

Greenhouse Policy Architectures and Institutions

Richard Schmalensee¹

CONTENTS

The Climate Issue Today.....	2
Developing Institutions and Architectures	5
Monitoring and Enforcement.....	8
Alternative Architectures.....	10
Some Additional Issues.....	12
Concluding Remarks.....	14
References	15

The IPCC Working Group III Report (IPCC, 1996; hereafter “the Report”) is a remarkable piece of work. It is little short of amazing that such a large group of authors and reviewers, operating under such stringent procedural and substantive constraints, could produce such a high-quality document. A policy-maker seeking guidance on the most useful things to do over the next few years could learn much from this Report about economic dimensions of climate change and about the design of efficient environmental policies in general. In aggregate, the Report does a very good job of providing a comprehensible overview of a lot of relevant intellectual territory, some of it no doubt politically treacherous. The exposition is usually clear and sometimes even elegant, and, while the Report is not fully internally consistent, the level of consistency attained is remarkable in light of the production process involved.

This said, however, I believe that a policy-maker seeking guidance for near-term actions would likely come away from the Report disappointed—or, in the worse case, misled—on some important issues. The main problem is omissions, not errors. The Report presents a great deal of information that would be useful to a climate czar making a once-and-for-all global policy choice, but there is no such czar, and the key near-term choices involve institutional designs and policy architectures, not particular policies. Moreover, the Report pays insufficient attention to the long-term consequences of possible near-term choices and fails to develop analytical points of which policy-makers should be aware.

The Report’s discussion of policy issues necessarily reflects its authors’ main assignment: assessment of the available literature.² The questions on which the Report concentrates—choice of policy instruments and of their optimal levels—are central to the literature on environmental economics and to the domestic policy debates that it mainly seeks to inform. As I argue in what

¹ Gordon Y Billard Professor of Economics and Management, Massachusetts Institute of Technology. An earlier version of this paper was presented at the NBER Conference, “Economics and Policy Issues in Global Warming: An Assessment of the Intergovernmental Panel Report,” July 23–24, 1996, in Snowmass, Colorado, and a very early version of portions of this essay was presented at an IPIECA workshop in Lisbon in November, 1993. I am indebted for financial support and intellectual stimulation to the MIT Joint Program on the Science and Policy of Global Change and to Jae Edmonds, Henry Jacoby, Bill Nordhaus, Eugene Skolnikoff, David Victor, and participants in the Snowmass and Lisbon meetings for thoughtful and useful suggestions.

² It also reflects the Report’s linkages with ongoing international negotiations, which seem fixated on mandating near-term emissions limits on a relatively small number of industrial nations (the so-called Annex I countries). As will become clear in what follows, I view this fixation as an unwise architectural decision.

follows, however, the arena in which climate change policy is shaped differs fundamentally from those in which domestic environmental policies are determined, particularly at this early stage in the international process. Moreover, the climate issue differs in important and perhaps fundamental ways from issues that have been addressed (with mixed success) by other environmental treaties. The authors of the Working Group III Report, and particularly the authors of Chapter 11 on “Policy Instruments,” have naturally written more about what we know than about what we need to learn, but, unfortunately, the latter is presently more important. By describing important gaps in our knowledge clearly, the Report could have made a significant contribution to the intelligent determination of research priorities.

The assertion that the Report pays inadequate attention to issues related to the near-term policy agenda plainly rests on a particular view of that agenda. The next section outlines that view.

The Climate Issue Today

There appears to be near-universal agreement regarding several key features of the climate change issue, most of which are developed by the Report.³ First, the relevant economic and physical processes operate globally and over decades rather than years. Most plausible emissions scenarios involve a significant human-induced increase in radiative forcing over the next century, with much of the increase coming from emissions of countries that are not now wealthy.⁴ Today’s emissions will affect the chemistry of the global atmosphere for a century or more and, perhaps, affect climate for longer. Today’s investments in research and in energy-sector capital will shape economic activities and affect emissions for at least several decades. Because these lags are very long, a range of current actions can be profitably thought of as having climate-related consequences that are to a first approximation irreversible. Few observers foresee substantial climate change for at least several decades, after emissions and atmospheric concentrations have increased substantially.

Second, important and probably long-lived uncertainties are ubiquitous. There are important unanswered questions involving the atmospheric chemistry of trace gases and aerosols, fundamental climatic processes, future emissions, future technologies, the costs of abating emissions, and the costs of adapting to climate changes. Despite the language of the Framework Convention on Climate Change, which calls for “stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system,” there are no known thresholds in that system, but I do not believe the existence of thresholds can safely be ruled out. Though emissions of many gases and aerosols apparently affect radiative forcing, significant uncertainties attach to the sources and effects of some of these emissions.

Third, the climate issue involves potentially huge stakes. On the one hand, the very survival of the human race depends on the earth’s climate, so that experimenting with that climate seems mad. On the other hand, stabilizing atmospheric concentrations of greenhouse gases within a century or so, even at levels well above today’s, is likely to be very expensive. It will almost certainly require

³ Schelling (1992) reaches broadly similar conclusions.

