

# OF MONTREAL AND KYOTO: A TALE OF TWO PROTOCOLS

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## INTRODUCTION

I am pleased to sign the instrument of ratification for the Montreal protocol [governing] substances that deplete the ozone layer. The protocol marks an important milestone for the future quality of the global environment and for the health and well-being of all peoples of the world. Unanimous approval of the protocol by the Senate on March 14<sup>th</sup> [sic] demonstrated to the world community this country's willingness to act promptly and decisively in carrying out its commitments to protect the stratospheric ozone layer . . . .

—Ronald Reagan<sup>1</sup>

I oppose the Kyoto Protocol because it . . . would cause serious harm to the U.S. economy. The Senate's vote, 95-0, shows that there is a clear consensus that the Kyoto Protocol is an unfair and ineffective means of addressing global climate change concerns.

—George W. Bush<sup>2</sup>

Of the world's environmental challenges, the two most significant may well be stratospheric ozone depletion and climate change. At first glance, the problems appear to be closely related. In fact ozone depletion and cli-

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<sup>1</sup> *President Signs Protocol on Ozone-Depletion Substances—Ronald Reagan's Statement—Transcript Apr. 5, 1988*, [http://www.findarticles.com/p/articles/mi\\_m1079/is\\_n2135\\_v88/ai\\_6495606](http://www.findarticles.com/p/articles/mi_m1079/is_n2135_v88/ai_6495606) (last visited Oct. 18, 2006) (on file with the Harvard Environmental Law Review).

<sup>2</sup> Letter from George W. Bush, U.S. President, to Senators Hagel, Helms, Craig, and Roberts (Mar. 13, 2001), *available at* <http://www.whitehouse.gov/news/releases/2001/03/20010314.html> (last visited Oct. 18, 2006) (on file with the Harvard Environmental Law Review).

mate change are so similar that many Americans are unable to distinguish between them.<sup>3</sup> Consider seven similarities between the two problems:

1. Both ozone depletion and climate change have received public recognition on the basis of relatively recent scientific work, theoretical and empirical. The risks associated with ozone depletion were first explored in a paper in 1974.<sup>4</sup> The risks of climate change have a much longer history, with an early paper in 1896,<sup>5</sup> but the current scientific consensus is recent.<sup>6</sup>
2. Both problems involve the effects of emissions from man-made technologies that come from diverse nations and that threaten to cause large-scale harm.
3. Both ozone-depleting chemicals and greenhouse gases stay in the atmosphere for an extremely long time. Hence the relevant harms are difficult to reverse. Even with action that is both immediate and aggressive, the underlying problems will hardly be eliminated all at once.<sup>7</sup>
4. No nation is able to eliminate either problem on its own. Indeed, no nation is even able to make significant progress on either problem on its own, especially not in the long run.<sup>8</sup> Because of the diversity of contributors, both problems seem to be best handled through international agreements.<sup>9</sup>

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<sup>3</sup> See ANDREW E. DESSLER & EDWARD A. PARSON, *THE SCIENCE AND POLITICS OF GLOBAL CLIMATE CHANGE* 10–11 (2006).

<sup>4</sup> See ROBERT V. PERCIVAL ET AL., *ENVIRONMENTAL REGULATION* 1047 (4th ed. 2003).

<sup>5</sup> See SCOTT BARRETT, *ENVIRONMENT & STATECRAFT* 363 (2005). Indeed, an even earlier paper, from 1827, sketched the possible contribution of greenhouse gases. See JAMES HOUGHTON, *GLOBAL WARMING: THE COMPLETE BRIEFING* 17 (3d ed. 2004).

<sup>6</sup> DESSLER & PARSON, *supra* note 3, at 64–66. I refer to a scientific consensus, but there are dissenting voices. See, e.g., Nir J. Shaviv, *The Spiral Structure of the Milky Way, Cosmic Rays, and Ice Age Epochs on Earth*, 8 *NEW ASTRONOMY* 39 (2003) (arguing that cosmic rays are responsible for most of recent variations in global temperatures); Nir J. Shaviv & Ján Veizer, *Celestial Driver of Phanerozoic Climate?*, 13 *GSA TODAY*, July 2003, at 4. For a reply, see Stefan Rahmstorf et al., *Cosmic Rays, Carbon Dioxide and Climate*, 85 *EOS, TRANSACTIONS, AM. GEOPHYSICAL UNION* 38 (2004).

<sup>7</sup> For ozone depletion see BARRETT, *supra* note 5, at 223; for climate change, the point is emphasized and explored in RICHARD POSNER, *CATASTROPHE* 161–63 (2004).

<sup>8</sup> A qualification is that the United States now accounts for about one-fifth of the world's emissions, and that by 2025, China will account for nearly one-fourth of the world's emissions. See *infra* table accompanying note 296. If either nation entirely eliminated its emissions—to say the least, an unlikely prospect—the progress might count as significant. Note, however, that because greenhouse gas emissions are cumulative, even a total elimination of greenhouse gas emissions, from the United States and China, would not make a major dent in the problem. HER MAJESTY'S TREASURY, *STERN REVIEW: THE ECONOMICS OF CLIMATE CHANGE* (2006), available at [http://www.hm-treasury.gov.uk/independent\\_reviews/stern\\_review\\_economics\\_climate\\_change/sternreview\\_index.cfm](http://www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/sternreview_index.cfm) [hereinafter STERN REVIEW].

<sup>9</sup> As we shall see, however, these statements must be qualified for ozone depletion. For some nations, including the United States, unilateral action was worthwhile. See *infra* Part I.C.1; James Murdoch & Todd Sandler, *The Voluntary Provision of a Pure Public Good*:

5. Both problems involve extremely serious problems of international equity. Wealthy nations have been the principal contributors to both ozone depletion and climate change, and hence it is plausible to argue that corrective justice requires wealthy nations to pay poorer ones to reduce the underlying risks. This argument might well mean that poor nations should be compensated for their willingness to enter into any international agreements that reduce emissions levels. Wealthy countries might owe significant duties of financial and technological assistance, either to help in emissions reduction or to pay for adaptation to the underlying problems.

6. Both problems present extremely serious problems of intergenerational equity. Future generations are likely to face greater risks than the current generation, and a key question is how much the present should be willing to sacrifice for the benefit of the future. The answer to this question is complicated by two facts: future generations are likely to be much wealthier than our own, and expenditures by the present, decreasing national wealth, may end up harming future generations, simply by ensuring that they too have less wealth on which to draw.

7. With respect to both problems, the United States is a crucial actor, probably the most important in the world.<sup>10</sup> The importance of the United States lies not only in its wealth and power, but also because the United States has been an extremely significant source of both ozone-depleting chemicals and greenhouse gases.<sup>11</sup>

Notwithstanding these similarities, there is one obvious difference between the two problems. An international agreement, originally signed in Montreal and designed to control ozone-depleting chemicals, has been ratified by almost all nations in the world (including the United States, where ratification was unanimous).<sup>12</sup> At last count, 183 nations have ratified the Montreal Protocol.<sup>13</sup> Nations are complying with their obligations; global emissions of ozone-depleting chemicals have been reduced by over

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*The Case of Reduced CFC Emissions and the Montreal Protocol*, 63 J. PUB. ECON. 331 (1997).

<sup>10</sup> On ozone depletion, see PERCIVAL ET AL., *supra* note 4, at 1048 (reporting that the U.S. accounted for almost one-half of global CFC use in the mid-1970s); *Record Increase in U.S. Greenhouse Gas Emissions Reported*, ENV'T NEWS SERVICE, Apr. 18, 2006, <http://www.ens-newswire.com/ens/apr2006/2006-04-18-02.asp> (on file with the Harvard Environmental Law Review) (reporting that the U.S. accounts for about 25% of the world's greenhouse gas emissions).

<sup>11</sup> See sources cited *supra* note 10.

<sup>12</sup> Montreal Protocol on Substances That Deplete the Ozone Layer, Sept. 16, 1987, S. Treaty Doc. No. 100-10 (1987), 1522 U.N.T.S. 3.

<sup>13</sup> BARRETT, *supra* note 5, at 239.

95%; and atmospheric concentrations of such chemicals have been declining since 1994.<sup>14</sup> By 2050, the ozone layer is expected to return to its natural level.<sup>15</sup> The Montreal Protocol, the foundation for this process, thus stands as an extraordinary and even spectacular success story. Its success owes a great deal to the actions not only of the United States government, which played an exceedingly aggressive role in producing the Protocol,<sup>16</sup> but to American companies as well, which stood at the forefront of technical innovation leading to substitutes for ozone-depleting chemicals.<sup>17</sup>

With climate change, the situation is altogether different.<sup>18</sup> To be sure, an international agreement, produced in Kyoto in 1997, did go into force in 2005 when Russia ratified it.<sup>19</sup> The Kyoto Protocol has now been ratified by over 130 nations,<sup>20</sup> but numerous nations are not complying with their obligations under the Kyoto Protocol.<sup>21</sup> Some of the ratifying nations, including China, have no obligations under the Protocol at all, despite their significant emissions of greenhouse gases. The United States firmly rejects the agreement, with unanimous bipartisan opposition to its ratification. Far from leading technical innovation, American companies have sharply opposed efforts to regulate greenhouse gas emissions, and have insisted that the costs of regulation are likely to be prohibitive.<sup>22</sup> Between 1990 and 2004, the United States experienced a decline in emissions of ozone-depleting chemicals, to the point where such emissions are essentially zero. But in the same period, the United States experienced a rapid growth in greenhouse gases.<sup>23</sup> The same is true of many wealthy nations nominally committed to the Kyoto Protocol.<sup>24</sup> In part as a result, worldwide emissions of greenhouse gases are projected to rise at a rapid rate. An additional complication stems from the fact that developing nations have refused to join the Kyoto Protocol, and it is in those nations that greenhouse gases

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<sup>14</sup> See *id.*

<sup>15</sup> See *id.*

<sup>16</sup> See EDWARD A. PARSON, PROTECTING THE OZONE LAYER 252–53 (2003).

<sup>17</sup> See *id.* at 126–27, 176–77, 180–82.

<sup>18</sup> An illuminating discussion of that difference can be found in Scott Barrett, *Montreal versus Kyoto: International Cooperation and the Global Environment*, in GLOBAL PUBLIC GOODS: INTERNATIONAL COOPERATION IN THE 21ST CENTURY 192 (Inge Kaul et al. eds., 1999). The conclusions of this essay (drawn to my attention after this Article was substantially completed) greatly overlap with my own, though Barrett places a greater emphasis on enforcement of compliance and on “leakage,” understood as the risk that polluting activity may merely shift from one nation to another. *Id.* at 213, 215. My discussion here offers more detail on the negotiations, on the posture of developing nations, and on the implications for the future prospects for controls on greenhouse gases. As the reader will notice, I have been influenced throughout by Barrett’s superb book ENVIRONMENT AND STATECRAFT. See BARRETT, *supra* note 5.

<sup>19</sup> See DESSLER & PARSON, *supra* note 3, at 129.

<sup>20</sup> See AL GORE, AN INCONVENIENT TRUTH 282–83 (2006).

<sup>21</sup> See *infra* Part II.C.1.

<sup>22</sup> See George Pring, *The United States Perspective*, in KYOTO: FROM PRINCIPLES TO PRACTICE 185, 195–97 (Peter Cameron & Donald Zillman eds., 2001).

<sup>23</sup> See *infra* Part II.B.2.

<sup>24</sup> See *id.*

are increasing most rapidly. In particular, India and China have shown explosive growth in recent years, and China will soon become the leading greenhouse gas emitter in the world.<sup>25</sup>

My goal in this Article is to understand why the Montreal Protocol has been so much more successful than the Kyoto Protocol, and in the process to shed some light on the prospects for other international agreements, including those designed to control the problem of climate change. A central conclusion is simple: both the success of the Montreal Protocol and the mixed picture for the Kyoto Protocol were largely driven by the decisions of the United States, and those decisions were driven in turn by a form of purely domestic cost-benefit analysis.<sup>26</sup> To the United States, the monetized benefits of the Montreal Protocol dwarfed the monetized costs, and hence the circumstances were extremely promising for American support and even enthusiasm for the agreement. Remarkably, the United States had so much to lose from depletion of the ozone layer that it would have been worthwhile for the nation to act unilaterally to take the steps required by the Montreal Protocol.<sup>27</sup> For the world as a whole, the argument for the Montreal Protocol was overwhelmingly strong.

