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International Policy Architecture to Address Global Climate Change: Beyond the Kyoto Protocol

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1. INTRODUCTION

The Kyoto Protocol (1997) to the United Nations Framework Convention on Climate Change (1992) may come into force despite the lack of participation by the United States, because 170 other nations are at least considering ratification, and the numerical requirements for entry into force may be met.[1] But the impacts of the Kyoto Protocol, targeted for the compliance period 2008-2012, will be much less than originally anticipated, because the largest emitter— the United States—will not be participating, and because the rules written at the post-Kyoto Conferences of the Parties significantly relaxed the aggregate target.[2] Yet a scientific consensus

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[1] Article 25 provides that the Protocol would enter into force 90 days after it has been ratified by 55 Parties to the Framework Convention on Climate Change, including Annex I countries accounting for at least 55 percent of total 1990 Carbon dioxide emissions by Annex I countries. Annex I (to the Framework Convention) is a list of industrialized nations plus economies in transition. The Kyoto Protocol designates the countries with emissions commitments as Annex B countries. With only a few exceptions, the set of countries with Annex B commitments is identical to the set of Annex I countries in the Framework Convention.

[2] The original Kyoto Protocol — if extended to the year 2050 — would lead to a 13 percent emissions reduction by that year, relative to 1990 emissions. Without the United States, the Protocol would lead to a 3-5 percent emission reduction world-wide. With the new rules, the anticipated aggregate emission reduction for the year 2050 would be only 1-2 percent, well within the bounds of prediction error. See: Böhringer 2002.

is increasing of likely future climate change due to anthropogenic emissions of carbon dioxide, methane, and other greenhouse gases (Watson 2001), and economic analysis points to the wisdom of some kind of policy action (Shogren and Toman 2000; Kolstad and Toman 2001). Given the global commons nature of the climate problem, a multi-national—if not fully global—approach is required.

Can the Kyoto Protocol provide the foundation for the way forward? To consider this question, it is helpful to examine the Protocol in terms of its major architectural elements:[3] its targets apply only to industrialized nations; it contains ambitious, short-term emissions reduction targets, but no long-term targets; and it provides flexibility through market-based mechanisms. This architecture has been widely criticized, chiefly because it would impose high costs, fail to provide for full participation by developing countries, and would generate only modest short-term climate benefits, while failing to provide a long-term solution. On the other hand, the argument has been made that the Kyoto Protocol is essentially "the only game in town," and "instead of suggesting alternatives, economists should concentrate on convincing policy makers how to get the long-term climate policy instruments right that build on Kyoto's foundations" (Michaelowa 2003).

Of course, even if the Kyoto Protocol were an ideal policy in abstract theoretical terms, it is noteworthy that it has failed to generate political support sufficient for it to come into force. A policy that appears perfectly efficient in theory but cannot be implemented is, in reality, highly inefficient, since all net benefits are foregone (McKibbin and Wilcoxen 2002; Barrett and Stavins 2003). Some have expressed the sentiment that given the tremendous amount of work that went into crafting the Kyoto Protocol, it should be kept and strengthened, not abandoned. But from an economic perspective, the previous investments are sunk costs, and the relevant question becomes the likelihood—going forward—that incremental improvements in the Protocol will yield greater net benefits than efforts dedicated to developing an alternative framework.[4]

[3] The importance of focusing on policy "architecture" in the global climate domain was first emphasized by Schmalensee 1998. See also: Victor and Salt 1995; Stavins 1997; and Sandalow and Bowles 2001.

[4] On the other hand, there have been valuable investments in human capital that reflect the long international negotiating process that led up to and followed the signing of the Kyoto Protocol (Aldy 2004). A prominent example is the gradual emergence of support from many countries for domestic and international emissions trading regimes. I consider the possible significance of this in section 2.3.

In this paper, I remain agnostic on the question of the Kyoto Protocol's viability. Some analysts see the agreement as "deeply flawed," while others see it as an acceptable first step.[5] But virtually everyone agrees that the Kyoto Protocol is not sufficient to the overall challenge, and that further steps will be required.[6] This is my starting point, and the policy architecture outlined below may be thought of either as a substitute for the Kyoto Protocol or as a post-Kyoto framework, that is, in either case, "beyond the Kyoto Protocol."