⁴ See, for instance, Alcamo, *et al.* (1995) and Schmalensee, Stoker, and Judson (1995).

reducing global emissions of carbon dioxide (CO₂) well below current levels.⁵ At the very least, since most anthropogenic CO₂ emissions are produced by combustion of fossil fuels, reducing global emissions would likely prevent today's poor nations from becoming wealthy using currently-known technologies. Reducing global CO₂ emissions substantially relative to trend would require transforming the energy systems of both developed and developing nations and, as Chapter 9 of the Report indicates, would likely involve annual costs on the order of several percent of world income. Such costs would dwarf those of eliminating CFCs from the global economy. The total direct cost of all current U.S. environmental programs, many of which are extremely controversial, comes to only about two percent of GDP. Agreeing to incur incremental costs of this magnitude without clear evidence that *any* benefits will result also seems a bit mad—particularly from the viewpoint of poor nations with more immediate environmental problems.

Fourth, analyses of globally optimal climate policies generally do not support imposing burdensome emission reduction policies over the next decade or so, though very stringent policies may be optimal thereafter.⁶ The basic argument is that to a first approximation damages depend on long-run cumulative emissions, and in the future we will know more about the consequences of our actions, we will have developed cheaper abatement methods, we will have had time to invest to prepare for their use, we will be wealthier, and we will have higher greenhouse gas emissions. This is of course not an argument for doing nothing today; in particular it is not an argument against developing technologies useful in abating greenhouse gas emissions or in adapting to climate change. But it is an argument for doing less to reduce current emissions than would be optimal if the world had to make a once-and-for-all policy choice.

Fifth, any serious program to control global emissions is almost certain to involve substantial international transfers, the pattern of which may change over time. As the Report (Section 2.4.2, p. 71) puts it, “International transfers, in one form or another, are likely to serve as both the building blocks of globally optimal action and the cement of global cooperation.” This reflects international differences in marginal costs of abatement, with emissions reductions relative to baseline typically cheaper in poor than in rich countries (see Section 9.2.5.1 of the Report, pp. 335-343), as well as in willingness to pay for greenhouse gas abatement. In the latter connection, it is important to recognize that the identities of rich and poor nations will likely change, along with patterns of social and political differences, in ways that are difficult to foresee. Only a few decades ago the U.K. was among the very richest nations, after all, Korea was a dreadfully poor Japanese colony, and the Soviet Union was a rapidly growing Stalinist superpower.

Finally, whatever the merits of the case for doing so, there is currently little political support for devoting substantial resources to this issue, and there is no obvious reason to expect this to change any time soon. In the U.S., neither the Bush nor the Clinton Administration has yet gone beyond research and voluntary measures. While some other OECD nations have done more, and

⁵ See, for instance, Richels and Edmonds (1995) and Chapters 8 and 9 of the Report. I am certainly not arguing that CO₂ should be the only focus of mitigation efforts, since it is not the only cause of the problem. On the other hand, CO₂ from fossil fuels is both the most important anthropogenic emission tending to increase radiative forcing and the source for which mitigation options are best understood; thus I believe that CO₂ is likely to be the main target of any serious mitigation policies adopted in the next few decades.

⁶ Most of the relevant “integrated assessment” studies, which include Manne and Richels (1992), Nordhaus (1994), and Kolstad (1993, 1994), are discussed in Chapter 10; see in particular Section 10.5.3, pp. 368-388.

compulsory measures are under active diplomatic discussion as this is written, it is fair to say that no government has yet imposed burdensome restrictions on its own citizens in the name of climate change. Moreover, none have shown any serious interest in financing the massive North-South transfers that are likely to be necessary for a globally affordable transformation of the world's energy system.⁷ Poor nations, of course, generally refuse to allocate any of their own resources to the climate problem, in part because they generally have trouble finding the resources to solve environmental and other problems that are literally killing their citizens every day.

Climate change is a difficult issue for the world's political system. There is no world government, so individual nations will participate in climate-related activities, including emissions control, only if they believe that the tangible and intangible benefits to them of doing so exceed the costs. Because the problem is global, unilateral emissions reductions would generally involve costs today and at most minuscule benefits ever. Because nations distrust each other and a round of broken emissions stabilization pledges will not help this,⁸ governments may be reluctant to spend resources to honor multilateral agreements. Because uncertainty is so high, of course, there is no guarantee that even global emissions reductions will yield any benefits. Under these conditions, refusal to go beyond symbolic actions is not surprising. As Skolnikoff (1990, p. 78) puts it, "...outside the security sector, policy processes confronting issues with substantial uncertainty do not normally yield policy that has high economic or social costs." Moreover, there is no obvious domestic constituency anywhere pressing for action on climate change, as distinct from other environmental issues.

