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on Sound Science,  
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Robert N. Stavins

1616 P St. NW  
Washington, DC 20036  
202-328-5000 [www.rff.org](http://www.rff.org)

# **CAN AN EFFECTIVE GLOBAL CLIMATE TREATY BE BASED ON SOUND SCIENCE, RATIONAL ECONOMICS, AND PRAGMATIC POLITICS?**

**Robert N. Stavins**

*John F. Kennedy School of Government, Harvard University and Resources for the  
Future*

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*Send Comments to:*

Prof. Robert N. Stavins  
John F. Kennedy  
School of Government  
Harvard University  
79 John F. Kennedy Street  
Cambridge, Massachusetts 02138  
Phone: 617-495-1820 Fax: 617-496-3783  
E-Mail: robert\_stavins@harvard.edu

## ABSTRACT

The Kyoto Protocol (1997) to the United Nations Framework Convention on Climate Change (1992) may come into force without U.S. participation, but its effects on climate change will be trivial. At the same time, the economic and scientific consensus points to the need for a credible international approach. A reasonable starting point is the Framework Convention on Climate Change (FCCC), which was signed by 161 nations and ratified by 50, including the United States, and entered into force in 1994. 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 or even excellent first step. But virtually everyone agrees that the Protocol is not sufficient to the overall challenge, and that further, subsequent steps will be required. This is my starting point for proposing a three-part policy architecture: first, all nations would be involved through the use of economic trigger mechanisms, such as growth targets; second, long-term targets would be required — in the short-term, firm, but moderate targets, and in the long-term, flexible, but much more stringent targets; and third, market-based policy instruments would be part of the package — emissions trading, carbon taxes, or hybrids of the two. This overall approach can be made to be scientifically sound, economically rational, and politically pragmatic.

**Keywords:** global climate change, global warming, policy architecture, Kyoto Protocol

**JEL Classification:** Q54, Q58, Q48, Q39

# **Can an Effective Global Climate Treaty Be Based on Sound Science, Rational Economics, and Pragmatic Politics?**

Robert N. Stavins\*

## **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 as of 2004, 170 other nations are at least talking about ratification, and the numerical requirements may be met. The key requirement is that a minimum of 55 nations, representing 55 percent of 1990 industrialized world emissions of carbon dioxide (CO<sub>2</sub>),<sup>1</sup> must ratify the agreement.

If all countries except the United States were to ratify the Kyoto Protocol, close to 64 percent of 1990 industrialized world emissions would be represented, and the Protocol would come into force. Australia, in addition to the United States, has indicated that it will not ratify the agreement. Removing Australia drops the relevant share of 1990 emissions to about 62 percent, still enough to bring the agreement into force.<sup>2</sup> If the United States, Australia, and Japan failed to ratify, then the emissions share covered would fall to less than 53 percent, below the 55 percent threshold.

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\*Albert Pratt Professor of Business and Government, John F. Kennedy School of Government, and Director, Environmental Economics Program at Harvard University; and University Fellow, Resources for the Future. This paper draws upon an oral briefing the author carried out for United Nations Secretary-General Kofi Annan, "After Kyoto: Climate Change Strategies for the United Nations" (April 24, 2002). Helpful comments on a previous version of the manuscript were provided by Joseph Aldy, John List, and Richard Richels, but the author is responsible for any errors.

<sup>1</sup>Article 25 of the Kyoto Protocol states that the agreement will enter into force 90 days after the date on which it has been ratified by at least 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.

<sup>2</sup>Previously there was some question whether Canada would decline to ratify the agreement. This would have cut the emissions share to less than 59 percent.

Likewise, if all countries except the United States, Australia, and Russia failed to ratify, then the total share of 1990 industrialized world emissions accounted for by ratifying countries would be only about 44 percent.<sup>3</sup>

These numbers are important because they explain why the rules of the agreement were re-written at the Conferences of the Parties (COPs) of the Framework Convention on Climate Change in ways that lowered the costs for Canada, Japan, and Russia to ratify the Protocol. In the process of doing so, the environmental integrity of the agreement was compromised; that is, the overall target was substantially decreased (McKibbin and Wilcoxon 2004).

The impacts of the Kyoto Protocol on emissions of greenhouse gases,<sup>4</sup> targeted exclusively for the compliance period 2008-2012, will be much less than originally anticipated. First, the largest emitter, the United States, apparently will not be participating. Second, as indicated above, the rules written at the COPs in Bonn and Marrakech in 2001 had the effect of significantly relaxing the aggregate target.<sup>5</sup> Yet a scientific consensus is increasing of likely future climate change due to anthropogenic emissions of carbon dioxide, methane, and other greenhouse gases (Watson 2001).<sup>6</sup> And economic analysis increasingly points to the wisdom of some kind of policy action (Shogren

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<sup>3</sup>On September 29, 2003, Russian President Vladimir Putin refused to commit his country to ratification of the Kyoto Protocol (Glasser 2003). For ratification to be completed, the document would need to be submitted to the Russian parliament, which was described as unlikely to review the Protocol before December parliamentary elections (Isachenkov 2003). On December 2, 2003, senior Russian officials indicated that Russia was unlikely to ratify the agreement (Myers and Revkin 2003).

