emissions targets. If the price is set low, it would likely be binding and effectively convert the system of quantitative emissions commitments to a tax-based emissions regime. Some may then view—or characterize—the safety valve as an indirect way to impose a harmonized emissions tax.[43] If the price is set "too low"—i.e., below the forecast cost of the quantity target —it could reduce the incentive for the near-term R & D investment necessary to produce lower-cost abatement technologies. With less price-induced innovation, the long-run cost of abating GHG emissions could then be higher with a safety valve than with fixed targets.[44]

Theoretically at least, the safety valve would have no impact on forecast aggregate cost. If countries do not expect to rely on the safety valve, then incorporating this mechanism in the international policy framework would not affect their forecasted cost estimate. It would only reduce aggregate costs relative to a policy without a safety valve if the costs of abatement were unexpectedly high. The safety valve provides greater, but not absolute, cost certainty. Countries would know the maximum they would pay for each ton above target, but not exactly how many tons they would need to offset at that price.

The primary tradeoff for greater certainty about the marginal abatement cost is greater *uncertainty* about the environmental outcome. Countries are free to exceed their emission commitments provided they are willing to pay the agreed price. However, the insurance provided by the safety valve may increase the willingness of countries to take commitments and the likelihood of compliance, and hence actually increase the likelihood of achieving at least some environmental benefits.

Indexed Targets

The emission targets in the Kyoto Protocol require absolute reductions from a base year by an agreed percentage. An indexed emissions target, by contrast, does not fix the quantity commitment at the time of the negotiations. Instead, it adjusts the quantity commitment based on measures of economic performance or other potentially relevant indicators. For example, Argentina proposed a commitment indexed to the square root of its GDP: a 10 percent increase of its GDP would add roughly 5 percent to its emissions goal. The United States has set a voluntary goal of reducing its ratio of GHG emissions to GDP to 151 million metric tons per million dollars by 2012 (from the 2001 ratio of 183).[45]

Indexing can reduce uncertainties stemming from the unpredictability of future economic and emissions trends. Many developing countries, for instance, argue that they cannot adopt fixed targets, even targets allowing emissions growth, because their emissions cannot be accurately forecast and an absolute target could constrain economic development. Under a target pegged to economic growth, if a country grows faster than expected, its total allowable emissions would also rise. However, since a GDP-based formula includes only one factor influencing the effective stringency of an emissions commitment, it neither eliminates cost variability nor provides certainty on the marginal cost of compliance.[46] For example, it does not offer insurance against weather-related shocks, energy price shocks, or changes in the expected rate of technological innovation and diffusion (except through their indirect effects on GDP).

Indexing can address another risk raised by setting absolute emissions objectives years in advance, the creation of so-called "hot air"—an allowance that exceeds a country's emissions even in the absence of any abatement efforts. With an indexing approach, if a country grows much slower than expected, the total quantity allowed under that country's commitment would be reduced, thereby reducing or eliminating the prospect of a commitment becoming a hot air target.

Integrating such an approach with international emissions trading may present challenges. For instance, a country may find it easier to allocate trading allowances to industrial sources on the basis of an absolute, Kyoto-type quantitative target than on the basis of an indexed emissions target in which the absolute reduction required is not known with certainty in advance of the commitment period. One approach would be to index the emissions commitment to economic growth between the date of negotiating the agreement and the year before the commitment period begins, instead of through the entire commitment period. The quantitative emissions target would then be a fixed, absolute quantity at the start of the commitment period, just like the Kyoto-type targets. This may reduce some of the benefits of indexing, but does provide an absolute quantity at the beginning of the commitment period in lieu of one determined at the end of the commitment period after the economic data have been compiled.

In designing an indexing approach, two principles are important. First, the indexing criteria should not create perverse incentives. For example, the preceding year's GHG emissions are a good predictor of next year's emissions, but including the previous year's emissions in a formula for an emissions target may create the incentive to increase the emissions intensity of the economy during the time leading up to the commitment period. Second, the indexing formula cannot be too complicated. The international climate change negotiations are already very technical, and complex formulas relating a country's commitment to various predictors of emissions may be too difficult to effectively negotiate. The U.S. and Argentine indexing approaches simply use economic growth as the indexing measure.

The level of effort ultimately required (i.e., the percentage reduction from projected emissions) depends on the form of the indexing approach, the rate of economic growth, and the structure of a country's economy. In some cases, the target will be progressive, requiring stronger abatement when economic growth is faster than expected and less abatement if growth is slower. The type of target proposed by the Argentine government—which allows emissions to grow with only the square root of GDP—will under most circumstances produce that result. Other targets, depending on an economy's structure, can have the opposite effect. An example is the Bush Administration target, which pegs emissions to GDP as a simple linear function, or ratio. Because any faster-than-expected growth in the United States is likely to be in activities (e.g., services and high-tech sectors) that are less carbon-intensive than the economy-wide average, the U.S. target effectively requires less abatement if the economy does better than projected. For instance, if the U.S. economy grows at 3.4 percent over the 2002-2012 period instead of 3.0 percent (the central economic forecast used in developing the climate change policy), the level of abatement required would be cut by nearly half. A linear target would work progressively, however, in a different economy—for instance, a rapidly industrializing country with rising GHG intensity.[47]

Sectoral Targets

One way to reduce uncertainty is to narrow the scope of an emissions target from the entire economy to certain sectors. Some activities and industries responsible for a large fraction of a country's emissions may be more amenable to emissions mitigation in the near term. A sectoral approach may be especially suited for developing countries without the capacity to monitor emissions throughout their economies.

The issues associated with the aggregate costs of a sectoral target are essentially the same as those in taking on an economy-wide commitment.[48] The magnitude of the costs will depend on the timing and stringency of the sectoral target. Such an approach does raise several questions about relative costs. It may reduce competitiveness concerns with respect to the affected sector—if it were in competition with

other countries on the international market. Firms in developed countries with emissions commitments competing with those in industries covered by a sectoral target may appreciate the policy's impact in leveling the playing field. It would also reduce sector-specific leakage from countries with economy-wide targets to those countries with the sectoral target. Such a policy option could result in giving a competitive advantage to those activities outside of the sector with the target, and may result in emissions leakage, if substitutes to the products of the capped activity were to be available and to generate GHG emissions.[49] Sectoral commitments do not specifically promote cost certainty, but such an approach could be integrated with a safety valve or indexing.

A sectoral target could allow a country to engage in international emissions trading, at least based on the activities in the covered sector, providing a potential source of financing for emissions abatement and technology improvements.[50] Such an approach could also be integrated in a CDM framework, with a modification for a sector-wide (in lieu of a project-specific) baseline.

"No-Lose" Targets

Some developing countries may prefer a policy approach that completely eliminates the economic risk of mitigating emissions. Non-binding—or "no-lose"—targets coupled with international emissions trading may allow developing countries to experiment with emissions mitigation efforts.[51] First, agreement must be reached on a country's business-as-usual emissions forecast for the commitment period.[52] Then the country can consider implementing various mitigation policies. At the end of the commitment period, if the country's actual emissions are lower than the forecast baseline, it could sell the "excess" allowances to countries with binding emissions commitments. The opportunity to gain revenues from participating in international emissions trading would create the incentive for the country to abate emissions below its otherwise non-binding target.

The aggregate costs for such a policy would obviously be negligible if not negative. A country that implements such a policy would incur cost to abate emissions, but would likely do so only if the international emissions market price exceeded the domestic cost, hence generating a net gain. The country would not need to acquire allowances if its emissions exceeded projections. The approach is in fact similar to the CDM: projects are only submitted if they achieve reductions and have something to sell.[53] If such a policy increased the number of countries participating in international climate efforts, it would reduce the aggregate costs to countries with binding targets that buy and finance emissions abatement in these developing countries. Promoting emissions mitigation in these developing countries could also reduce the incentive for emissions leakage.

Emissions Taxes

In contrast to the preceding discussion of policy options based on quantitative emissions commitments, a harmonized emissions tax would set a common world price for emitting greenhouse gases.[54] While emissions targets can provide certainty about the quantity of emissions, an emissions tax provides certainty about the cost of emitting another ton of greenhouse gases. By equating the marginal cost of emissions across all countries, an emissions tax can result in least-cost emissions abatement comparable to what would occur in theory under an emissions trading regime. An emissions tax can thus minimize aggregate costs, and provide certainty on marginal cost, but at the price of uncertainty in emissions abatement and without a possibility to negotiate over the distribution of cost across countries.

Some proponents of emissions taxes note that they can allow governments to substitute taxing a "bad" (e.g., pollution) for current taxes on "goods" (e.g., labor). This shift in taxation away from valuable factors of production could increase economic output and offset some of the costs of the climate change policy. The sizable revenues can also finance programs to alleviate the distributive impacts of climate policy, such as transition assistance for workers who lose their jobs or subsidies to help low-income households pay for more expensive heat and electricity. Note that in a domestic context, governments can employ a comparable approach under emissions targets by auctioning emissions allowances and using the auction proceeds in a similar fashion.

While emissions taxes appear to have favorable characteristics on the three key cost dimensions and could improve the means of government financing, the approach suffers from several drawbacks. First, some may be concerned that emissions taxes trade emissions certainty for cost certainty.[55] Second, governments could effectively circumvent the effect of an emissions tax by reducing other taxes affecting energy-related activities. For example, a government could reduce existing gasoline and diesel taxes in response to a carbon tax. This fiscal cushioning would undermine the environmental effectiveness of a climate policy without triggering non-compliance penalties.[56] Third, a harmonized emissions tax would make an equitable distribution of the mitigation burden more difficult. Under quantitative targets, higher-income countries may induce lower-income countries to participate by granting them less stringent commitments (more emissions allowances). Under an emissions tax, these countries may need to make overt financial transfers to induce participation, which may not be as politically acceptable as granting extra emissions allowances.

Finally, an emissions tax makes the costs of climate policy more transparent than a quantitative approach. Even if the impact on consumers' electricity bills, heating bills, and gasoline expenses is the same as under a tradable allowances program, a tax may be politically less palatable because it highlights the cost, presenting an easier target for opponents of climate action. The strong aversion in some

countries to taxes generally—and the notion of an international tax in particular—helps explain why this option has never been seriously pursued in the climate negotiations.

Technology Standards

The preceding sections have focused on the two primary means of achieving emissions abatement at least cost–quantitative targets with emissions trading and emissions taxes. An alternative approach could focus on an international agreement to finance climate-friendly R & D and mandate such technologies once they become commercially available.[57] Such a technology development effort would likely aim to deliver the breakthroughs necessary to significantly abate GHG emissions in the medium to long term, but offer little of the near-term incentive for technology investment that might be provided by quantitative targets or emissions taxes.

A global technology standards agreement would not likely compare well with alternative policies in terms of aggregate, relative, or predictable costs. Policymakers and economists have learned through experience with domestic environmental policies that one size does not fit all. Imposing technology standards, perhaps tailored to specific industries, would not result in cost-minimizing emissions abatement because the technology would be very expensive for some firms and less expensive for others. Allowing governments to select technologies—instead of the private sector operating under a clear market signal—may result in the choice of an unnecessarily expensive suite of technologies, raising aggregate cost. Further, the process of setting standards may risk regulatory capture—policy makers with the mandate to design standards become strongly influenced by interest groups—resulting in greater disparities in abatement effort across industries (and countries), exacerbating the relative costs of the policy. Finally, a technology standards agreement provides no certainty about the costs of climate policy.

Some have argued that technology standards could address a fundamental problem in international environmental negotiations: securing participation and promoting compliance.[58] The voluntary nature of international negotiations effectively requires self-policing, even if some agreements call for "binding commitments." The Framework Convention and the Kyoto Protocol, like virtually every other international agreement, allow parties to withdraw from the agreement without explicit penalty. Achieving participation and compliance requires an agreement consistent with the interests of all the negotiating parties—a much higher standard than necessary in the domestic context in which legal coercion can secure participation and compliance.[59] The Kyoto Protocol clearly suffers on these grounds given its inability to secure participation by the world's largest emitter, despite its cost-effective design. Whether these participation and compliance problems are fatal to *any* quantitative emissions commitments and whether a technology standards approach can effectively circumvent these problems are essentially empirical questions that merit additional research.

V. Synthesizing the Options

Each of the options described above has different implications for the three critical cost dimensions that present themselves in climate negotiations: aggregate cost, relative cost, and cost certainty.

Regarding aggregate cost, an efficient international emissions trading system appears the most effective means of minimizing cost in any regime based on quantitative emissions targets. Emissions taxes could result in low aggregate costs, but it would be difficult to monitor their effective implementation at the national level—governments would have many ways to mitigate the impact of the emissions tax (e.g., by cutting energy taxes), yielding higher emissions. Several forms of quantitative commitments can limit or eliminate aggregate costs—such as sectoral targets and no-lose commitments—and may serve as useful incentives for developing country participation. The safety valve and indexed commitments may take advantage of emissions trading and guard against unexpectedly high aggregate costs. A technology standards approach would result in higher aggregate costs than targets-and-trading or emissions taxes.

Regarding relative costs, an effective international emissions trading system again could help eliminate the differences in marginal cost across countries. In the ideal outcome—all countries adopting emissions commitments and participating in trading, with one global emissions allowance price—no incentive for industry to relocate would effectively exist. Less than full global participation, variations in domestic implementation, and possible trading frictions may be a more realistic outcome for some time. In contrast with a regime based on emissions trading, technology standards would likely result in substantial variations in costs across industries and across countries.[60] Emissions taxes could equalize marginal cost as well as a system of quantitative emissions targets, so long as fiscal cushioning is not pursued. In the end, however, while international regime design may have a significant bearing on relative cost, the choice of *domestic* measures may be just as critical in minimizing competitiveness impacts.

Regarding cost certainty, the standard Kyoto-type target provides very little certainty. In contrast, modifications to quantitative targets such as the safety valve or indexed targets could reduce the uncertainty in marginal cost. The safety valve, functioning basically as an insurance mechanism to quantitative targets with trading, would eliminate marginal cost uncertainty at some threshold. Similarly, an emissions tax would provide full certainty on the marginal cost of compliance. Indexed targets would limit uncertainty, at least that associated with economic growth and other potential measures used to index the commitment. No-lose targets eliminate the downside risk of an emissions commitment, but obviously can only be pursued by a subset of countries—otherwise, there would be no buyers of emissions allowances to provide the incentive for countries to abate their emissions below their forecast no-lose objective. In all of these cases, increasing certainty about costs presents a trade-off to policymakers: it reduces the certainty about the environmental objective.

It is important to note that these policy options are not mutually exclusive. They can, in fact, complement each other in an international regime, and coordination among them can help further address cost concerns. For instance, different categories of countries could take on different types of commitments, with higher-income countries adopting Kyoto-style quantitative targets and lower-income countries first adopting some form of sectoral and/or no-lose targets. Coupled with a system of international emissions trading, this suite of policies could allow for lower aggregate costs for a given level of emissions abatement than the current approach under the Kyoto Protocol focused almost exclusively on the industrialized countries.

VI. Conclusions

Many factors influence the viability of an international climate agreement—not only its political acceptability in the first instance, but also its stability over the long term. Acceptability will hinge heavily on questions of fairness: whether countries feel the agreement provides for an equitable sharing of burdens and benefits.[61] Developing countries will carefully assess whether a proposed agreement is compatible with their development priorities and, particularly for those most vulnerable to climate impacts, whether it addresses their adaptation needs. In the long run, an agreement will prove viable only if it provides sufficient pressure or incentive for parties to fulfill their commitments. To be effective, a climate agreement must in other words promote both participation and compliance. And how well it manages cost is more than a strictly economic concern; it is critical to achieving both.

There is, in fact, a two-way interaction between cost and participation. Approaches that minimize, or provide greater certainty over, cost can help draw more countries into an agreement or even foster more ambitious commitments. As different approaches may best suit the circumstances of different countries, this suggests a flexible architecture that accommodates multiple types of commitments. Broader participation can, in turn, ease the cost of meeting a collective climate target. Compatibility with an international emissions trading system would ensure that each country minimizes its aggregate compliance cost. Competitiveness impacts and emissions leakage would also be reduced.

With more countries participating in trading, emissions allowance prices would be subject to less uncertainty and variability. It is important that the current fragmentation of climate policy approaches does not become permanent: the cost of GHG mitigation in various regions could diverge to the point where reconciling regimes becomes unfeasible. This would hinder a broad-based emissions trading mechanism in the future, lead to higher costs, and deter more ambitious abatement goals.

Action on climate change by necessity entails decision making in the face of uncertainty. Our limited understanding of both physical and social systems allows only a crude approximation of either the

costs or the benefits of any climate strategy. Even in the absence of better data, economics can still offer guidance on the most cost-effective ways to reduce greenhouse gas emissions. Experience has demonstrated the value of market-based approaches in minimizing the cost of achieving a given environmental goal. While taxes or trading might appear equally effective in strictly economic terms, the international community has shown a strong preference for trading, which is likely to remain central to any future multilateral climate strategy. The implementation of Kyoto will provide crucial lessons on the real-world performance of this mechanism.

More difficult is the question of efficiency—deciding the right balance between costs and benefits. The uncertainties over both are too great at present to allow a reliable economic rendering even with the most sophisticated modeling. The balancing must, in the end, be a political calculation. It is premised in part on the perceived need: how much action do we think is necessary? But it rests also on willingness to pay: how much action do we think we can afford? In searching for the appropriate balance, countries will seek to narrow the range of uncertainty. One approach is to favor certainty on the environmental outcome, for instance through a fixed target that delivers a given emission reduction. This raises the question of whether the target can be reasonably attained. Another approach is to favor certainty on cost, for instance through a safety valve. While the affordability of the commitment may be more apparent, the environmental outcome is less certain. As the ultimate goal is reducing GHG concentrations in the atmosphere, however, flexibility on the near-term emissions target may be deemed acceptable, particularly if the assurance of affordability allows a more ambitious goal.

Cost is an economic term. But in the political arena, particularly when the data are so uncertain, what may matter most is not cost in the true economic sense, but rather how cost is presented and perceived. The safety valve that some may promote as "insurance," for instance, may be derided by others as an unbearable "tax" and yet by others as an "escape clause." The latter argument was used by non-governmental organizations to lobby against this option at the Sixth Conference of the Parties in The Hague.

Experience with emerging climate policies, particularly the international and domestic emissions trading systems and the full suite of domestic policies now taking shape, will provide stronger insight into the best ways to manage the costs of mitigating climate change. The lessons learned may help replace competing perceptions with a clearer consensus on the best approaches, allowing a more effective and durable international response to the challenge of climate change.

Endnotes

1. Article 4.2(a).

2. While economic modeling and the successful U.S. experience with sulfur dioxide (SO_2) trading supported the view that GHG trading would be critical to making Kyoto's emission targets affordable, the usefulness of this tool was not universally recognized during the Kyoto negotiations. However, even reluctant parties, such as the European Union, have since embraced the concept of emissions trading as evident in the effort to implement an EU-wide trading program to reduce emissions from industrial sources.

3. IPCC (2001).

4. See Weitzman (2001); Newell and Pizer (2001); and Philibert (2003).

5. Hourcade (1993); Grubb (1997).

6. Hourcade and Shukla et al. (2001).

7. IPCC (2000).

8. IPCC (2001).

9. See Nordhaus and Boyer (2000) for a recent attempt to monetize the costs of global climate change.

10. See Jorgenson et al. (2000).

11. These estimates assume full participation of all countries listed in Annex B of the Kyoto Protocol in the trading regime, including the United States. See Weyant and Hill (1999).