All this seems to have clear implications for the near-term policy agenda. As uncertainties are resolved, and new ones are discovered, the perceived threat of climate change will almost change in importance over the next few decades. There is no guarantee that this change will be monotonic: we "learned" from models that the ozone depletion problem was not as serious as had been initially believed, before detection of the ozone hole refuted those models. A key task of current policy deliberations thus must be to seek inexpensive, politically salable actions that can be taken today to reduce the costs of substantial reductions in future emissions, should they become desirable.⁹

Central to this task must be establishment of effective institutions for policy-making,¹⁰ as well as a policy architecture that permits efficient transitions between particular policies. When time is

⁷ At the MIT Global Change Forum held in Oslo in May, 1996, during a discussion of the ongoing negotiations on emission limits for Annex I nations, it was suggested (not by the author) that perhaps negotiations should focus instead or in addition on the amount of money each rich nation would contribute to an international fund aimed at solving this problem, since any serious solution would clearly involve substantial North-South transfers. (This is consistent with Schelling's (1992, p. 14) suggestion that, "While the developing countries are feeling their way into some common attack on their own carbon emissions, a tangible expression of their interest and an effective first step would be to establish a permanent means of funding technical aid and technology transfer for developing countries, as well as research, development, and demonstration in carbon-saving technologies suitable to those countries.") One negotiator rejected this approach out of hand, and no one else even bothered to address it.

⁸ I believe that there is a good chance that Skolnikoff's (1990, p. 91) assertion on the eve of Rio that "A premature commitment to action can pose dangers of error and backlash and can incur costs that would affect a wide variety of interests" will turn out to have been prophetic.

⁹ I do not mean to suggest that an exclusive focus on abatement is appropriate, though the international policy process seems to have adopted such a focus. Logically, it is also important to see what can be done today to reduce the costs of adapting to future climate change.

¹⁰ I hope it becomes clear in what follows that I am not simply calling for the adoption of a voting rule by the Framework Convention's Conference of Parties.

measured in centuries, the creation of durable institutions and frameworks seems both logically prior to and more important than choice of a particular policy program that will almost surely be viewed as too strong or too weak within a decade. Writing before Rio, Skolnikoff (1990, p. 92) captured the importance of process nicely:

Stringent policies to cut emissions may be politically impossible or even inappropriate today; but if they prove to be justified in the future, it would be of enormous value to have a clearer idea of the issues at stake, the policy alternatives, and a process for rapid response.

In the face of great uncertainty, robustness and flexibility are key to minimizing expected regrets,¹¹ and their achievement requires attention to institutional design rather than to policy details. This is not a call to do nothing, just as a call to focus on near-term emissions reductions is not necessary a call to take effective action; as the Norwegian Prime Minister, Gro Harlem Bruntland (1996), recently put it, “An ambitious short term emission reduction target without the introduction of long term practical policies does not necessarily imply a commitment to a long term global reduction strategy.”

Developing Institutions and Architectures

I do not think the Report analyzes architectural and institutional issues in as serious and thorough a fashion as they deserve, and it thus pays insufficient attention to the development of “long term practical policies.” As Prime Minister Bruntland (1996) has said, speaking of the Rio negotiations, “We knew the basic principles on which we needed to build: cost-effectiveness, equity, joint implementation, and comprehensiveness. But not how to make them operational.” In this section and the next I want to consider the Report’s treatment of two important operational issues: the importance of institutional and architectural design as against policy choice, and the implications of measurement and enforcement problems.

Much of the Report, particularly Chapter 11, is written as if the world were facing a once and for all policy choice. In this context, Chapter 11 considers command-and-control regulation, emission taxes, and tradable permit or quota regimes and comes down in favor of tradable quotas.¹² Presumably policy-makers are to deduce the fairest international allocation of quotas from the analysis of equity in Chapter 3. There are a number of problems with this picture.

To start with, as Carraro and Siniscalco (1993) and Heal (1994) have emphasized, in the absence of a world government, substantive actions on climate change will be taken by sets of

¹¹ In a world of uncertainty, all policies will normally generate regrets with positive probability, since there will normally be one or more states of nature in which another policy would have been better. Policies that have positive net benefits whether or not the climate problem turns out to be serious have been widely described as “no regrets” policies. I believe this terminology is misleading for two reasons. First, “no regrets” policies may impose unacceptable costs on some groups, even though they have positive net benefits in aggregate. These groups may profoundly regret adoption of “no regrets” policies. Second, if the climate problem turns out to be serious and only “no regrets” policies have been adopted, many regret that more was not done. It might have elevated the level of debate if the Report had made these elementary points or at least avoided use of “no regrets.”