<sup>4</sup>CO<sub>2</sub> is the primary anthropogenic driver of climate change. Other important anthropogenic greenhouse gases are: methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), and various halocarbons (Watson 2001).

<sup>5</sup>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, for example: Böhringer (2002).

<sup>6</sup>Also see Holdren (2003) for a survey of the risks of global climate change.

and Toman 2000; Kolstad and Toman 2001).<sup>7</sup> In summary, the Kyoto Protocol may come into force without U.S. participation, its effects on climate change will be trivial to virtually non-existent, and yet, the economic and scientific consensus points to the need for a credible international approach.<sup>8</sup>

What can be done?

A reasonable starting point is the Framework Convention on Climate Change (FCCC), which was signed by 161 nations and ratified by 50, including the United States, and entered into force in 1994. Among other things, the Convention established the principle of “common but differentiated responsibilities,” meaning that all nations should engage in the solution (because of the global-commons nature of the problem), but different countries could participate in different ways.

If the FCCC provides a reasonable starting point, can the Kyoto Protocol provide the way forward? To consider this question, it is helpful to examine the Protocol in terms of its major architectural elements:<sup>9</sup> 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, such as tradeable permits. This architecture has been widely criticized,<sup>10</sup> chiefly because it would impose high costs, fail to provide for full participation by developing countries,

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<sup>7</sup>In this essay, I take as given the desirability of limiting long-term concentrations of CO<sub>2</sub> (and other greenhouse gases) in the atmosphere. For examinations of dynamically efficient policies (which maximize present value net benefits), see: Hammitt (1999); and McKibbin and Wilcoxon (2002).

<sup>8</sup>Given the global commons nature of the climate problem, a multi-national — if not fully global — approach is required. A truly efficient climate change agreement would secure full participation by all countries, with each and every country mitigating its emissions to the point where its own marginal abatement costs equaled the sum of marginal benefits globally. But taking the behavior of other countries as given, each country can do better by mitigating only up to the point where its own marginal benefit equals its marginal cost. As long as global marginal benefits exceed every nation’s own marginal benefits, countries will either want to avoid participating or avoid complying fully, if they do participate. Successful international cooperation must change these incentives. See: Barrett and Stavins (2003). Despite these arguments, some have pressed for unilateral approaches, as in the United States (McCain and Lieberman 2003).

<sup>9</sup>The general importance of focusing on policy “architecture” and institutions in the global climate domain was first noted by Schmalensee (1998). See also: Victor and Salt (1995); Stavins (1997); and Sandalow and Bowles (2001).

<sup>10</sup>For a summary of critiques of the Kyoto Protocol, and alternatives that have been proposed, see: Aldy, Barrett, and Stavins (2003)

and generate 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).

Even if the Kyoto Protocol were an ideal policy in abstract theoretical terms, its failure to generate support sufficient for it to come into force is significant. 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 Wilcoxon 2003; 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. Of course, 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.

In this paper, I remain agnostic on the question of the Kyoto Protocol’s viability. Some analysts see the agreement as “deeply flawed,”<sup>11</sup> while others see it as an acceptable first step.<sup>12</sup> But virtually everyone agrees that the Kyoto Protocol is not sufficient to the overall challenge, and that further steps will be required.<sup>13</sup> This is my starting point, and the policy architecture outlined in this paper may be thought of either as a substitute for the Kyoto Protocol or as a post-Kyoto framework.

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<sup>11</sup>See, for example: Victor (2001); Cooper (2002); and McKibbin and Wilcoxon (2002, 2004).

<sup>12</sup>See, for example: Grubb (2003); and Michaelowa (2003).

<sup>13</sup>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).

## 2. A THREE-PART POLICY ARCHITECTURE

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) all nations are involved; (2) emphasis is given to long-term targets; and (3) market-based policy instruments are employed.

### 2.1 Global Participation

Broad participation — both by major industrialized nations and by key developing countries — is essential to address this global commons problem effectively and efficiently. 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.<sup>14</sup> A frequently voiced response to this assertion is that — on an ethical basis — industrialized countries should — on their own — take the initial steps of making serious emissions reductions. But the simple reality is that developing countries provide the greatest opportunities now for relatively low-cost emissions reductions (Watson 2001). Hence, it would be excessively and unnecessarily costly to focus emissions-reductions activities exclusively in the developed world.