12. Fisher (2000).

13. Dixit and Pindyck (1994).

14. Pindyck (2000).

15. Arrow and Fisher (1974).

16. Chichilinsky and Heal (1993).

17. Webster (2002).

18. Aldy et al. (2001).

19. Weyant and Hill (1999); Hourcade and Shukla et al. (2001).

20. See Hourcade and Shukla et al. (2001) for a discussion of negative cost potentials.

21. Hourcade and Shukla et al. (2001).

22. IPCC (2000).

23. See Hourcade and Shukla et al. (2001) for a survey of studies on the ancillary benefits of GHG mitigation.

24. ABARE (1995), (1997); Richels et al. (1996); Weyant and Hill (1999).

25. This may not hold true over very long periods of time, if damages from climate change were a function of the rate of change in global concentrations; Grubb et al. (1995) argue that this would call for more reductions early. Wigley, Richels, and Edmonds (1996) argue that fewer reductions now would not endanger our capacity to control the world's climate, provided that accelerated reductions occur in the future. The GHG absorption capacity of the climate system would allow more overall emissions and therefore require a lesser constraint, if more emissions were released early. A critique of this approach on economic grounds was provided by Grubb (1997).

26. Expanding the coverage from energy-related CO_2 to CH_4 and N_2O, including emissions from agriculture, lowers the GDP cost for Annex I countries by some 30 percent (OECD, 2000). Reilly et al. (2003) arrive at a similar result for the United States, when all six gases are taken into account instead of CO_2 only, if the U.S. were to meet its objective under Kyoto through purely domestic measures.

27. The comparability of a ton of sequestration and a ton of abatement depends on the long-term integrity of the sequestration effort.

28. However, empirical evidence indicates that multinational companies often use an identical technology irrespective of country location implying that new plants would probably have an efficiency far above the average level in the host country; see Jaffe et al. (1995). This is likely to reduce the potential for GHG leakage.

29. Natural gas, however, could benefit from a GHG advantage against coal, especially in power generation. Depending on the stringency of the GHG constraint, this could result in a net increase for natural gas for some time.

30. The effect on major oil exporters will depend on how they respond collectively in terms of production and further exploration. Note that in response to depressed world petroleum demand after the Asian financial crisis in 1998 and 1999 (when crude oil prices fell to nearly $10 per barrel), OPEC effectively increased the size of the cartel by engaging in informal production agreements with non-OPEC members, such as Mexico. This effort, coupled with increases in demand, supported a tripling the price of crude oil in less than a year. Research by OPEC Secretariat staff shows that such an approach could maintain OPEC crude export revenues at forecast levels under the implementation of the Kyoto Protocol; see Ghanem et al. (1999).

31. Hourcade and Shukla et al. (2001). In contrast to this literature on leakage, some recent research has shown the potential for positive technology spillovers to reduce GHG emissions in countries without emissions commitments. Grubb et al. (2002) evaluated the Kyoto Protocol and found that, by accounting for technology spillovers to non-Annex I countries, global emissions may grow more slowly.

32. Pershing (2000).

33. IEA (2002a).

34. See Aldy et al. (2003) for a review of these proposals.

35. Hourcade and Shukla et al. (2001); IEA (2001); Edmonds, Scott et al. (1999); Weyant and Hill (1999); Richels et al. (1996).

36. Weyant and Hill (1999).

37. However skillful the negotiators are in agreeing to emission goals, it is unlikely that countries' commitments will ever result in equal marginal costs across countries and therefore make international emissions trading redundant. In addition, if this had been negotiators' primary objective, they would have chosen the tax approach, as this provides full certainty about the marginal cost of reduction.

38. See IEA (2001) for further discussion on this issue. Although eco-taxes and tradable permits have a role to play in curbing GHG emissions and are already used in a number of countries, a range of activities are covered by other policy instruments of a regulatory or fiscal nature (IEA 2002b).

39. The notion that they would take action up to the point where the cost reaches the price of internationally traded allowances does not stand the test of even simplified market experiments. A simulation conducted by the IEA for governments of Annex I Parties showed that the theoretical efficiency gains may not be met as governments and market participants would face uncertainty about future allowance prices and about overall market size—it takes about two years to finalise a country's GHG inventory, and would be subject to policy inertia. Once negotiated and launched, domestic policies are unlikely to be reconsidered on the ground of variations in the international price of allowances (IEA 2001).

40. See Hahn and Stavins (1999) for a discussion of the difficulties in integrating international emissions trading with domestic policy regimes.

41. See Bovenberg and Goulder (2000); Burtraw et al. (2002); Goulder (2001); and Kopp et al. (1999).

42. See Kopp et al. (2000). This concept has received substantial attention from economists for three decades. See IEA, (2002a) for a summary of this debate, starting with the paper by Weitzman (1974) comparing price (i.e., tax) and quantity (i.e., tradable permits) instruments for pollution control under uncertainty.

43. With the caveat that countries, not their sources, would be subject to this "tax." How they implement it domestically is entirely up to them. They may well levy a tax on all fossil fuel uses to finance the purchase of the emissions over and above their target, e.g., a tax on 1000 Mt CO_2 to pay for 25 Mt CO_2: the price signal on energy users would be much lower than the safety valve.

44. Conversely, an overly stringent target without a safety valve will result in too high a price, causing too much investment in climate-related R & D and diverting resources from investments with potentially greater social benefit.

45. The Argentine proposal reflects an evaluation of a number of emissions forecasts reflecting different assumptions about economic growth, the structure of the energy sector, and agricultural sector (especially livestock) emissions. Argentina's analysis indicated that its emissions would not likely grow in a linear fashion with economic growth, but instead would grow slower with economic growth, and that this would become more pronounced at higher rates of economic growth. For details on the Argentine proposal, see the Argentina National Communication, First Revision at http://unfccc.int/resource/docs/natc/argnc1e.pdf. For details on the Bush Administration proposal, see http://www.whitehouse.gov/news/releases/2002/02/climatechange.html. For more information on indexing, refer to Lutter (2000) and Baumert et al. (1999).

46. Pizer (2003) illustrates the variability in GHG intensity and questions how well these types of commitments would mitigate cost uncertainty.

47. See Aldy (2003) for details on this analysis. Note that whether the emissions abatement necessary to comply with a linear indexed commitment decreases with faster economic growth would depend on the composition of that country's economic growth.

48. In addition, a sector-based commitment offers no guarantee that the cheapest potential for reductions is being exploited in the country that commits to this approach. The possibility, however, to sell allowances on the basis of such commitment may offset this loss in economic efficiency.

49. IEA (2002a).

50. Interestingly, the EU emissions trading directive may create a precedent of sectoral targets for countries otherwise without commitments under the Protocol. Some industrial activities in Cyprus and Malta, two accession countries, fall under the jurisdiction of the trading directive and as such should be allocated absolute caps to allow trading with other industrial companies in the rest of the EU.

51. Philibert (2000).

52. The no-lose target could also be set at some level below its forecast business-as-usual, e.g., to ensure that potential no-regret options are undertaken before a country achieves the no-lose target, and only starts selling tons when cost is incurred to achieve reductions.

53. See IEA (2002a) for further details on this option.

54. See Cooper (1998) and Nordhaus (2002).

55. This tradeoff, however, appears sensible on economic grounds—research indicates that by reducing the uncertainty in costs, the net expected benefits of a price-based climate policy would exceed those of a quantity-based policy; Pizer (2002).

56. Wiener (1999a).

57. See Barrett (2001), (2003); and Benedick (2001).

58. Barrett (2003).

59. Wiener (1999b).

60. For example, an obligation to adopt a capture and storage technology for fossil-based generation would entail a higher cost for a country whose generation is mostly based on coal than for a country where hydro and nuclear account for a large share of supply.

61. Ashton and Wang (2003).

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Development and climate

Engaging developing countries

Thomas C. Heller and P.R. Shukla

I. Introduction

In the decade since its launch, the international effort to address climate change has centered primarily on the most immediate challenge: establishing a multilateral framework to control greenhouse gas (GHG) emissions from industrialized countries, historically and currently the largest emitters. In the near term, mitigating developed country emissions remains the fundamental priority of any effort to strengthen the international response. Increasingly, however, the focus will turn as well to a second central challenge: devising and implementing effective strategies to achieve climate-friendly actions in developing countries. This paper examines this second critical challenge. While much of the underlying analysis could apply as well to developed countries, the focus here is integrating climate and development objectives in the developing world.

Climate is not an arcane or peripheral question for development. Both concern fundamental issues of energy, transport, land use, and food security that are priorities for developing countries. Development and climate intersect across two broad dimensions. First, the localized impacts of climate change—including water shortages, agricultural disruption, and coastal flooding—pose serious long-term threats to development. These impacts will be felt disproportionately in developing countries. At the same time, development is itself the driving force behind climate change. In the long run, achieving the deep reductions in global emissions necessary to stabilize the climate will require fundamental shifts in development pathways. Vulnerability to climate impacts has been a common concern of all developing countries since the start of the climate effort. Particularly for the least developed countries, assistance in reducing their vulnerability to climate-induced damages will remain a central focus of development policy and an overriding objective in multilateral negotiations. The analysis here, however, concentrates on the mitigation side of the development-climate interaction. Consequently, the issues it examines concern primarily advanced developing countries with large and growing emissions and, therefore, the most to contribute to the mitigation effort.

Greenhouse gas emissions from developing countries are rising rapidly. On a per capita basis, they will remain far below those of the developed countries well into the future. However, total emissions from developing countries are projected to surpass those of the developed countries within a decade or two (see Figure 1). Most plausible emission scenarios suggest that, even with strong efforts in developed

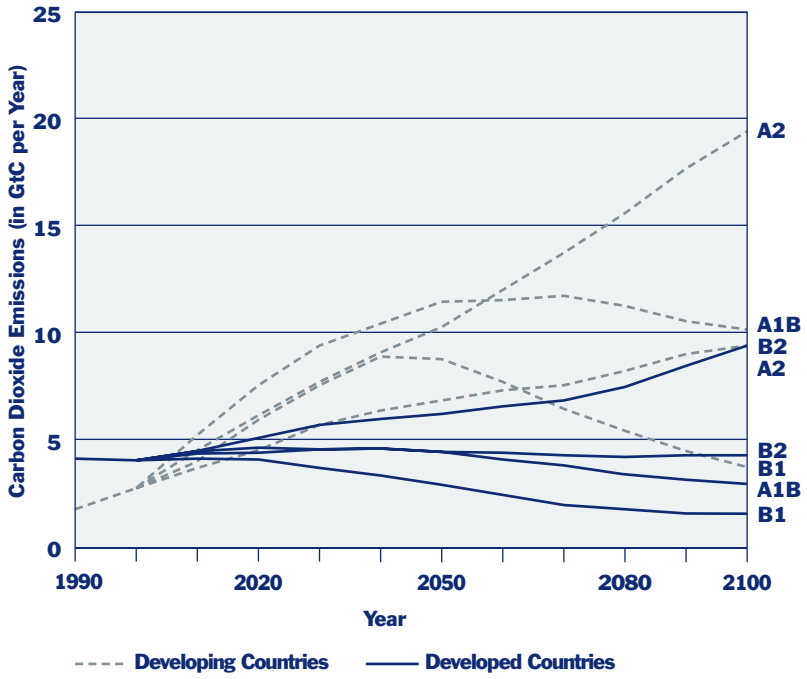
countries, developing country emissions must fall below business-as-usual projections if atmospheric GHG concentrations are to be stabilized by 2100.[1]

The rapid rise in developing country emissions is driven by development imperatives—in particular, the need for energy and economic growth—and is encouraged by flows of investment and technology that support conventional paths of development. Future climate strategies must explicitly address these fundamental needs of developing countries if they are to be constructively and seriously engaged in common efforts toward climate protection.

There is strong evidence that strategies driven by core development priorities can at the same time produce climate benefits. For instance, China's rapid improvements in energy efficiency, while motivated principally by economic goals, have significantly slowed the growth of its GHG emissions.[2] Recent analyses identify similar experiences and opportunities in major developing countries.[3] However, to the extent that developing nations regard climate concerns as no more than potential barriers to their ability to reduce poverty and increase income levels, climate issues will not command the attention of core political actors. Since constraining economic growth is not an option for these policy makers, the only politically viable approach to climate mitigation is to devise development strategies that can produce climate benefits ancillary to sustained economic expansion. A principal aim of climate policy must be to influence and facilitate the capacities of developing nations to recognize and meet this challenge.

Figure 1

Projected CO_2 Emissions for Developed and Developing Countries



Note: The projected trends correspond to a set of emission scenarios developed by the Intergovernmental Panel on Climate Change and described in its Special Report on Emissions Scenarios (SRES).

Source: IPCC (2000).

Economic growth has a dual relationship to emissions. Globally, economic growth, energy use, and GHG emissions

have remained coupled through modern history.[4] In developing countries, particularly those with low per capita energy use, sustained growth will require an absolute increase in total energy production and consumption. However, growth also raises the demand for environmental quality and, through improved technology, creates new opportunities to produce and use energy more cleanly and efficiently. The emission scenarios of the Intergovernmental Panel on Climate Change (IPCC) highlight the potential importance of technology innovation and diffusion in weakening the historical linkages between growth, energy intensity, and carbon output. In the Special Report on Emissions Scenarios (SRES),[5] certain scenarios project both lower emissions and higher economic growth relative to alternative scenarios, with technology choice among the critical underlying variables. Technology patterns, and the organizational and institutional arrangements that encourage and maintain them, emerge as key determinants of future emissions paths—regardless of the rate of economic growth.

To date, however, the international climate regime has been largely ineffective in de-linking economic, energy, and emissions growth, providing neither the incentive nor the means for developing countries to pursue alternative paths. If future mitigation efforts are to succeed, they must align with the overriding development priorities of developing countries, and must provide incentives and mechanisms to redirect investment and technology flows from conventional to more climate-friendly pathways. Put simply, effective climate action must be "mainstreamed" to re-orient development toward those paths that are most climate-friendly.[6] This paper explores how this challenge is best met:

- Section II examines the current climate regime and shows how, by virtue of its orientation and architecture, it is unlikely to induce stronger mitigation efforts by developing countries.

- Section III describes important transformations underway in advanced developing countries. Any future mitigation effort must be grounded in a clearer understanding of the economic and governance context within which development choices are made, and how that context—now the subject of far-reaching reform efforts in many developing countries—is evolving. It is within this shifting context that incentives for climate-favoring development choices must be made salient to public and private actors who will chart their countries' future development paths.

- Section IV suggests principles to guide a reformed climate strategy. It envisions a multi-faceted approach that would seek to accelerate climate-favoring energy and transport systems by linking climate-specific national and international efforts with non-climate programs supporting development paths with less climate impact. Such a strategy also would explicitly differentiate between those developing nations where reducing climate vulnerability is the overriding concern and those where rapid growth generates rising emissions and, hence, greater mitigation potential.

- Finally, section V presents specific policy options to simultaneously promote development and climate mitigation within or alongside an evolving climate regime. It suggests mechanisms flexible enough to link national and transnational, climate and non-climate, mandatory and voluntary, and public and private efforts.

II. The Climate Effort to Date

As presently constituted, the international climate effort is unlikely to significantly alter the development pathways of developing countries. This stems both from the basic architecture of the climate regime and from inherent weaknesses in the means it has established to deliver technology and resources to developing countries: the Clean Development Mechanism (CDM) and the various funds meant to channel government assistance from developed countries.

Regime Architecture

The UN Framework Convention on Climate Change (UNFCCC) establishes a broad foundation for multilateral action on climate change, one flexible enough to accommodate a wide variety of approaches. At this stage, however, the architecture of the climate regime is defined far more concretely by the subsequent Kyoto Protocol.

The regime's design flows from theoretically sound central tenets. First, it is climate-centric: all of its provisions are driven by the core objective of achieving and maintaining a tolerable level of GHG concentrations in the atmosphere. Second, it assumes universal accession and adherence to a single set of implementing principles and rules. Third, it prescribes a property rights model in which the permitted global quota of emissions is divided among parties according to some equitable or practical formula. Fourth, it seeks to foster efficient markets in which property rights will be traded to yield emission reductions at the lowest total cost. Fifth, it contemplates a "hard law" system in which compliance is enforced with defined sanctions by a body internal to the regime.

In broad terms, the logic of the regime's design so far might be characterized as flowing from output to input. Aiming for an as yet undetermined cap on concentrations, the regime imposes limits on emissions "output." Governments are charged to move back from that output to place constraints on the various "inputs"—namely, major energy-consuming activities. The fundamental regime program thus proceeds from climate to all other variables. Although the abstract logic of this architecture has clear advantages,[7] the problematic politics of this program are already apparent. Even among the developed countries, this architecture has failed to induce full participation, with the United States unwilling to assume the uncertain costs of meeting a fixed level of emissions output. And in the preliminary skirmishes over the question of future commitments at the 8th Conference of the Parties in New Delhi, developing countries again strongly resisted any hint of their potential inclusion in a global cap-and-trade system.

Despite the possible entry into force of the Kyoto Protocol, and emerging national efforts to meet emission targets, there is little evidence in the first decade of climate action that nation states have been willing through the medium of collective action to assume significantly higher constraints or costs than they would acting independently.[8] This calls into question a regime design that treats sensitive national inputs as functions of less immediate global outputs. Particularly with respect to developing countries, it remains unclear that climate outputs have sufficient salience as a political driver to motivate the implied constraints on inputs that are presumed essential to achieving overriding development objectives.

The Clean Development Mechanism

The regime relies on the Kyoto Protocol's Clean Development Mechanism as the principal instrument to encourage climate-friendly technology and resource flows to developing countries. The CDM's design is ambitious and innovative. In theory, the CDM provides incentives to developed countries and their firms to invest in climate-friendly projects in developing countries because they generate emission reduction credits that can be applied toward developed country emission targets.

At least in the near term, however, there appears to be only marginal potential for development assistance through the CDM. First, there remain uncertainties about the rules and practices governing the certification of projects other than small-scale, end-use efficiency and renewables. For example, initial proposals include hydroelectricity generation and reforestation for charcoal production that will be highly controversial.[9] More significantly, the removal of U.S. demand for mitigation has depressed prices for all emissions trading programs, including the CDM. Projections of the annual mitigation market in 2008-2012 have dropped from 300-700 million tons of carbon equivalent (Mtce) to 0-300 Mtce. Carbon price estimates for 2010 have dropped from a range of $60 to $160 per tce with U.S. participation in the Kyoto regime to $3 to $87 per tce without U.S. participation.[10]

Even apart from these concerns, however, the CDM as now constituted may hold only limited prospect of increased or redirected flows. To earn offset credit, the CDM requires that investment be "additional" in the sense that the reduction would not have occurred but for the incremental value of the resulting credit to the investor. This rule would seem to work well for small projects, especially in renewable energy, that have no commercial market counterparts. However, it is much less likely to function credibly with investments of substantial size—particularly in the incompletely reformed markets of developing countries—for at least two reasons. First, where future development paths hinge on a range of policy decisions that are not yet sufficiently settled to determine what constitutes business-as-usual, apolitical baselines cannot credibly be defined. Second, the additionality rule does not align adequately with the practical realities of business decision-making. For many multinational investors, it is unlikely that the value of CDM credits will be sufficient to offset the commercial, political, legal, and social risks associated with infrastructure investments of a scale large enough to significantly alter emission pathways

(see discussion below). For firms willing to adopt a more aggressive investment strategy to build market share in the longer run, it is more likely that CDM might induce a shift in the rank order of particular projects within a portfolio of financially plausible investments. However, it will be difficult for a firm to prove that it has actually reordered its portfolio to favor those investments whose expected returns are increased by the value of the climate credits but otherwise would not be undertaken. In these circumstances, even if the still undefined rules for setting baselines ultimately credit such projects, the environmental credibility of CDM will be subject to both political disrepute and legal challenges that will deter its easy use.[11]

Assistance to Developing Countries

Under the UNFCCC, developed countries pledged to provide "new and additional" resources and to promote technology transfer to support climate action in developing countries. They also pledged adaptation assistance to developing countries particularly vulnerable to climate impacts. These are general commitments with no specific formula or schedule for flows. The adequacy of the assistance provided has been a chronic source of friction between developed and developing countries in the climate negotiations.