¹² The Report usefully distinguishes between emissions quotas, allocated to governments and tradable only between governments, and emissions permits, initially allocated to governments but tradable between any parties to which governments allocate or sell them. This distinction is not important for my purposes, and I will refer to these regimes interchangeably.

nations if any only if each nation believes it benefits on balance—taking into account international transfers and any intangible benefits from altruistic behavior. Though Chapter 2 of the Report does make this point in passing, the Report does not note that there is no reason to think that there is any relation between Chapter 3’s principles of fairness and quota allocations that will induce widespread participation in abatement programs.¹³ Even if widespread participation is not an objective (as it does not appear to be at present), a political process is necessary to allocate quotas in any tradable quota system. When the stakes are substantial, it is generally difficult to explain political outcomes using simple philosophical principles. In the U.S., for instance, the allocation of tradable permits to emit sulfur dioxide among electric utilities cannot be explained by any simple principle or rule.¹⁴

The Report does not recognize the importance of political decision-making in this context, so it does not consider how a political process might operate to allocate tradable emission rights or what sorts of institutions might best facilitate its operation. This omission would not matter, of course, if the Framework Convention’s Conference of Parties had already established an adequate institutional structure for this purpose. Since I believe it plainly has not done so, I think this omission is potentially important.

In fact, serious operational and political problems make it unlikely that the world will soon adopt anything like a serious (*i.e.*, expensive) global system of tradable emissions quotas or permits.¹⁵ Thus the Report’s concentration on the desirable properties of such systems seems to leave concerned policy-makers nothing constructive to do in the short run but to struggle against barriers to their adoption. Similarly, Chapter 11 seems to suggest that the only interesting research topics relate to implementation problems of these sorts of regimes. In fact, both policy-makers and researchers confront issues today that have implications both for menus of feasible future policies and for transitions to such policies. Moreover, the inevitability of multi-dimensional social, economic, and scientific change on the time-scales involved here makes once-and-for-all adoption of any particular set of climate-related control policies inconceivable.

At the simplest level, it seems almost inevitable that the optimal stringency of emissions control policies will change over time in response to changes in scientific knowledge and the development of new technologies. Thus, even though Chapter 11 appears almost exclusively concerned with once-and-for-all adoption of either a long-term emissions trajectory or of “hard” or “soft” abatement policies, such a decision would be both extremely unwise and almost certainly temporary. Any international climate regime that responds to new evidence and swings of opinion will change course over time, so an important near-term task is to establish institutions capable of doing this effectively and efficiently. If, for instance, it is decided (unwisely, I will argue) that the right policy architecture involves a focus on CO₂ emission limits, it follows that one must initially confront the institutional/constitutional questions of how and how often such limits are to be revised.

¹³ On this point, see Edmonds, Wise, and Barns (1995).

¹⁴ See Joskow and Schmalensee (1996).

¹⁵ Chapter 11 of the Report outlines some of these operation problems. For further discussion, see Chichilnisky and Heal (1995), Tietenberg and Victor (1992); see also Victor’s (1991) argument that monitoring problems would currently limit any tradable permit scheme to CO₂ emissions from fossil fuel combustion.

Questions of this sort, which are generally ignored by the Report, are far from trivial. While flexibility is a virtue, it is important to recognize that policy uncertainty inhibits desirable investment in new technologies and long-lived capital goods, so that stability is also a virtue. In the context of tradable permits, an unanticipated increase (decrease) in allowable emissions imposes capital losses (gains) on the holders of existing rights to emit. Similarly, unanticipated changes in fossil fuel prices alter the value of past investments in energy-producing and energy-using assets. Thus today's policy choice creates winners and losers from an array of possible future policy choices, and the effects of those interests will depend on the institutional/political structure within which future policies are chosen.

Joint implementation illustrates the likely complexity of future policy changes. When marginal abatement costs differ, global costs can in principle be reduced by international coordination of abatement policies. However, the U.S. experience with emissions trading programs demonstrates that substantial potential cost reductions may go unrealized when transactions costs are high. The current version of joint implementation, "activities implemented jointly" involves both high transactions costs and "trading" in undefined property rights. It thus seems very unlikely to produce noticeable short-term economic gain.¹⁶ On the other hand, attempts to reduce transactions costs and to clarify property rights may yield substantial long-term gains. And attempts to coordinate abatement policies serve to increase developing country participation in climate-related activities and to demonstrate the link between international cooperation and cost-effectiveness.

Similar issues are raised by shortcomings of current measurement technology. The Report (Section 11.7, p. 429) notes that "technology for accurately monitoring many sources and sinks of greenhouse gases has not yet been developed." Indeed, David Victor (1991) has persuasively argued that it may only be possible today to monitor CO₂ emissions from fossil fuel combustion with the reliability necessary for a tradable permit system. Since, as I discuss further below, it is hard to imagine any serious mitigation policy in which outcomes cannot be monitored, it seems likely that the only policy of this sort that could be adopted in the near future would focus almost exclusively on CO₂ emissions from fossil fuels. But today's measurement problems will some day be solved, and we may learn that CO₂ is less important relative to other greenhouse gases than we now understand.¹⁷ The more comprehensive the coverage of trace gases in an abatement policy, all else equal, the lower its global costs. It follows that we need to establish policy architectures and institutions that permit changing the treatment accorded emissions of each of a long list of trace gasses.