There is also a reasonable response to this observation about cost-effectiveness, namely that it is the industrialized countries that are solely responsible — virtually by definition — for anthropogenic concentrations of greenhouse gases in the atmosphere, since the emissions were the result of industrialization, that is, the result of emissions by industrialized countries. Hence, the argument is made that industrialized countries should go first with emissions reductions, and

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<sup>14</sup>See, for example: Nakicenovic and Swart (2000); and Pies and Schröder (2002).

developing countries take on such efforts only later. Although sensible arguments can be made in support of this position on the grounds of distributional equity, there is a serious problem.

If developing countries are not included in an agreement now, 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<sup>15</sup>). 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.<sup>16</sup> This would increase their cost of joining the coalition later. Still, on equity grounds, it is unreasonable to expect developing nations to incur significant emissions-reduction costs in the short-term. It would retard their economic development.

There is thus a policy conundrum. On the one hand, for purposes of environmental effectiveness and economic efficiency, developing countries must be full 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?

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<sup>15</sup>Even if an agreement were restricted to the industrialized countries, as under the Kyoto Protocol, 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).

<sup>16</sup>It is an empirical reality that with most pollutants, as countries become more wealthy beyond some threshold level of wealth, their emissions decrease, at least partly as a function of endogenous domestic environmental policy initiatives, exhibiting the so-called environmental Kuznets curve, which Grossman and Krueger (1995) found peaked at per capita income levels below \$8,000. Grossman and Krueger did not examine CO<sub>2</sub> emissions. Subsequent studies that did so estimated turning points of \$10,000 per capita income (Schmalensee, Stoker, and Judson 1998), \$14,000 (Cave and Blomquist 2003), \$25,000 (Cole, Rayner, and Bates 1997), or higher, but the focus in each of those studies was per capita CO<sub>2</sub> emissions, not aggregate emissions.

Four key elements of this first architectural component — global participation — can provide incentives for developing countries to accept a complementary ticket on the global climate policy train. 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 (SO<sub>2</sub>) 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 countries as they become more wealthy.<sup>17</sup> In the short-term, such indexed targets could be set at business-as-usual (BAU) emissions levels,<sup>18</sup> but would become more stringent over time *if* the countries in question became wealthier. In other words, a growth target is not a number, but an equation that relates targeted emissions to per capita income and possibly other variables. Thus, if a developing country was doing particularly well economically, its target would become proportionately more stringent, but, likewise, if a developing country was doing worse economically than anticipated, its target would be less stringent than otherwise.

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<sup>17</sup>This is a natural extension of the pattern of target allocation present in the Kyoto Protocol. The extension is from the industrialized world to the developing world, and from the cross-sectional dimension to the temporal dimension. The Kyoto Protocol’s targets already exhibit some degree of positive correlation between national wealth (in particular, gross domestic product per capita) and degree of targeted emissions reduction. Frankel (1999) finds that the Kyoto targets exhibit an “income elasticity of reductions” of 0.10, that is, for a ten percent increase in per capita GDP, the targets — on average — become about one percent more stringent. On this, and other aspects of growth targets, see: Frankel (1999) and (2002). In 1999, the Argentine government offered to take on an emissions commitment indexed to its economic growth. Lutter (2000) provides an analysis.

<sup>18</sup>For that matter, the short-term targets for developing countries could be set at emissions levels that are *above* BAU levels, although such headroom has been denigrated as “hot air” in the case of Russia’s target in the Kyoto Protocol. If combined with an international trading program (see section 2.3), this would provide a direct economic incentive (subsidy) for developing-country participation.

It should be noted that the degree of abatement (percentage reduction below BAU emissions) depends upon a number of factors, including the specific formula (index) employed in the growth target equation, the affected country's rate of economic growth, and the make-up of the country's economy. A target such as that proposed in 1999 by Argentina — for emissions growth to be proportional to the square root of GDP — would have the effect of setting more stringent abatement targets when economic growth is more rapid than anticipated, and less stringent targets when economic growth is slower than anticipated. In any event, two necessary characteristics of a growth target formulation are that: (1) it not create perverse incentives; and (2) be relatively simple, so as not to create impediments to negotiation (Aldy, Baron, and Tubiana 2003).

Fourth, by combining growth targets with a well-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.<sup>19</sup>

## **2.2 Long-Term Targets**

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 may sound like a modest reduction, but it translates into a severe 25-

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<sup>19</sup>If provision is not made for growth targets or some other mechanism that includes developing countries at low or no cost to them, then analysis inevitably points to a trade-off between cost effectiveness (or efficiency) and distributional equity. For a recent example of this phenomenon, see: Sugiyama and Deshun (2004).