The Kyoto Protocol presented a radically different picture. To the United States alone, prominent analyses suggested that the monetized benefits of the Kyoto Protocol would be dwarfed by the monetized costs.<sup>28</sup> If the United States complied with the Kyoto Protocol on its own, those analyses suggested that it would spend a great deal and gain relatively little. If all parties complied, some of the most influential analyses suggested that the United States would nonetheless be a net loser. Because of the distinctive properties of the agreement, it was not at all clear that the world as a whole had more to gain than to lose from the Kyoto Protocol.<sup>29</sup> Hence

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<sup>25</sup> See *infra* Part III.C.

<sup>26</sup> Within political science, my emphasis on domestic self-interest will come as no surprise. For a classic treatment, see ROBERT O. KEOHANE, *AFTER HEGEMONY* 56–92 (2d ed. 2005).

<sup>27</sup> See BARRETT, *supra* note 5, at 228.

<sup>28</sup> See WILLIAM NORDHAUS & JOSEPH BOYER, *WARMING THE WORLD* 162–68 (2000); *infra* Part II.B.2. During the Clinton Administration, certain studies suggested low costs from compliance with the Kyoto Protocol. See PRING, *supra* note 22, at 194, but those studies were not widely accepted even within the executive branch. See *id.* at 196. Throughout I emphasize the importance of an analysis of costs and benefits, but that analysis is not the only relevant factor. Enforcement issues, for example, create serious problems for the Kyoto Protocol—more serious than for the Montreal Protocol. See generally BARRETT, *supra* note 5. In addition, I do not mean to endorse any particular set of figures. My purpose is positive, not normative, and the suggestion is that *perceived* high costs and low benefits contributed to the American position on the Kyoto Protocol. For a suggestion that prominent analyses of climate change understate the benefits, see Frank Ackerman & Ian J. Finlayson, *The Economics of Inaction on Climate Change: A Sensitivity Analysis* (forthcoming 2006) (on file with the Harvard Environmental Law Review). An especially comprehensive treatment can be found in STERN REVIEW, *supra* note 8, at 57 (suggesting, for example, that 1–3 million people will die from malnutrition at 3 °C warming).

<sup>29</sup> I am putting to one side the possibility that the Kyoto Protocol might have been the start for a broader and more inclusive set of agreements.

the circumstances were unpromising for a successful agreement—and they were especially unpromising for American participation, no matter the political affiliation of the relevant president. The different perceptions of costs and benefits, for the United States in particular but also for the world, provide the central explanation for the success of one agreement and the complex picture for the other. To make these points, it is unnecessary to accept any particular projection of costs and benefits, or to reach a final conclusion about whether ratification and compliance with the Kyoto Protocol might have been in the interest of the United States. The only suggestion is that on the basis of the understandings of the relevant actors at the relevant time—including public officials at many different points in the ideological spectrum—the Kyoto Protocol was taken to be a bad deal.

There is a more general point. It has become standard to explore whether international agreements solve a prisoner's dilemma by using the force of law to produce an outcome that rationally self-interested states could not produce on their own.<sup>30</sup> To know whether an agreement provides such a solution, it is necessary to investigate the payoff structures. For the United States and other key nations the payoff structures of the two agreements were fundamentally different. For some nations, including the United States, unilateral compliance with the requirements of the Montreal Protocol was justified even if no other nation complied. It is impossible to say the same for the Kyoto Protocol. Indeed, it is plausible to suggest that for the United States and some other nations, compliance with the Kyoto Protocol was not justified even if such compliance was both necessary and sufficient to ensure that all parties complied. Neither situation presented the simplest situation for an international agreement: a prisoner's dilemma in which all or most nations will do badly if each acts in its individual self-interest, but gain a great deal if all are able to enter into a binding agreement.

The Montreal Protocol did not present a prisoner's dilemma because key nations, including the United States, would gain from unilateral action. In fact, many nations engaged in such action.<sup>31</sup> The problem of climate change might well present a prisoner's dilemma, in the sense that nations and their citizens, acting in their private self-interest, may produce bad or even catastrophic outcomes that can be avoided with a binding agreement (whose precise provisions of course must be specified). Indeed, I believe that a suitably designed international agreement, includ-

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<sup>30</sup> In a prisoner's dilemma, rational, self-interested behavior produces outcomes that are inferior to those that could be achieved if the parties were mutually bound together. See, e.g., COLIN CAMERER, *BEHAVIORAL GAME THEORY* 44–46 (2003). On the international implications see JACK GOLDSMITH & ERIC POSNER, *THE LIMITS OF INTERNATIONAL LAW* 30–32 (2005); KEOHANE, *supra* note 26, at x–xii, 65–84. On private interests and international cooperation in general, see generally Detlev Sprinz & Tapani Vashtoranta, *An Interest-Based Explanation of International Environmental Policy*, 48 *INT'L ORG.* 77 (1994).

<sup>31</sup> See Murdoch & Sandler, *supra* note 9, at 347.

ing developing countries and mechanisms for global emissions trading, would be in the world's interest.<sup>32</sup> But for the United States, and for at least some other nations as well, the Kyoto Protocol did not solve the prisoner's dilemma, and it might even have produced an outcome worse than what would follow from unregulated self-interested action by all sides.

In both cases, the United States (and it was hardly alone in this respect) acted like *homo economicus*—a self-interested welfare maximizer, focusing not on its moral obligations, but on the perceived material incentives.<sup>33</sup> If such incentives generally play a key role, we might suggest that there is a kind of individual rationality constraint, or at least constraining factor, operating at the level of nations.<sup>34</sup> Of course nations are not individual people, and their decisions do not always reflect or promote the interests of their citizens, who may also have altruistic motivations; it remains necessary to specify the mechanisms by which perceived assessments of national interest constrain national decisions. Perhaps interest-group power, or moral commitments of various sorts, can overcome the results of any kind of domestic cost-benefit analysis. But in the contexts I am exploring, the different cost-benefit assessments help to explain other apparent anomalies as well. For example, they illuminate the pat-

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<sup>32</sup> For one account, see STERN REVIEW, *supra* note 8, at I–xi.

<sup>33</sup> A helpful, supportive discussion, which also requires a qualification, is Stephen J. DeCanio, *Economic Analysis, Environmental Policy, and Intergenerational Justice in the Reagan Administration: The Case of the Montreal Protocol*, 3 INT'L ENVTL. AGREEMENTS: POL., LAW & ECONO. 299 (2003). The support stems from the fact that the core justification came from "[p]rojected health risks to the U.S. population from stratospheric ozone depletion." *Id.* at 302 tbl. 1. The qualification is that the choice of a relatively low discount rate can be taken to suggest a degree of altruism toward future generations, through a principle of intergenerational neutrality. *See id.* at 306–10. Note, however, that these were future generations of Americans. On the general role of domestic self-interest in the international domain, see KEOHANE, *supra* note 26, at 78–84, 220–40.

<sup>34</sup> The point is emphasized more generally in GOLDSMITH & POSNER, *supra* note 30, which draws in turn on an elaborate literature in political science, including, for example, KEOHANE, *supra* note 26. For an overview and a critique, see Oona Hathaway & Ariel Lavinbuk, *Rationalism and Revisionism in International Law*, 116 HARV. L. REV. 1404 (2006). An evident problem with rational actor models, for both individuals and states, is that such models are powerless to explain decisions unless they incorporate a sense of the relevant utility functions—of what concerns the relevant actors. If the relevant actors care about endangered species, wherever they might be found, then it is in their rational self-interest to attempt to protect endangered species. And if the relevant actors care about producing signals to their own citizens and to other nations, they might be willing to sacrifice their material self-interest for the sake of ensuring those signals. For example, a leader of Germany might want to signal comparatively stronger concern about environmental protection than that of the leaders of the United States and France.

A final complication stems from the fact that governments and their citizens suffer from bounded rationality, which may lead them to make decisions that do not reflect an accurate understanding of the facts. The availability heuristic, for example, may steer all relevant actors to both an excessive and an insufficient appreciation of probabilities. *See* CASS R. SUNSTEIN, *LAWS OF FEAR: BEYOND THE PRECAUTIONARY PRINCIPLE* 36–39 (2005) [hereinafter SUNSTEIN, *LAWS OF FEAR*]. I take up some of these issues below. *See infra* Part III.A. In the context of the Montreal and Kyoto Protocols, I shall put bounded rationality to one side and emphasize the role of perceived material concerns, including of course concerns about the health and wealth of American citizens.

tern of apparently universal compliance with the Montreal Protocol and the likelihood of widespread noncompliance with the Kyoto Protocol. They help explain why many nations reduced their CFC emissions *before* the Montreal Protocol took effect and why their reductions were not only in advance but also in excess of the mandates of the agreement.<sup>35</sup> They also help explain the fact that American companies strongly supported the Montreal Protocol while sharply opposing the Kyoto Protocol. They help explain why China and India refused to accept emissions reductions requirements in the Kyoto Protocol. They illuminate another apparent anomaly: European nations, above all the United Kingdom, were initially quite cautious in reacting to the problem of ozone depletion, suggesting that the scientific evidence was both theoretical and speculative, but these same nations have been more aggressive in reacting to the problem of climate change. They even help to explain the particular commitments made in the Kyoto Protocol—commitments that, as we shall see, fit with the material self-interest of many of the relevant actors, including several of those that seemed to reflect altruistic motivations and to promise significant reductions.

The implications of these points are simple. With respect to international environmental agreements in general, the participation of the United States, and of other nations as well, is greatly affected by perceived domestic consequences.<sup>36</sup> To say this is not to deny that moral judgments may play some role and even a significant one—not only, but above all, if injured nations are in a position to punish those who do not diminish their injury. Many billions of dollars are spent each year on foreign aid,<sup>37</sup> and an international agreement to control global environmental problems might operate as a form of such aid. If, for example, the citizens of the United States care a great deal about the welfare of endangered species, the nation may well be willing to enter into a costly agreement to protect endangered species. As we shall see, there are exceedingly good reasons, grounded in corrective justice, to ask the United States to assist those nations that are most vulnerable as a result of climate change. In addition, reputational incentives may matter, complicating the outcome of an unduly simple cost-benefit analysis.<sup>38</sup> But if the United States is spending much more than it receives, it is unlikely to be an enthusiastic participant.

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<sup>35</sup> See Murdoch & Sandler, *supra* note 9, at 347.

<sup>36</sup> This is an explicit theme of James H. Maxwell & Sanford L. Weiner, *Green Consciousness or Dollar Diplomacy? The British Response to the Threat of Ozone Depletion*, 5 INT'L ENVTL. AFF. 19, 36–38 (1993).

<sup>37</sup> See CURT TARNOFF & LARRY NAVELS, FOREIGN AID: AN INTRODUCTORY OVERVIEW OF U.S. PROGRAMS AND POLICY 4, 6, 16 (Cong. Research Serv., CRS Report for Congress Order Code 98-916) (2005), available at <http://fpc.state.gov/documents/organization/31987.pdf> (reporting, among other things, \$7.35 billion for development assistance and \$2.68 billion in humanitarian assistance).

<sup>38</sup> See KEOHANE, *supra* note 26, at xvi, 105–06.

For climate change in particular, it is reasonable to predict that the United States will ratify an international agreement to reduce greenhouse gases only if the perceived domestic costs of the relevant reductions decrease, the perceived domestic benefits increase, or both. It is possible that the perceived cost-benefit ratio of aggressive controls will change significantly with new information, or with better understanding of old information.<sup>39</sup> There is a still more general lesson. Without the participation of the United States, the success of any such agreement is likely to be limited, if only because the United States accounts for such a high percentage of the world's greenhouse gas emissions. Indeed, I have noted that China and India are anticipated to be increasingly large emitters in the near future,<sup>40</sup> and they are most unlikely to participate if the United States does not. These points have large implications for the prospects for and contents of a successful agreement, to which I shall turn in due course. I do believe that a suitably designed agreement, calling for significant restrictions, is very much in the world's interest; the contrast between the Montreal Protocol and the Kyoto Protocol helps to show how that interest might be promoted.

The remainder of this Article comes in three Parts. Part I explores the Montreal Protocol and the role of scientific evidence, European caution, American enthusiasm, and cost-benefit analysis in producing it. Part II examines the Kyoto Protocol and American reservations, with special emphasis on the possibility that the agreement would deliver low benefits for the world and impose significant costs—with particularly high costs and low benefits expected for the United States. Part III explores the lessons and implications of the two tales.