In their national communications to the UNFCCC Secretariat, developed countries report a wide assortment of bilateral and multilateral projects and contributions. The level of support varies from donor to donor and from year to year. Some funding covers the cost to developing countries of fulfilling Convention commitments such as preparing emission inventories and national communications. Some reported flows are for projects such as forest protection, in which climate is one among many benefits. From 1997 to 2000, the combined flows reported by developed countries were in excess of $12 billion.[12]

Some of the funding reported by developed countries flows through the Global Environment Facility (GEF), which was established in 1992 to fund projects in areas of global environmental concern (these also include biodiversity, international waters, ozone depletion, land degradation, and persistent organic pollutants). From 1991 to 2001, GEF funding for climate projects amounted to $3 billion, or 37 percent of the GEF disbursal. In 2001, GEF disbursed $472 million in climate funds, with nearly 80 percent directed to renewable energy and energy efficiency projects.

GEF funding follows the "incremental cost" principle established in the UNFCCC: developed countries are to pay the "agreed full incremental costs" of developing country efforts under the Convention. Incremental funding has helped push advanced technologies, such as solar photovoltaics, fuel cells, biomass gasifier engines, and electrical vehicles, which may face high initial costs or other barriers. However, while GEF programs are often input-based, there is no stipulated or evident tie between

the environmental goals of the GEF and leading political priorities in developing nations.[13] In addition, concerns have been raised about GEF program implementation, including its weak incentives for discovering least-cost mitigation options and inadequate replication of successful projects.[14]

UNFCCC parties agreed in 2001 to establish three new funds to support technology transfer, capacity building, adaptation planning, and other needs in developing countries. They are the Special Climate Change Fund, which also aims to assist countries whose economies are highly dependent on income generated from fossil fuels; the Least Developed Countries Fund; and the Adaptation Fund, to be financed in part by a charge of 2 percent of the certified emission reductions issued for CDM projects. Developed countries, however, have not committed to particular levels of funding. Apart from the CDM surcharge for the Adaptation Fund, the funds are supported entirely by discretionary contributions. To date, developed countries have announced commitments of 450 million Euro per year by 2005. However, the funds are not yet operational and no disbursals have taken place.

In summary, the present climate regime adopts an architecture centered on emission outputs, with little consideration of inputs closely tied with fundamental development needs; creates a market-based mechanism with only limited potential to channel private investment toward large-scale, climate-friendly endeavors; and provides no assurance of significant or stable assistance from developed country governments. In these circumstances, it is understandable if there is only limited interest among developing countries in exploring the road beyond Kyoto.

III. The Shifting Context

Any effort to more fully engage developing countries in the international climate regime, or to steer investment and technology flows toward climate-friendly development, must take account of circumstances and trends that shape present development patterns and condition possibilities for the future. The most important of these are:

- The far-reaching but incomplete structural and economic transitions underway, especially in advanced developing countries;
- The growing contribution of foreign direct investment to overall North-South flows and the evolving business strategies that allocate this private capital; and
- New forms of selective development assistance that focus increasingly on governance reform, public-private cooperation, and performance commitments.

New "Hybrid" States

The rapid growth of many developing countries—and the concomitant rise in energy use and emissions—take place in the context of fundamental economic transformation and reform. Each of the major developing economies, to one degree or another, is in the midst of transition from a largely state-centered to a more market-centered system. Even where important political forces are committed to fundamental structural change, this transition is contested and prolonged, and its likely endpoint difficult to discern. In reality, the process of transition itself has become a semi-permanent state that is likely to persist for several decades. These countries are in a sense "hybrid" states caught between market- and state-centered regimes.

Prior to transition, these economies were most often directed by state-owned enterprises (SOEs) operating under the guidance of sector-specific ministries. These SOEs and the supervising agencies normally determined policy in their fields relatively free from central control or systematic coordination. State firms directly implemented economic, social, and limited environmental policies through internal decisions about production, wages, investment, technology, or social services provision. Financing to support these enterprises was channeled through a state banking system, and limitations were placed on the competition that state enterprises confronted. In effect, a social contract—with administered prices and employment security—was built into the fabric of the pre-transition political economy.

During transition, the old contract has eroded but a new one has yet to fully form. On the surface, reforms are motivated by concern for improved efficiency and usually guided by a standard program of privatization, decentralization, deregulation, and independent regulation that substitutes markets for political administration. Below the surface, the driver of change is more often the need to attract new development capital from sources other than state banks, themselves often in financial distress. Established state firms and agencies frequently do not accept internally the external faith in competitive markets even as their governments announce their conversions. Reform is uneven, with lags especially prominent in the development of new legal and regulatory institutions and the emergence of markets with effective competition. The result is an irregular patchwork of reformed and residual practices as new spheres of market-dominated activity emerge alongside the defended offices, routines, and cultures of the previous socialist, corporatist, or colonial systems.

In the hybrid state, political and economic institutions face new incentives and engage in new behaviors. The overlapping established and reformed agencies produce contradictory incentives, inducing complex adaptive strategies by private and public actors unsure which system will ultimately take hold. Corporatized state enterprises, increasingly free of central administrative influence, make use of their

established political connections to consolidate their inherited national market power, even as they reorganize themselves for international competition. Simultaneously, the reduction and decentralization of governmental authority results in the dissipation of policymaking and implementing capacity, pushing bureaucrats into greater dependence on the former state firms they used to control. Political tensions, often fueled by invigorated democratic competition, are inflamed by the threatened abandonment of familiar social commitments in new markets popularly perceived as non-competitive and corrupt. Consequently, the normal state of societies undergoing market reform includes political backlash and nostalgia that reinforce the strength of the institutional and cultural residues of the past, and, in turn, prolong the term of the hybrid political economy.[15]

Within this fractured and evolving decision-making context, development politics continue to focus overwhelmingly on a few priority concerns. These include food security and agriculture—which are threatened by many factors including, at the margin, climate change—and increased capacity and efficiency in the energy and transport services that underpin economic growth. However, in this hybrid context, coordinating authorities that are motivated or able to optimize across policy goals or economic activities are scarce. Instead, choices among development paths flow largely from incentives salient to particular interests. Even in priority areas, organizational fragmentation and self-interest continue to determine favored projects and outcomes. For example, in energy policy, separate agencies and associated firms frequently compete for financing and commissions with scant coordination between oil and gas, nuclear, and coal projects. In the transport sector, auto, rail, and urban mass transit authorities propose and develop investment projects in the absence of encompassing and compelling land use planning. In these different sectors, policy and business decisions are dominated by public-private coalitions of newly autonomous state enterprises and their newly dependent allies in government administration. Both favor, and are favored by, sectoral prosperity and expansion. Policy, including environmental policy, becomes an instrument to support the claims of sponsoring coalitions to resources, market position, or other means of industrial growth. Policy outcomes are the products of negotiations between these quasi-autonomous sectoral coalitions.

To the degree that environmental needs become priorities, climate change is rarely among them. The political capital and mandate of environmental regulators, particularly at the central state level, runs thin compared to finance or line ministries and their industrial partners. Even though the threat of climate-induced damage is most severe in developing nations, political actors concentrate on immediate issues like local air and water pollution that may help them claim public resources and satisfy popular expectations, rather than on long-term, invisible concerns like climate change.

The Rise (and Instability) of Private Flows

Increasingly, private markets have become the primary mode for technology and resource flows from developed to developing countries.

As official development assistance stagnated over the past decade, private flows increased roughly five-fold (see Figure 2). The share of flows represented by private capital peaked in 1996 at 90 percent and has declined only slightly since, despite the East Asian crisis, the resultant volatility in capital markets, and a global economic slowdown.

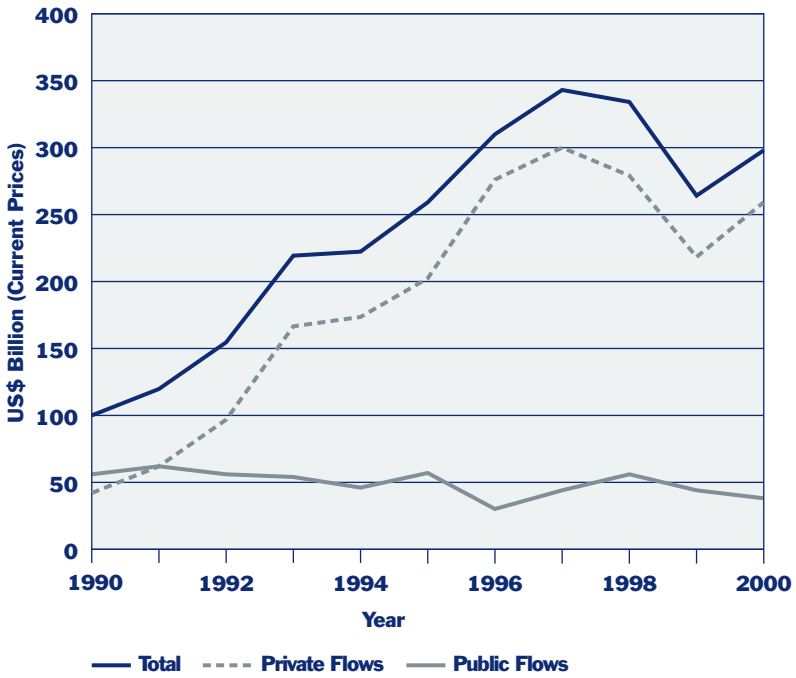
Prior to 1990, international capital came primarily as bank lending to governments or the private sector. In the 1990s, capital flows increasingly took the form of foreign direct investment (FDI) and portfolio investments, including bond and equity flows. Foreign direct investment is now by far the largest component of external financing to developing countries. However, FDI flows disproportionately to a small number of developing countries, with just 10 countries receiving 70 percent.[16]

Along with the rise in private flows has come a substantial shift in the nature of cross-border business transactions. In qualitative terms, the proportion of business operations conducted through investment in joint ventures and subsidiary corporations expanded relative to independent trade in goods and international technology licensing. Multinational investment has also become less associated with the exploitation of natural resources or low-wage manufacturing, expanding widely into the provision of commodities and services in host country and regional markets.

The rise in private flows is closely tied to the ongoing transformation of advanced developing economies. For instance, between 1970 and 1990, investment in state-controlled power sectors came regularly in the form of (soft) loans from state development

Figure 2

Resource Flows to Developing Countries



Sources: *Global Development Finance Country Tables* and sources cited therein; World Bank Global Economic Model; OECD Development Assistance Committee's *Geographic Distribution of Flows.*

banks and from multilateral concessionary financing. However, those sources began drying up in the 1990s because of mounting national debt burdens, bank insolvencies due to non-performing financial assets, and greater attention to environmental and institutional considerations in multilateral lending. With the demand for power continuing to rise, countries like Brazil, China, India, and Mexico looked increasingly to foreign investors and initiated energy sector reforms to attract them. From 1990 to 2000, more than $680 billion was invested in infrastructure in more than 120 developing countries. These investments peaked in 1997 at $123.3 billion, declined in the crisis years of 1998-99, and began to climb again in 2000. Electricity and natural gas investment accounted for $229.6 billion, second only to telecom investments of $292 billion over the same period.[17] Investment took place in both greenfield projects, overwhelmingly in generation by independent power producers (IPPs), and in the privatization of existing assets, more heavily in distribution systems.[18] Asia attracted the largest share of contracted IPPs, with $54 billion in projects concentrated in China, India, Pakistan, Indonesia, Malaysia, the Philippines, and Thailand. Latin America was second at $28 billion.

Ironically, as the importance of multinational business to development finance and technology transfer exploded, so did the transaction costs and business risks of investing in nations experiencing incomplete market reform. In the energy sector, the negotiating and financial carrying costs of licensing and contracting have been high, with median elapsed times of four to six years between initiating a project and being ready to begin construction.[19] Efficiency gains and technology transfer have been limited by legal requirements for local participation in the construction, equipping and operation of plants. Power purchase agreements (PPAs), the standard contracts that define risks for international equity investors and bank lenders by fixing the prices and quantities of output to be purchased, have provided few incentives to look for cost savings or efficiency improvements. Regulatory rules and the direction of market reform have often been unclear and irregular, while political reluctance to raise retail electricity rates has compromised the ability of utilities to comply with contracts in the wholesale market for new and more expensive power. Especially when extraordinary events occurred, such as the Asian downturn after 1998 or the drought that curtailed Brazil's hydroelectric supplies in 2001, foreign investors found agreements were abrogated by state-owned utilities or public regulators who expected them to share risks they thought had been assigned through contracts to other parties.[20]

It is too early to discern the significance of these recent events for private markets as the primary mode of technology and resource flows. But in 2003 there is effectively a standstill in foreign greenfield investment in Chinese or Indian power; Brazil has not found international bidders for the sale of relatively well-run utilities in Parana and Goias states; and IPP formation in Mexico is paralyzed by judicial ambiguity about the constitutionality of private power.[21] As growth and electricity demand in emerging markets rekindle, it is likely there will be new pressures for foreign flows into infrastructure investments important to climate action. What is less clear is whether these flows will take forms that accommodate to, or anticipate the passing of, the hybrid state.

Evolving Business Strategies

Foreign investors operating within this evolving context face new risk profiles and respond with new business strategies. In the 1970s and 1980s multinational firms had adapted to managing the commercial risk of uncertainties in developing markets and the political risks of wholesale expropriations (principally in the natural resource sector). However, a multi-country portfolio of direct infrastructure investment presents an expanded set of risks arising from more intimate involvement with host country laws and regulations, judicial failures to enforce contracts and judgments, and weak corporate governance.[22] Multinational firms continue to confront incomplete market reforms, immature regulatory institutions, and residual expectations about the social allocation of risk. To mitigate these risks, direct foreign investors increasingly adopt business strategies that ally them with national enterprises emerging from state control, which have the experience and political assets to flourish in hybrid political economies.

Foreign investors following a conservative business strategy that bets on the stability of existing institutions, policies, and firms may hedge against risk by acquiring local partners in a position to influence government decision-making to structure markets, financing, and contracts along favorable paths. This strategy underlies the current trend to acquire important share interests in brownfield assets like older power plants. Such ventures have an established history of tariff determination and proven record of power off-take (sales). Moreover, national co-owners often have a background in and personal ties with the government departments that regulate the industry involved. The firm in effect prefers to trade the corporate governance risks of unfair behavior by their joint venture partners for the political risks it would run without it. The state, in turn, acquires a source of fresh capital for new investment and reinforces existing political networks whose value as a form of risk insurance can now be marketed internationally.

More aggressively, multinational investors in partially reformed markets may bet on continuing institutional change creating conditions that will benefit the lines of business in which they specialize. Where the development of new production processes and markets depends on the creation of complementary infrastructures and policies, the radical openness of reform may encourage firms to invest resources in shaping future markets that will enhance their long-term returns. Pragmatic new business strategies that link risk-tolerant foreign investors with national, industry-specific coalitions of firms and agencies with political associations rooted in the pre-reform regime, but positioned to increase (market) power through prospective market-making, may present exceptional opportunities for climate action.

For example, the proportion of natural gas that will be used in a fast-growing developing nation probably depends more on the capacity of sectoral groups to acquire political sponsorship, financing, and tailored rules favoring the placement of pipelines, LNG terminals, and urban distribution than on an integrated assessment of relative fuel prices (and environmental shadow values). Once infrastructure is built, the marginal costs and administrative dynamics of gas-fired power lead development down an

alternative path. Multinational businesses with particular gas expertise, upstream resources, and financial credibility are obvious entrepreneurs for such market-making, supplying offshore technology and resources that complement the political and institution-shaping assets of onshore groups. While individual projects early in the process of market development may not appear as attractive as other near-term investments, the long-term prospects of market-making in a field that matches the firm's organizational expertise and profitability can redefine investment choices.[23]

Finally, coalitions of multinational and empowered national firms may help diffuse climate-friendly technologies and practices throughout the larger regional market. For instance, other nations in southern Africa are more likely to emulate the development pathways demonstrated by successful South African firms with local knowledge and concentrated organizational interests than by firms with headquarters in Europe or America.

New Directions in Development Assistance

While private flows rose through the 1990s, flows of official development assistance (ODA)[24] declined in nominal and in real terms. At the same time, donor countries have begun to emphasize new forms of assistance and new conditions on its receipt.

To many developing countries, an important benchmark remains the commitment by developed countries to increase their level of assistance to 0.7 percent of their gross national incomes.[25] The trend, however, has moved in the opposite direction. Despite a modest increase in the late 1990s, ODA was 10 percent lower in 2000 than a decade earlier.[26] As a share of donor countries' GNP, aid has leveled off in nominal terms and declined in real terms from 0.33 percent in 1991 to 0.22 percent in 2000.[27] This decline is attributed in part to the diminished importance of strategic and military aid since the end of the cold war.[28] While total flows have declined, aid for social programs (such as education and health) and environmental investments has increased, reaching about 5 percent of total ODA.

From the perspective of developing countries, the shifts from public to private funds and the declining quantity of ODA flows over the past decade have in some respects supported, but in other respects undermined, their overriding development objectives. On one hand, priorities such as accelerated growth and trade have clearly benefited from increased private investment and technology flows from developed countries. However, this shift in private flows driven by global and regional markets remains alien to other development priorities such as poverty relief, health, and education, particularly in smaller and poorer recipient countries more favored by ODA than FDI.

Also of concern to many developing countries is the disproportionate distribution of development assistance. For instance, ODA to the Sub-Saharan African and the South Asian countries has declined, while flows to relatively more affluent nations in East and Central Asia and the Pacific, and to Europe's transitioning economies, have increased markedly. As often in the past, state aid appears to move where

the political bargaining power or strategic importance of recipients is greatest, rather than where poverty reduction or marginal development gains may, in theory, be maximized. (A similar pattern can be seen with respect to private flows, which are moving towards countries with sound investment climates, usually the middle-income countries, leaving aside least developed countries where development gains can be larger.)

In broad terms, private and public flows from developed countries have done more to exacerbate than reduce disparities between fast- and slow-growing nations within the developing world. In both their size and their distribution, they are perceived by developing countries as poorly matched with their paramount development needs.

To help correct these widely acknowledged failures, a new round of development-focused summits has brought renewed but softer pledges of assistance and new emphases by donor countries. At the International Conference on Financing for Development in Monterrey in 2002, donors pledged an additional $25 billion through 2006.[29] They pledged further assistance, not readily quantifiable, later that year at the World Summit on Sustainable Development (WSSD) in Johannesburg. In many instances, these new pledges aim to reform assistance flows in several dimensions. First, a new emphasis on public-private partnerships attempts to coordinate complementary public and private efforts supporting public goods like water, health, and education. Second, there is enhanced concentration on the impact of ODA on the income and quality of life of the poorest populations as a criterion for evaluating aid programs. Third, there is increased focus on expanding the governance capacity of recipient nations to ensure that assistance will be not be wasted or stolen.[30]

The type of assistance donors now favor has shifted in quality from hard, technological, and unconstrained to soft, institutional, and selective as to both which nations (those most committed to governance reform) and which populations (those most in poverty) qualify for aid.[31] There is increasing insistence that aid promote institutional reform to encourage governance that is transparent, non-corrupt, and respectful of civil and political rights, and able to provide an effective legal framework for competitive markets. This selective assistance, coupling economic support with commitments to reform and performance monitoring, is best developed in the various partnership and association agreements the European Union offers to nations on its eastern and southern peripheries. It is also reflected in the incipient Millennium Challenge Account unveiled by the United States at Monterrey, which would rank potential recipient nations according to their accomplishments in reforming the rule of law, fighting corruption, and strengthening democratic institutions. New and additional funding will be selectively available only to those countries with high compiled scores on these indices. In addition, continued flows will be subject to contracts in which recipient nations promise further progress on reforms.