Some critics of the Protocol have raised an additional, broader question: whether an inclusive international agreement — labeled a "top-down" approach by Victor (2004a, 2004b)— is appropriate for the climate change challenge, or whether success is more likely with a "bottom-up" approach from a relatively small set of nations (including presumably the European Union, Canada, Japan, and the United States), facilitated by a multilateral agreement ("communiqué") by the heads of state of twenty leading nations — the "L20."[7] In this paper, I also am agnostic on this question of top-down versus bottom-up approaches. The policy architecture I offer may be considered either as a top-down alternative to Kyoto or as a triad of principles for a L20 communiqué that could lead to a bottom-up approach.

2. A THREE-PART POLICY ARCHITECTURE

In a survey of global climate policy architectures, Aldy, Barrett, and Stavins (2003) reviewed the Kyoto Protocol and thirteen alternative architectures, employing six criteria to evaluate each policy proposal: environmental outcome, dynamic efficiency, cost effectiveness, equity, flexibility in the presence of new information, and incentives for participation and

[5] Among the skeptics are Victor 2001, Cooper 2002, and McKibbin and Wilcoxen 2002, 2004. The Kyoto optimists include Grubb 2003 and Michaelowa 2003.

[6] Claussen (2003) has written: "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" (p. ii).

[7] Victor (2004b) does not specify the list of countries for a L20 meeting, but notes that twenty countries were responsible for 74 percent of global CO2 emissions in 2001: United States, 24%; China, 13%; Russia, 7%; Japan, 5%; India, 4%; Germany, 3%; Canada, United Kingdom, Italy, Korea, France, South Africa, and Australia, 2% each; and Ukraine, Mexico, Brazil, and Iran, 1% each. This list omits some countries that presumably would be important to include, such as Indonesia and Malaysia, because of their regional prominence or their importance for other issues (Victor 2000c).

compliance. Four major themes emerged: Kyoto is "too little, too fast"; developing countries should play a more substantial role; implementation should focus on market-based approaches; and participation and compliance incentives should be included.

The framework I suggest is based on fundamental aspects of the science, economics, and politics of global climate change policy. In the sections that follow, I describe the architecture of this alternative approach in terms of its three chief components: (1) participation includes major industrial nations and key developing countries; (2) emphasis is given to an extended time-path of targets, employing a cost-effective pattern over time; and (3) market-based policy instruments are used.[8]

2.1 Expanding Participation

Expanding participation—to include both major industrialized nations and key developing countries—is essential to address this global commons problem effectively and efficiently.[9] This is because, first of all, the share of global emissions attributable to developing countries is significant and growing. In fact, developing countries may account for more than half of global emissions by the year 2020, if not before (Nakicenovic and Swart 2000; Pies and Schröder 2002). It has been argued that industrialized countries should take initial steps of making serious emissions reductions, but developing countries provide the greatest opportunities for relatively low-cost emissions reductions (Watson 2001).

A reasonable response to this observation about cost-effectiveness is that industrialized countries are solely responsible for the bulk of anthropogenic concentrations of greenhouse gases in the atmosphere. Hence, industrialized countries should go first with emissions reductions. Although sensible arguments can be made in support of this position on grounds of distributional equity, there is a serious problem.

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[8] In this essay, I take as given the desirability of limiting long-term concentrations of CO2 (and other greenhouse gases) in the atmosphere. For examinations of dynamically efficient policies (which maximize present value net benefits), see: Hammitt 1999; Nordhaus and Boyer 2000; and McKibbin and Wilcoxen 2002.

[9] See Schmalensee's (1998) endorsement of a "broad and shallow agreement," in contrast with a "narrow and deep" one.

If key developing countries are not included in an initial agreement, then comparative advantage in the production of carbon-intensive goods and services will shift outside of the coalition of participating countries, making developing country economies more carbon intensive than they otherwise would be (through so-called emissions leakage[10]). Rather than helping developing countries move onto less carbon-intensive paths of economic development, the industrialized world would actually be pushing them onto *more* carbon-intensive growth paths. This would increase their cost of joining the coalition later. Still, it is probably unreasonable to expect developing nations to incur significant emissions-reduction costs in the short-term, because doing so could severely retard their economic development.

There is thus a policy conundrum. On the one hand, for purposes of environmental effectiveness and economic efficiency, key developing countries must be participants in an international effort to reduce greenhouse-gas emissions. On the other hand, for purposes of distributional equity, they cannot be expected to incur the consequent costs. There is a solution. These countries must "get on the global climate policy train, but they need not pay for their tickets." How can this be accomplished?