Finally, it must also be possible to change the treatments accorded to different nations. It would be a great departure from history and from current growth projections if countries' relative incomes did not change markedly between now and, say, the middle of the next century.¹⁸ Thus to the extent fairness depends on relative incomes, burden-sharing arrangements that are fair today will surely not be fair in a few decades. Unfortunately, history, particularly the history of long-term economic forecasting, also teaches that it is essentially impossible to know how relative incomes

¹⁶ On the U.S. experience, see Hahn and Hester (1989); for discussions of the potential of joint implementation and the steps necessary to realize it, see Torvanger, *et al.* (1994), Selrod, *et al.* (1995), and Richards (1996).

¹⁷ It is, of course, equally likely that we will learn that CO₂ is relatively more important than we currently believe.

¹⁸ For discussions of this point and its implications in the climate context, see Edmonds, Barns, and Ton (1993) and Edmonds, Wise, and Barns (1995).

will have changed over such a period. There seems to be widespread agreement now that China will continue to grow rapidly for some time, while Brazil's future seems more problematic. Not long ago, however, Brazil's prospects looked rosy, while China's seemed hopeless.

For these and other reasons, an institutional structure is required both to generate and to readjust political bargains as circumstances, inevitably, change, as well as an architecture that permits rational adjustment of policy choices over time. There is, perhaps, much to be learned from such institutions as the GATT (now the WTO), the ILO, and the OECD. The Report's near-total silence on these long-term issues seems likely to reinforce the unfortunate tendency of the diplomatic process to focus on "an ambitious short term emission reduction target" to the exclusion of "long term practical policies."

Monitoring and Enforcement

Much of the Report is written as if there were a world government capable of levying taxes, enforcing emission limits, and defending property rights.¹⁹ Thus Chapter 1 (Section 1.3.4.3, p. 30) simply asserts that "In the absence of compulsory taxation, externalities can only be addressed with well-defined property rights ... and a legal system that enforces compensation for externalities" without seriously addressing the consequences of the absence of all of these elements from the current scene. All supranational discussions of climate change occur within the conventional framework of international law, within which compliance with treaty obligations is voluntary or, in some cases, enforced by limited sanctions. And there is no provision in the Framework Convention as it now stands for any use of sanctions to compel parties to meet their obligations. While it is conceivable that global institutions dealing with climate change could somehow come to exercise the sort of supranational authority that has been given to, say, the European Union, the enormous effort necessary to create the Union in a relatively small, culturally and economically homogeneous region indicates how very far away we are from anything like "compulsory taxation."

The problem of inducing compliance with emission mitigation policies without the ability to impose sanctions is raised toward the end of Chapter 11 (Section 11.6.5, p. 426), only to be immediately dismissed:

Indeed, it is a fundamental norm of international law that treaties are to be obeyed, and as a rule countries do not negotiate, sign, and ratify agreements with the intention that they will not comply fully with all relevant provisions. Hence, compliance is not as great a problem as it is sometimes taken to be. More difficult are the problems of negotiating an agreement that requires real sacrifices by the parties and of getting countries to sign the agreement in the first place.

Two examples are discussed just below this asserted proposition, presumably in order to support it. Instead, they seem to cast serious doubt on its validity.

It is first argued that widespread noncompliance with the reporting requirements of the Montreal Protocol have arisen not from bad intentions, "but rather because [countries] did not have

¹⁹ Indeed, one sometimes gets the impression that some sort of global climate czar is implicitly assumed. Thus, in discussing the effects of future carbon taxes, the Report notes (Section 1.5.5.5, p. 39), "If that were the only matter of concern, one could simply announce a commitment to impose such a tax sometime in the future..." Who could the "one" in this sentence possibly be?

the resources and technical know-how needed to carry out their obligations.” As even non-economists know, “I don’t have the money,” almost always means, “I have better things to do with the money.” If half the signatories to the Montreal Protocol are willing to claim in public that they couldn’t afford to meet the Protocol’s reporting requirements, it does not take much imagination or cynicism to predict near-universal non-compliance with a climate protocol involving costs that are orders of magnitude larger. A history of partial compliance with low-cost environmental treaty obligations argues that compliance with any burdensome future climate-related agreements is likely to be very spotty indeed.

Second, it is noted that noncompliance with certain oil pollution treaties was solved when an equipment standard was adopted that made monitoring easy, and it is asserted in passing that “monitoring of international agreements may be the more important problem.” This assertion is hard to dispute; one can only wish its implications had been explored. Most international environmental agreements rely on self-reporting, and almost none are well-monitored.²⁰ And, as I noted above, it is at least arguable that for technical reasons only CO₂ emissions from fossil fuels can be reliably monitored today.

Of course, as long as there is little political support anywhere for spending significant resources to control greenhouse gas emissions, problems of monitoring and compliance are not a binding constraint on the policy process. If there is no effective pressure to act, barriers to action have no consequences. But if perceptions and the political climate change, failure to have dealt with monitoring and enforcement problems may suffice to block significant collective action to mitigate climate change. After all, the compliance problem is not merely that agreements will fall short of their stated goals, but that nations fearing noncompliance by others will not sign agreements in the first place.²¹

Part of the solution to these problems clearly lies in research on methods of measuring greenhouse sources and sinks. If the world is to have the option of adopting a significant, comprehensive program of emission mitigation in the future, it must at least be possible for nations to monitor each others’ emissions. But an important part of the solution also lies in architectural and institutional design. Any serious abatement policy requires investment in collection of credible, internationally comparable data on sources and sinks. This, in turn, requires an institution with technical expertise, financial resources, and some degree of independence.