## I. OZONE AND MONTREAL

### A. *Science and Policy*

Chlorofluorocarbons (“CFCs”) were originally used as working fluids for refrigerators, in part because they appeared to be far safer than the alternatives, which were either inflammable or dangerously toxic.<sup>41</sup> In the

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<sup>39</sup> See the interesting discussion in William Cline, *Climate Change*, in GLOBAL CRISES, GLOBAL SOLUTIONS 13 (Bjorn Lomborg ed., 2004), and in particular the conclusion that the Kyoto Protocol “accomplishes relatively little in curbing warming. For the world as a whole, then, it is better than nothing, but not a persuasive answer to the problem of global warming. To the industrialized countries, its economic costs outweigh its economic benefits.” *Id.* at 31. A different view is sketched in STERN REVIEW, *supra* note 8, at 130 (offering optimistic and pessimistic cases for the United States, with pessimistic case involving a loss of 1.2% GDP for 3 C warming; the pessimistic case does not take full account of the effects of extreme weather events, such as hurricanes).

<sup>40</sup> See HOUGHTON, *supra* note 5, at 244–45 (noting that between 1990 and 2000, China saw a 19% increase in greenhouse gas emissions, and India a 68% increase).

<sup>41</sup> See PARSON, *supra* note 16, at 20.

decades that followed, CFCs were found to have numerous cooling applications, notably including air-conditioning. But CFCs came to be used most significantly as propellants in aerosol spray cans.<sup>42</sup> CFCs and related chemicals, including halons, acquired widespread commercial and military uses,<sup>43</sup> producing billions of dollars in revenues.

The idea that CFCs posed a threat to the ozone layer was initially suggested in an academic paper in 1974, written by Sherwood Rowland and Mario Molina.<sup>44</sup> According to Rowland and Molina, CFCs would migrate slowly through the upper atmosphere, where they would release chlorine atoms that could endanger the ozone layer, which protects the earth from sunlight.<sup>45</sup> Rowland and Molina specified the “catalytic chain by which the chlorine atoms released would destroy ozone.”<sup>46</sup> The potential consequences for human health were clear, for Rowland and Molina wrote only three years after the loss of ozone had been linked with skin cancer.<sup>47</sup> In 1971, it had been suggested that a 1% ozone loss would cause an additional 7000 cases of skin cancer each year.<sup>48</sup> Hence the finding by Rowland and Molina indicated that significant health risks might well be created by emissions of CFCs.

In the immediately following years, depletion of the ozone layer received widespread attention in the United States, which was the world’s leading contributor to the problem, accounting for nearly 50% of global CFC use.<sup>49</sup> A great deal of theoretical and empirical work was done within the scientific community, with the National Academy of Sciences and many others making contributions.<sup>50</sup> Much of this work was supportive of the initial claims by Molina and Rowland.<sup>51</sup> At the same time, industry attempted to conduct and publicize its own research, mounting an aggressive public relations campaign to discredit the association between CFCs and ozone depletion.<sup>52</sup> A senior executive at DuPont, the world’s largest CFC producer, testified before a Senate panel that the “chlorine-ozone hypothesis is at this time purely speculative with no concrete evidence . . . to support it.”<sup>53</sup> At the very least, industry representatives suggested that no harm would come from each year’s delay and that costly regula-

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<sup>42</sup> *Id.* at 21.

<sup>43</sup> *Id.* at 22.

<sup>44</sup> See PERCIVAL ET AL., *supra* note 4, at 1047 (referencing Mario J. Molina & F. S. Rowland, *Stratospheric Sink for Chlorofluoromethanes: Chlorine Atom-Catalysed Destruction of Ozone*, 249 NATURE 810 (1974)).

<sup>45</sup> *Id.* at 1047–49.

<sup>46</sup> PARSON, *supra* note 16, at 23.

<sup>47</sup> *Id.* at 23, 31.

<sup>48</sup> *Id.* at 25.

<sup>49</sup> See RICHARD ELLIOT BENEDICK, *OZONE DIPLOMACY: NEW DIRECTIONS IN SAFEGUARDING THE PLANET* 26 (enlarged ed. 1998) [hereinafter BENEDICK, *OZONE DIPLOMACY*].

<sup>50</sup> *Id.* at 11.

<sup>51</sup> PARSON, *supra* note 16, at 33.

<sup>52</sup> See BENEDICK, *OZONE DIPLOMACY*, *supra* note 49, at 12.

<sup>53</sup> *Id.*

tion should not be imposed until further research had been established that real risks were involved.<sup>54</sup>

Nonetheless, intense media attention to the problem greatly affected consumer behavior. In a brief period, American consumers responded to warnings by cutting their demand for aerosol sprays by more than half, thus dramatically affecting the market.<sup>55</sup> The same public concern spurred domestic regulation. In 1977, Congress amended the Clean Air Act to permit the Administrator of EPA to regulate “any substance . . . which in his judgment may reasonably be anticipated to affect the stratosphere, especially ozone in the stratosphere, if such effect may reasonably be anticipated to endanger public health or welfare.”<sup>56</sup> In 1978, EPA used the Toxic Substances Control Act<sup>57</sup> to ban the use of CFCs as aerosol propellants in nonessential applications and defined criteria for exemptions of “essential uses.”<sup>58</sup> As a result of the ban, aerosol production in the United States fell by nearly 95%.<sup>59</sup> A significant reduction in the American contribution to ozone depletion was achieved in a way that “was remarkably fast, simple, and seemingly rational”—and that imposed little cost.<sup>60</sup>

The role of the public is especially noteworthy here. It is not surprising to find considerable mobilization on the part of environmentalists and those with environmentalist inclinations. But changes in consumer behavior were quite widespread, in a way that makes a sharp contrast with other domains (including climate change). Two points are relevant here. The first is that skin cancer, the harm associated with ozone depletion, is highly salient and easily envisioned; and a salient, easily envisioned harm is especially likely to affect behavior.<sup>61</sup> This point is connected to the fact that it is not difficult to energize people with the vivid image of a loss of the earth’s “protective shield.” The second point is that the change in consumer behavior was not, in fact, extremely burdensome to consumers. Aerosol spray cans are not central to daily life, and a refusal to purchase them, or a decision to take other steps to reduce uses of ozone-depleting chemicals, did not impose large costs. Because the relevant harms were vivid, directly involving human health, and because no real hardship was imposed by taking steps to reduce those costs, consumer behavior was significantly affected. As we shall see, there is no parallel to date in the context of climate change.

Despite the flurry of domestic activity, no international agreement was in sight. In fact the effort to produce international cooperation was at

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<sup>54</sup> PARSON, *supra* note 16, at 33.

<sup>55</sup> BENEDICK, *OZONE DIPLOMACY*, *supra* note 49, at 27–28, 31.

<sup>56</sup> 42 U.S.C. § 7457(b) (1977) (repealed and recodified at 42 U.S.C. § 7671n (2005)).

<sup>57</sup> 15 U.S.C. § 2605 (2005).

<sup>58</sup> 43 Fed. Reg. 11,301 (Mar. 17, 1978) (codified at 21 C.F.R. § 2.125).

<sup>59</sup> BENEDICK, *OZONE DIPLOMACY*, *supra* note 49, at 24.

<sup>60</sup> PARSON, *supra* note 16, at 40.

<sup>61</sup> *See generally* SUNSTEIN, *LAWS OF FEAR*, *supra* note 34.

first “an unmitigated failure.”<sup>62</sup> A central reason was the skepticism and opposition of the European Community, which firmly rejected regulatory measures of the sort taken by the United States.<sup>63</sup> In Europe, it was widely believed that science did not justify those measures, which would inflict high costs for speculative benefits. In most European countries, unlike in the United States, the public was relatively indifferent to the ozone question.<sup>64</sup> Heavily influenced by private groups with an economic stake in the outcome, most European nations resorted to symbolic action rather than regulatory restrictions.<sup>65</sup> That action included voluntary emissions codes, unaccompanied by regulatory requirements of any kind.<sup>66</sup> Industry arguments about the expense of such requirements, and the potential loss of tens of thousands of jobs, contributed heavily to the weak response of the European Community.<sup>67</sup> The result of the disparity in reactions, and a source of continuing tension between the United States and Europe, was a significant shift from American to European dominance in emissions of CFCs.<sup>68</sup>

While American companies, above all DuPont, showed some sensitivity to the scientific evidence and potential risks, their European counterparts sought “to preserve market dominance and to avoid for as long as possible the costs of switching to alternative products.”<sup>69</sup> The United Kingdom was a central actor here, and it was not a coincidence that the export of CFCs played a large role in Britain’s foreign exchange.<sup>70</sup> The British government was heavily influenced by one of the world’s largest CFC producers, Imperial Chemical Industries.<sup>71</sup> But facing significant public concern and regulatory restrictions, major American producers began the process of finding effective substitutes.<sup>72</sup> To be sure, DuPont and other companies also emphasized the tentative and theoretical nature of the evidence and lobbied hard against the most aggressive domestic controls.<sup>73</sup> The election of President Reagan in 1980 signaled a period of skepticism about imposing new restrictions on CFCs, and hence little happened in the period from 1980 to 1982.<sup>74</sup> In 1982, in fact, members of the U.S. delegation to international negotiations indicated if they had known in 1977 what they now knew, they would have declined to ban aerosols.<sup>75</sup>

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<sup>62</sup> PARSON, *supra* note 16, at 44.

<sup>63</sup> BENEDICK, OZONE DIPLOMACY, *supra* note 49, at 24.

<sup>64</sup> PARSON, *supra* note 16, at 43.

<sup>65</sup> BENEDICK, OZONE DIPLOMACY, *supra* note 49, at 24.

<sup>66</sup> *Id.* at 25.

<sup>67</sup> *See id.*

<sup>68</sup> *See id.* at 26–27.

<sup>69</sup> *Id.* at 33.

<sup>70</sup> *Id.* at 38–39.

<sup>71</sup> *See* Maxwell & Weiner, *supra* note 36, at 20–21.

<sup>72</sup> PARSON, *supra* note 16, at 53.

<sup>73</sup> *Id.* at 57–58.

<sup>74</sup> *Id.* at 58–59.

<sup>75</sup> *Id.* at 114–15.

In 1983, however, the United States started to support international controls, essentially asking the world to follow its own policies by banning uses of CFCs in aerosol propellants.<sup>76</sup> Notably, the United States did not ask for international action that would inflict new costs on the nation; it sought an agreement that would replicate its existing domestic action,<sup>77</sup> imposing regulatory burdens on others and thus conferring benefits on Americans at little or no additional expense. Industry organizations within the United States initially objected vigorously to the new position, contending that it gave undue credence to speculative science and fearing the rise of further controls on CFCs.<sup>78</sup> While the government maintained its position in the face of these objections, continuing negotiations produced an international stalemate through 1984.<sup>79</sup>

In 1985, the United States emphasized a new theory indicating that truly catastrophic harm was possible, stemming from a sudden collapse of ozone concentrations. Because of this worst-case scenario, immediate action would be desirable.<sup>80</sup> Still skeptical of the science, and attuned to the costs, European leaders continued to reject the effort to produce an international agreement, contending that the United States was engaged in “scare-mongering”<sup>81</sup> and that “Americans had been panicked into ‘over-hasty measures.’”<sup>82</sup> Strikingly, the British government played an important role in leading public opposition to regulatory controls.<sup>83</sup> A relevant fact was that “a ban on CFCs as aerosol propellants would have imposed economic consequences for the United Kingdom that would be markedly different from those for the United States.”<sup>84</sup> Because of European skepticism, an international agreement seemed highly unlikely, with industry favoring the European position.<sup>85</sup>

### *B. The Road to Montreal*

The emergence of a strengthened scientific consensus suggested that the problem was both more serious and less disputable than had previously been thought. New findings in 1985 and 1987 showed a “hole” in the ozone layer over Antarctica that had grown to the size of the United States.<sup>86</sup>

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<sup>76</sup> PERCIVAL ET AL., *supra* note 4, at 1048. The shift in American policy appears to have had something to do with the replacement of Ann Gorsuch by William Ruckelshaus, as Administrator of the Environmental Protection Agency. See PARSON, *supra* note 16, at 115.

<sup>77</sup> PARSON, *supra* note 16, at 116–17.

<sup>78</sup> *Id.* at 117.

<sup>79</sup> *Id.* at 121.

<sup>80</sup> BENEDICK, *OZONE DIPLOMACY*, *supra* note 49, at 43.

<sup>81</sup> *Id.*

<sup>82</sup> *Id.* at 33.

<sup>83</sup> PERCIVAL ET AL., *supra* note 4, at 1050.

<sup>84</sup> Maxwell & Weiner, *supra* note 36, at 21.

<sup>85</sup> PARSON, *supra* note 16, at 125.

<sup>86</sup> PERCIVAL ET AL., *supra* note 4, at 1048.