Another characteristic of the emerging shape of aid may be foreshadowed in the emphasis in Johannesburg on public-private partnerships. Within a context of less assertive and well-endowed states, and concurrent reluctance to transfer powers to international bodies, there has been a surge of interest in

collaboration by intergovernmental bodies, private firms, and non-governmental organizations (NGOs). While the exact nature of governance powers, financing responsibilities, and monitoring and evaluation in these partnerships remains quite unclear, it is increasingly likely that aid will be packaged in task-specific public-private coalitions. Illustrations include incipient efforts like the Global AIDS partnership or the public-private consortium that designed the new Chad-Cameroon pipeline project. In the latter case, the partners agreed to divert the greater portion of royalties into an offshore trust account, with public and NGO stewards and carefully defined fund allocations, to ensure local poverty reduction, create equitable regional distributions, and fight national corruption.[32]

IV. Principles Going Forward

The challenge of climate protection might well be understood as one of establishing climate-favoring markets—self-sustaining markets that support the adoption and diffusion of climate-friendly technologies and practices. In "hybrid" economies in transition from state- to market-centered systems, this requires simultaneous mobilization of resources and reform of key institutions that are concerned overwhelmingly with non-climate rather than with climate policies. The foregoing analysis of the international climate effort to date, and of the context within which any future efforts must be undertaken, suggests several broad principles to establish and strengthen climate-favoring markets in developing countries. These principles concern the nature of the commitments or goals that advanced developing countries might undertake in a new or modified climate regime; the alignment of interests necessary to promote climate-favoring development choices and mobilize private capital in support of them; and the focusing of direct assistance from developed countries primarily on reducing climate vulnerability in the least developed countries, and supporting public and private initiatives that build climate-friendly markets in the more advanced countries.

From Output to Input

The continued resistance of developing countries to even discussing an evolution of commitments within the existing climate framework suggests the need for alternative approaches. Rather than proceeding exclusively from output (emissions) back to input (energy use and other emissions-generating activities), as at present, a future or modified regime might better match the overriding needs and priorities of developing countries, and thereby more directly engage them in international climate efforts, if it allows approaches that proceed instead from input to output. Further, the regime might more effectively channel investment toward climate-friendly development if, rather than focusing on discrete improvements relative to predicted business-as-usual baselines, it aims instead to fundamentally shift those baselines in a lower-carbon direction.

Developing countries care deeply about a core set of development priorities, including food security, water, energy, transportation, and urbanization. Frequently, the activities undertaken to meet these priorities are, in turn, the inputs driving emissions output. For some time to come, developing country emissions will continue to be derivatives of other development choices, and can be better managed if recognized as such.

Climate-related policies, then, are most likely to draw political support within developing countries when they piggyback on and enhance more salient development priorities. A climate strategy that takes these priorities as its starting point reverses the focus of decision analysis and cooperative action from the long-range and constraining to the immediate and enabling. This can serve to deescalate the debate over global burden sharing, reduce the perception that climate protection is a constraint on development, and increase the political salience of climate concerns among empowered development elites. Further, it can allow for recognition of mitigation benefits resulting from efforts not driven primarily by climate concerns, in the same way that under Kyoto industrialized countries are credited for domestic emission reductions regardless of their source.

A climate policy focused on inputs should seek opportunities to shift those fundamental drivers in climate-favoring directions. As developing countries weigh options for meeting a given development priority—for instance, increased energy supply—climate policy should provide incentive to tilt the choice toward that option most likely to avoid or reduce GHG emissions. The policy, however, must bear on decision-making at a scale large enough to significantly affect emissions trajectories. Focusing exclusively on discrete projects, such as a retrofitted power plant or small-scale renewables, though beneficial and symbolic, affects emissions only marginally.[33] Further, as presently constituted, a project-based approach to mitigation requires the tedious and contentious calculation of a presumed business-as-usual baseline—an exercise which, especially in countries undergoing transformation and reform, may hinge more on conjecture than fact. An alternative approach will pay far greater climate dividends if it seeks to transform the very baseline itself by, for instance, promoting actions and reforms across the entire energy sector. The same broad logic can apply as well in other sectors, such as agriculture and forestry, where practices that sequester carbon can simultaneously conserve soil and promote sustainable production. Climate policies that focus on inputs and motivate action at the sectoral, rather than project, level also conform better to the investment behavior of the developed country firms whose resources are key to achieving climate-friendly development.

There are tradeoffs between input- and output-based approaches. Theoretically, at least, an output target allows countries and emitters greater flexibility in their choice of mitigation strategies and, hence, greater cost-effectiveness.[34] In practice, an input-based approach may be more likely to induce participation in, and compliance with, an agreement, two fundamental conditions for its success.[35]

Aligning Interests

The success of any policy depends in part on its ability to align the interests of multiple parties that, in combination, have the capacity to deliver the desired outcome. In the case of climate action, this requires broadening the range of interests and actors involved. Within governments, for instance, mainstream development and economic ministries must be more fully engaged.[36] In developing countries, particular attention should also be paid to the incomplete nature of the transition of "hybrid" states and, consequently, to the residual importance of organizations and agencies with roots in the older political-economic order.

To promote climate-favoring markets, the climate regime should favor stable alliances between three key sets of actors: domestic firms and state agencies in a position to bring about the reforms and mobilize the institutions needed for the markets to evolve; foreign investors who, whether motivated by commercial interest or by their own climate constraints, have incentive to invest technology and capital in market-making; and international ODA providers that can enhance the technical and financial capacities of host nations to undertake institutional reforms. Most prominent in the first category are host nation government agencies and corporatized or semi-privatized state enterprises in a position to pledge political assets toward the institutional reforms needed to make these new markets operate efficiently and free from extraordinary regulatory or legal risks.

The international climate regime cannot alone motivate mainstream national decisions with positive climate impacts. However, it can provide means and incentive at the margin for coalitions of public, private, and semi-privatized actors with the necessary expertise, resources, and political assets to enact climate-favoring development. Although the entrepreneurial initiative to organize such coalitions may come from government agencies or NGOs, experience with the multilateral banks and the GEF suggests that projects instead be designed to encourage private and quasi-private firms to play the coordinating role. The business interests of companies with a stake in new baseline-shifting markets are more likely to yield replicable results than are the political influences that often motivate government-sponsored efforts.

Targeting Assistance

It is likely that some commitment of additional aid under a modified climate regime will be necessary if it is to be politically viable with developing countries. From both a political and a policy perspective, it seems appropriate to suggest a crude division between private and public flows according to the types of "need" to be met.

For a variety of reasons, mitigation needs within developing countries are better addressed largely through private flows. Private investment will continue dwarfing public flows in any case, and the market-making activities most likely to deliver substantial emission reductions are also those most likely to draw the interest of foreign investors, particularly if those activities generate emissions credits or otherwise can

help investors meet carbon obligations in other jurisdictions. However, it is likely that private investment will continue to flow primarily to the relatively more advanced developing countries where the growth in energy use and other climate inputs makes such investment economic. The less advanced developing countries present fewer mitigation opportunities—and hence, can expect less private investment.

At the same time, however, the least developed countries will be forced to cope increasingly with climate impacts generated elsewhere. To the degree that public flows are made available, they might be better dedicated to the two broad categories of need that are more relevant in these poorer nations: expenditures for adaptation and building of adaptive capacity.[37]

The experience thus far suggests that any future public flows will fall well below the needs identified, and may be more episodic than regular. In addition, given the growing emphasis by donor countries on selectivity in ODA, future climate flows may be contingent on meeting some type of performance-based criteria. Finally, negotiation over adaptation funding is likely to be difficult as it is inherently suffused with sensitive questions of responsibility, compensation, and equity. Beyond stipulating that some form of accommodation on adaptation is probably necessary—from both an ethical and a negotiating standpoint—how this is best achieved is outside the scope of this paper. (Nor does this paper address the claims of fossil fuel exporters for compensation for the adverse economic effects of climate-related measures.)

In more advanced developing countries with large mitigation potential, the principal need to be addressed through public flows is the facilitation of technical and institutional capacity to undertake the kinds of climate-favoring development that can be supported by private flows. An input-focused approach requires different funding priorities. Rather than devoting resources, for instance, to detailed accounting of emission sources and sinks to monitor progress against presumed baselines, aid could be more strategically invested in building linkages with investors and mobilizing the political capital necessary to forge climate-friendly development pathways. In part this entails crosscutting reforms aimed at greater transparency and rule of law that extend well beyond the purview of the climate regime. Apart from any climate-specific aid, then, ODA agencies, multilateral banks, and national export-import agencies might also coordinate specific initiatives to tie together policy change and market-making investments that enhance climate objectives. It will be imperative to developing countries, however, that climate-related aid be "new and additional," as specified in the Framework Convention, and that ODA not be diverted from existing priorities such as health and poverty reduction.

In brief, private investment will remain the most likely source of flows directly supporting mitigation activities in developing countries, while public flows would be most productively dedicated to building mitigation capacity in the more advanced developing countries, and to meeting adaptation needs in the least developed countries.

Creating Regional Models

Climate strategies should complement and capitalize on natural patterns of diffusion of technology and know-how from developed to developing nations. Increasingly, initial diffusion into the advanced regions of advanced developing states can take place through market operations without much resistance or delay. However, there are significant lags in the diffusion of these innovations and routines into the slower growing provinces of leading developing states and into the other countries in the regions that they dominate.

Selective targeting of climate-favoring technologies into the more advanced areas of leading developing nations can produce important multiplier effects throughout their regions. First, there is often a strong tendency to mimic the most modern forms of architecture, law, or technology because they are seen as defining the recognized path of development.[38] If Shanghai has an opera, an LNG plant, or a subway system, then so should a number of other Chinese and regional cities that aspire to high status. Second, development in transnational regions is often more easily led by firms from the lead regional nation. For example, South African firms (alone or in coalition with global allies) diffuse technology in southern Africa. If new standards or initiatives for emissions mitigation take root initially in the more advanced developing countries, these nations will become the probable bases for technology and organization diffusion in their regions. Enhanced emphasis on regionalization in climate action will improve access to more climate-friendly development (e.g., substituting gas for coal in South and East Asia), introduce regional actors with more capacity and credibility to carry it forward, and, perhaps, induce advanced developing countries to become more comfortable with differentiated roles in the future climate architecture that are more commensurate with their power and interests.

V. Options for a Future Architecture

Drawing on these broad principles, it is possible to begin exploring specific options for international policy that can better engage developing countries in climate protection by more directly linking it to their overriding development objectives. The UNFCCC is broad and flexible enough to serve as a framework for such approaches. Yet even if the goal of a climate regime is an inclusive and integrated system of commitments and instruments that binds all major emitting countries, the reality for some time may instead be parallel and differentiated regimes that encompass smaller groups of like-minded countries.[39] Similarly, even if the ideal form of the climate regime is a legal order with certain obligations and credible sanctions for non-compliance, the near-term integration of leading developing countries may suggest starting with looser forms of engagement.

Willingness to participate in inclusive multinational regimes has frequently begun with less than binding commitments monitored by networks of interested public and private actors from the cooperating states that rely principally on transparent reporting (reputation) and positive assistance (conditional incentives).[40] Just as the path to an inclusive international regime may lie through the competition and learning associated with parallel approaches, so a strong legal order may be the capstone of a process of experimentation, trust-building, and extended deliberation over norms, rather than the foundation of multinational collaboration.

While alternative approaches may help promote climate action in developing countries, their degree of participation in any future effort will hinge heavily on other conditions as well. These include demonstrable progress by developed countries to fulfill their agreed climate commitments; the adoption of a serious, even if distinct, climate program by the United States; and expanded assistance in meeting adaptation needs. From a practical standpoint, stronger emission constraints in developed countries also can help create the necessary incentives for private investment facilitating climate-friendly development in developing countries.

This section explores policy options in four areas:

- Flexible input-based programs, goals, or commitments that could be elaborated by leading developing countries as part of an evolving international climate regime;
- Mechanisms internal to the climate regime to channel technology and resources—and, in particular, private investment flows—to climate-friendly development;
- Approaches to foster regional cooperation on non-climate-specific development programs with associated climate benefits; and
- Targeted use of ODA by agencies outside the climate regime to facilitate non-climate policies and investments that enhance both development and climate objectives.

Input-Based Goals

One approach might be a regime structure allowing different types of goals, commitments, instruments, and compliance rules for developed countries and for rapidly growing developing countries whose conduct is most consequential for medium-term climate effects. For the latter, in particular, climate action could take the form of input-based standards that correspond to development priorities of these states. Given the resistance of developing countries to mandatory commitments, more flexible measures may be more likely to induce near-term engagement. These measures could fall anywhere along the continuum from strictly voluntary goals on a transparent pledge-and-review model to performance commitments tied either to specific incentives or to qualification for membership in transnational institutions.

Input-based programs might relate directly to national development plans like energy or transport that influence climate or could relate indirectly to other high-priority areas like water or land use with substantial impacts on energy demand. Developing countries have in the past been more apt to participate actively in international regimes in which their engagement has evolved from reporting to voluntary measures to mandatory obligations. Such progressive regime evolution has also been generally more successful in promoting ambitious behavioral changes than have been regimes demanding hard commitments and sanctioned compliance.[41]

Specific approaches to more closely link climate action to inputs are the use of sectoral and/or intensity goals and the systematic reform of domestic policies and measures consistent with these objectives.

Sectoral Goals

Unlike a national target, which requires detailed accounting across sectors, a sectoral goal focuses attention and resources on the predominant inputs and options for steering them in climate-favoring directions. The goal could take the form of a numerical target, or could entail a suite of measures that, while not guaranteeing a given impact on emissions output, can reasonably be expected to produce a lower emissions trajectory while also meeting a development priority. The recent conversion of Delhi's public bus and taxi system to compressed natural gas indicates that developing countries have already undertaken input-based actions of this character that could be better recognized and multiplied.[42] Additional programs might include the adoption and implementation of a national energy policy promoting lower- or non-carbon fuel sources or the introduction of less water-intensive agricultural patterns that reduce the need for irrigation pumping sustained by subsidized electricity rates.

Indexed Goals

An emissions goal set relative to an indicator such as GDP is neither a pure "output" nor a pure "input" approach but, in a sense, a hybrid of the two. By its very form, an indexed or intensity goal expressly links climate and development objectives. It aims for *emissions reduction* relative to *economic growth*. A goal of declining energy (or carbon) intensity focuses directly on the two most critical inputs: energy use and economic growth. For developing countries, this approach can provide assurance that development priorities are not subservient to climate objectives. The major drawback of an intensity approach is that it does not ensure a given level of emissions output. However, in rapidly evolving economies, the difficulty of accurately forecasting future baseline emissions makes nations reluctant to commit to specific emission levels.

Policies and Measures

Another approach is to invite developing countries to pledge to undertake specific policies and measures, either sector-based or economy-wide. Policy changes merit particular attention when they have

the capacity to alter the baseline of expected emissions pathways. Policy reforms as disparate as improved enforcement of coal mining safety regulations, increased collaboration on regional gas infrastructure and security, relaxed foreign exchange or tariff restrictions for imported high-efficiency turbines, or carbon-differentiated fuel taxes could all cause permanent shifts in the relative economics of many discrete climate-related projects. Such policies could be complemented by supportive ODA and private commitments to invest and participate in the emergent markets facilitated by reformed institutions. Either through programs tailored to their specific development goals and policy cultures or through multi-party negotiations that produce lists of pre-qualified measures, developing countries could certify how they have modified policies in accordance with the criteria of the climate regimes to which they associate themselves.

Programmatic Climate Cooperation

Climate goals or commitments will be more attractive to developing countries if linked to mechanisms generating resource and technology flows that will help meet them. Input-based goals could be complemented by CDM-like mechanisms that move away from an emphasis on stand-alone projects and promote investment in broader strategies that shift what constitutes business-as-usual for whole classes of projects.[43] This programmatic approach could avoid many of the technical and procedural complications of the project-based approach and spur investment for initiatives with far larger emission reduction potential. Rather than basing emission offsets on discrete reductions from projected emission baselines, the programmatic approach credits the transformation of policies and institutions. For example, as noted above, a coalition of organizations—both public and private, foreign and national—could unite to put forward a program to develop a gas pipeline infrastructure necessary to substitute gas for coal in electric power production. Public authorities (regulators or grid operators) associated with this coalition may agree to reform the rules establishing the order in which electricity is sold by imposing a shadow charge for carbon pollution to the prices bid by existing coal-fired plants. The combination of the investment pledges and policy change will shift the profitability of subsequent power projects toward gas and thereby generate a continuing stream of carbon benefits.

Programmatic climate cooperation intended to make new markets for climate-favoring investments may seem less amenable to credible evaluation or to the proper calculation of realized climate benefits. How much of the long-term emission reduction resulting from a reformed baseline should be attributed to a change in the law or new investment in infrastructure? These uncertainties are real and can be settled only by the political negotiation of the volume of credits granted. However, making explicit the negotiation of credit volume does not exacerbate, and may improve, the problem of defining additionality now encountered project by project within the CDM. More fundamentally, politics cannot be eliminated from any process to determine offsets that begins with a hypothetical business-as-usual

baseline. Every definition of business-as-usual assumes some set of regulatory policies and infrastructures, so to accept any baseline is to accept the political choices embedded in it. Negotiating exactly how large a transfer of credits or other resources is to go with each certification of programmatic cooperation makes transparent what is hidden within the baselines of all project-based mechanisms. Once it is understood that this determination is ultimately a matter of political judgment, the question for mechanism design is how to elicit the best possible set of proposals for comparison by an independent body subject to open comment and a continuing critical review.[44]

One way to think about managing programmatic cooperation is through competitive bidding processes. Funds of cash or carbon permits contributed by governments (or by private subscribers) might be allocated by a new financial institution like a climate bank, operating through auctions similar to those conducted by the United Kingdom for subsidies for credible and cost-effective GHG reductions. Beginning with a fixed annual stock of money or credits, the bank could accept proposals from competing coalitions of public and private actors across or within different countries who promise investment commitments and supportive policy reforms at a stated price. The bank might tie the release of assets to contracted performance, as do other security arrangements common in financial markets. Bank conduct would be periodically appraised by regime authorities or their delegates. Alternatively, the stock of credits or monies could be distributed by the regime to one or more funds that would themselves compete on the basis of the success of the several assistance programs in which they had invested their assets. Finally, competing proposals for programmatic climate-favoring assistance could be concurrently submitted for evaluation to non-climate development assistance organizations, multilateral financial institutions, or export-import banks. Although these proposals would have to qualify under the normal organizational criteria, the centrality of energy, transport, and other key carbon inputs to development more generally could make the consideration of relative environmental benefits in determining investment profiles only a marginal departure from established practice.[45]

Regional Cooperation

Climate-friendly development could be encouraged by providing incentives for, and removing barriers to, regional cooperation on energy. Such efforts could be undertaken through existing regional organizations promoting economic cooperation, such as the South Asian Association for Regional Cooperation and the Association of Southeast Asian Nations. The technology and investment flows that would benefit the climate would also contribute to the principal aims of these organizations, such as enhanced regional trade and more competitive regional economies. Regional cooperation on water, including hydropower, would help address both climate mitigation and adaptation.

Stronger regional cooperation could yield significant climate benefits. In South Asia, for instance, there is little intra-regional energy trade even though countries have diverse energy endowments and the region as a whole is a net energy importer. Obstacles to regional energy and electricity trade include the lack of a regional energy agency, cross-border regulations, protocols and policies; the absence of a regional grid and infrastructure; and, more importantly, myriad political barriers. An analysis of the potential for integrated energy and electricity markets in South Asia shows significant direct, indirect, and spillover benefits in terms of economic efficiency, energy security, water security, and the environment. From 2010 to 2030, regional energy cooperation could reduce cumulative carbon emissions growth by 1.4 billion tons.[46]

Regional initiatives by public-private coalitions could be structured outside any climate regime or could qualify as programmatic measures within a regime, as discussed above.

Recasting ODA

As noted earlier, future flows of climate ODA should be directed toward adaptation needs in the poorer developing countries and, in the more advanced countries, serve as a complement to private funds targeted to mitigation. The question of adaptation assistance is likely to figure prominently in future climate negotiations and, consequently, any resulting flows would likely be provided through the climate regime. Mitigation-related assistance, however, could flow not only through the climate regime but also through existing aid channels if climate benefits are more routinely recognized as contributing to other development and reform goals. While such synergies could generate stronger climate-related flows, any recasting of ODA may be resisted by developing countries if it comes at the expense of traditional aid priorities.