More importantly, I believe that even though the Report’s acceptance, particularly in Chapter 11, of the importance of at least nominally fixing the level of greenhouse gas emissions in the short run reflects the current tenor of international negotiations, it is nonetheless unwise.²² Countries can almost always plausibly blame unexpected fluctuations in domestic output or world markets—or the previous government—for failure to meet fixed emissions targets. And, if only

²⁰ See, for instance, Ausubel and Victor (1992) and U.S. General Accounting Office (1992).

²¹ The is but one reason why, in a world of poorly-monitored treaty compliance, it is a bit hard to take seriously the assertion quoted above that compliance is less of a problem than inducing nations to sign.

²² The Report asserts (Section 11.7.3, p. 431) that “the main advantage” of a tradable quota scheme over a carbon tax approach is that under the former “the resulting global emissions will be known with certainty for a global agreement and, net of carbon leakage for a nonglobal agreement.” It is at least very optimistic to assume perfect compliance in the absence of sanctions, as this statement does, and it is absolutely unclear why, when incomes, technologies, abatement costs, climate processes, and impacts are uncertain, there would be some special value in making emissions certain even if one could do so.

because there is a stochastic element in economic activity, and governments do change, it is difficult to imagine an international regime imposing sanctions tough enough to serve as deterrents on the basis of past violations of emission limits, particularly in the face of (nearly inevitable) promises to do better in the future.

Alternative Architectures

Because the Report does not seriously consider alternative institutional paths to strict global emission control regimes, it suggests that architectural issues of policy sequencing and dynamics are unimportant. This, in turn, tends to support simply doing the easiest tasks first. I believe that international negotiations are currently taking us down a path of this sort, with inadequate thought being given to where it is likely to lead.

The current focus of international negotiations is on achieving reductions in CO₂ emissions from fossil fuel use by industrialized (Annex 1) nations over the next few decades. In the summer of 1996, the U.S. joined other nations in calling for “legally binding” emissions limits.²³ It is not clear exactly what “legally binding” can mean in the absence of international enforcement, but the only way to guarantee that any nation’s emissions do not exceed any particular limit is to use a system of tradable permits domestically. Presumably little will be accomplished until most Annex 1 nations are willing to impose such systems on their domestic energy markets; what will happen thereafter will depend on how seriously nations choose to take the limits to which they have subscribed.

The policy architecture implicit in this approach may be characterized as “deep, then broad,” since any serious program of emission control must involve participation by developing as well as developed nations.²⁴ Unfortunately, it is not likely to be easy to broaden a geographically narrow tradable permits regime. In the first place, tradable permits regimes tend to be resistant to policy changes of any sort, since changes impose capital gains and losses on those with long or short positions in permits. In addition, as many studies have shown, any geographically limited regime would induce investment in CO₂-intensive activities in non-participating nations, and the owners of those investments would be new opponents of their nations’ participation. The need to obtain their assent would increase the international transfers required to broaden participation. Unfortunately, little if any attention is now being paid to the institutions necessary to effect such transfers or, more generally, to produce efficient international allocation of abatement effort. As noted above, achieving such an allocation would require moving well beyond the current pilot phase of joint implementation.

Schelling’s (1992, p. 13) reaction to commitments he anticipated that rich nations would make to specific percentage reductions in emissions points to an alternative architecture that I believe is superior on both environmental and economic grounds.²⁵

²³ Statement of Hon. Timothy E. Wirth, U.S. Under Secretary of State for Global Affairs, to the Second Conference of the Parties to the Framework Convention on Climate Change, Geneva, July 17, 1996.

²⁴ It will also ultimately be necessary to broaden emissions coverage beyond CO₂ emissions from fossil fuel use, but I believe the problem of broadening in this direction does not differ in severity between the alternative architectures considered here.

²⁵ To be clear, I do not believe that all nations that have adopted percentage reduction commitments have necessarily done so insincerely. A can be an indication of B without their being perfectly correlated.

I cannot help believing that adoption of such a commitment is an indication of insincerity. A serious proposal would specify policies, like taxes, regulations, and subsidies and would specify programs (like research and development), accompanied by very uncertain estimates of their likely effects on emissions. In an international public forum, governments could be held somewhat accountable for the policies they had or had not put into effect, but probably not for the emission levels achieved.

As I interpret Schelling's comments, they point to a "broad, then deep" architecture. This alternative would place less stress on near-term emissions reductions, which are of relatively little importance over the long haul, and would concentrate instead on developing institutions to ensure broad international participation in emissions abatement, which is essential to any serious effort. "Deepening" would involve later tightening constraints on global emissions and, perhaps, developing the institutions necessary to give teeth to "legally binding" emissions constraints, when and if participating nations make a collective decision to do this.