Four elements of this first architectural component—expanding participation—can provide appropriate incentives for developing countries. First, a mechanism is needed for voluntary accession of developing countries into the group of nations that takes on binding commitments. Examples exist for such voluntary accession in the case of the sulfur dioxide (SO2) allowance trading program in the United States under the Clean Air Act amendments of 1990. Second, and much more important, a trigger mechanism is required whereby developing countries would be obligated to take on binding commitments once their per capita gross domestic product reached agreed levels. Third, an even better approach would be "growth targets" that would become more stringent for individual developing counties as they become more wealthy (Frankel 1999, 2002). In the short-term, such indexed targets could be set at business-as-usual (BAU) emissions levels, but would become more stringent over time *if* the countries in question became wealthier. Fourth, by combining growth targets with a well-

[10] If an agreement is restricted to the industrialized counties, such emissions leakage can be significant, with rates ranging from 5% to 34% for individual countries if they were required to meet their targets domestically; international emissions trading might reduce the leakage rates by half (Paltsev 2001).

designed international tradeable permit program, which I discuss below, developing countries can fully participate without incurring prohibitive costs (or even any costs in the short term). That is, both cost effectiveness and distributional equity can be addressed. By providing a forum where a relatively small number of key countries can take on initial commitments, the L20 can help facilitate this first element of the three-part architecture.

2.2 An Extended Time-Path of Targets Employing a Cost-Effective Intertemporal Pattern

Global climate change is a long-term problem. The relevant greenhouse gases remain in the atmosphere for decades to centuries. The Kyoto Protocol does not sufficiently reflect this fundamentally important reality: the cumulative, stock-pollutant nature of the problem. The Protocol has only short-term targets, an average 5 percent reduction from 1990 levels by the 2008-2012 compliance period. That apparently modest reduction translates into a severe 25-30 percent reduction for the United States from its BAU emissions path.[11] The reason for this is that the United States economy grew at an exceptionally rapid rate during the 1990s, exhibiting a remarkable 37 percent increase in real GDP from 1990 to 2000.[12] Thus, the Kyoto Protocol's targets are *too little, too fas*t: they do little about the problem, but are unreasonable for countries that enjoyed significant economic growth post 1990.

Two elements are needed: firm but moderate targets in the short term in order to avoid rendering large parts of the capital stock prematurely obsolete (Frankel 2002); and flexible but

[11] This contrasts dramatically with the situation in Europe and elsewhere. Emissions of CO2 from the United Kingdom, Germany, and Russia fell significantly subsequent to 1990 (the Kyoto Protocol's baseline year), and for reasons having nothing to do with climate change or other environmental policy. It is well known that emissions fell in the United Kingdom because of structural changes in the domestic coal industry initiated by the Thatcher government, that emissions fell in Germany because reunification led to the closure of energy-inefficient plants in the former East Germany, and that emissions fell in Russia because of that nation's economic collapse in the 1990s (McKibbin and Wilcoxen 2002). Importantly, it has been estimated that 80 percent of the European Union's CO2 reductions under the Kyoto Protocol would be achieved by two countries — Germany and the United Kingdom (Andersen 2002), facilitated via the EU bubble that is part of the Protocol. These factors help explain the very different perspectives on the Kyoto Protocol held by Europeans and Americans, but other historical phenomena are also at work Kagan 2002).

[12] Real GDP increased from $6.71 trillion in 1990 to $9.19 trillion in 2000 (U.S. Council of Economic Advisers 2003). U.S. carbon emissions increased by 12 percent (165 million metric tons) between 1990 and 1999, whereas Western European emissions increased by 1 percent (9 million metric tons) over the same period (McKibbin and Wilcoxen 2002).

more stringent targets for the long term[13] to motivate (now and in the future) needed technological change to bring down costs over time (Goulder and Schneider 1999; Jaffe, Newell, and Stavins 1999; Pershing and Tudela 2003). Emissions targets ought to begin at BAU levels, then gradually depart from these, so that emissions targets in the short term would, in fact, be increasing over time, but at rates below the rate of increase exhibited by BAU levels. Such intertemporal emissions targets should not be monotonically increasing, but reach a maximum level, and then begin to decrease, eventually becoming substantially more severe than the constraints implied by the Kyoto Protocol's short-term targets.[14]

This pattern would be consistent with estimates of the least-cost time path of emissions for achieving long-term greenhouse-gas concentration targets:[15] short-term emission increases, just slightly below the BAU path, and subsequent emission reductions (Wigley, Richels, and Edmonds 1996; Manne and Richels 1997).[16] Such a time path of future targets, put in place now, would be consistent with what has been denigrated as "politics as usual." In representative democracies there are strong incentives to place costs on future, not current voters, and if possible, future generations. It is the politically pragmatic strategy. There is no denying that there are serious questions regarding the stability of a system of long-term targets, but in the case of global climate policy, it is a scientifically correct and economically rational approach.