A paper published in 1985 suggested that between 1957 and 1984, total column ozone over Antarctica had decreased by 40%.<sup>87</sup> The discovery of the Antarctica hole “dramatically transformed the politics of the international negotiations as well as the science.”<sup>88</sup> The sheer vividness of the discovery, which “captured the public’s imagination,”<sup>89</sup> played a significant role in that transformation.

Equally important, perhaps, were major assessments of the problem from 1986 and 1988. In 1986, a NASA/World Meteorological Association group provided an exceptionally detailed review of the evidence, concluding that continued growth in CFCs would produce large losses in the ozone layer.<sup>90</sup> In 1988, the Ozone Trends Panel, established by NASA, reiterated the basic finding that CFCs were the primary cause of the ozone hole with a new analysis of a significant global trend.<sup>91</sup> These conclusions, generally taken as authoritative, helped to pave the way toward the negotiations leading to the Montreal Protocol.

Within the United States, the position of industry began to shift in 1986, apparently as a result of significant progress in producing safe substitutes for CFCs.<sup>92</sup> While arguing that CFCs produced no imminent hazard, DuPont supported an international freeze on CFC emissions, seeing that step as a justified precautionary measure<sup>93</sup> after the discovery of the Antarctic ozone hole.<sup>94</sup> Indeed, DuPont and other producers pledged to phase out production by an early date and also supported international controls.<sup>95</sup> The reasons for this shift remain unclear. It is likely that public relations concerns played a significant role, especially in light of the fact that the relevant products were not especially profitable.<sup>96</sup> It is also likely that American producers saw that good commercial opportunities lay in the development and marketing of new products for which they had a comparative advantage over foreign producers.<sup>97</sup> In support of this hypothesis, consider DuPont’s warning “that international cooperation was essential, and that participation in an agreement to phase out CFCs needed to be as broad as possible, to avoid production by other manufacturers relocating to non-signatory states . . . .”<sup>98</sup> Earlier regulatory measures undoubtedly affected the incentives of American producers. Because those measures had restricted CFCs, American companies both had a strong

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<sup>87</sup> See Maxwell & Weiner, *supra* note 36, at 26.

<sup>88</sup> *Id.*

<sup>89</sup> *Id.*

<sup>90</sup> See PARSON, *supra* note 16, at 251.

<sup>91</sup> *Id.* at 252.

<sup>92</sup> See *id.* at 126.

<sup>93</sup> *Id.*

<sup>94</sup> See James Hammitt, *Stratospheric-Ozone Depletion*, in *ECONOMIC ANALYSES AT EPA 131*, 157 (Richard Morgenstern ed., 1997).

<sup>95</sup> *Id.*

<sup>96</sup> *Id.*

<sup>97</sup> *Id.*

<sup>98</sup> Barrett, *supra* note 5, at 234.

incentive to innovate and less to lose from regulation at the international level. Notably, the European Community speculated that the Reagan Administration's support for aggressive controls was driven by the fact that "U.S. producers had secretly developed substitutes."<sup>99</sup>

In December 1986, the international negotiations became increasingly serious. Within the United States, there was mounting disagreement within the executive branch. Some officials agreed with the industry suggestion that a freeze might be justified, but that emissions reductions would not.<sup>100</sup> But the legislative view was unambiguous. By a vote of 80-2, the Senate voted in 1987 to ask President Reagan to take aggressive action to protect the ozone layer.<sup>101</sup> The resulting resolution said that the President should "strongly endorse the United States' original position . . . and continue to seek aggressively . . . an immediate freeze . . . a prompt automatic reduction of not less than fifty percent . . . and the virtual elimination of [ozone-depleting] chemicals."<sup>102</sup>

A period of intense discussions within the Reagan Administration followed,<sup>103</sup> with sharp differences between the Office of Management and Budget, skeptical of aggressive controls, and EPA, favorably disposed to such controls.<sup>104</sup> The internal disagreement was resolved after a careful cost-benefit analysis suggested that the costs of controls would be far lower than anticipated, and the benefits far higher.<sup>105</sup> In the words of a high-level participant in the proceedings: "A major break . . . came in the form of a cost-benefit study from the President's Council of Economic Advisers. The analysis concluded that, despite the scientific and economic uncertainties, the monetary benefits of preventing future deaths from skin cancer far outweighed the costs of CFC controls as estimated either by industry or by EPA."<sup>106</sup> This conclusion was generally in line with EPA's own analysis of the problem, in the sense that both were highly supportive of aggressive controls.<sup>107</sup> In particular, both EPA and the Council of Economic Advisers concluded that ozone layer depletion would cause a "staggering" increase of over five million skin cancer deaths by 2165.<sup>108</sup>

Though the formal analysis played a role, "even a qualitative benefit-cost comparison was sufficient to support regulation," especially in light of the risk of "global-scale catastrophic damages."<sup>109</sup> Recall in this connection that skin cancer is a salient harm, one that is likely to energize

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<sup>99</sup> Hammitt, *supra* note 94, at 157.

<sup>100</sup> See PARSON, *supra* note 16, at 133-135.

<sup>101</sup> See BENEDICK, *supra* note 49, at 61-62.

<sup>102</sup> S. Res. 226, 100th Cong. (1987).

<sup>103</sup> See BENEDICK, *OZONE DIPLOMACY*, *supra* note 49, at 62-65.

<sup>104</sup> See PARSON, *supra* note 16, at 135-36.

<sup>105</sup> See BARRETT, *supra* note 5, at 227-30.

<sup>106</sup> See BENEDICK, *OZONE DIPLOMACY*, *supra* note 49, at 63.

<sup>107</sup> See HAMMITT, *supra* note 94, for a general discussion.

<sup>108</sup> See DeCanio, *supra* note 33, at 302.

<sup>109</sup> HAMMITT, *supra* note 94, at 155.

citizens and officials alike. The association between skin cancer and cherished leisure activities, such as sunbathing, undoubtedly helped to spur the sense that the problem needed to be addressed in aggressive terms.

With the American position fixed, the stage was set for the negotiation of a new protocol. At an early point, the European Community, led above all by France, Italy, and the United Kingdom, urged caution and a strategy of "wait and learn."<sup>110</sup> Concerned about the economic position of Imperial Chemical Industries, the United Kingdom rejected an aggressive approach.<sup>111</sup> The United States took the lead in endorsing stringent additional controls, joined by several other nations, including Canada, New Zealand, Finland, and Norway.<sup>112</sup> Those urging stringent controls placed a particular emphasis on the problem of irreversibility. Because some CFCs last for a century or more, it was necessary to act immediately to avoid the need for "even more costly measures in the future."<sup>113</sup>

Many months of discussions led to the decisive meeting in Montreal, starting on September 8, 1987, and including over sixty countries, more than half of them developing.<sup>114</sup> The key part of the resulting protocol was not merely a freeze on CFCs, but a dramatic 50% cut by 1998, accompanied by a freeze on the three major halons, beginning in 1992.<sup>115</sup> The most important factor behind this aggressive step "was the promotion by an activist fashion of U.S. officials of an extreme negotiating position and its maintenance through several months of increasingly intense domestic and international opposition."<sup>116</sup> The 50% figure operated as a compromise between the American proposal for 95% reductions and the European suggestion of a freeze; it was also supported by scientific evidence suggesting that minimal ozone depletion would follow if the 50% reduction were implemented.<sup>117</sup>

A knotty question involved the treatment of developing countries. While CFC consumption was low in those countries, their domestic requirements were increasing,<sup>118</sup> and a badly designed agreement might merely shift the production and use of CFCs from wealthy nations to poorer ones, leaving the global problem largely unaffected. On the other hand, developing nations reasonably contended that they should not be held to the same controls as wealthier nations, which were responsible for the problem in the first place. India and China emphasized that nations with less than 25% of the world's population had been responsible for over

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<sup>110</sup> See BENEDICK, *OZONE DIPLOMACY*, *supra* note 49, at 68.

<sup>111</sup> See Maxwell & Weiner, *supra* note 36, at 27.

<sup>112</sup> See BENEDICK, *OZONE DIPLOMACY*, *supra* note 49, at 69.

<sup>113</sup> *Id.*

<sup>114</sup> *Id.* at 74.

<sup>115</sup> PARSON, *supra* note 16, at 240.

<sup>116</sup> *Id.* at 143.

<sup>117</sup> See HAMMITT, *supra* note 94, at 155-56.

<sup>118</sup> See BENEDICK, *OZONE DIPLOMACY*, *supra* note 49, at 93.

90% of the world's CFCs.<sup>119</sup> This claim was answered by several proposed steps, including both loosened restrictions on developing nations and financial assistance to them. Under Article 5 of the Montreal Protocol, developing countries are authorized to meet “basic domestic needs” by increasing to a specified level for ten years, after which they are subject to a 50% reduction for the next ten years.<sup>120</sup> In addition, a funding mechanism was created by which substantial resources—initially \$400 million—were transferred to poor countries.<sup>121</sup> These provisions have been criticized as unduly vague, essentially a way of deferring key questions.<sup>122</sup> But they provided an initial framework that has since worked out exceedingly well. Notably, the Montreal Protocol contains trade sanctions for those who do not comply, and these create a strong incentive for compliance.<sup>123</sup>

### C. Costs and Benefits

#### 1. Numbers

Why did the United States adopt such an aggressive posture with respect to ozone depletion? I have referred to the significant effect of a study by the Council of Economic Advisers, suggesting that a well-designed agreement would give the United States far more than it would lose. A further clue is provided by the following contemporaneous account by EPA of the costs and benefits of the Montreal Protocol:<sup>124</sup>

FIGURE 1: COSTS AND BENEFITS OF MONTREAL PROTOCOL TO THE UNITED STATES (IN BILLIONS OF 1985 DOLLARS)

	No Controls	Montreal Protocol	Unilateral Implementation of Montreal Protocol by the United States
Benefits	—	3,575	1,373
Costs	—	21	21
Net Benefits	—	3,554	1,352

<sup>119</sup> See PERCIVAL ET AL., *supra* note 4, at 1052.

<sup>120</sup> *Id.* at 1051.

<sup>121</sup> See *id.* See also Rene Bowser, *History of the Montreal Protocol's Ozone Fund*, 14 INT'L ENV'T. REP. 636 (1991).

<sup>122</sup> PARSON, *supra* note 16, at 146.

<sup>123</sup> Montreal Protocol, *supra* note 12, at art. 4 para. 6.

<sup>124</sup> BARRETT, *supra* note 5, at 228.

These figures were generated by a projection of over five million skin cancer deaths by 2165, together with over twenty-five million cataract cases by that year—figures that would be cut to two hundred thousand and two million, respectively, by a 50% CFC reduction.<sup>125</sup> Of course it is possible to question these numbers; the science does not allow uncontroversial point estimates here, and perhaps EPA had an interest in showing that the agreement was desirable. What matters, however, is the perception of domestic costs and benefits, and in the late 1980s, no systematic analysis suggested that the Montreal Protocol was not in the interest of the United States. It should be clear that on these numbers, even unilateral action was well-justified for the United States, because the health benefits of American action would create such substantial gains for the American public. But if the world joined the Montreal Protocol, the benefits would be nearly tripled, because it would prevent 245 million cancers by 2165, including more than five million cancer deaths.<sup>126</sup> At the same time, the relatively low expected cost of the Montreal Protocol—a mere \$21 billion—dampened both public and private resistance, and the cost turned out to be even lower than anticipated because of technological innovation.<sup>127</sup>

One of the most noteworthy features of the ozone depletion problem is that over time, the United States was anticipated to become a decreasing contributor to that problem. By 2050, a lack of controls was expected to result in a 15.7% decrease in the ozone layer, whereas unilateral American action would produce a 10.4% decrease, and the international agreement would result in a mere 1.9% decrease. By 2100, a lack of controls was expected to result in a 50% decrease; unilateral action a 49% decrease; and the international agreement a 1.2% decrease.<sup>128</sup> In the short run, aggressive action by the United States alone was amply justified by the domestic cost-benefit calculus. In the long run, the United States would fare much better with global cooperation, especially from developing nations, which would become increasingly important sources of ozone-depleting chemicals. American enthusiasm for the Montreal Protocol and for aggressive regulatory steps can be understood only in this light.

A full account of the costs and benefits of the Montreal Protocol for the world is not available. But if we build on a 1997 Canadian study, we can generate the following numbers as a rough approximation:<sup>129</sup>

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<sup>125</sup> See DeCanio, *supra* note 33, at 302 (providing more information on how these harms were turned into monetary equivalents and discussing the choice of a low discount rate).

<sup>126</sup> BARRETT, *supra* note 5, at 228.

<sup>127</sup> *Id.* at 228 tbl.8.1.