The question of how ODA agencies or multilateral lenders should take environmental quality into account in appraising potential recipients or investments has been a subject of intensive consideration. At least three levels of response have emerged, each postulating a more assertive and active stance by international agencies. First, multilateral banks in particular have developed comprehensive policies to veto projects that have negative environmental consequences. Second, ODA may adapt selective mechanisms with positive incentives for, and monitoring of, performance commitments to create incentives for improved environmental governance. Similarly, project finance insurers such as the U.S. Overseas Private Investment Corporation, national export-import banks, or other financers of infrastructure could favor proposals that surpass business-as-usual technologies or standards, conditioned on security guarantees for non-compliance. Third, beyond positive incentives, ODA agencies or lenders might augment their environmental agenda by becoming entrepreneurs coordinating the provision and financing of public goods, especially at the trans-national level, that enhance environmental benefits. For example, the Asian Development Bank proposes its own active role in leading the evaluation, and potential financing, of options for a gas pipeline network in Central and Southwest Asia that could extend the regional cooperation discussed above to reduce

reliance on coal and fuel oil in South Asia. Such transnational public goods with potentially enormous impact on climate trajectories are at a scale that demands entrepreneurial initiative unlikely to come from either private firms or individual nations, but could serve as a point of attraction for their cooperation.

VI. Conclusions

Since the constitution of the Framework Convention on Climate Change in 1992, perhaps more acrimony than cooperation has been generated in the North-South dimensions of climate change. A principal reason for this lack of cooperation between developed and developing countries is that climate change is not yet a salient political concern of development policy. It remains too marginal to the pressing issues of food security, poverty relief, energy growth and access, urban transport, and land use to capture the sustained attention of developing countries. A second barrier to cooperation is the framework of burden sharing in which climate policy has been framed. Although the logic of a cap-and-trade system at some point requires an inclusive allocation of obligations, the distribution of this "burden" is just one more obligation seen as unwanted and undeserved by developing countries. A third obstacle is the perceived failure of the developed countries to fulfill commitments to transfer resources with the scale or effect expected through the climate regime.

Two observations may help us move beyond the present difficulties of North-South collaboration. First, we should note that up to now the search for cooperative solutions has been rooted in climate change science and policy. At best, high-priority development goals might be served by the ancillary benefits of climate actions. An alternative strategy is to ground analyses and programs in priority development objectives and to work up from this foundation to climate objectives. Second, in many developing countries climate-favoring activities are emerging as ancillary benefits of sound development programs. This suggests that it may often be possible to build environmental policy upon development priorities and interests that are of central concern to responsible public and private actors in the still evolving political economies of developing nations.

As such strategies promise multiple benefits internal to developing countries, their acceptability and success need not hinge on the emergence of a truly effective global climate effort. However, an intensified, sustained multilateral effort that drives down developed country emissions and addresses itself to core development imperatives could substantially reinforce the incentives and abilities to select development paths that yield lower emissions in developing countries. Ultimately, then, integrating climate and development objectives calls for a new political bargain with new political actors to redefine collective responsibilities to address climate change.

Endnotes

1. A preliminary finding of the Intergovernmental Panel on Climate Change's most recent emissions scenarios is that, "assuming CO_2 emission reduction needed for stabilization occurs in Annex I countries only, per capita CO_2 emissions in Annex I countries will fall below per capita emissions in non-Annex I countries during the 21st century... This suggests that, especially for more stringent stabilization targets and/or worlds with relatively high baseline emissions, there is a need for emissions to diverge from baseline levels in developing countries." IPCC (2001a).

2. Sathaye et al. (1999)

3. Chandler et al. (2002); Munasinghe (2001).

4. In the first half of the 1990s, global commercial energy use grew at roughly the same rate as the economy; however, in the OECD, energy demand grew at roughly the same rate as GDP. In transition economies, energy intensity increased due to a fall in outputs; and in developing countries, energy intensity improved but energy demand followed the high economic growth. Nakicenovic et al. (1998) at 21-22.

5. IPCC (2000).

6. Understanding climate benefits as a by-product of mainstream policies is not unique to developing countries. For example, the carbon intensity of the U.S., Japan, and France were similar in 1970. Intensities have declined in all three countries, though at different rates. By 2000, French intensity (following the growth of nuclear electricity and high-speed rail) was 60 percent and Japanese intensity (via efficiency and structural investments) was 80 percent of U.S. intensity.

7. A universal property rights regime with trading based on output targets is desirable in theory because, among other advantages, it provides flexibility to each country to select the least-cost portfolio of inputs to reduce its GHG emissions. The political imperative to postpone emission commitments for developing countries raises questions about the ultimate credibility of the international system and requires problematic compensatory adjustments like the CDM to try to recapture efficient global solutions. Adjusting climate policy to the necessary tradeoffs between the logic of an ideal regime and less explicit political economic realities that affect capacity to reduce emissions is central to the authors' argument.

8. Barrett (2003).

9. See Decision 15/CP.7, clauses 6 (ci, cii, ciii) at www.unfccc.int/cdm/cop.html. Baseline calculation and additionality criteria may be particularly controversial. For examples of carefully analyzed projects that illustrate these difficulties, see the Brazil Plantar (afforestation and fuel switching) project and the Chacabuquito hydro (Chile) project and baseline documents on the World Bank Prototype Carbon Fund website: http://prototypecarbonfund.org/router.cfm?Page=Doclib&Dtype=1. Other problems with project-based mechanisms like the CDM include uncertainties for investors arising from ex-post verification of the emission credits generated by a project; validation, monitoring and verification costs; and lack of clarity about the reviewing practices of the CDM Executive Board.

10. IEA (2001); see also Grubb (2003).

11. See discussion of additionality in Rosensweig et al. (2002). It may be noted that at the June 2003 meeting of the CDM Executive Board, six of the first fourteen proposals for baseline and monitoring methodologies were held "sufficiently elaborated" and could be reconsidered expeditiously if the proponents made the required changes. The other eight proposals, including all the larger projects put forward, would require more extensive work and revisions. See Press Release, June 10, 2003 at http://unfccc.int.cdm.

12. The $12 billion estimate is based on tables in UNFCCC (2003). Available on-line at http://unfccc.int/resource/docs/2003/sbi/07a01.pdf

13. These shared features, beyond input-based interventions, are support for either project or programmatic (policy) measures, an emphasis on regional cooperation, and the use of public resources as seed money for public-private collaboration.

14. The GEF process requires proposal submissions by national governments, which may correspond poorly to lower-cost options that lack domestic political sponsorship. Proposals to input-based ODA or other international support programs may suffer from the requirement for entrepreneurial sponsorship that rarely results from integrated least cost planning. The lack of an evident connection between development and environment in GEF programs tends to consign focus on its opportunities to more marginal national political agencies and engender a lukewarm response from actors with operational responsibilities for key inputs. Finally, while GEF formal criteria insist on replicability, empirical outcomes may prove disappointing. Proposals that suggest commercial replication will follow from learning and scale advantages achieved by a project frequently overlook the lack of a complementary policy and organizational context needed for success. Nevertheless, the GEF experience does provide a platform from which to investigate related input-based assistance mechanisms that counter the implementation concerns that have been noted.

15. While organizational fragmentation can be found in all governments, its intensity in developing countries undergoing reform is enhanced by their disenchantment with central planning agencies that claimed to optimize across sectors; the concentrated market power of state firms that are only partially insulated from political agencies; and the inherited disproportionate strength of finance and other key ministries.

16. Brazil, China, and Mexico accounted for more than half of the developing countries' FDI. World Bank (2002).

17. Grey (2001).

18. Electricity sector reform was pursued differently across regions. In Latin America (and later in India), the privatization of existing generation and distribution assets dominated FDI. In Mexico, and across Asia, IPPs were expected to provide incremental generation assets while distribution remained in state hands. Of $131 billion contracted in 1990-97, 56% was investment in greenfield or newly developed infrastructure projects. Financial closures involving large greenfield IPPs from 1991 to 1997 included 137 projects for 67GW of new capacity worth $65 billion. Albouy (1998).

19. Albouy (1998).

20. Expected returns for foreign investors were lower both in privatizations of existing assets and in additions to infrastructure. For examples, see analysis of the renegotiation of PPA tariffs in the Meizhouwan Power Project in China, in Woo (2003) at 208-217; and investors' problems with currency and rationing risks in Brazil, in Brown (2001) at 22-24.

21. Ruffin (2002); Sanchez-Galindo (2003). Note national IPPs may still form as with the National Thermal Power Corporation in India or the Huaneng Corporation in China.

22. These risks are derived principally from national tax, customs, and labor law, the absence of enforced intellectual property rules, fluctuating exchange controls, and cost increases in state-supplied inputs.

23. Market-making investments may produce ancillary climate benefits even if there are no specific incentives or aid programs from developed countries to subsidize them. The primary motivations are commercial, although the prospects for acceptable returns in the longer run demand coalitions with empowered national interests to take advantage of local political connections and the development of an appropriate policy environment. The indeterminate state of the legal rules and business practices that constitute business-as-usual in partially reformed political economies opens these commercial opportunities. It also suggests that directing international aid or other incentive measures such as credits to the support of such projects would merit consideration.

24. Concessional aid flows are referred to as Official Development Assistance. The principal donors are the 22 country members of the OECD Development Assistance Committee.

25. The 0.7 percent of gross national income figure was first agreed at a 1970 UN General Assembly meeting.

26. World Bank (2002).

27. The UN target of ODA at 0.7% of donors' gross national income has been achieved by only Denmark, Norway, Sweden, Luxembourg, and the Netherlands.

28. Much of the bilateral aid has strategic and political considerations, though the multilateral aid generally favors countries with sound policies.

29. UN General Assembly (2002); European Union (2002); and White House (2002).

30. Easterly (2001) offers a broad critique of the effectiveness of international development assistance.

31. Direct arguments for institutional reform as the missing ingredient in aid are made in Easterly (2001) at 217-252, and Stiglitz (2002). Stiglitz charges that the IMF in particular remains locked into an inadequate theory of development with its continuing focus on macroeconomic stability, fiscal balance, trade openness, and financial liberalization despite inadequate regulatory agencies and pervasive unemployment. The importance of institutions especially related to climate action is notable in the large assistance flows that have always gone into energy, transport, and water infrastructure in the developing world. However, these subsidies until recent years have been directed into state monopoly utilities subject to charges of operating inefficiency and investment misallocation. See Speth (2002) at 10,486.

32. The consortium sponsoring the Chad-Cameroon Petroleum Development and Pipeline Project includes the World Bank, ExxonMobil, Chevron, and Petronas. For a description of the stewardship arrangements, see http://www.worldbank.org/afr/ccproj/. It should be noted that this project has been controversial because of its implications for traditional notions of national sovereignty and that the first test of the arrangements will not occur before late 2003 when the pipeline revenues are first generated and paid.

33. For example, of the first 30 projects proposed for CDM validation one year after the Marrakech Accords had adopted the initial CDM certification guidelines, 18 were in renewables, one in plantation afforestation, one in energy efficiency, four in fuel switching and waste incineration, and seven in hydropower projects that ranged from 6.6 megawatts to 200 megawatts. Only 27 percent of the proposed carbon credits would be generated by the 18 renewable projects while 38 percent would come from the hydroelectricity projects. However, it is clear the certification of hydro projects will be contested as non-additional, reflecting the difficulties with project-based CDM. Haya et al. (2002).

34. Input-based climate approaches need not abandon these important benefits. Output measures derived from long-term stabilization scenarios can be used as guidelines to evaluate climate performance. In addition, there is no reason why sectoral or other input policies should not be implemented through market instruments such as taxes. Finally, as discussed below, competitive mechanisms such as auctions may be employed in pursuit of more cost-effective subsidization of input-based measures.

35. From the standpoint of ideal regime design, the political-economic factors that impede "first-best" solutions are barriers to be removed. However, renaming politics a barrier that one assumes can then be removed does not reduce the operational power or vitality of political interests.

36. There are several scenarios that would suggest that, in spite of the record so far, mainstream development agencies might adopt policies that favor both their development goals and climate mitigation. In states transitioning from planning to markets, there is often potential to pursue less-polluting market efficiencies politically disfavored in prior regimes. Munasinghe (2001). More broadly, hybrid states are typically characterized by protracted struggles about how markets will be configured by policy and organizations. Because different firms and agencies will disproportionately gain market share and regulatory authority depending on how hybrid markets are configured, alternative development paths attract self-interested advocates in emergent markets.

37. The particular weakness of adaptive capacity in the least developed countries is defined and discussed in IPCC (2001), Technical Summary 6.1.

38. Meyer et al. (1997).

39. The outstanding recent example of the evolutionary approach to regime building is the gradual expansion of the European Union. Linking like-minded national groups in a variety of differentiated schemes including sectoral coordination (e.g., the Coal and Steel Community), close functional integration (the European Economic Community), and a series of agreements that depict a range of looser ties (the European Free Trade Association; Mediterranean and Eastern European Accession pacts), the process has led toward a more unitary legal order that has constructed both normative and institutional confidence over four decades of cooperation.

40. Victor et al. (1998).

41. Pledge-and-review mechanisms combine standards or goals with international monitoring of achievements. They imply no material sanctions for failing to reach the pledged standards, but good-faith failures may trigger international assistance to understand and fix what went wrong. Performance standards may be associated with benchmarking, mechanisms for learning, and conditional positive recognition and reward. For discussion of the effectiveness of these soft, often aspirational, measures, see Victor et al. (1998).

42. The example of CNG buses in Delhi illustrates the fundamental dilemma of compromising analytical exercises with political realities. Critics have noted that using low-sulfur diesel would have been less disruptive and cheaper than using CNG, and avoided the risk of increasing GHG emissions due to a gas leak. However, diesel use would have required imports and foreign exchange expenditures, while gas interests within the Indian government and leading Indian firms engaged in domestic (offshore) gas exploration were in a position to back expanded gas use.

43. Related proposals to programmatic cooperation have been made under the rubric of sectoral CDM by Samaniego and Figueres; see Baumert et al. (2002). It is possible to imagine an amendment of the current project-based CDM as the basis for programmatic cooperation. However, using the CDM structure would import debate over additionality and force programmatic assistance into a legal and conceptual framework that would not fit easily. Moreover, programmatic cooperation could also be developed in bilateral or multinational cooperation programs outside the Kyoto Protocol.

44. This recognition has been termed "regulatory additionality" and suggested as another criterion to be applied to CDM projects. What constitutes the business-as-usual state of regulation is fundamentally political, and has more often been noted as a moral hazard risk that states would lower policy standards or implementation to increase emissions available for international sale. Whatever this risk, some division of responsibility between governments about what national governments are expected to do (and pay for) in terms of global collective goods cannot be avoided.

45. Auctions have become commonplace in areas like electricity that were once the province of non-competitive state supply, but have also been developed in areas like government procurement. The theory of auction design has advanced rapidly as their use has spread. See Klemperer (1999).

46. Indian Institute of Management (2003).

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Trade and climate

Potential conflicts and synergies

Steve Charnovitz

International trade and global climate change are closely linked. To date, multilateral efforts to liberalize trade and to prevent global warming have proceeded largely on separate paths. Increasingly, however, these parallel regimes—one defined by the Agreement Establishing the World Trade Organization (WTO) and its annexes, the other by the UN Framework Convention on Climate Change (UNFCCC) and its Kyoto Protocol (not yet in force)—are likely to come into closer contact as climate policies lead to significant economic effects. Already, a significant potential for conflict exists between the regimes and the interests they represent (Brewer 2003). Yet there are also a number of important synergies that can be better developed.

This paper explores the interplay between the trade and climate regimes, the potential areas of conflict, and what can be done to promote mutual gains. Section I introduces the key issues and examines the conceptual underpinnings of the two regimes, revealing important symmetries as well as some divergence. Section II analyzes the implications of WTO rules for various national climate policies. Section III analyzes the implications of WTO rules for multilateral climate efforts, and section IV looks at future opportunities for improving harmony between the two regimes. The paper concludes that while there are no fundamental incompatibilities between expanding trade and reducing greenhouse gas (GHG) emissions, the two goals can come into conflict, and may increasingly do so unless the interactions are better managed.

I. Introduction

Trade liberalization has significant ramifications for the effort to control climate change. On the one hand, lowering trade barriers and opening markets boost economic growth, which tends to increase GHG emissions. On the other hand, bigger markets spur technological innovation and diffusion, which can reduce the GHG intensity of economic growth. Moreover, as trade promotes higher national incomes, some countries will find themselves better able to afford emission abatement efforts.

Just as trade policy will have climate effects, climate policy will have significant implications for trade relations and for the trade regime (Gibbs 2003, pp. 16–17). By raising the cost of energy and energy-intensive goods, climate policies will affect economic competitiveness—both among countries undertaking climate efforts, due to different mitigation costs, and between those countries that undertake significant action and those that do not. To protect vulnerable sectors, governments may seek to compensate

for the costs of domestic climate action by imposing comparable costs on imported products or by reducing costs on exported products. Either approach is likely to invite challenge in the WTO. Apart from efforts to address competitiveness, national policies to reduce GHG emissions may also come into conflict with trade rules to the extent they affect domestic and imported products differently. In an acknowledgement of these possibilities, Article 2.3 of the Kyoto Protocol states that the parties shall strive to implement policies and measures in such a way as to minimize adverse effects, including effects on international trade.[1] Moreover, the Protocol authorizes the parties to take further action to promote implementation of this provision.[2]

Another potential source of tension would be the use of trade measures to induce other countries to participate in a climate regime or to enforce compliance among those that do participate. The idea that governments participating in the Kyoto Protocol should act together to impose trade measures against the United States (in view of its decision not to join the Protocol) is a recurrent image in writings about the climate regime, particularly by Europeans (e.g., Legrain 2002, p. 253). Some analysts have also suggested that the evolving climate regime employ trade sanctions to hold parties to their commitments. Both uses of trade measures could be challenged in the WTO.

Although no climate-related dispute has yet reached the WTO, potential conflicts appear on the horizon. Following the U.S. rejection of the Kyoto Protocol, the European Parliament called for new initiatives "within supranational structures (in particular the World Trade Organisation)... designed to prevent countries which do not ratify the Kyoto Protocol from obtaining unfair competitive advantages, particularly where energy products are concerned."[3] Venezuela has told a WTO committee that measures taken to implement the Protocol could run afoul of trade rules and raise trade concerns (WTO 2002, para. 198). Saudi Arabia has cited "a number of areas in which countries pursuing environmental objectives (such as climate change policy) may contravene their WTO obligations and seek to protect their domestic interests" (Saudi Arabia 2002, para. 57).

That no dispute has bubbled up may suggest that trade action—either unilateral or within the WTO—is more easily threatened, perhaps for political advantage, than actually launched. But it may also be a sign of a constriction underneath the surface. Worries about infringing trade rules, reportedly, have led to a "chilling effect" in some environmental negotiations in which prospective treaty measures are taken off the table because of concerns that such measures might violate the WTO. The claim that prospective climate measures are a WTO violation may also inhibit consideration of policies and measures at the national level.

The good news is that opportunities exist for making the trade and climate regimes more complementary and, potentially, synergistic. The two regimes could, at a minimum, work independently and together to anticipate and avoid conflicts between their mandates. The climate regime, for instance, could facilitate a uniform approach to energy/GHG taxation, and particularly, the application of taxes to

imports and exports. Opportunities may also exist to promote climate objectives actively through the WTO, for instance by launching negotiations to phase out fossil fuel subsidies. Yet at this time, there may be some trepidation within both trade and climate circles about engaging directly one with another. Many feel that both sets of issues are complicated enough in their own right, and each regime is best left to mind its own affairs.

The Trade and Climate Regimes

To assess the potential for promoting greater cohesion between world trade and global climate policy, one should start by considering the nature of the two regimes. Obviously, they pursue distinct functional aims. Yet the question is whether the two regimes share a common orientation, at a fundamental level, that can form the basis for greater accord.

Although the trade and climate regimes have different aims and organization, they do in fact enjoy many common features. Both regimes aim to promote greater economic efficiency in order to enhance public welfare. Both regimes recognize linkages between the economy and the environment.[4] Both look to the future and advocate actions that, while bringing on short-term adjustment costs, anticipate long-run benefits. Both regimes are worried about free riders and devote considerable attention to securing compliance. Both regimes are deferential to the volitions of developing countries, and follow principles of "special and differential treatment" or "common but differentiated responsibilities." Lastly, both regimes are dynamic works-in-progress, continuing institutional improvements during successive negotiations (Murase 2003).