30 percent reduction for the United States from its BAU emissions path.<sup>20</sup> 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.<sup>21</sup>

Thus, the Kyoto Protocol's targets are *too little, too fast*: they do little about the problem, but are unreasonable for countries that enjoyed significant economic growth post 1990. Two elements are needed: first, firm but moderate targets in the short term in order to avoid rendering large parts of the capital stock prematurely obsolete (Frankel 2002); and second, flexible but more stringent targets for the long term<sup>22</sup> in order 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).<sup>23</sup> Specifically, emissions targets ought to start out 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. Importantly, these intertemporal emissions targets should not be monotonically increasing, but reach a maximum

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<sup>20</sup>This contrasts dramatically with the situation in Europe and elsewhere. Emissions of CO<sub>2</sub> 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 Wilcoxon 2002). Importantly, it has been estimated that 80 percent of the European Union's CO<sub>2</sub> reductions under the Kyoto Protocol will 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 to explain the very different perspectives on the Kyoto Protocol held by Europeans and Americans, but other historical phenomena are also at work. On this, see, for example: Kagan 2002.

<sup>21</sup>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 Wilcoxon 2002).

<sup>22</sup>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. See, for example: Richels, Manne, and Wigley (2004).

<sup>23</sup>For a broader survey of the relationship between technological change and the environment, see Jaffe, Newell, and Stavins (2003).

level, and then begin to decrease, eventually becoming substantially more severe than the constraints implied by the Kyoto Protocol's short-term targets.<sup>24</sup>

This pattern would be consistent with estimates of the least-cost time path of emissions for achieving long-term greenhouse-gas concentration targets: short-term emission increases, just slightly below the BAU path, and subsequent emission reductions (Wigley, Richels, and Edmonds 1996; Manne and Richels 1997).<sup>25</sup> Such a time path of future targets, put in place now, would be consistent with what is often denigrated as “politics as usual.” Frequently politicians are condemned for the fact that 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. In the case of global climate policy, it is also the scientifically correct and economically rational approach.

### **2.3 Market-Based Policy Instruments**

The final component of the three-part policy architecture is — in principle — part of the Kyoto Protocol: working through the market rather than against it. There is widespread agreement that conventional regulatory approaches — so-called “command-and-control” policies — cannot do the job, certainly not at acceptable costs. 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).

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<sup>24</sup>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).

<sup>25</sup>For the global goal — often discussed — of stabilizing atmospheric concentrations of CO<sub>2</sub> 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 21<sup>st</sup> century.

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 (SO<sub>2</sub>) 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).

For some countries, systems of domestic carbon taxes may be more attractive (Kolstad and Toman 2001; McKibbin and Wilcoxon 2002).<sup>26</sup> 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; Kopp, *et al.* 2000; Pizer 2002; McKibbin and Wilcoxon 2002). This creates a price (and thereby cost) ceiling, and has hence been labeled a safety-valve system.<sup>27</sup>

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 (directly regulated under the Kyoto Protocol) — could reduce costs by 50 percent; and if such a system included major developing countries, costs could be lowered to 25

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<sup>26</sup>Norway introduced a carbon tax in 1991. Despite its considerable magnitude and consequent induced increases in fuel prices, impacts on CO<sub>2</sub> emissions were modest, in part because of extensive tax exemptions (Bruvoll and Larsen 2004).

<sup>27</sup>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).

percent of what they otherwise would be (Edmonds *et al.* 1997).<sup>28</sup> 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 permit 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.<sup>29</sup> 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.

If an international trading system is used, it must be designed to facilitate integration with domestic policies that nations use to achieve their respective domestic targets.<sup>30</sup> In the extreme, if all countries use domestic tradable permit systems to meet their national targets (that is, allocate shares from the 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).<sup>31</sup> Thus, individual nations' choices of domestic policy

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<sup>28</sup>Others have argued in favor of an international tax regime. See, for example: Cooper 1998; McKibbin and Wilcoxon 2002, 2004; Pizer 2002; and Newell and Pizer 2003.

<sup>29</sup>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).

<sup>30</sup>Note that the Kyoto Protocol explicitly provides for national sovereignty regarding domestic instrument choice.

<sup>31</sup>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. For a review of the anticipated transaction costs associated with the CDM and other “flexibility mechanisms” in the Kyoto Protocol, see: Michaelowa, *et al.* (2003).

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.

International permit trading remains a promising approach to achieving global greenhouse targets, although any program must be integrated carefully with domestic policies. This is a significant challenge. 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. This brings to mind Churchill’s famous observation regarding democracy.<sup>32</sup>

### 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 builds upon the Framework Convention on Climate Change. First, all nations have to be involved through the use of economic trigger mechanisms, such as growth targets. Second, long-term targets are required: in the short-term, firm, but moderate targets, and in the long-term, flexible, but much more stringent targets. 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.

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<sup>32</sup>The most common form of the quotation is: “It has been said that democracy is the worst form of government, except all those other forms that have been tried from time to time.” Reproduced from the House of Commons, November 11, 1947, in James (1974).

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