<sup>128</sup> *Id.*

<sup>129</sup> See BARRETT, *supra* note 5, at 237 tbl.8.2.

FIGURE 2: GLOBAL BENEFITS AND COSTS OF MONTREAL PROTOCOL,  
1987–2060

Avoided cases of skin cancer	20,600,000
Avoided skin cancer deaths	333,500
Avoided cases of cataracts	129,100,000
Monetized benefits (including damages to fisheries, agriculture, and materials; not including the health benefits mentioned above)	\$459 billion
Monetized benefits in terms of skin cancer deaths averted	\$333 billion
Monetized health benefits (nonfatal skin cancers and cataracts averted)	\$339 billion
Monetized costs	\$235 billion
Net benefits	>\$900 billion

To be sure, many of these numbers might be questioned, because they depend on a series of controversial assumptions.<sup>130</sup> Nonetheless, the clear conclusion is that the Montreal Protocol was an extraordinary bargain for the world in general and for the United States in particular.

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<sup>130</sup> For discussion, see DeCanio, *supra* note 33, at 304–06; SUNSTEIN, *LAWS OF FEAR*, *supra* note 34.

## 2. *Two Questions*

This point raises two obvious questions. First: is it really right to think that national decisions are motivated by cost-benefit analysis? Second: why was an agreement necessary at all? It would indeed be odd to suggest that national decisions are always motivated by the outcome of cost-benefit analysis.<sup>131</sup> Moral motivations can play a technical role, and if the citizenry demands a response to its judgment about what morality requires, governments are likely to respond. In any case, nations are not persons, but are instead aggregations of people, and the behavior of nations must be explained by reference to specific mechanisms. What would link cost-benefit analysis to national behavior? These are good questions, and I do not mean to offer any kind of general response here. But it is well established, even a cliché, that domestic self-interest plays a large role in motivating national behavior<sup>132</sup> and cost-benefit analysis provides clues to national self interest.

Undoubtedly interest groups can press national judgments in directions that diverge from the outcome of cost-benefit analysis. What can be said in this context, however, is that the analysis played a real role in deliberations within the executive branch, and a kind of informal echo of that analysis affected many other actors as well. It was generally perceived that the costs of the Montreal Protocol would not be high, signaled in part by the absence of serious industry opposition. Citizens and consumers seemed to favor, rather than to disfavor, regulatory controls, evidently with the understanding that they did not have much to lose from them. At the same time, an informal understanding of the benefits, affected by the discovery of the ozone hole, the emphasis on skin cancer, and the judgments of scientific bodies, suggested that the relatively low costs were worth incurring. In a well-functioning democracy, nations will be responsive to the informed assessments of relevant actors, including citizens. In the context of the Montreal Protocol, both formal and informal assessments of consequences supported an aggressive American posture.<sup>133</sup>

But in this light, why was an agreement necessary at all? As we have seen, severe reductions in CFC emissions preceded the ratification of the agreement. At first glance, many nations had self-interested motives with respect to the ozone problem, and these were sufficient to justify large reductions in such emissions.<sup>134</sup> If so, an international accord might not have been required at all. The United States made substantial reductions

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<sup>131</sup> See, however, the emphasis on domestic self-interest in KEOHANE, *supra* note 26, at x-xi, 65-84.

<sup>132</sup> See KEOHANE, *supra* note 26.

<sup>133</sup> On the role of national self-interest and international agreements generally, see GOLDSMITH & POSNER, *supra* note 30. For a critical account, see generally Hathaway & Lavinbuk, *supra* note 34.

<sup>134</sup> See Murdoch & Sandler, *supra* note 9, at 332-33.

on its own, as did other nations, and still more nations might have done so without the Montreal Protocol.<sup>135</sup> But many nations, including the United States, nonetheless embraced the agreement. One reason is undoubtedly the “signal” provided by participation in the agreement. If a nation promises before and with the world to reduce its emissions, it can send a valuable signal both to its own citizens and to other nations with which it must interact. Participation in the Montreal Protocol might be worthwhile for this reason alone.

As we have seen, the United States itself was much better off with cooperation from other countries. For some of those countries, the purely domestic cost-benefit calculus was undoubtedly less clear than it was for the United States. It is plausible to think that numerous nations were willing to make significant cuts only on the assumption that other nations would do so as well. Recall that at the time of the Montreal Protocol, European nations sought a freeze, not a 50% emissions reduction. Perhaps their position was uninformed by an accurate understanding of the domestic costs and benefits, but the agreement was nonetheless necessary to ensure significant cuts in CFC emissions.

The posture of the developing nations also helps explain why an agreement was valuable. For them, cuts were not perceived as justified by reference to the domestic calculus; side-payments were required.<sup>136</sup> Perhaps it is relevant, for some of those nations, that the skin cancer risks associated with ozone depletion primarily threaten light-skinned people,<sup>137</sup> and hence nations with mostly dark-skinned populations had relatively little to gain from the agreement.

To see why an agreement was necessary, we shall notice that American producers, above all DuPont, were more enthusiastic about the development of substitutes on the assumption that there would be an international market for them. These producers not only would not be losing, but might even be gaining market-share by virtue of their efforts to produce CFC substitutes. The final point is that an international process, culminating in the Montreal Protocol, helped to spread relevant information about both costs and benefits, spurring nations to take notice of a problem that some of them might have neglected on their own. That process involved a high degree of information-sharing, both about the risk of ozone depletion and about the costs of substitutes. Even if reductions were in the interest of

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<sup>135</sup> Indeed, many nations did so. *See id.* at 347–48. It is not clear, however, whether all or most of their reductions would have occurred without the shadow of obligations under the Montreal Protocol. It is possible that the protocol helped spur these ahead-of-schedule and above-requirement reductions, because of the information that the meetings and the protocol provided, the technology-forcing role of the protocol, and the symbolic value of early and substantial reductions both domestically and internationally.

<sup>136</sup> On side payments in general, see BARRETT, *supra* note 5, at 335–54

<sup>137</sup> *See* DeCanio, *supra* note 33, at 302.

all nations, some of them were made more keenly aware of that fact through international negotiations.

None of this means that the problem of ozone depletion presented a standard prisoner's dilemma, in which all or most nations needed an enforceable agreement to produce a result better than what would emerge from purely self-interested action. The ozone problem had no such structure. As we have seen, the United States essentially complied with the requirements of the Montreal Protocol before the Montreal Protocol, and many nations went well beyond those requirements both before and after the Protocol.<sup>138</sup> There was no incentive to defect. But the agreement was certainly in the interest of the United States because it greatly increased the health benefits for the nation's citizens. Additionally, at least some of the parties would not have reduced at all or as much on their own.

#### *D. Beyond Montreal*

After the Montreal Protocol, restrictions on ozone-depleting substances have been rapidly strengthened,<sup>139</sup> to the point where a world-wide phase-out of several different CFCs was accepted in London in 1990.<sup>140</sup> At that stage, the European Community, now convinced,<sup>141</sup> sought a clear timetable for further reductions, leading to an agreement for total elimination of CFC use and production by 2000.<sup>142</sup> Imperial Chemical Industries, an original source of the British and European skepticism about regulatory controls, now played a different role, having "realized—even more strongly than before—the potential commercial opportunities, as well as the risks, involved in shifting to substitute chemicals."<sup>143</sup>

Action to control ozone-depleting chemicals has increased since the early 1990s, to the point where almost all nations have agreed to it. As a result of the various restrictions, new damage to the ozone layer has essentially ceased, the ozone "hole" is shrinking,<sup>144</sup> and ozone concentrations are expected to return to natural levels by 2068.<sup>145</sup> This, then, is a stunning story of successful international cooperation.

If we examine the American role here, we can see that the development of the Montreal Protocol is in some ways a case study in a well-known phenomenon in the political science literature, which involves the provi-

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<sup>138</sup> Murdoch & Sandler, *supra* note 9, at 347.

<sup>139</sup> An informative capsule summary can be found in PARSON, *supra* note 16, at 240–41.

<sup>140</sup> *Id.* at 205.

<sup>141</sup> On the British turnaround, see Maxwell & Weiner, *supra* note 36, at 32–36.

<sup>142</sup> *Id.* at 36.

<sup>143</sup> *Id.* at 33.

<sup>144</sup> PARSON, *supra* note 16, at 242–43.

<sup>145</sup> *Scientists Find Antarctic Ozone Hole To Recover Later Than Expected*, June 29, 2006, [http://www.nasa.gov/centers/goddard/news/topstory/2006/ozone\\_recovery.html](http://www.nasa.gov/centers/goddard/news/topstory/2006/ozone_recovery.html) (last visited Oct. 25, 2006) (on file with the Harvard Environmental Law Review).

sion of public goods by international powers, or “hegemons.”<sup>146</sup> On this view, the most powerful nations are often in a good position to provide global public goods, such as financial stability and peace, entirely on their own. Consider protection against terrorist threats: If the United States succeeds in reducing those threats, it might well benefit many nations, not simply the United States.<sup>147</sup> The domestic actions of the United States—significantly reducing CFC emissions before any international requirements—conferred substantial benefits on other nations (though admittedly, those benefits might be characterized as a reduction of harm). And in pressing successfully for aggressive action at the international level, the United States provided large health benefits to citizens all over the globe.

## II. CLIMATE CHANGE

Concern about greenhouse gases has arisen in the same general period as concern about ozone-depleting chemicals. But there is an initial puzzle: In the two contexts, many of the major actors have reversed their positions. The best example is the United States, at once the most important agent behind the Montreal Protocol and among the most important obstacles to an international agreement to govern greenhouse gases.<sup>148</sup> For ozone depletion, the United States first acted unilaterally and then sought international restrictions. For greenhouse gases, the United States has hardly acted unilaterally. On the contrary, international action came first, and has spurred the exceedingly modest domestic measures that are now on the books.<sup>149</sup>

For their part, European nations were significant obstacles to international regulation of ozone-depleting chemicals, favoring an approach of “wait and learn”; for climate change, they have been favorably disposed

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<sup>146</sup> See generally Kris James Mitchener & Marc Weidenmier, *Empire, Public Goods, and the Roosevelt Corollary*, 65 J. ECON. HIST. 658 (2005) (discussing the role of powerful nations in producing public goods); Deepak Lal, *Globalization, Imperialism, and Regulation*, 14 CAMB. REV. INT'L AFF. 107 (2001); Charles P. Kindleberger, *Dominance and Leadership in the International Economy: Exploitation, Public Goods, and Free Rides*, 25 INT'L STUD. Q. 242 (1981).

<sup>147</sup> It is possible, however, that efforts to protect the United States from terrorist attacks will cause terrorists to shift their attention to other nations. To know whether the United States is conferring benefits on such nations, it is necessary to know the nature of its efforts: discouraging global terrorism, through military or other means, will of course help multiple nations.

<sup>148</sup> For a helpful overview, see generally PRING, *supra* note 22.

<sup>149</sup> Since 1992, the Department of Energy has been required to estimate aggregate greenhouse gas emissions in the United States, and annual reports are available. These estimates are mandated by the United Nations Framework Convention on Climate Change, signed by the United States. See ENERGY INFO. ADMIN., U.S. DEP'T OF ENERGY, EMISSIONS OF GREENHOUSE GASES IN THE UNITED STATES 2004 xiv (2005), available at <http://www.eia.doe.gov/oiaf/1605/ggrpt/pdf/057304.pdf> [hereinafter GHG EMISSIONS 2004]. For figures of these estimates see *id.* at ix tbl.ES1; see also U.S. ENVTL. PROT. AGENCY, INVENTORY OF U.S. GREENHOUSE GAS EMISSIONS AND SINKS, 1990-2004 (2006), available at [http://yosemite.epa.gov/oar/globalwarming.nsf/UniquekeyLookup/RAMR6MBSC3/\\$File/06\\_Complete\\_Report.pdf](http://yosemite.epa.gov/oar/globalwarming.nsf/UniquekeyLookup/RAMR6MBSC3/$File/06_Complete_Report.pdf).

toward regulatory controls, with the United Kingdom in the forefront.<sup>150</sup> The reversal of positions suggests that it is inadequate to portray the United States as skeptical of global solutions to environmental problems, or to see the European Union as more committed to environmental goals. Nor is it adequate to portray the American position on greenhouse gases as entirely a function of Republican leadership. The difference depends instead on assessments of national interest, public opinion, and the role of powerful private actors.<sup>151</sup>

#### A. From Framework to Kyoto

Since the late 1980s, international organizations have shown a great deal of concern about climate change. The initial activity occurred in December 1988, when a resolution of the United Nations General Assembly declared climate change to be a “common concern of mankind” and asked for a global response.<sup>152</sup> In 1989, the European Community signaled that it would support an international agreement to deal with the problem. In 1992, more than 180 nations, including the United States, signed the Framework Convention on Climate Change during the Rio Conference on Environment and Development.<sup>153</sup> In fact, the United States was the first industrialized nation to ratify the Framework Convention,<sup>154</sup> which set the stage for everything that has happened since.