Nevertheless, some fundamental differences exist. The climate regime is driven by the need to correct market failure. Therefore, governments want maximum flexibility at the national level in using economic instruments to influence individual behavior. By contrast, the trade regime is not a response to market failure; it is a response to government failure, that is, the distortions of policy fomented by mercantilism and protectionism.[5] Thus, the trading system often seeks to disable economic instruments at the national level. Unlike the climate regime, the trading system does not aspire to change the behavioral incentives for individual economic actors. Another difference between the two regimes is cultural. In the climate regime, science plays a central role in measuring the problem, and in evaluating policy responses. In the trading system, science plays no role in rulemaking.[6]

Because of their distinctive motivations, successful outcomes in the two regimes are defined differently. Although the trading system prefers to move ahead with joint cooperation, the reality is that trade liberalization is often in each country's own interest, and so countries can move at different speeds. By contrast in the climate regime, a high degree of inter-governmental cooperation is necessary if GHG emissions reduction is to be obtained. As a result, non-participation in the climate regime is ultimately a more serious matter than in the trade regime. Even if countries did not trade with each other, the climate

regime would need cooperation in order to succeed. The fact that countries do trade brings the WTO into the picture.

A Primer on the WTO

The WTO is the international organization overseeing the multilateral trading system.[7] It commenced operations in 1995 following the Uruguay Round of trade negotiations that converted the institutional aspects of the General Agreement on Tariffs and Trade (GATT) into the WTO. The WTO is also a treaty consisting of the umbrella Agreement Establishing the WTO plus 17 subsidiary agreements containing detailed rules. One of those agreements is the GATT, which contains obligations regarding trade in goods.

Although WTO rules pertain only to the 146 governments that are members, most of the countries in the UNFCCC are WTO Members, or candidates to join the WTO (such as the Russian Federation). Not all UNFCCC Parties plan to ratify the Kyoto Protocol, however, and the membership of any future climate agreement is difficult to predict.

The WTO has the strongest compliance system of any global organization today, the Dispute Settlement Understanding (DSU). An allegation of a violation can be brought to a WTO panel, which issues a ruling on whether the measure being complained about is consistent with WTO law. Either side may appeal the decision to the WTO Appellate Body whose findings are to be "unconditionally accepted" by all parties to the dispute.[8] A losing defendant government is given an allotted period of time to bring its measure into compliance, and that implementation is monitored by the WTO's Dispute Settlement Body. If the defendant government fails to comply, the complaining party may seek authority from the Dispute Settlement Body to impose trade sanctions on the defendant country. Such authority is automatically granted unless all governments disapprove.

Because the WTO dispute system is oriented toward correcting treaty violations, it does not provide much of a disincentive to avoid a violation in the first place. Recognizing that WTO remedies lack deterrent power, many governments engage in trade or economic policies that test the limits of WTO law. This pattern of behavior ought to be kept in mind in considering the extent to which WTO rules lacking clarity should constrain the design of climate policies.

It should also be remembered that WTO law is not immutable. If WTO rules do not meet the needs of WTO Members, the rules can be altered. Nevertheless, the difficulty of waiving or changing WTO rules is not to be underestimated. Under current decisionmaking practice, such actions require a consensus of all WTO member governments (although voting remains a possibility).

The WTO is now sponsoring a major multilateral negotiation, begun at Doha in 2001. For the first time in a trade round, the environment is on the agenda. Although climate per se is not a negotiating

issue, governments are considering issues that have implications for climate policy such as: the elimination of barriers to trade in environmental goods and services, the relationship between existing WTO rules and specific trade obligations set out in multilateral environmental agreements, the overall developmental and environmental aspects of the negotiations, and the relationship between trade and technology transfer.[9] The new WTO negotiations, when completed, will bring some changes in WTO rules. The projected finish date of 2005 now seems unlikely, however, because the recent Cancún Ministerial Conference, in September 2003, failed to reach agreement on negotiating modalities.

II. National Government Policies

Section II of this paper discusses ways in which WTO rules might constrain governmental climate policies. It first examines *domestic* policies, that is, policies principally aimed at controlling internal emissions. It then looks at *trade* policies, that is, policies aimed at influencing behavior in foreign countries.

In asking how trade law might constrain climate policy, one should not lose sight of the obverse question—namely, whether environmental law could constrain trade policy. Although some trade cognoscenti might dismiss this as an impertinent query, the notion that international trade law trumps international environmental law is wrong. Both bodies of law exist on the same level. The fact that trade law is largely negative in orientation—meaning that governments give up discretion to take certain kinds of economic action—makes it hard for trade rules to violate the positive norms of international environmental law, and much easier for environmental action to violate trade rules.

Domestic Policies

This section considers whether various domestic climate policies are compatible with WTO rules. Four policy areas will be discussed: energy/GHG taxes, product regulations and standards, subsidies, and domestic emissions trading. Note that any of these might be perceived by someone as a "trade barrier." But they are categorized as "domestic" policies in this study because they are not premised on treating imports differently from domestic products.

For many policies, the most relevant GATT law constraints will be Article III, which bars a government from discriminating against "like" products from other countries, and Article XX, which allows General Exceptions for several purposes, including measures necessary to protect human, animal or plant life and health, and measures relating to the conservation of exhaustible natural resources. Article III imposes the obligation of "national treatment," requiring imported goods to be treated no less favorably than "like" domestic goods. In a dispute, the two key questions will be: (1) whether the domestic product and the competing import are "like" and (2) whether the treatment of the import is less favorable (Regan 2002; Ehring 2002). A government measure that violates Article III can be excused under Article XX

when the policy fits within one of the General Exceptions, provided that the measure is not applied in an arbitrary or unjustifiable manner and is not a disguised restriction on international trade. In the first eight years of the WTO, Article XX has been interpreted more flexibly than in previous GATT jurisprudence (Wiers 2002, pp. 361–64).

Energy/GHG Taxes

A tax may be an appropriate instrument to address climate change because it can reduce demand for energy, promote more efficient technologies, and, with GHG taxes, lead to the adoption of cleaner energy. Because a tax conveys the same incentive to all emitters, those who can reduce emissions at a low cost will do so.

WTO rules have many implications for how a government may employ domestic taxes. If a government refrained from rebating any tax on exports and refrained from applying any tax to imports, then no WTO legal problems would be encountered. But such tax restraint is unlikely. Governments will usually seek to apply domestic taxes symmetrically to imported products in order to prevent distortions and seek a level playing field (Westin 1997, pp. 111–14). Similarly, governments may want to unburden exports from taxes in order to prevent double taxation. Such governmental concerns about fairness can, in general, be carried out in conformity with WTO rules. Nevertheless, many potential points of tension exist. To explain the application of WTO rules to energy/GHG taxes, the study presents several hypotheticals below.

Gasoline Tax Start with a tax on gasoline at the retail level. As long as the tax is imposed identically on gasoline produced from domestic and imported sources, it would be in accord with the "national treatment" requirement in GATT Article III that a tax on an imported product cannot be in excess of the tax on a like domestic product.

Automotive Fuel Economy Tax Consider a tax on automobiles based on the fuel economy of each model type. If such a tax is applied in an origin-neutral manner, it could be in accord with GATT Article III. Yet complications can arise if it turns out that the brunt of the tax is borne by imported vehicles. The exporting country can argue that the tax amounts to de facto discrimination because the tax accords protection to domestic production. Should a dispute panel agree, the taxing government would have an opportunity to defend the difference by invoking the exceptions in Article XX. How successful such a defense would be would depend on the precise facts of the case including how the tax is being administratively applied. In the 1994 *Automobile Taxes* case, a GATT panel ruled that high-fuel efficient cars are not "like" gas-guzzling cars, but whether the contemporary WTO jurisprudence would lead to the same result is unclear.

Fuel Carbon Tax Another hypothetical is a tax based on the carbon content of fuel. In a recent submission to the WTO Committee on Trade and Environment,[10] Saudi Arabia advocated basing fossil fuel taxes on carbon content in order to reduce energy market distortions (Saudi Arabia 2002, paras. 17,

58-59). A key legal judgment would be whether differential taxes on fuel (e.g., natural gas versus coal) lead to higher taxes being imposed on imports, in violation of GATT Article III. If so, then the government applying the tax would seek to offer a defense under GATT Article XX. Some analysts doubt that such a defense would be successful (e.g., Zarrilli 2003, p. 393).

Process-Based Electricity Tax Greater legal complexity would ensue with a tax on electricity based on the amount of GHG emissions during the generation of the power. For example, electricity produced from hydropower could be taxed lower than electricity produced from oil. The discussion here assumes that electricity is a good rather than a service.[11]

A 1998 case arising under European Union law is instructive because of its similarity to WTO law. In the *Outokumpu Oy* proceeding, Finland taxed electricity using different rates depending on how it was generated.[12] Because of the practical difficulty of determining how imported energy was produced, Finland taxed imports at a flat rate set to approximate an average of the domestic rates.[13] The importer complained that this flat rate was a violation of the European Communities Treaty, which forbids direct and indirect discrimination against imported products. The Court agreed, and explained that Finland's law did not give the importer the opportunity to demonstrate that its electricity was produced by a particular method in order to qualify for the rate applicable to domestic electricity produced by the same method.[14] It is unclear how the Court would have ruled had Finland provided importers the same variable rates (see Krämer 2002, p. 125).

Tax on Energy Used Instead of a gasoline tax at the consumer level, a government might impose a tax at the producer level based on the amount of energy used in production. If set at high rates, such a tax can reduce the international competitiveness of energy-intensive industries. Two responses to this loss of competitiveness are in use. One is to grant tax exemptions to the most energy-intensive industries. This is the approach sometimes used in Europe for high energy taxes. The other is to provide for a border tax adjustment on imports and exports. Because it is the energy inputs that are being taxed, the addition of a tax to an imported product constitutes a border adjustment because the tax is not a straight levy on an imported product. It is interesting to recall that when the U.S. House of Representatives passed a Btu tax in 1993, it included a provision for a border tax adjustment, which was criticized by the European Communities as a GATT violation.

Both responses to a loss of competitiveness—tax exemptions and border tax adjustments—present trade law concerns. If a government generally imposes a high energy tax but then exempts particular industries, such an exemption might be viewed as a specific subsidy that would be actionable under the WTO Agreement on Subsidies and Countervailing Measures (SCM). Furthermore, if an exemption is targeted to industries that export, it might be viewed as an export subsidy illegal under the SCM. The other option, a border tax adjustment, is problematic for energy because that is a murky area of trade law. Indeed, the WTO Secretariat has recently opined that a tax on the energy consumed in producing a ton of steel "cannot

be applied to imported steel, even if it is charged on domestically produced steel," and even though this difference in treatment would make the imported steel cheaper and less environmentally friendly.[15]

To understand the legal uncertainty regarding border adjustments for energy, one should start with the basic contours. According to the GATT, nothing prevents a government from imposing at the time of importation a charge equivalent to an internal tax on a like article from which the imported product has been manufactured "in whole or in part."[16] This principle became a key issue in the *Superfund* case of 1987.[17] This was the first GATT-based legal challenge to a domestic environmental tax. The United States had imposed an excise tax on some harmful chemicals produced domestically. In addition, the U.S. government taxed imported substances based on the content of "chemicals used as materials in the manufacture or production of the imported substance" when those chemicals were subject to U.S. taxation.[18] The European Economic Community challenged this border adjustment on several grounds, but the GATT panel dismissed this effort to prevent border adjustments for an environmental tax.[19] The panel held that whether a tax is enacted for revenue or to encourage rational use of environmental resources is irrelevant to the legality of the border adjustment.[20] The holding in *Superfund* permitting the border adjustment would apply, in principle, to any ingredient physically present in the imported product.

How the *Superfund* holding would apply to materials or energy used in manufacturing a product is uncertain. Such materials would not be physically present in the final product. In 1970, a GATT Working Party was constituted to examine "Border Tax Adjustments," and this report has often been cited authoritatively in subsequent jurisprudence.[21] The Working Party agreed that taxes directly levied on products (e.g., a sales tax) are eligible for a tax adjustment, and taxes not levied on products (e.g., a payroll tax) are not eligible for adjustment. Yet the Working Party was unable to agree on the status of adjustments for "taxes occultes," which are taxes on capital equipment, advertising, energy, machinery, transport, and other services.[22] The category of taxes occultes includes many excise taxes that are of interest in the current climate debate, such as taxes on energy, refrigerants, cleansers, and transport used in the production process. Whether or not such a tax adjustment on imports would meet the WTO's border adjustment rules would seem determinative of its legality. While one can easily see a competitiveness rationale to use a border tax adjustment, it is difficult to visualize a valid environmental reason under GATT Article XX in support of a border adjustment.

In sum, upstream or downstream taxes on energy can be a valuable climate instrument, and, so far, WTO case law has not diminished options for determining the best point of compliance (Fischer, Hoffman, and Yoshino 2002, p. 18). Governments considering such taxes and border adjustments should design them carefully, taking into account WTO law and using any space created by legal ambiguities (Biermann and Brohm 2003).

Product Regulations and Standards

In the WTO lexicon, "regulations" are defined as mandatory instruments and "standards" are defined as non-mandatory. The analysis below will follow WTO usage. Both regulations and standards are important components of climate policy, and may be increasingly so in the future. Some examples are regulations/standards on automobile fuel economy, emissions reduction in manufacturing, and energy efficiency in homes. Being mandatory, regulations are imposed by governments. Standards, however, can be authored by numerous actors—e.g., governments, international organizations, private bodies, and nongovernmental organizations. Furthermore, an economic or social actor can impose a standard upon itself. For example, an Olympic Committee or a corporation can commit to emission reduction goals.

The application of WTO rules to climate regulations and standards is explained below through hypotheticals.

Fuel Economy Regulation A fuel economy regulation will be subject to the same National Treatment requirements as a fuel economy tax. More importantly, however, such a regulation will also be subject to the disciplines of the WTO Agreement on Technical Barriers to Trade (TBT), which are more stringent than those in the GATT.[23] The most onerous substantive requirements are that a regulatory measure be the least-trade-restrictive way to fulfill a legitimate objective and that the measure be based on an international standard (should one exist) unless that standard would be an ineffective or inappropriate means to fulfill a legitimate objective. The TBT Agreement includes the protection of the environment in an illustrative list of legitimate objectives.

Consider the example of Japan's automotive fuel efficiency law. In 1998, Japan announced that it would be promulgating binding regulations for energy efficiency of nine classes of automobiles grouped by weight of the vehicle. The target in the year 2010 for each class was pegged at the "top runner," which happened to be a Japanese vehicle. Manufacturers selling vehicles in a weight class that cumulatively perform less well on average than the top runner are to be assessed a penalty. Several governments complained about this regulation, and called it a violation of the TBT Agreement (Yamaguchi 2003). The dispute was never brought to the WTO, however, and Japan has expressed confidence that its regulation conforms to TBT.

One lesson from this episode is that any national regulation having a disparate trade effect on foreign producers will raise concerns under TBT. The underlying problem is that the regulator may center attention on one attribute that may be relatively less important in other countries. In this episode, Japan was most concerned about fuel economy, but imported vehicles that are heavier may reflect competing concerns in the country of manufacture about pollution or safety.

HFC Regulation Some regulations are based on product characteristics or the absence thereof. An example is the Danish law to prohibit after 2007 the sale or importation of products containing hydrofluorocarbons (HFCs), a potent greenhouse gas used in refrigerators (Atlantic Council 2002, pp. 22–23). European and U.S. trade associations expressed concern that this legislation could violate the TBT Agreement. One argument made was that HFCs are harmless if they do not leak, and therefore, the legitimate climate objectives of Denmark can be achieved in a less trade-restrictive way.

Voluntary Standard Corporate action to adopt voluntary climate standards has become increasingly salient. A standard that is exclusively internal to a company is not covered by the TBT Agreement even if it has transborder effects. Yet when a standard-setting organization devises a standard, it can come within the scope of these rules. The TBT Agreement permits any standardizing body (in a WTO Member country) to accept the TBT Code of Good Practice for the Preparation, Adoption and Application of Standards.[24] Some of the most important norms in the Code for climate standard-setting are the procedural provisions. For example, the requirement that interested parties be given 60 days to submit comments can assist in the design of fair and effective standards.[25]

Climate Labeling Labeling is a key instrument of environmental policy implemented via the market. Because everyone contributes to GHG emissions, encouraging individual responsibility can be an important component of an overall climate policy. In order to act knowledgeably, however, individuals need information about the environmental impact of production and consumption. If it turns out that the WTO inhibits such information flows, that would present a serious problem. In recent years, the trade community has criticized eco-labels—even private, voluntary ones (see Vitalis 2002).

Labels that describe the characteristics of a good are unlikely to conflict with WTO rules. For example, the European Community has directed Member States to require a label for new automobile models that would display information about fuel consumption and carbon dioxide (CO_2) emissions. So long as such a label applies equally to domestic and imported cars, it would seem to be consistent with both GATT and TBT rules.

By contrast, mandatory labels regarding the production process could trigger a WTO-based challenge. Many climate-related life cycle labels are imaginable. Suppose that a government requires a product to be labeled with information regarding the GHGs emitted during its production process. How TBT obligations would apply to such a label is not settled in WTO law. Because the scope of the TBT Agreement is limited to regulations/standards on product characteristics and their *related* processes, many trade law experts had assumed that so-called unrelated processes—such as the type and quantity of energy used in manufacturing—were beyond the TBT's purview (see Petersmann 1995, p. 46).[26] But in 1997, the WTO's TBT Committee asked governments to provide notification of all new labeling schemes by standardizing bodies, including process-related labels (Lopez-Hurtado 2002, p. 737). If the WTO

moves to assert jurisdiction over all labels, then the various TBT requirements will become more constraining factors in designing and applying climate-related labeling.

Some trade law experts argue that WTO law would almost certainly prohibit a government from requiring a label specifying the level of GHGs emitted in the production process (e.g., Appleton 2001, p. 17). An analogous issue that arose in the WTO was a proposal by The Netherlands to require a label identifying whether timber was harvested under sustainable forestry management. When the WTO was notified of this measure, several governments raised objections on the grounds that such a measure would violate trade rules.[27] The proposal was also criticized within the European Union. In face of these objections, the Dutch government did not finalize the proposal.

Subsidies

Governmental subsidies are helpful to whoever receives the subsidy, but have a variable value for the commonweal. When poorly conceived or designed, subsidies can make societies worse off by exacerbating market or government failures. The environmental community often criticizes perverse subsidies that aggravate environmental damage (e.g., subsidies for coal extraction) and distort markets. The trade community often criticizes subsidies that distort international trade, both within the subsidizing country and in other markets if the subsidized products are exported.

The WTO rules on subsidies are contained in the SCM Agreement and the Agreement on Agriculture. Non-agricultural subsidies can raise WTO concerns if they are "specific"—that is, if they are channeled to certain enterprises. If a specific subsidy causes adverse effects to competing entities in foreign countries, then it can be actionable in the WTO.[28] In the climate context, government funding for new technologies to control wildfires would not meet the "specificity" test in the SCM Agreement, and any non-agricultural subsidy that is not specific would not be illegal under the WTO.[29] Government grants to the automobile industry to develop new technologies, or subsidies for afforestation, could be "specific," especially in the absence of objective criteria for eligibility. An agricultural subsidy to sequester carbon in soil, or to reduce GHG emissions from rice cultivation or raising cattle, would be permitted under the "Green Box" (in the Agreement on Agriculture) so long as the subsidy did not have more than minimal effects on production.[30]

The transborder applicability of the WTO's export subsidy rules may also be important in climate policy. If Government A subsidizes entities in Country B so as to promote exports from Country A, such a subsidy may be prohibited by the SCM Agreement.[31] These disciplines will need to be examined in designing climate partnership programs between industrial and developing countries.

Domestic Emissions Trading

Because of the wide range of implementation costs in reducing GHG emissions, domestic programs with flexible emissions trading can reduce overall costs. Emissions trading can be carried out under the aegis of an international treaty, under national regulation, or in voluntary programs. Emissions trading between economic actors in the same country does not raise any WTO-related concerns. The WTO problems, if they exist, are in the interface between the trading programs in two countries. If Country A's trading rules make it harder for an economic actor in Country B to do business with actors in Country A, that could trigger a complaint to the WTO by Country B.