In order to enhance participation in a "broad, then deep" approach, I believe attention should not initially focus on actual emissions, which are affected by many factors beyond governments' control. Instead, I would follow Schelling and adopt a hybrid between tax and tradable permit regimes. This hybrid would involve international review of government actions, as do proposals for harmonized greenhouse gas taxes, but, unlike those proposals, it would not prescribe the form of domestic emissions control policies. It would make participation more attractive by not forcing nations to choose between adopting tradable permit systems and risking involuntary violations of their treaty commitments. It would involve internationally negotiated emission targets, as do tradable quota or permit schemes. Negotiation would concentrate on maximizing participation at acceptable cost, not on implications of abstract notions of fairness, and targets would accordingly not be burdensome on average in the short run. In order to provide policy flexibility, nations would demonstrate compliance by showing *ex ante* that their targets would likely be met rather than by demonstrating *ex post* that they were actually met.

The general approach of concentrating on *ex ante* evaluation of policies rather than *ex post* assessment of outcomes is not common in environmental treaties, but it has been employed to good effect by the OECD and the IMF, among other international organizations.²⁶ It also bears some resemblance to the administration of clean air policy in the U.S., which involves federal review of state implementation plans that link planned actions with achievement of air quality standards. It is in any case much easier to hold governments accountable for current policies than for past emissions, since the latter depend on policies in effect and random shocks occurring in the past.²⁷

Key to this hybrid approach, of course, is the ability to relate a nation's current policies to its likely future net trace gas emissions. This requires developing both data sources and modeling capabilities, as both the OECD and the IMF have done. If international public opinion is to be the main enforcement agent for the foreseeable future, and I believe this is likely to be the case, public opinion should be well and credibly informed by, at least, able and objective audits of national emissions forecasts. Developing an international institution capable of predicting individual

²⁶ For an insightful discussion of this approach and of the importance of developing data and expertise (along with a critique of the current "targets and timetables" approach), see Victor and Salt (1995).

²⁷ Largely for this reason I would favor an international carbon tax over a tradable permit or quota scheme, had I not been convinced by Chapter 11 that the carbon tax involves more serious implementation problems.

nations' greenhouse gas emissions with accuracy comparable to, say OECD predictions of national inflation rates is a difficult task, but, I would argue, an important one.

Both the "deep, then broad" and "broad, then deep" architectures imply feasible short-run agendas. The latter would build information, institutions, and international participation that have considerable insurance value, while the former would have difficulty moving beyond limited abatement efforts in a few nations. The hybrid approach described above would prepare the ground for more stringent policies, should they turn out to be justified. An important challenge would be to make this approach consistent with effective international cooperation involving both equitable burden-sharing and equalized marginal abatement costs. At the very least, it is hard to see the case for adoption of a "deep, then broad" architecture based on tradable permits without any serious analysis of "broad, then deep" architectures or other alternatives.

Some Additional Issues

The Report's discussion of several issues not mentioned above could have been more useful to policy-makers. First, and in some ways most important, is the Report's failure to point out the inconsistency between the cost-benefit approach and the objective specified in Article 2 of the Framework Convention:

... to achieve stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time frame 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.

The first and more quoted of these sentences presumes the existence of a threshold level of greenhouse gas concentrations, above which lies danger and below which lies safety. It seems to me that the charge to explore the use of benefit-cost analysis to inform climate change decision-making carries with it the requirement to consider the consistency of such analysis with the climate change objective that has been adopted by the international community. Since I have seen nothing suggesting the existence of a meaningful concentration threshold, I suspect this Emperor has no clothes. One could argue that the Report says as much, implicitly, by discussing the assessment of costs and benefits elsewhere instead of the existence or measurement of thresholds, but straight talk would have done much more to elevate the level of debate.²⁸

The second sentence quoted above seems to involve thresholds relating to rates of change of atmospheric concentrations. It appears to be presumed that ecosystems and food production can adapt without harm to rates of change below some level, while economic development will not be adversely affected if emissions and thus rates of change are (at least temporarily) above some level. The presumption that these goals are not inconsistent requires that the second of these thresholds is above the first. Again, nothing I have seen in the Report or elsewhere that justifies any of these

²⁸ Similar problems have arisen in other contexts, of course. U.S. Clean Air legislation rests on the assumption that there are threshold atmospheric concentrations of "criteria pollutants," below which human health is protected "with an adequate margin of safety." Limitations of measurement typically make it possible to find concentrations below which no health effects have been detected and, generally with a straight face, to identify those as the sought-after thresholds, but there is little support for the idea that such thresholds actually exist. See, *e.g.*, Portney (1990, pp. 31-36)

presumptions. If the Convention's objectives require policy debates to be somehow driven by unknown and probably imaginary thresholds, policy-makers should surely be told this. The high cost of a serious mitigation program could be substantially increased if it must be erected on an unsound conceptual foundation. On the other hand, if the Convention's stated objectives were not intended to be taken seriously, IPCC Working Group I's much-publicized analysis of stabilization at alternative concentration levels was largely wasted effort.