Unlike the Montreal Protocol, the Framework Convention lacked quantitative limits for emissions reductions.<sup>155</sup> The absence of such restrictions had everything to do with the posture of the United States, which strongly resisted them,<sup>156</sup> here occupying the place of the United Kingdom in the early stages of the debate over ozone-depleting chemicals. The Framework Convention generally limited itself to information-gathering requirements and broad aspirations, calling in abstract terms for stabilization of emissions to prevent “dangerous . . . interference” with global climate.<sup>157</sup> Thus the Convention urged that it would be desirable to “return by the end of the present decade to earlier levels of anthropogenic emissions of carbon dioxide and other greenhouse gases.”<sup>158</sup> The parties agreed to produce, at a latter stage, a legal instrument that would establish quantitative lim-

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<sup>150</sup> See Tony Blair, *Foreword* to AVOIDING DANGEROUS CLIMATE CHANGE, at vii (Hans Joachim Schellnhuber et al. eds., 2006).

<sup>151</sup> See PRING, *supra* note 22, at 201–05.

<sup>152</sup> PERCIVAL ET AL., *supra* note 4, at 1062.

<sup>153</sup> See BARRETT, *supra* note 16, at 368–69.

<sup>154</sup> See PRING, *supra* note 22, at 185.

<sup>155</sup> U.N. Framework Convention on Climate Change, May 9, 1992, 1771 U.N.T.S. 107, available at [http://unfccc.int/essential\\_background/convention/background/items/1349.php](http://unfccc.int/essential_background/convention/background/items/1349.php) [hereinafter Framework Convention].

<sup>156</sup> BARRETT, *supra* note 16, at 368.

<sup>157</sup> See Framework Convention, *supra* note 155, at art. 2.

<sup>158</sup> See *id.* at art. 4 para. 2.

its for developing countries. The United States Senate ratified the Convention in 1992, and it entered into force two years later.

The Framework Convention inaugurated a new process of meetings, to be held annually. In 1995, the parties to the Convention (including the United States, now led by President Clinton) met in Berlin and agreed to set emissions limits at specific periods and to accept a protocol that would embody those limits.<sup>159</sup> The Clinton Administration appeared to support the “Berlin Mandate,” asking industrialized nations to accept restrictions on greenhouse gas emissions.<sup>160</sup> Other national leaders, however, were not enthusiastic about this commitment. In 1997, a unanimous Senate adopted Senate Resolution 98, which asked President Clinton not to agree to limits on greenhouse gas emissions if the agreement would injure the economic interests of the United States or if it would not “mandate new specific scheduled commitments to limit or reduce greenhouse gas emissions for Developing Country Parties within the same compliance period” as for the United States.<sup>161</sup> Indeed, the unanimous Senate concluded that any “exemption for Developing Country Parties is inconsistent with the need for global action on climate change and is environmentally flawed,” and indicated that it “strongly believed” that the proposals under consideration “could result in serious harm to the United States economy, including significant job loss, trade disadvantages, increased energy and consumer costs, or any combination thereof.”<sup>162</sup> Recall that a near-unanimous Senate had voted in favor of aggressive action to protect the ozone layer, and that a unanimous Senate voted to support a more rapid phase-out of CFCs than was required by the Montreal Protocol and its amendments.<sup>163</sup> Evidently the Senate was aware that developing nations have recently been responsible for a significant percentage of the world’s greenhouse gases and that their contributions are expected to grow over time.<sup>164</sup> It follows that stabilization of emissions by the industrialized world would do relatively little to control climate change.

This was an exceedingly important resolution—even more important than it might have seemed. Because such commitments from developing countries were highly unlikely—indeed, no commitments “within the same compliance period” had been made even for the Montreal Protocol<sup>165</sup>—this vote essentially suggested that the United States should accept no commitments at all. It is worth underlining the bipartisan nature of the vote, as no Democratic member of the Senate opposed it.

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<sup>159</sup> BARRETT, *supra* note 16, at 369.

<sup>160</sup> *Id.*

<sup>161</sup> S. Res. 98, 105th Cong. (1997).

<sup>162</sup> *Id.*

<sup>163</sup> BARRETT, *supra* note 5, at 369–70.

<sup>164</sup> *See infra* Part III.C.

<sup>165</sup> *See supra* Part I.B.

The Clinton Administration took an equivocal approach to this resolution and indeed to the Kyoto negotiations in general. In part because of the presence of Vice President Gore, the administration did favor some kind of international response.<sup>166</sup> Nonetheless, it spoke at some points in favor of voluntary responses rather than regulation and adopted negotiating positions that would impose relatively little burden on the national economy.<sup>167</sup> In the complex Kyoto negotiations in December 1997, the United States did support regulatory limits, although relatively modest ones, arguing against reductions in emissions levels and instead for the stabilization of current levels.<sup>168</sup> The United States also urged several other steps: inclusion of the developing countries in the treaty through their acceptance of some kind of quantitative limits; a rejection of early deadlines in favor of a ten-year delay; and a base year of 1995 rather than 1990, which would make quantitative limits less stringent.<sup>169</sup>

The United States vigorously opposed mandatory “domestic measures,” such as energy taxes,<sup>170</sup> and sought ample mechanisms to ensure emissions trading, a sensible idea that would have the advantage of driving down costs. The restrictions supported by the United States were distinctly less aggressive than those sought by the European Union and Japan.<sup>171</sup> In conformity with Senate Resolution 98, American negotiators made serious efforts to persuade the major developing countries to agree to limit their emissions at some future date, but they refused.<sup>172</sup> A plausible explanation is that such nations, above all China and India, were aware that regulatory controls would impose significant burdens and costs.

In fact many of the key American positions were rejected during the negotiations. Ultimately, most of the major developed nations, including the United States, agreed to the Kyoto Protocol. The Protocol sets forth firm quantitative limits on greenhouse gas emissions. Specified reductions were listed for, and limited to, the “Annex 1” nations—those bound by the Kyoto Protocol.<sup>173</sup> The list was designed to ensure that, taken as a whole, the nations would show a reduction of 5% over 1990 levels—a reduction that must be met in the period between 2008 and 2012.<sup>174</sup> For example, the United States was required to reduce emissions by 7%; Japan by 6%; and the European Union by 8%. Some nations, including Iceland, Nor-

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<sup>166</sup> See PRING, *supra* note 22, at 196.

<sup>167</sup> *Id.* at 197–98.

<sup>168</sup> *Id.* at 198. Again this posture is a sharp contrast from the negotiations that led to the Montreal Protocol, in which the United States sought significant reductions, while other nations urged stabilization.

<sup>169</sup> *Id.*

<sup>170</sup> *Id.* at 198–99.

<sup>171</sup> See PERCIVAL ET AL., *supra* note 4, at 1063.

<sup>172</sup> See *id.* (citing Sharon Begley, *Too Much Hot Air*, NEWSWEEK, Oct. 20, 1997, at 48).

<sup>173</sup> Kyoto Protocol to the United Nations Framework Convention on Climate Change art. 3, Dec. 10 1997, 37 I.L.M. 22, available at [http://unfccc.int/essential\\_background/kyoto\\_protocol/items/1678.php](http://unfccc.int/essential_background/kyoto_protocol/items/1678.php) [hereinafter Kyoto Protocol].

<sup>174</sup> *Id.* at art. 3 para. 1.

way, and Australia, were permitted to increase their emissions.<sup>175</sup> Notably, the Kyoto Protocol does not impose trade sanctions or other penalties on those who do not comply (as does the Montreal Protocol). Developing nations made no commitments at all. At the same time, they were permitted to engage in emissions trading with Annex 1 nations.

It is worth asking why, exactly, these particular targets were chosen. The simplest answer is that national self-interest played a key role.<sup>176</sup> Contrary to a widespread perception, it is simply not true that most of the world's nations were willing to sacrifice much to deal with climate change, while the United States ultimately refused to do so.<sup>177</sup> The point is most obviously true for developing nations. India's greenhouse gas emissions exceed Germany's; those of South Korea exceed France; and next to the United States, China is the largest emitter of greenhouse gases in the world.<sup>178</sup> But none of these nations is controlled by the Kyoto Protocol. Indeed, many of the nations that accepted specified reductions actually promised to do little or nothing beyond what had already been done as a result of economic developments. Russia was given a target of 100% of its 1990 emissions, but by 1997 its actual emissions had already dropped to a mere 70% of that amount due to economic difficulties. The trading system created by the Kyoto Protocol actually ensured a huge economic boon to Russia, as everyone was aware.<sup>179</sup> Germany appeared to accept a significant reduction—8% by 2012—but in 1997, its own emissions were already 10% lower than in 1990, as a result of reunification with the former East Germany, whose plummeting economy resulted in radical emissions decreases.<sup>180</sup> For the United Kingdom, the story is not very different. The target reduction of 8% was less severe than it seemed, because in 1997, the United Kingdom was already at a level 5% below that of 1990.<sup>181</sup> By far, the largest loser, in terms of the actual anticipated costs of mandatory cuts, was the United States.

With these numbers it should be unsurprising that in the United States, a strong bipartisan consensus stood in opposition to ratification. No member of the Senate, Democratic or Republican, supported ratification. (To get ahead of the story, it should be clear that if the perceived costs of the Kyoto Protocol were low, or if the perceived costs were high, some support would undoubtedly have been found). Although Vice President Gore played a key role in producing the Kyoto Protocol, the Clinton Administration took an ambivalent approach in the aftermath of negotiations. On

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<sup>175</sup> *Id.* at Annex B.

<sup>176</sup> See Richard Benedick, *Morals and Myths: A Commentary on Global Climate Policy*, 109 WZB-MITTEILUNGEN 15 (Sept. 2005) [hereinafter Benedick, *Morals*].

<sup>177</sup> *Id.* at 15–16.

<sup>178</sup> *Id.* at 16.

<sup>179</sup> *Id.*

<sup>180</sup> *Id.*

<sup>181</sup> *Id.*

the one hand, it emphasized the flexible nature of some of the provisions—including emissions trading—and urged that developing countries might eventually be persuaded to be included.<sup>182</sup> On the other hand, the Clinton Administration promised Congress that it would not adopt measures to implement the Kyoto Protocol before Senate ratification and that it would not seek such ratification unless it had obtained “meaningful participation” from developing countries.<sup>183</sup> Under intense international pressure, the United States signed the Protocol on September 12, 1998.<sup>184</sup> But it is an understatement to say that the signing was not well-received in Congress, which added a proviso to the 1999 Environmental Protection Agency Appropriations Act banning the agency from using appropriations “‘to propose or issue rules, regulations, decrees or orders for the purpose of implementation, or in preparation for implementation’ of the Kyoto Protocol.”<sup>185</sup> At this point, Vice President Gore indicated that the Protocol would not be submitted for ratification without meaningful participation by developing nations.<sup>186</sup> Indeed the whole process had an air of unreality to it, because “everyone on both sides of the Atlantic already knew in 1997 that the U.S. could never join the Protocol as drafted.”<sup>187</sup>

The Bush Administration’s position was not nearly so ambiguous. In 2001, President Bush described the Kyoto Protocol as “fatally flawed” and “effectively dead,” emphasizing the nonparticipation of developing countries. In the key letter, President Bush wrote, “I oppose the Kyoto Protocol because it exempts 80% of the world, including major population centers such as China and India, from compliance, and would cause serious harm to the U.S. economy.”<sup>188</sup> In fact the United States attempted to persuade other nations, including Japan, to reject the Protocol as well.<sup>189</sup> In addition, the United States has done exceedingly little to reduce the emission of greenhouse gases, relying largely on collecting information about emissions levels and encouraging further research.<sup>190</sup> One of the na-

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<sup>182</sup> PRING, *supra* note 22, at 200–01.

<sup>183</sup> *Id.* at 205.

<sup>184</sup> *Id.* at 206.

<sup>185</sup> *Id.*

<sup>186</sup> *Id.* at 206–207.

<sup>187</sup> See Benedick, *Morals*, *supra* note 176, at 16.

<sup>188</sup> See *supra* note 2.

<sup>189</sup> PERCIVAL ET AL., *supra* note 4, at 1071.