A threshold question is whether "emissions trading" (as discussed in Article 17 of the Kyoto Protocol) is even covered by WTO rules. Sometimes analysts mistakenly assume that WTO rules would ineluctably govern world trade in climate units. Despite its name, the WTO does not govern trade itself. What it governs are the trade restrictions that nations impose on transborder trade in goods and services.

Marketable rights created via an emissions trading regime are unlikely to be a "service" or "good" that fits under the scope of the WTO's General Agreement on Trade in Services (GATS) or the GATT (Werksman 1999; Petsonk 1999, pp. 197–200; Wiser 2002, pp. 295, 304). So far, governments have not suggested that trade in rights created by a government are within the purview of the WTO. For example, regulations on the transborder sale of a land title, a license, a patent, sovereign debt, and currency are not covered by WTO rules.[32] Indeed, the GATS Annex on Air Transport Services specifically excludes "traffic rights, however granted."[33]

Yet even though emissions trading *per se* is not supervised by WTO rules, these rules may come into play when: (1) there is government involvement in the emissions trading system and (2) emissions trading affects the flow of trade in goods and services. Thus, emissions trading can have indirect effects on commerce that might lead to a violation of trade rules (Werksman 2001, p. 156). For example, suppose that Country A has a GHG trading system that does not recognize emission units originating in countries outside the Kyoto Protocol.[34] Such a requirement might make it harder to import energy products from non-Parties because fuel producers therein might not have emission units to accompany sales. That could infringe the GATT Article III national treatment rule because it would destabilize competition between imported and domestic products, giving less favorable treatment to the foreign product.[35] In that scenario, Country A might seek to offer a defense under GATT Article XX, such as the impracticality of verifying foreign units.

Another concern regarding emissions trading is whether the free transfer by governments of units to private companies would be considered a subsidy. One analyst has cogently argued that the allocation of an allowance is not a "financial contribution" by a government within the definition of subsidy in the SCM Agreement (Petsonk 1999, pp. 208–09). Recent WTO jurisprudence has planted some doubts,

however. In the WTO *Lumber* decision, the panel ruled that a financial contribution is not limited to a money-transferring action, but also encompasses an in-kind transfer of resources that can be valued, such as the "right" to harvest public trees.[36] This ruling might suggest that the giveaway of a valuable emission right by a government is a subsidy. Of course, the lumber precedent is distinguishable from a GHG emission because lumber itself is a traded good in a way that an emission is not.

Trade Measures

In a global economy, the line between domestic and trade policies is fuzzy. The policies discussed in the preceding subsection are called domestic—rather than trade—because they are ostensibly aimed at regulating internal production and/or consumption.[37] By contrast, the trade measures discussed below have a primary purpose of influencing behavior in other countries.

The GATT has two rules that curtail the use of outwardly directed trade measures. First, GATT Article XIII forbids the imposition of quantitative restrictions on imports and exports that discriminate between countries. Second, GATT Article I requires most-favoured-nation (MFN) treatment, meaning that a product from a WTO member country should be accorded treatment no less favorable than the like product from any other country. By forbidding trade discrimination, the GATT makes it hard to employ trade restrictions that treat two countries differently depending on an internal policy in one of the countries. The rules in GATT Articles I and XIII are subject to the General Exceptions in GATT Article XX.

Should a complaint occur, the attitude of a WTO panel may depend on whether the disputed trade measure stems from a treaty obligation or a national policy. Neither the UNFCCC nor the Kyoto Protocol has language that can be reasonably interpreted to require or authorize a trade measure as a strategy to promote membership, make the climate regime more effective, or enforce the treaty.[38] Thus, any use of a climate trade measure would be considered a national-level action.

It is sometimes suggested that governments might impose unilateral trade measures or sanctions against countries that are not a party to the Kyoto Protocol. Many hypotheticals are imaginable—for example, a punitive tax on imports from those non-parties. What would be the status of such a sanction under WTO rules? Certainly, it would violate the non-discrimination requirement in GATT Article I, and the question would be whether such an action is defensible under a GATT environmental exception in Article XX.

It may be difficult to justify such an action under Article XX. Some analysts have argued that the WTO *Shrimp* decision points to the legality of a discriminatory trade measure—such as a punitive tax on imports—to influence environmental policies in other countries (e.g., Aldy, Orszag, and Stiglitz 2001, p. 15). In the most recent proceeding in the *Shrimp* dispute, the WTO panel acknowledged the WTO-consistency of a U.S. ban on the import of shrimp from countries that had not adopted practices to protect turtles comparable to practices required of U.S. trawlers (Charnovitz 2002a, pp. 98–99). Nevertheless, important differences exist between the situation in *Shrimp* and a hypothetical punitive tax.

In *Shrimp*, the Appellate Body held that banning shrimp from countries that had not sufficiently regulated harvesting practices injurious to turtles bore a "means and end relationship" that was "close and real."[39] An analogous relationship would seem to be missing with an across-the-board tax. Arthur Appleton makes another telling point: he posits that the existence of a climate treaty is a strike against a unilateral action. As he explains, "It is unreasonable to expect that the WTO panels or the Appellate Body would do more to address climate change issues than the parties to the Kyoto Protocol and Bonn Accord have agreed" (Appleton 2001, pp. 15–16).

While many governments might avoid using trade controls against non-parties to the Kyoto Protocol out of a concern that such action could violate WTO rules, another important reason why such unilateral measures are unlikely is that governments can instead rely upon domestic measures that would stand a much greater chance of passing muster in the WTO. For example, rather than using trade bans or tariffs to induce other countries to join the Kyoto Protocol, concerned governments (e.g., in Europe) may seek to use border tax adjustments to undo the competitive advantage of countries that are not undertaking emissions reductions. The domestic measure could be as disadvantageous to a target foreign country as a trade measure. In a recent study, a prominent U.S. business group points to that scenario as problematic for U.S. companies (U.S. Council for International Business 2002).

III. Multilateral Climate Policies

Section III discusses ways in which WTO rules might pose constraints on multilateral action to combat climate change. In addressing this issue separately from the governmental actions in section II, the underlying assumption is that it will matter to the WTO dispute resolution system whether the contested action arises from a multilateral obligation. A recurrent theme in the trade-and-environment debate over the past 13 years has been the desirability of approaching global environmental problems through multilateral cooperation. Therefore, it seems likely that in adjudicating the GATT environmental exceptions, a dispute panel would be sympathetic to a defense based on a parallel obligation under a climate treaty.

At present, however, the WTO lacks any specific provisions of deference to environmental regimes. Such deference does exist for a few other regimes, however. For example, the GATT provides that nothing in its rules would inhibit the use of exchange restrictions in accordance with the Articles of Agreement of the International Monetary Fund.[40] The GATS Annex on Air Transport Services affirms that the GATS does not reduce or affect obligations under bilateral or multilateral air transport agreements in effect on January 1, 1995.[41] An analogous provision on the environment could have been written into the WTO, but was not.

Section III examines the WTO implications of five topics in multilateral climate policy—international emissions trading; the Clean Development Mechanism; clean energy export credit; trade controls on parties and non-parties; and trade sanctions for enforcement.

International Emissions Trading

The trade law implication of domestic emissions trading was discussed in section II, and international trading would be analyzed similarly. Under the Kyoto Protocol and the Marrakech Accords, governments may permit private economic actors to engage in domestic or transborder trades of emissions reduction units (ERUs), certified emissions reductions (CERs), and assigned amount units (AAUs) of national allocations. The conclusion in section II that trade in government-created rights is not covered by the WTO would be even stronger for rights created at the international level, such as an emissions unit or a fishery quota. When governments create obligations among themselves, such as reducing GHG emissions, a subsequent rearrangement of these obligations is not a trade in goods or services.

Thus, WTO rules would not dictate whether a Kyoto Protocol Annex B party has to permit climate unit trading with a non-Annex B party, or with a non-party to the Kyoto Protocol, or with a party that is out of compliance. WTO rules would also be inapplicable to the question of whether the climate regime can limit the amount of traded units creditable to meet a national target. Of course, it would always be possible for the WTO to adopt an official interpretation of its rules that would bring trade in allowances within the scope of WTO disciplines (Stewart and Wiener 2003, p. 119).

Clean Development Mechanism

The Kyoto Protocol includes a Clean Development Mechanism (CDM) in which a UNFCCC Annex I party can earn CERs when its government or private actors invest in a climate project inside a non-Annex I party. CDM projects might contradict GATS rules if a government discriminates against service suppliers from particular countries. Would a CDM rule requiring project developers to be from Kyoto Protocol parties be permissible? The question would require considerable analysis. One affirmative consideration is that the GATS allows governments to recognize the qualifications of service suppliers according to multilaterally agreed criteria (Wiser 2002, pp. 297–98).[42]

Clean Energy Export Credit

The volume of energy trade between contiguous countries could lead to problems when such countries follow different climate policies. The most obvious example is trade between Canada and the United States if the Kyoto Protocol goes into force with Canada inside and the United States outside the climate regime. Canada has unsuccessfully sought approval of a clean energy export provision to give it

credit for exports to the United States (Page 2002, pp. 63–64). If the climate regime were to provide some accommodation to Canada in a manner that promotes exports, there would be an issue of conformity with SCM rules. A key question would be whether the Canadian government transfers a benefit directly to its energy sector contingent on exports to the United States. If so, that would violate the SCM Agreement.

Trade Controls on Parties and Non-Parties

A consideration of trade controls should start with the distinction between a treaty-based control and a trade sanction. A trade control is an instrument used in a regular way to regulate the product addressed in the treaty. Trade controls have been employed in a wide array of environmental treaties—such as hazardous waste, fisheries, endangered species, and ozone depletion—over many decades. By contrast, a trade sanction is a specific action to coerce governmental behavior. It is a response to non-compliance or non-conformity to an international norm. A sanction is clearly being used when the targeted products are arbitrary and unrelated to the non-compliant act (GATT Secretariat 1992, p. 36; Esty 1994, p. 132). The only two international organizations that impose trade sanctions against non-compliance are the UN Security Council and the WTO.

The Kyoto Protocol does not seek to control trade in climate-related goods and services among parties, and no government has publicly proposed such controls as a way to make the Protocol more effective. Governments have considered limits on trade in emissions units, but, as noted in section II, such units are neither goods nor services.

The positive experience with trade controls in the Montreal Protocol on ozone has led analysts to consider an analogous use of trade controls in a future climate agreement. In the ozone regime, parties are required to ban trade with non-parties of ozone-depleting substances and products containing them. Surveying that experience, Duncan Brack points out that similar controls for most GHGs would be difficult to apply and could lead to a severe restriction on trade and an accompanying high welfare loss (Brack 2000, pp. 132-38). Nonetheless, Brack argues that by the same token, such controls would be highly effective and should be contemplated as part of the evolving climate regime. More limited measures such as the application of duties or taxes against various categories of imports from non-parties could also be employed, according to Brack.

Suppose a climate agreement were to adopt controls on trade with non-parties. Would such a measure be consistent with WTO law? Several analysts have cautioned that even multilateral measures against non-parties could violate WTO rules (e.g., Sampson 2000, p. 87). The resolution of any ensuing dispute would depend on how a WTO panel applies the environmental exceptions in GATT Article XX to the facts of the case, and how much weight the panel gives to the norm in the climate treaty. If the complaining government were the non-party to the treaty, it would argue against giving it any weight.

This situation can be called the non-party conundrum: Although the WTO itself does not disallow trade discrimination against countries that are not WTO Members (and indeed promotes new membership in the WTO as a way to avoid such discrimination), WTO rules could prevent other regimes from making use of discrimination against non-parties.

The most recent development in trade controls occurred in May 2003, when the WTO granted a temporary waiver for the Kimberley Process Certification Scheme.[43] The Scheme requires participating governments to ban trade in rough diamonds with non-participants. This episode marks the first time that the GATT or WTO granted a waiver for a trade control in a multilateral agreement. The waiver states that this WTO action does not prejudge the WTO-legality of trade actions in the Kimberley Scheme, but rather is a step taken to achieve legal certainty.

Trade Sanctions for Enforcement

At present, no environmental treaty employs trade sanctions as an instrument of enforcement in a manner similar to WTO practice.[44] Suppose that the parties to a future climate agreement were to do so, perhaps even modeling the compliance sanction on the one in the WTO. Could such a system be implemented consistently with WTO rules? Several analysts have expressed doubts (e.g., Chambers 2001, p. 104).

Perhaps a more important question than the WTO legality of using trade measures to enforce a climate treaty is whether such enforcement would be effective (because if the measures would be effective, then WTO rules could be changed if needed). David Victor contends that enforcement in the climate regime could fruitfully be linked to the WTO (Victor 2001, pp. 87–88). Specifically, he suggests a program of penalty tariffs and trade sanctions to counteract the economic advantage gained through non-compliance. Olav Schram Stokke has also argued that trade measures could be an effective instrument against non-compliance (Stokke 2003). Stokke predicts that such sanctions would work best if they were carried out multilaterally against the country at fault.

In general, research on the role of economic sanctions in international organizations does not point to a high efficacy. Based on their comprehensive study, Abram and Antonia Handler Chayes downgraded the usefulness of coercive sanctions in favor of "interacting processes of justification, discourse, and persuasion" (Chayes and Chayes 1995, p. 28). In the WTO, evidence of the pro-compliance effect of trade sanctions is mixed, at best (Charnovitz 2002b).

Although trade measures for enforcement should not be categorically ruled out, the climate regime should look for alternative enforcement techniques. One possibility would be to enhance transparency and public participation in the international supervisory system in the hope of putting internal political pressure on governments to comply. The climate regime could also consider the use of monetary

assessments against non-complying governments, a technique employed in the European Union, and being tested in new free trade agreements (e.g., U.S.–Singapore). Certainly, some type of sophisticated legal enforcement strategy will be needed (Nakatani 2002).

IV. Promoting Synergies Between the Trade and Climate Regimes

Although the trade and climate regimes are charged with different mandates, the goals of open trade and reduced GHG emissions are not inconsistent. This points to an opportunity for the two regimes to move ahead in tandem, in contrast to current trends of low cooperation. At a minimum, the two regimes should be working together to prevent trade conflicts over the use of climate policies and measures at the national level.

This section looks at seven ways in which greater cooperation between the two regimes could be promoted. They are: catalyzing international standards; facilitating taxes on energy; opening markets for environmental and energy goods and services; expanding subsidy law; safeguarding eco-labeling; improving climate and trade regime coordination; and integrating climate and trade bargaining.

Catalyzing International Standards

Achieving minimum international standards on energy efficiency or definitions of clean energy would provide several benefits. One is trade facilitation stemming from harmonization. Another is inducing technological breakthroughs from larger potential markets. Taking note of the role of the catalytic converter in promoting the phaseout of leaded gasoline, Scott Barrett has suggested that common technology standards can be used to reduce GHG emissions from automobiles or from fossil-fuel power plants (Barrett 2001).

International product standards are proposed in many fora, the most prominent of which is the International Organization for Standardization (ISO). In recent years, the ISO has set up a Climate Change Task Force and begun developing standards for GHG measurement and verification. For energy efficiency, there are several international standards programs, such as the International Energy Conservation Code. For automotive standards, the Economic Commission for Europe's World Forum for Harmonization of Vehicle Regulations is starting to consider standards for hybrid and hydrogen fuel cell vehicles.

TBT Article 2.4 promotes the expanded use of international standards, stating that:

> *Where technical regulations are required and relevant international standards exist or their completion is imminent, Members shall use them, or the relevant parts of them, as a basis for their technical regulations except when such international standards or relevant parts would be an ineffective or inappropriate means for the fulfilment of the legitimate objectives pursued, for instance because of fundamental climatic or geographical factors or fundamental technological problems.*[45]

Other than the availability of dispute settlement, the WTO has not done much to implement this rule. Even back in 1965, the GATT adopted a discipline in favor of the harmonization of standards, but the trading system failed to follow through.[46] Perhaps the cause of the inaction is that trade officials are ill suited to promote international standards in the abstract. What is needed is a policy context so that trade ministries can work together with kindred ministries.

Building on the above TBT rule, the WTO could collaborate with the UNFCCC to promote minimum international (or regional) standards pertinent to climate.[47] Addressing global warming would be an ideal objective to test the possibilities of new efforts to bring together trade, energy, and environmental officials at the national and international levels. The governments could encourage standard-setting institutions to accelerate the development of climate-related standards, and once such international standards are devised in a suitable manner, governments could use them as a basis for technical regulations.

Developing countries, of course, warrant special assistance. The WTO has a mandate to help developing countries pursuant to the TBT rule stating that "Members shall take into account the special development, financial, and trade needs of developing country Members in the implementation of this Agreement, both nationally and in the operation of this Agreement's institutional arrangements."[48] One might hypothesize that developing countries are most in need of international standards because they do not have resources to squander on reinventing standards that are already working well in comparable countries.

Facilitating Taxes on Energy

In view of the negative environmental externalities caused by the production and consumption of energy, strong grounds exist to subject energy to greater taxation. Several governments have made energy or GHG taxes a major part of strategies to combat climate change. A coordinated approach to national energy taxes could be an effective and flexible way to control emissions without leading to inter-country distortions (Victor 2001, pp. 79–86). Although the idea of getting governments to agree on a uniform rate of energy taxation has been discussed for years, very little progress in that direction has been made at the global level, or even within customs unions and free trade agreements. Looking ahead, the outlook for such agreements remains poor.

It may be possible, however, to seek harmonization on technique rather than tax level. As section II explained, while many energy taxes and border tax adjustments can be applied without contradicting WTO rules, some forms of taxation may lead to trade disputes. Such disputes may be fomented when governments engineer taxes to favor homegrown energy sources and to gratify public biases against particular energy sources, such as nuclear. In other words, what will seem a reasonable method of taxation within Country A may, when applied to imports from Country B, seem unfair to economic actors in Country B. Right now, there is considerable uncertainty within the WTO as to the rules for border tax adjustments on energy. If these uncertainties are left to resolution by a WTO panel, the results may be unsatisfactory from an environmental standpoint.

Therefore, the climate regime could assume greater responsibility for promoting a uniform approach to energy/GHG taxation, and particularly, the application of taxes to imports and exports. Such an effort could prevent the problem of a hodgepodge of energy/GHG taxes that will confound exporters and lead to trade disputes. The reason why the climate regime might take the lead is that the trade regime is unlikely to solve this problem. Such futility is indicated by the fruitless discussions in the WTO Committee on Trade and Environment, which has had the issue of "charges and taxes for environmental purposes" on its agenda since 1994 without producing any tangible result.

The product of a new harmonization effort would be guidelines for the form of energy/GHG taxes applied to imports and exports. A core principle might be to not discriminate based on the country of origin whether taxes are calculated by the type of fuel, its carbon content, or otherwise. If process-based criteria are employed, the tax rules should provide for recognition of similar processes used in other countries.

Opening Markets for Environmental and Energy Goods and Services

Liberalization of trade in environmental goods and services is on the negotiating agenda for the Doha Round. The climate imperative is to convince governments, particularly in developing countries, to eliminate unjustified barriers to technology and services related to climate change mitigation and the CDM. One obstacle to fruitful negotiations on environmental technology is that this sector is poorly mapped in WTO classifications, and so the scope for beneficial liberalization is often not appreciated (Andrew 2003). WTO negotiations on the movement of natural persons supplying services can also be important for climate policy by facilitating the entry of foreign technicians to offer de-carbonization services in developing countries.

In addition, the climate community has an interest in the ongoing WTO negotiations on energy goods and services. Recently, Qatar offered a suggestion that the focus on environmental goods and services be broadened to include trade barriers to less GHG-emitting fuels, and technologies related to natural gas (Qatar 2003). Yet while it is true that the substitution of cleaner fuels can contribute to climate goals, that does not transform energy goods/services into environmental goods/services.