Second, the Report almost completely ignores the non-trivial scientific/economic problem of how to compare emissions of different greenhouse gases for the purpose of designing policy.²⁹ In the cost-benefit framework, comparisons of emissions of different gases at the margin must logically be based on discounted net damages. This basic principle implies that the GWPs computed by Working Group I and endorsed by the IPCC have no logical foundation or value for policy-analytic purposes. If this principle is ever stated (or disputed, for that matter) in the Report, I missed it.³⁰ Certainly, the Report does not attempt to apply this principle. It thus ignores an economic question that is central to the design of the comprehensive, multi-gas policies mandated by both the Framework Convention and common sense.

Third, the Report also pays insufficient attention to analytical issues raised by North-South resource transfers. At several points the Report does note both the likely importance of such transfers in any substantial mitigation effort and the difficulty of effecting them; *e.g.*, Section 2.4.2, p. 71:

Nevertheless the political and managerial difficulties surrounding such transfers need to be understood and respected by all parties if the process is not to collapse into an unproductive struggle over resource transfers.

Unfortunately, "the political and managerial difficulties" are not spelled out, nor are any related economic issues examined. Chapter 11 considers the potential role of carbon taxes or allocations of tradable quotas or permits in effecting transfers, but the discussion stops short of providing any useful guidance—or even indicating whether such guidance can currently be provided.

Finally, the Report properly notes at several points that because of the long time intervals involved, the development of new technologies has the potential to reduce dramatically the ultimate costs of both mitigation and adaptation policies. And at several points the Report goes on to argue for increased government spending for basic and near-basic research as insurance against the need to adopt stringent climate-related policies in the future. Most integrated assessments similarly conclude that near-term policies should include acceleration of the development of technologies that would be useful in connection with such policies.

But advances in basic research do not generate new commercial technologies without considerable additional investment, and it is not clear how, if at all, governments can usefully enhance this critical stage of the innovation process. As the Report (Section 1.5.4, p. 37) correctly notes, "...there is a general consensus among economists that the patent system provides a better basis for financing applied research than do government grants, largely because of the difficulties

²⁹ For treatments of this problem, see Hammitt, *et al.* (1996), Kandlikar (1995), Reilly and Richards (1993), Schmalensee (1993). The last of these papers is cited in passing in Chapters 1 and 11.

³⁰ The closest the Report seems to come to such a statement is to note (Chapter 1, note 8, p. 41) that Schmalensee's (1993) criticisms of GWPs would be immaterial "if all greenhouse gases had the same rate of decay." But, of course, they don't.

government has in picking those innovations most likely to produce high returns.” U.S. experience appears consistent with this consensus.³¹ Thus we have a potentially important and difficult question that the Report ignores: How can governments most efficiently encourage the development of new technologies that will reduce future abatement and mitigation costs? A related set of ignored questions have to do with efficient policies to enhance North-South technology transfer.

In a recent paper, Grubb, Chapuis, and Duong (1995) argue that a good way, perhaps the only good way to encourage development of energy-saving technologies is simply to raise the price of energy. Thus they argue that recognition of induced innovation tends, for instance, to raise optimal global carbon taxes. An interesting question in this context is whether or not slightly higher energy prices tend to accelerate development of technologies useful at much higher energy prices. It seems at least plausible that slightly higher prices would call forth incremental improvements, while the best response to much higher prices would be to investigate radical departures from current technologies. If this is true, the insurance value of feasible induced innovation is limited, and the search for alternative, relatively efficient approaches to encouraging the development and deployment of efficient, greenhouse-friendly technologies becomes more important.

Concluding Remarks

On the whole, the IPCC Working Group III Report is a very impressive document that clearly embodies many, many hours of hard and competent work. It presents much useful information on the economics of climate change, and its discussions of cost-benefit analysis and the principles of cost-effective environmental policy should be required reading for policy-makers with a wide range of responsibilities. Its generally negative evaluation of traditional command-and-control approaches to environmental policy should be read closely by those advocating adoption of common standards of various sorts by Annex I states.

On the other hand, the Report does not cover in adequate depth some issues that are important to near-term decisions. Considerable attention is devoted to hypothetical once-and-for-all policy choices that are not on the table, while the longer-term implications of current decisions are largely ignored. While the Report does note that the stringency of optimal abatement policies are likely to vary over the next several decades, the implications for institutional and architectural choice are not explored. The Report understates the importance of monitoring and enforcement problems. It is written as if a comprehensive global tradable permits regime were a live policy option instead of possible but distant goal. It ignores the value of building global participation and climate-related institutions and accepts the myopic focus of current international negotiations on (relatively) short-term reductions in emissions from industrial nations. To be clear, all these gaps mirror shortcomings in the existing literature, but that does not make them less important.

³¹ For an overview in the context of energy supply technologies, see Schmalensee (1980). Few observers would claim that the U.S. government’s large investment in research on those technologies has yielded competitive returns.

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