<sup>190</sup> For overviews, see U.S. Dept. of State, Climate Change Fact Sheet (May 18, 2005), available at <http://www.state.gov/g/oes/rls/fs/46741.htm>; U.S. DEPT. OF STATE, U.S. CLIMATE ACTION REPORT (May 2002), available at <http://yosemite.epa.gov/OAR/globalwarming.nsf/content/ResourceCenterPublicationsUSClimateActionReport.html>; Overview of U.S. Research in Climate and Global Change, <http://www.climate-science.gov/about/overview-a.htm> (last updated Oct. 11, 2003) (on file with the Harvard Environmental Law Review). See also Press Release, The White House Office of the Press Secretary, President Bush Discusses Global Climate Change (June 11, 2001), available at <http://www.whitehouse.gov/news/releases/2001/06/20010611-2.html>; DANIEL R. ABBASI, AMERICANS AND CLIMATE CHANGE 20–23 (2006). On June 22, 2005, a 53-44 majority of the United States Senate approved a “sense of the Senate” resolution to the effect that “Congress should enact a

tion's principal goals is an 18% improvement in greenhouse gas intensity between 2002 and 2012,<sup>191</sup> with intensity measured as emissions per unit of GDP. But the goal is an aspiration, not a requirement,<sup>192</sup> and in any case significant reductions in greenhouse gas intensity can be accompanied by extremely large increases in greenhouse gas emissions.<sup>193</sup>

Nonetheless, the Kyoto Protocol went into effect in 2005, and the number of nations formally committed to it is impressive indeed. Of the original participants in the process that led to Kyoto, the United States and Australia are the only non-ratifiers. In 2001, the Marrakech Accords led to further innovations, in which developing countries were made beneficiaries of funds to assist with technology transfer.<sup>194</sup> Although the level of the funds remains unspecified, donors led by the European Union pledged to grant \$410 million annually.<sup>195</sup> To this extent, the Montreal Protocol and the Kyoto Protocol might appear to be roughly parallel. But the appearance is badly misleading, as we shall shortly see.

### B. Costs and Benefits

For the United States and the world, the benefits of the Montreal Protocol were projected to dwarf the costs. What are the relevant figures for the Kyoto Protocol? Because of the nature of the climate change problem, any answer will be highly disputable,<sup>196</sup> and I shall devote some attention to the disputes here. It is an understatement to say that there is disagreement about the likely costs of climate change and the likely expense of emissions reductions.<sup>197</sup> My principal concerns are the benefits and costs

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comprehensive and effective national program of mandatory market-based limits and incentives on greenhouse gases that slow, stop and reverse the growth of such emissions . . . ." *Id.* at 20. The most aggressive legislative proposal, from Senators John McCain and Joseph Lieberman in 2003, would have capped greenhouse gas emissions at 2000 levels. The proposal was defeated by a vote of 55-43. For an overview, see Press Release, U.S. Senate, Committee on Commerce, Science, and Transportation, *Senate Casts Historic Vote on McCain-Lieberman Global Warming Bill* (Oct. 30, 2003), available at <http://commerce.senate.gov/newsroom/printable.cfm?id=214305>. For an analysis of the proposal, see Sergey Paltsev et al., *Emissions Trading to Reduce Greenhouse Gases in the United States* (The McCain-Lieberman Proposal), MIT GLOBAL CHANGE JOINT PROGRAM REPORT SERIES, June 2003, available at <http://web.mit.edu/globalchange/www/reports.html>.

<sup>191</sup> For a helpful outline, see Pew Center on Global Climate Change, *Analysis of President Bush's Climate Change Plan*, [http://www.pewclimate.org/policy\\_center/analyses/response\\_bushpolicy.cfm](http://www.pewclimate.org/policy_center/analyses/response_bushpolicy.cfm) (last visited Oct. 25, 2006) (on file with the Harvard Environmental Law Review).

<sup>192</sup> *See id.*

<sup>193</sup> This in fact has been the experience of the United States between 1990 to 2004, with significant reductions in greenhouse gas intensity (by 21%) accompanied by significant growth in carbon dioxide emissions (by 19%). *See* GHG EMISSIONS 2004, *supra* note 149, at xii.

<sup>194</sup> *See* PERCIVAL ET AL., *supra* note 4, at 1072-73; Matthew Vespa, *Climate Change 2001: Kyoto at Bonn and Marrakech*, 29 *ECOLOGY L. Q.* 395 (2002).

<sup>195</sup> PERCIVAL ET AL., *supra* note 4, at 1073.

<sup>196</sup> For illuminating discussions, see NORDHAUS & BOYER, *supra* note 28; Cline, *supra* note 39; Ackerman & Finlayson, *supra* note 28.

<sup>197</sup> *See* sources *supra* note 196. *See also* STERN REVIEW, *supra* note 8, at I-xviii;

as they were perceived at the relevant times. Of course most members of the Senate do not base their decisions on technical cost-benefit analysis, and the role of such analysis within the executive branch varies over time. But the underlying figures, or at least a rough perception of their magnitude, undoubtedly affected the behavior of some legislators and those in the White House—a point to which I will return.

### 1. American Costs

We begin with the United States, focusing on the cost side. At the time of ratification, the proper analysis of costs was highly contested. An early analysis in the Clinton Administration found “modest” costs from the Kyoto Protocol, producing a non-trivial but hardly devastating \$0.04 to \$0.06 increase in the price of gasoline, and an annual increase in the average family’s energy bill of \$70 to \$110 by 2010.<sup>198</sup> Within the Clinton Administration itself, however, these projections were disputed. A study by the Department of Energy projected substantial gasoline price increases from \$1.39 to \$1.91, and 20% to 86% increases in the price of electricity by 2010.<sup>199</sup> Compare in this regard an industry-funded study done at the Wharton School, which projected costs in excess of these projections<sup>200</sup>—including a loss of 2.4 million jobs and \$300 billion in the nation’s GDP, with an average annual cost of \$2,700 per household, including a \$0.65 per gallon increase in the price of gasoline and a near-doubling of the price of energy and electricity.<sup>201</sup>

In my view, these last figures are wildly inflated, but they received a great deal of publicity. One of the most careful and influential analyses comes from William Nordhaus and Joseph Boyer.<sup>202</sup> As Nordhaus and Boyer show, a great deal depends on the amount of emissions trading. If trading were freely available, the cost to American companies would be dramatically reduced, because they could avoid expensive emissions reduction requirements and rely instead on purchasing permits.<sup>203</sup> Additional uncertainty about the numbers stems from the fact that technological innovation might drive down costs, as indeed it did in the context of CFCs.<sup>204</sup> According to Nordhaus and Boyer, the worst-case scenario for the Kyoto

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P. WATKISS ET AL., *The Impacts and Costs of Climate Change* (2005), available at [http://ec.europa.eu/environment/climat/pdf/final\\_report2.pdf](http://ec.europa.eu/environment/climat/pdf/final_report2.pdf); Claudia Kemfert, *Global Climate Protection—Immediate Action Will Avert High Costs*, DIW WKLY. REP. 135 (2005) (on file with the Harvard Environmental Law Review).

<sup>198</sup> PRING, *supra* note 22, at 194.

<sup>199</sup> *Id.* at 196.

<sup>200</sup> WEFA, INC., *GLOBAL WARMING: THE HIGH COST OF THE KYOTO PROTOCOL* (1998), available at <http://www.heartland.org/pdf/11399.pdf>.

<sup>201</sup> *Id.*

<sup>202</sup> NORDHAUS & BOYER, *supra* note 28.

<sup>203</sup> *Id.* at 155–62.

<sup>204</sup> PERCIVAL ET AL., *supra* note 4, at 1051.

Protocol, involving no effective trading, would produce total present value costs of \$852 billion.<sup>205</sup> The best case scenario, involving global trading, would involve costs of \$91 billion.<sup>206</sup> Nordhaus and Boyer suggest that the most likely figure for costs is \$325 billion, involving trading among the Annex 1 nations.<sup>207</sup>

For the world as a whole, however, the costs are actually lower—merely \$217 billion in the case of Annex 1 trading, and \$884 billion in the case of no trading.<sup>208</sup> The reason is that many nations, especially those in Eastern Europe, would receive a great deal of money from permit sales, and therefore they would count as net winners quite apart from any benefits from reducing global warming. The mere grant of permits produces tens of billions of dollars in gains for both Russia and Europe—a total of \$112 billion from Annex I trading.<sup>209</sup> It is a real question whether these billions of dollars in revenue, amounting to a kind of transfer, should count as a “benefit” from the Kyoto Protocol. But even if such amounts are included, Nordhaus and Boyer project the worldwide costs of the Protocol in the hundreds of billions of dollars.

## 2. *American Benefits*

What would the United States and the world receive in return for these costs? Here too there is a great deal of uncertainty—even more so than on the cost side.<sup>210</sup> Let us begin with the anticipated costs of climate change in general, and then turn to the effect of the Kyoto Protocol. The two issues are quite different, and it is important to separate them. Even if the anticipated costs of climate change are high, a particular response might do little to reduce those costs, and hence produce little in the way of benefits.

In its 2001 report, the Intergovernmental Panel on Climate Change projected an increase of between 1.4 and 5.8 °C by 2001.<sup>211</sup> It is clear that an increase of 1.4 °C would cause far less damage than an increase of 5.8 °C.<sup>212</sup> If climate change is abrupt, the cost will be far higher than

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<sup>205</sup> NORDHAUS & BOYER, *supra* note 28, at 159.

<sup>206</sup> *Id.*

<sup>207</sup> *Id.*

<sup>208</sup> *Id.*

<sup>209</sup> *Id.* at 162.

<sup>210</sup> For valuable overviews, see generally AVOIDING DANGEROUS CLIMATE CHANGE, *supra* note 150; Richard S.J. Tol, *The Marginal Damage Costs of Carbon Dioxide Emissions: An Assessment of the Uncertainties*, 33 ENERGY POL’Y 2064 (2005); NORDHAUS & BOYER, *supra* note 28; Cline, *supra* note 39; ACKERMAN & FINLAYSON, *supra* note 28.

<sup>211</sup> See PERCIVAL ET AL., *supra* note 4, at 1058. According to one account of current trends, warming of 2 to 3 °C is anticipated within the next fifty years, see STERN REVIEW, *supra* note 8, at vi, and in the longer term, there is a greater than 50% change of warming in excess of 5 °C. *Id.* at vi.

<sup>212</sup> STERN REVIEW, *supra* note 8, at 55–84; PERCIVAL ET AL., *supra* note 4, at 1059.

otherwise; abrupt climate change may lead to worldwide catastrophe.<sup>213</sup> The magnitude of the risk of catastrophe is disputed, and any such risk must be incorporated in the overall analysis.<sup>214</sup> How to incorporate a risk of catastrophe is a disputed question. Perhaps a significant margin of safety is appropriate.<sup>215</sup> The question of monetization creates many additional puzzles. To these points it must be added that specialists greatly disagree about the likely damage from climate change, even assuming a particular increase in global mean temperatures.<sup>216</sup> For example, a great deal turns on the selection of the discount rate, because many of the gains from emissions reductions will be experienced in the future, a low discount rate will obviously mean higher benefits from risk reduction than a high one.<sup>217</sup>

According to one influential estimate, however, the present worldwide cost of climate change is projected to be in the vicinity of \$4 trillion.<sup>218</sup> That cost should be put in perspective: the annual GDP of the United States is \$10 trillion, suggesting a capital stock value of at least \$100 trillion.<sup>219</sup> But \$4 trillion is a great deal, and even that figure may be far too low if a low discount rate is used<sup>220</sup> or if climate change is abrupt.<sup>221</sup> According to other estimates, climate change will reduce the GDP of developed nations by 1% or 2%, and reduce the GDP of developing nations by 5% or more.<sup>222</sup> Still other estimates now suggest that the overall cost of climate change may be significantly higher, perhaps as high as 6% to 8% of the world's GDP,<sup>223</sup> or even more.<sup>224</sup>

<sup>213</sup> See POSNER, *supra* note 7, at 163.

<sup>214</sup> See STERN REVIEW, *supra* note 8, at v, 152–65, 195 (discussing analysis of probabilities of bad outcomes); NORDHAUS & BOYER, *supra* note 28, at 87–89 (projecting a catastrophic risk of between 2% and 6%); Peter Challenor et al., *Towards the Probability of Rapid Climate Change*, in AVOIDING DANGEROUS CLIMATE CHANGE, *supra* note 150, at 55, 61 (projecting a risk of abrupt climate change, which is potentially catastrophic, at 30% to 40%).