Instead, the WTO should explicitly recognize the goal of liberalizing energy trade. Countries with closed, uncompetitive markets are unlikely to be leaders in clean energy. New rules are needed to gain transborder access to energy networks, and to assure free energy transit without excessive fees (Wälde and Gunst 2002). So far, attention to energy within the WTO has occurred mainly in negotiations for accession (Gibbs and Mamedov 2001) in which governments applying for membership have been pressed to eliminate dual pricing (i.e., low domestic prices in energy-exporting countries).

Expanding Subsidy Law

The WTO has complex rules on subsidies that are stronger than in the GATT era, yet still far from comprehensive. If there is any conceptual thread that knits the rules together, it would be a distaste for subsidies that potentially distort international trade. Yet while that is an appropriate purpose, the WTO could aspire to do more by helping governments eliminate subsidies with high negative externalities. It is interesting to recall that during the Uruguay Round, the negotiations on intellectual property began with a narrow focus on counterfeit goods, but later expanded to a much broader set of legal norms.

Although one strain of the ecological critique of trade law over the past decade has been that GATT/WTO rules are too stringent, environmentalists have also observed that on some issues, trade rules are too weak. After all, many government subsidies harmful to the global environment are *not* impeded by WTO rules. The worst offenders are the subsidies for the development of fossil fuels and for unsustainable harvesting of timber. Some agricultural subsidies by the richest countries are also deplorable, as they make it harder for poor countries to gain income through exports.

Perhaps the most significant environmental achievement in the Doha Declaration was the mandate for negotiations on fisheries subsidies. If this initiative were successful in curtailing such subsidies, it would establish an important precedent for WTO action on other environmentally damaging subsidies. For example, a future trade initiative could address perverse subsidies that worsen climate change. At a recent meeting of the WTO Committee on Trade and Environment, Saudi Arabia advocated the removal of coal and gas subsidies.[49] Such discourse shows the potential for some convergence with the Kyoto Protocol which calls on Annex I parties to implement "policies and measures" including: "Progressive reduction or phasing out of market imperfections, fiscal incentives, tax and duty exemptions, and subsidies in all greenhouse gas emitting sectors that run counter to the objection of the [UNFCCC] Convention and application of market instruments...."[50]

By contrast, the Doha Declaration is silent on the status of the one environmental achievement of the Uruguay Round. In the early 1990s, suggestions were made that subsidy disciplines could provide a carve-out for environment-enhancing government aid (Jackson 1992, p. 1248). This was accomplished in the Uruguay Round when the SCM Agreement was constructed to include a category of Non-Actionable subsidies that would neither be prohibited by the WTO nor subjected to countervailing duties. One such Non-Actionable subsidy was government assistance to promote adaptation of existing facilities to new environmental requirements.[51] But the entire Non-Actionable category expired at the end of five years. Now, even the most justified subsidies redressing market failure are potentially actionable in the WTO. The current WTO negotiations could renew the Non-Actionable category, particularly subsidies to address global problems, such as climate change. To date, no government has proposed a plan for renewal.

Safeguarding Eco-labeling

Environmental labeling is on the WTO's Doha Agenda, but a decision has not yet been made as to whether negotiations on rulemaking should be launched. The underlying problem is that trade rules cast a shadow over mandatory and voluntary labeling systems because, as explained in section II, the meaning of those rules is unclear. The trade regime has a valid interest in assuring that labels do not impede trade through misinformation or unjustified inferences. The climate regime has a valid interest in assuring that labels and seals can be used to inform the public about the ecological footprint of products, in order to encourage market-based solutions to environmental challenges.

Thus, the two regimes have a basis to work together to assure that WTO law does not constrain well-designed climate labels. Right now, it seems doubtful that climate interests are being voiced in the WTO. If the WTO launches negotiations on labeling, those missing interests need to be factored in. Whatever negotiations the WTO commences could be facilitated by the ISO, which is developing a series of standards (ISO 14020) for environmental labeling.

Improving Climate and Trade Regime Coordination

So far, the WTO has remained largely aloof from efforts to address climate change. Other organizations, such as the World Bank, the Organization for Economic Co-operation and Development, and the UN Conference on Trade and Development, have recognized that climate change is an important global issue, and have responded constructively. Despite the fact that the WTO is trying to increase its attention to development, the WTO, as an intergovernmental organization, has not yet connected climate issues to trade and investment.

Some analysts question whether the WTO *should* do so. The case for such engagement is that greater attention by the WTO to problems of poverty, employment, health, and environment could improve the coherence of global governance and perhaps enhance public support for the WTO. The case against engagement is that the trade diplomats and bureaucrats in the WTO system have too narrow a mindset to make constructive contributions to non-trade issues. Yet even within the traditional trade-centrism of the GATT/WTO, the trade regime could benefit from stronger institutional linkages with the climate regime in order to seek mutual supportiveness and prevent conflict. The current baseline is that the UNFCCC Secretariat has been granted observer status in the WTO Committee on Trade and Environment and is being invited to its negotiating sessions. Furthermore, WTO Secretariat officials attend intergovernmental climate sessions.

Although these observerships are useful in improving mutual understanding, much more institutional cooperation could be attempted. The WTO General Council and the various WTO subsidiary bodies (such as the TBT Committee) could explore ongoing relationships with the conferences and meetings of the parties of the climate regime, and its subsidiary bodies. This would allow climate and trade officials from numerous countries to work together. One possibility might be a joint WTO/UNFCCC

working group (Assunção and Zhang 2002, p. 25). The fact that the states in the WTO are not the same as in the UNFCCC is no barrier to holding joint meetings. Certainly, adequate authority exists under WTO rules for such inter-regime cooperation.[52]

Recognizing that WTO Members are unlikely to agree to such an arrangement—which would have to be approved by consensus—an alternative strategy would be to get parliamentarians from different countries to cooperate in holding "trade and climate" meetings. In recent years, there has been an increase in inter-parliamentary cooperation along functional lines. One initiative would be to highlight opportunities for carrying out joint trade/climate capacity-building on issues like energy standards. If parliamentarians were to regularly meet to discuss the trade and climate linkages, that would put some pressure on executive officials to devote more attention to this nexus.

Another regime coordination issue is how the WTO dispute system should relate to the compliance structure in the climate regime. At present, no interface exists. An approach sometimes used when tribunals have contending jurisdiction is for one tribunal to await the judgment of the other. That is the approach taken in the GATS Annex on Air Transport Services which states that WTO dispute settlement may be invoked only when dispute settlement in bilateral or other multilateral agreements has been exhausted.[53]

Integrating Climate and Trade Bargaining

Some analysts have suggested that governments could bargain simultaneously on climate and trade in order to achieve deals that would be unattainable in separate fora (e.g., Whalley and Zissimos 2002, pp. 175-76). This proposal should not be dismissed outright on grounds of imagined regime purity. Instead, such interlacing should be assessed on its own merits.

One clear impediment is the MFN rule. If Country A agrees to lower its trade barriers in return for Country B's agreement to regulate internal emissions, then A will have to give the same trade benefit not only to B, but also to C, D, etc., even though those countries have not agreed to reduce emissions. This is not a fatal problem, because MFN is already inherent in trade negotiations. Nevertheless, MFN does undermine the viability of "climate for trade" deals.

While there could well be pairs of governments willing to exchange action to liberalize trade for action to combat global warming, no example leaps to mind. The most obvious deal would be a promise by developing countries to undertake climate commitments in return for a promise by developed countries to give more market access. But that swap seems impractical. Since low-income countries have been demanding greater market access for its own virtue, they would surely resist the notion of "paying" for it through a costly link to climate. At the same time, few high-income countries would be interested in such a deal because there would be no anticipated trade gains to offset the trade losses, and trade benefits may be needed to sustain a domestic political coalition.

Although the challenges of climate/trade *multilateral* bargaining are daunting, some possibilities could exist in regional or bilateral free trade negotiations. This may seem paradoxical since few single-nation climate commitments would be weighty enough to make a noticeable contribution. But offsetting that math may be the ability of governments in a small negotiation to particularize their bargains and to experiment with new ideas. For example, the Europe Association Agreement with the Czech Republic combines provisions on trade with other issues, including a commitment to cooperate on global climate change and its prevention.[54]

V. Conclusion

Reducing trade barriers and greenhouse gas emissions can be complementary objectives, and the trade and climate regimes should be looking for opportunities for mutual supportiveness. This paper presents several ideas for how that might be done on issues including international standards, energy taxes, subsidies and institutional coordination between the WTO and the UNFCCC. The trade regime should be thinking about how it can help to head off global warming, and the climate regime should be thinking about how environmental policy can benefit from trade liberalization.

If implementation of climate policies threatens to reduce national competitiveness, the governments in the regime will be driven to take actions to offset that disadvantage. This paper identifies several potential legal conflicts between WTO rules and national policies to meet emission targets. Although no trade disputes have yet occurred, the onset of such conflicts is only a matter of time, especially when WTO rules remain unclear. The most contentious issue will probably be the application of process-based energy taxes to imported products. Whether such measures can pass WTO muster will depend on how carefully they are written to avoid arbitrary discrimination, and whether a future climate agreement incorporates such a tax.

This paper also considers whether multilateral climate agreements should adopt trade controls or sanctions. One problem is that such measures will raise legal concerns in the WTO. Equally or more important, however, is the unlikelihood that trade measures would prove useful in enhancing cooperation on climate policy. Of course, the difficult challenges of gaining international cooperation dictate that no instruments be ruled out.

Any advocate of more dialogue between the trade and climate regimes has surely heard the retort that the two regimes are too single-minded to have anything to talk about. One hopes that this paper demonstrates the fertile ground for collaborative efforts. Although such collaboration is hardly an antidote for all of the pathologies of the WTO or the Kyoto Protocol, much good can come from seeking to forestall trade-climate conflict and building more environmental sensitivity into the trading system.

Endnotes

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1. Kyoto Protocol, art. 2.3. Relatedly, the UNFCCC (art. 3.5) states that "Measures taken to combat climate change, including unilateral ones, should not constitute a means of arbitrary or unjustifiable discrimination or a disguised restriction on international trade." Cameron and Makuch (1994): 117.

2. Kyoto Protocol, art. 3.14.

3. European Parliament Resolution on the European Union's Strategy for the Bonn Conference on Climate Change, B5-0473/2001, para. 9.

4. For example, the UNFCCC states that "The Parties should cooperate to promote a supportive and open international economic system that would lead to sustainable economic growth in all Parties, particularly developing country parties, thus enabling them better to address the problems of climate change" (art. 3.5). This is mirrored in the Preamble of the WTO Agreement which recognizes that "relations in the field of trade and economic endeavour should be conducted with a view to raising standards of living...while allowing for the optimal use of the world's resources in accordance with the objective of sustainable development, seeking both to protect and preserve the environment and to enhance the means for doing so...."

5. In climate policy, the negative externality is at the individual level, viz., emitting GHG without regard to the aggregate costs of such emissions. The market on its own will not correct that. In trade policy, no negative externality exists at the individual level. Trade is a market success, not a market failure.

6. Science does play a role in some WTO dispute settlement. The WTO Agreement on the Application of Sanitary and Phytosanitary Measures, (art. 2.2), states that measures should be based on scientific principles, and not maintained without sufficient scientific evidence (subject to an exception). In disputes where the scientific validity of a trade barrier is in question, WTO panels have sought advice from scientists. In general, however, the WTO does not draw upon scientists in WTO subsidiary bodies or in negotiations.

7. Of course, the trade regime is broader than WTO law. Because of space constraints, there will be only brief mention of bilateral free trade agreements and European Union treaties. Another exclusion is the Energy Charter Treaty, which includes some WTO rules as disciplines, and also contains a Protocol on Energy Efficiency and Related Environmental Aspects. Several countries that are not yet WTO Members are parties to the Energy Charter Treaty.

8. Understanding on Rules and Procedures Governing the Settlement of Disputes (DSU), art. 17.14.

9. See World Trade Organization (2001). Consideration of the relationship between the Kyoto Protocol and the WTO is generally thought to be excluded from the mandate since the Doha Declaration only refers to multilateral environmental agreements that have "specific trade obligations." In a recent paper, Korea has raised the question of whether the Kyoto Protocol contains obligations regarding emissions trading that might be considered "specific trade obligations" for purpose of the WTO negotiating mandate. See Korea (2002), para. 10.

10. The Committee on Trade and Environment was established at the outset of the WTO to consider several issues related to the trade/environment linkage. The Committee is composed of all WTO member governments, and does not have a policymaking role.

11. Whether electricity is a good or a service in the WTO is unclear. Little elucidation can be found in the GATT which explains that the term "goods" is limited to products as understood in commercial practice and does not include services; see GATT Ad art. XVII, para. 2. The GATT's negotiating history includes a statement that it was generally agreed that electricity is a service, not a good (Jackson 1969, p. 745). But since then, commercial practice has evolved to treat electricity as a good (Pierros and Nüesch 2000). When it considered this question in 1994, the European Court of Justice reached that conclusion. Municipality of Almelo and others v NV Energiebedrijf Ijsselmij, Case C-393/92 (Apr. 27, 1994), para. 28.

12. Outokumpu Oy, C–213/96 (Apr. 2, 1998).

13. Finland's assumption was that because only some of the foreign electrical generator's production is exported, there is no way for the importing country to determine how that particular electricity was generated, given that electricity is fungible. By contrast, because the total amount of domestic electrical generation is taxed, the tax can be calculated using the proportions of various production processes.

14. Outokumpu Oy, para. 39.

15. See Environmental Charges and Taxes, available at http://www.wto.org/english/tratop_e/cte03_e.htm.

16. GATT art. II:2(a).

17. United States—Taxes on Petroleum and Certain Imported Substances, GATT, BISD 34S/136 (June 17, 1987).

18. Id., paras. 2.5, 5.2.8.

19. Id., paras. 5.2.7–5.2.8.

20. Id., para. 5.2.4. The *Superfund* decision did not consider GATT Article XX.

21. Border Tax Adjustments, GATT, BISD 18S/97.

22. Id., para. 15.

23. It should be noted that the stringency gap between TBT and the GATT is narrowing. In the *Asbestos* case, the WTO Appellate Body interpreted the GATT Article XX(b) exception to require the use of a less trade restrictive alternative, if available, to achieve the same end. European Communities—Measures Affecting Asbestos and Asbestos-Containing Products, Report of the Appellate Body, WT/DS135/AB/R, para. 172 (adopted Apr. 5, 2001). This was the first time that any GATT or WTO panel had imposed such a stringent requirement on a government seeking to rely on the GATT's life or health exception.

24. TBT Code of Good Practice for the Preparation, Adoption and Application of Standards (art. 4.1). The Code was written by governments during the Uruguay Round without conducting any multilateral consultation with standard-setting bodies.

25. Id., para. L.

26. If such labels are not covered by TBT, they would be governed only by the GATT. See Marceau and Trachtman (2002): 862.

27. WTO, Committee on Technical Barriers to Trade, Specific Trade Concerns related to Labelling brought to the Attention of the Committee since 1995, G/TBT/W/184, Item 18 (Oct. 4, 2002).

28. An actionable subsidy is a specific subsidy that (1) injures the domestic industry of another country, (2) nullifies or impairs WTO benefits, or (3) causes serious prejudice to another country (SCM Agreement, art. 5). A country harmed by such a subsidy could challenge it in the WTO or impose a countervailing duty on imports of goods benefiting from such a subsidy if the required domestic injury can be shown.

29. The complex definition of specificity appears in SCM Agreement, art. 2. When subsidies are granted through objective criteria and are not limited to certain enterprises, they are probably not specific.

30. Agreement on Agriculture, Annex 2, paras. 2(g), 12.

31. SCM Agreement, arts. 3, Annex I, paras. (j), (k); Agreement on Agriculture, art. 10.4. In the *Foreign Sales Corporation* case, the WTO panel assumed (in accord with both parties) that a subsidy under the SCM Agreement could include a subsidy that confers a benefit exclusively outside the territory of the government providing the subsidy. The panel reserved judgment on this legal point however. United States—Tax Treatment for "Foreign Sales Corporations," Recourse to Article 21.5 of the DSU by the European Communities, Report of the Panel, WT/DS108/RW, para. 8.63 (adopted Jan. 29, 2002).

32. Nevertheless, there may be scope in GATS Article XVIII (Additional Commitments) for a government to make a commitment on government-created rights, including perhaps emissions trading.

33. GATS Annex on Air Transport Services, para. 2(a).

34. For example, the European Community's Greenhouse Gas Emission Trading system provides for mutual recognition of allowances from non-EC countries that have ratified the Kyoto Protocol. The Directive says nothing about non-ratifying countries. See Council Directive 96/61/EC (amended Dec. 9, 2002), arts. 12.1, 24, and Communication from the Commission to the European Parliament, SEC(2003) 364 (Mar. 25, 2003), para. 3.2.1.

35. Another claim would be a violation of GATT Article I (Most Favoured Nation) on the grounds that it is easier to import products from Kyoto Protocol parties than from non-parties.

36. United States—Preliminary Determinations with Respect to Certain Softwood Lumber from Canada, Report of the Panel, WT/DS236/R, paras. 7.17–7.29 (adopted Nov. 1, 2002).

37. Of course, the impact of domestic policies will go beyond territorial borders, as many of the examples in the previous section demonstrated.

38. Nevertheless, it is interesting to note that the Government of Switzerland presented a position paper to the WTO suggesting that the Kyoto Protocol conveys an obligation to achieve results, and so trade measures used by a government should be viewed as a specific trade obligation. See Switzerland (2003).

39. United States—Import Prohibition of Certain Shrimp and Shrimp Products, Report of the Appellate Body, WT/DS58/AB/R, para. 141 (adopted Nov. 6, 1998).

40. GATT art. XV:9(a).

41. GATS Annex on Air Transport Services, para. 1.

42.Such an analysis assumes that project developers are service suppliers. For the rule, see GATS art. VII:5.

43. Waiver Concerning Kimberley Process Certification Scheme for Rough Diamonds, WT/L/518 (May 27, 2003). See WTO Okays Kimberley Process, PanAfrican News Agency, May 26, 2003.

44. The non-compliance procedure in the Montreal Protocol contemplates sanctions, but any trade measure would only involve ozone-depleting substances. See Yoshida (1999). Similarly, the non-compliance procedure of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) can use trade measures against non-complying parties and non-parties, but only regarding trade in covered species.

45. Relatedly, TBT Agreement art. 12.4 states a recognition that developing countries should not be expected to use international standards that are not appropriate to their development, financial, and trade needs.

46. The GATT calls on parties to collaborate through international harmonization and adjustment of national policies through technical and commercial standards affecting production (art. XXXVIII:2(e)).

47. In noting this option, the author is not suggesting that the WTO itself develop environmental standards.

48. TBT Agreement art. 12.1. Relatedly, the TBT Agreement (art. 2.6) directs WTO governments to play a full part in the preparation of international standards.

49. WTO Committee on Trade and Environment, Report of the Meeting Held on 8 October 2002, WT/CTE/M/31, para. 63 (Dec. 2, 2002). Saudi Arabia is a WTO observer.

50. Kyoto Protocol, art. 2.1(v).

51. SCM Agreement, art. 8.2(c). Eligible environmental subsidies must: (i) be a one-time measure, (ii) be limited to 20 percent of the cost of adaptation, (iii) exclude costs of replacing and operating the investment, (iv) be linked to and proportionate to a firm's planned reductions of nuisances and pollution, and (v) be available to all firms that can adopt the new equipment and/or production processes.

52. Marrakech Agreement Establishing the World Trade Organization, art. V:1; GATT arts. XXXVI:7, XXXVIII:2(b).

53. GATS Annex on Air Transport Services, para. 4.

54. Europe Agreement Establishing an Association between the European Communities and their Member States, of the one part, and the Czech Republic, of the other part, art. 81, available at http://europa.eu.int/comm/enlargement/pas/europe_agr.htm.

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This report is a compilation of six "think pieces" exploring core issues in designing and negotiating a long-term international climate change strategy. The Pew Center on Global Climate Change was established by the Pew Charitable Trusts to bring a new cooperative approach and critical scientific, economic, and technological expertise to the global climate change debate. We intend to inform this debate through wide-ranging analyses that will add new facts and perspectives in four areas: policy (domestic and international), economics, environment, and solutions.

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