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[13] The longer-term targets should be flexible, because there is considerable uncertainty throughout the policy-economics-biophysical system, some of which will be resolved over time (Richels, Manne, and Wigley 2004). The decision rules that would introduce flexibility to targets should therefore be linked with learning about both the economic and the biophysical realm (and both of these realms connect with the damage — benefit — as well as the cost side).

[14] For an analysis of the implications of combining such an intertemporal pattern of targets with gradual expansion of the coalition of nations that take on targets, see: Den Elzen 2002.

[15] This leaves open the question of what criterion or criteria should be used to identify a long-term concentration target and time-path: dynamic efficiency (Hammitt 1999; Nordhaus and Boyer 2000; McKibbin and Wilcoxen 2002); a time-path of emissions that will not rule out a change to a very low concentration target (for example, 350 or 450 parts per million in 2100) if learning indicates that climate sensitivities and/or damages are greater than originally thought (Aldy 2004); or others.

[16] For the global goal — often discussed — of stabilizing atmospheric concentrations of CO2 at twice pre-industrial levels (that is, approximately 550 parts per million), Wigley, Richels, and Edmonds (1996) estimated that the cost-effective time path of emissions would involve global emissions peaking in 2030. Manne and Richels (1997) found that severe emission reductions should take place only in the second half of the 21st century. Another reason why such time-paths of emissions are cost-effective is that they allow the natural carbon cycle "to do some of the work:" a portion of the higher emissions occurring in the short term are absorbed by the oceans, where they may be stored as deepwater carbon concentrations for centuries (Aldy 2004).

Several analysts have expressed considerable skepticism regarding the ability of nations to commit credibly to long-term goals (Cooper 2002; Victor 2004a, 2004b). The bottom-up L20 approach may offer a forum where a relatively small number of key countries can make visible commitments and thereby ease the task of setting a credible time-path of targets (Victor 2004c).

2.3 Market-Based Policy Instruments

The final component of the three-part policy architecture is to work through the market rather than against it. To keep costs down in the short-term and bring them down even lower in the long-term through technological change, it is essential to embrace market-based instruments as the chief means of reducing greenhouse gas emissions (Stavins 1997).

For some countries, domestically, systems of tradeable permits might be used to achieve national targets. This is the same mechanism used in the United States to eliminate leaded gasoline from the market in the 1980's at a savings of over $250 million dollars per year (Stavins 2003). It is also the same mechanism now being used to cut sulfur dioxide (SO2) emissions as a precursor of acid rain in the United States by 50 percent, at a savings estimated to be $1 billion dollars per year (Schmalensee *et al.* 1998; Stavins 1998; Ellerman *et al.* 2000). Of the two systems, the better model for climate change is the upstream lead-rights system (analogous to trading based on the carbon content of fossil fuels), rather than the downstream SO2 emissions trading system.[17]

For some countries, systems of domestic carbon taxes may be more attractive (Kolstad and Toman 2001; McKibbin and Wilcoxen 2002).[18] Another promising market-based approach is a hybrid of tax and tradeable-permit systems, that is, an ordinary tradeable permit system, plus a government promise to sell additional permits at a stated price (Roberts and Spence 1976;

[17] It is not necessary that the (upstream) level of compliance be the same as the (possibly downstream) level of initial allocation.

[18] Norway introduced a carbon tax in 1991. Despite its considerable magnitude and consequent induced increases in fuel prices, impacts on CO2 emissions were modest, in part because of extensive tax exemptions (Bruvoll and Larsen 2004).

Kopp, *et al.* 2000; Pizer 2002; McKibbin and Wilcoxen 2002). This creates a price (and thereby cost) ceiling, and has hence been labeled a safety-valve system.[19]

International policy instruments are also required, of course, for this fundamentally international—indeed global—problem. The Kyoto Protocol includes in Article 17 a system whereby the parties to the agreement — the respective governments—can engage in trading their "assigned amounts," that is, their reduction targets, translated into quantitative terms of emissions. In theory, such a system of international tradeable-permits—if implemented only for the industrialized countries (as in the Kyoto Protocol)—could reduce costs by 50 percent; and if such a system included major developing countries, costs could be lowered to 25 percent of what they otherwise would be (Edmonds *et al.* 1997).[20] An undisputed attraction—in theory—of an international trading approach is that the equilibrium allocation of permits, the market-determined permit price, and the aggregate costs of abatement are independent of the initial allocation of permits among countries, as long as particularly perverse types of transaction costs are not prevalent (Stavins 1995), and individual parties — be they nations or firms — do not have market power. The last concern is a significant and real one in the Kyoto context, however.[21] In any event, the initial allocation can be highly significant distributionally, implying possibly massive wealth transfers. Essentially, it is in this way that a permit system can be used to address both cost effectiveness and distributional equity.[22]

If an international trading system is used, it must be designed to facilitate integration with domestic policies nations use to achieve their targets. In the extreme, if all countries use domestic tradable permit systems to meet their national targets (that is, allocate shares from the

[19] For a description of the origin and evolution of the concept in climate policy deliberations, an assessment of its potential application as a domestic policy instrument, and an evaluation of potential problems it would present if adopted as an international policy instrument, see: Jacoby and Ellerman 2004.

[20] Others have argued in favor of an international tax regime. See, for example: Cooper 1998; McKibbin and Wilcoxen 2002, 2004; Pizer 2002; and Newell and Pizer 2003.

[21] If, for example, the majority of excess permits (allowable emissions in excess of business-as-usual emissions, or so-called "hot air") is found in a relatively small number of nations in Central and Eastern Europe and the former Soviet Union, then the possibility of collusion among such sellers becomes quite likely (Manne and Richels 2004). Also see: Springer and Varilek 2004.

[22] Phrased differently, freely-allocated tradeable permits can be used to buy political support — domestically or internationally. Not surprisingly, private industry endorses the trading approach, rather than taxation (Browne 2004).

international permit system to private domestic parties), then an international system can—in theory—be cost-effective. But if some countries use non-trading approaches, such as greenhouse gas taxes or fixed-quantity standards—which seems likely—cost minimization is not ensured (Hahn and Stavins 1999).[23] Thus, individual nations' choices of domestic policy instruments to meet their targets can substantially limit the cost-saving potential of an international trading program. In this realm, a trade-off exists between the degree of domestic sovereignty and the degree of cost-effectiveness.

Not long ago, most observers would have predicted that few, if any, European countries would employ tradeable permit systems, given the European Union's strenuous opposition to such approaches dating back to the time of the Kyoto Protocol. But the EU has now launched a continent-wide trading system. Furthermore, by the time of the Conferences of the Parties in Bonn and Marrakech, China and the G-77 had, in effect, dropped their opposition to international emissions trading (Aldy 2004). Combined with the strong U.S. preference for trading, these realities represent important political arguments for this element of a future international policy architecture.

International permit trading thus remains a promising approach to achieving global greenhouse targets, despite the challenge that any program must be integrated carefully with domestic policies. It is probably fair to state that the more one studies international tradeable-permit systems to address global climate change, the more one comes to believe that this is the worst possible approach, except—of course—for all the others.

3. CONCLUSION

The three-part global climate policy architecture outlined above can be viewed either as a follow-up to or as a substitute for the Kyoto Protocol, and either as a top-down alternative or as the framework for a L20 communiqué that could lead to a bottom-up approach. First, key nations have to be involved, including major developing countries through the use of economic trigger mechanisms, such as growth targets. Second, extended, cost-effective time-paths of

[23] In such cases, achieving the potential cost savings of international trading would require some form of project-by-project credit program, such as the Kyoto Protocol's Clean Development Mechanism (CDM). But theory and experience with such credit programs suggest that they are less likely to facilitate major cost savings, because of large transaction costs, likely government participation, and the absence of a well-functioning market.

targets are required: in the short-term, firm but moderate, and in the long-term, flexible but much more stringent. Third, market-based policy instruments are part of the package, whether emissions trading, carbon taxes, or hybrids of the two.

This overall approach can be made to be scientifically sound, economically rational, and politically pragmatic. There is no denying that the challenges facing adoption and successful implementation of this type of climate policy architecture are significant, but they need not be insurmountable, and they are not necessarily any greater than the challenges facing other approaches to addressing the threat of global climate change.

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