<sup>215</sup> See CASS R. SUNSTEIN, WORST-CASE SCENARIOS (forthcoming 2007) [hereinafter SUNSTEIN, WORST-CASE SCENARIOS].

<sup>216</sup> See STERN REVIEW, *supra* note 8; Tol, *supra* note 210; HOUGHTON, *supra* note 5.

<sup>217</sup> For relevant discussion, see STERN REVIEW, *supra* note 8, at 43–52; DeCanio, *supra* note 33 at 302–03 (supporting intergenerational neutrality and suggesting that a low discount rate is compatible with this principle); Richard B. Howarth, *Against High Discount Rates*, in PERSPECTIVES ON CLIMATE CHANGE: SCIENCE, ECONOMICS, POLITICS, ETHICS 217, 229 (Walter Sinnott-Armstrong & Richard B. Howarth eds., 2005).

<sup>218</sup> See NORDHAUS & BOYER, *supra* note 28, at 130–32 (estimating \$4 trillion); see also POSNER, *supra* note 7, at 44 (noting but raising doubts about estimates of \$4 trillion or \$5 trillion). For a much more systematic effort see STERN REVIEW, *supra* note 8, at i–xi (suggesting an anticipated 5% to 10% loss in global GDP from 5 to 6 °C warming, with a 10% loss in poor nations).

<sup>219</sup> See POSNER, *supra* note 7, at 44.

<sup>220</sup> See Ackerman & Finlayson, *supra* note 28.

<sup>221</sup> *Id.*

<sup>222</sup> See Houghton, *supra* note 5, at 188.

<sup>223</sup> See Kemfert, *supra* note 197, at 140. See also Ackerman & Finlayson, *supra* note 28.

<sup>224</sup> See STERN REVIEW, *supra* note 8, at x (projecting total losses between 5% and 20% of world GDP).

It is difficult to doubt the proposition that the Kyoto Protocol would be worthwhile if it would eliminate the total cost of climate change. But according to the prominent estimate by Nordhaus and Boyer, the agreement would actually have a meager effect, reducing anticipated warming by a mere 0.03 °C by 2100.<sup>225</sup> According to another estimate, the agreement would reduce anticipated warming by 1.2 °C by 2300.<sup>226</sup> The reason for these low estimates is that climate change is a function of aggregate emissions of greenhouse gases, and the Kyoto Protocol would have only a small effect on those aggregate emissions. At the very least, this has been the perception of prominent observers during the period in which the United States refused to ratify the Kyoto Protocol.

There are three points here. First, emissions from China, India, and other developing countries—whose substantial contributions to climate change are expected to grow much larger in the near future—are not regulated by the agreement at all. Second, past emissions of greenhouse gases will contribute to warming; it follows that even a substantial reduction in future emissions would not eliminate the problem. Third, the Kyoto Protocol requires the parties not to make substantial cuts in emissions, but merely to return to a point slightly below emissions levels in 1990. It is for these reasons that its contribution to the problems caused by climate change are anticipated to be small.

What are the anticipated effects of the agreement for the United States? According to prominent projections, the most serious damage from climate change is unlikely to be felt in the United States.<sup>227</sup> On some estimates, American agriculture will actually be a net winner as a result of climate change.<sup>228</sup> On other estimates, Americans will be net losers, but not nearly to the same extent as most other nations.<sup>229</sup> In this light, we can offer a projection of the costs and benefits of the Kyoto Protocol for the United States alone—a projection designed not to offer anything like an unimpeachable point estimate, but to describe what prominent analysts expected when the United States was making its key decisions.<sup>230</sup>

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<sup>225</sup> NORDHAUS & BOYER, *supra* note 28, at 152.

<sup>226</sup> See Cline, *supra* note 39, at 29.

<sup>227</sup> See NORDHAUS & BOYER, *supra* note 28, at 96–97.

<sup>228</sup> See OLIVIER DESCHENES & MICHAEL GREENSTONE, *THE ECONOMIC IMPACTS OF CLIMATE CHANGE: EVIDENCE FROM AGRICULTURAL OUTPUT AND RANDOM FLUCTUATIONS OF WEATHER* (2006), available at <http://www.aei-brookings.org/admin/authorpdfs/page.php?id=1237>. Compare the suggestion in NORDHAUS & BOYER, *supra* note 28, at 97, that “the economic impact of gradual climate change (that is, omitting catastrophic outcomes) is close to zero for a moderate (2.5 °C) global warming.” Note that this conclusion does not come to terms with the economic effects on the United States that would result from serious economic harms in other nations.

<sup>229</sup> See NORDHAUS & BOYER, *supra* note 28, at 96–97; STERN REVIEW, *supra* note 8, at 130 (noting possible effects ranging from a loss of 1.2% GDP to a gain of 1% GDP from 3 °C warming, and emphasizing that this assessment does not take full account of the effects of extreme weather events such as hurricanes).

<sup>230</sup> Compiled on the basis of NORDHAUS & BOYER, *supra* note 28, at 156–67.

FIGURE 3: COSTS AND BENEFITS OF KYOTO PROTOCOL FOR THE UNITED STATES (IN BILLIONS OF 1990 DOLLARS)

	No Controls	Kyoto Protocol	Unilateral Action to Comply with Kyoto Protocol
Benefits	—	12	0 <sup>231</sup>
Costs	—	325	325
Net Benefits	—	-313	-325

It should be immediately clear that on these numbers, the Kyoto Protocol is not a good bargain for the United States. The anticipated benefits of \$12 billion are hardly trivial, but they are dwarfed by the anticipated costs of \$325 billion. For the United States, unilateral action to comply with the Kyoto Protocol may well produce no benefits at all, and on these projections, it would not be easy to defend in cost-benefit terms. If the United States engaged in emissions reduction on its own, it would be taking extremely costly action for speculative benefits—or at least prominent actors so perceived the situation at the time.

To say this is not to say that unilateral action by the United States would have no rationale.<sup>232</sup> Perhaps such action could begin a much broader and more inclusive process, ultimately persuading other nations, including China and India, to reduce their emissions. Perhaps such action could spur technological innovation in a way that would have substantial long-term consequences for the problem of climate change—and do so at a cost lower than what is now anticipated. If the actions of the United States helped to produce energy sources that greatly reduced greenhouse gases, we might find a parallel to the process that led to the Montreal Protocol, as technological innovation led the world to believe that it had less to lose from regulation than it originally feared. As we have seen, substitutes for ozone-depleting chemicals developed more rapidly, and more cheaply, than anyone expected.<sup>233</sup> But for climate change, any such strategy would be a gamble, and on the figures offered by prominent analysts, it would be difficult to defend the Kyoto approach using conventional analysis.

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<sup>231</sup> This estimate is of course rough. It is based on the assumption that unilateral action would have no significant effect in reducing the harms associated with climate change for the United States.

<sup>232</sup> See POSNER, *supra* note 7, at 163. There is an analogous puzzle here about why California, in 2006, unilaterally adopted a significant restriction on greenhouse gases, roughly parallel to the restrictions in the Kyoto Protocol. See Felicity Barringer, *California Taking Big Gamble, Tries to Curb Greenhouse Gases*, N.Y. TIMES, Sept. 15, 2006, at A1. I explore this puzzle below.

<sup>233</sup> See PERCIVAL ET AL., *supra* note 4, at 1051.

The larger point is that for the United States, the perceived values presented a much less favorable picture for the Kyoto Protocol than for the Montreal Protocol. The perceived costs of the Kyoto Protocol were much higher than the costs of the Montreal Protocol (by some \$313 billion), and the perceived benefits of the former were much lower than the benefits of the latter (by some \$3,562 billion). As I have emphasized, I do not mean to suggest that all of the relevant officials, in the Senate or in the Bush Administration, were aware of specific figures, or based their decisions on a formal cost-benefit calculation of any kind. Recall that nations are not persons, and that any national response to cost-benefit analysis has to explain the mechanism that makes that response possible. The central point is instead that an intuitive understanding of consequences—that the Kyoto Protocol would deliver few benefits, because of the exclusion of the developing nations, while imposing significant burdens—played a key role. In the Senate, both Republicans and Democrats appeared to be aware that the Kyoto Protocol would impose significant costs and deliver relatively low benefits, because of the exclusion of developing nations. In the executive branch, this view was widely held at the relevant times, even among those who believed that climate change was a significant problem.

Of course interest-group power, or moral commitments, may push nations away from the outcome that expert cost-benefit analysis suggests. Interest groups and moral commitments have played a significant role in the American debate over climate change.<sup>234</sup> But with respect to the Kyoto Protocol, both formal and informal assessments of domestic costs and benefits had large effects in discouraging ratification.

### 3. *The World*

For the world as a whole, the picture is better, but not particularly good, and not nearly as good as that for the Montreal Protocol.<sup>235</sup>

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<sup>234</sup> See, e.g., PRING, *supra* note 22, at 196–97 (noting role of interest groups); GORE, *supra* note 20 (pressing moral argument).

<sup>235</sup> These figures were calculated on the basis of NORDHAUS & BOYER, *supra* note 28, at 145–64.

FIGURE 4: COSTS AND BENEFITS OF KYOTO PROTOCOL FOR THE WORLD  
(IN BILLIONS OF 1990 DOLLARS)

	No Controls	Kyoto Protocol
Benefits	—	96
Costs	—	338 or 217 (if we include, as offsetting benefits, 112 in permits for Eastern Europe)
Net Benefits	—	-242 or -119

As I have suggested, these numbers are merely estimates, and they depend on contentious assumptions about the degree of emissions trading, about technological innovation, about discount rates, about the likelihood of abrupt or catastrophic warming, and about the valuation of life and health. With a lower discount rate, and modest changes in underlying assumptions, the benefits of greenhouse gas reductions can grow dramatically.<sup>236</sup> Reasonable people might expect the costs to be significantly lower or offer a significantly higher estimate of the benefits.<sup>237</sup> Perhaps the Kyoto Protocol would have served, and might still serve, as a start toward a broader and more inclusive agreement. But on the numbers that confronted the United States at the pertinent times, the argument for ratification of the Kyoto Protocol was certainly unclear—far more so than the argument for ratification of the Montreal Protocol.

#### 4. A Final Mystery

If all of the relevant facts are taken together, it is possible to explain why the United States was skeptical of the Kyoto Protocol. But a mystery remains: Why did so many nations express significant enthusiasm for it? Why was the Kyoto Protocol possible at all? We already have some clues. Part of the answer undoubtedly involves an assessment of domestic costs and benefits—an assessment that seemed favorable or at least not greatly unfavorable for many of the signatories, but uniquely unfavorable for the United States.<sup>238</sup> Many nations undoubtedly had more to gain than to lose,

<sup>236</sup> See Ackerman & Finlayson, *supra* note 28.

<sup>237</sup> Cline, *supra* note 39, at 31 (suggesting that the Kyoto Protocol would deliver worldwide benefits in excess of costs, but that it accomplishes relatively little in reducing warming).

<sup>238</sup> Cline, *supra* note 39, at 31 (suggesting that the protocol would on balance be undesirable for the industrialized nations). It is clear that if this conclusion is right, it is because the agreement would be highly undesirable for the United States, which would bear the lion's share of the cost.

such as those in Eastern Europe that acquired valuable emissions licenses. Some of the nations that appeared to make ambitious promises, such as Germany and the United Kingdom, did no such thing. Hence domestic self-interest played a large role in producing the particular targets in the treaty; it should not be terribly surprising that many nations accepted targets that they helped to create, and that were not, therefore, terribly demanding. Moreover, some nations, or their leaders, may have benefited from the signaling effect of participation, especially if they could simultaneously attempt to embarrass the United States. If national leaders in certain countries could show a strong commitment to meet a global international challenge, many domestic constituents would be pleased and impressed, and it would be all the better if the apparently strong commitment did not impose significant domestic costs.

To be sure, it is possible that some such nations were acting as global altruists. Perhaps some of them had an unusually pessimistic account of the consequences of climate change. Perhaps some, or many, believed that the Kyoto Protocol would initiate a set of agreements that would ultimately do far more good than harm. But perhaps some nations, especially those with the most to lose, did not believe that the Kyoto Protocol would actually prove to be binding. For them, the requirements were goals or aspirations rather than a binding obligation.<sup>239</sup> On this view, the agreement was a kind of “cheap talk”—a way of signaling a commitment that would not operate as a commitment in practice. Let us now explore some evidence for this view.

### *C. Notes on Practice*

The Kyoto Protocol has been ratified by all of the Annex 1 nations except the United States and Australia. But this simple fact does not tell us what nations are actually doing. Moreover, it is impossible to come to terms with the conflicting American approaches to the two problems without exploring actual American practices. The key points here are that the United States is the world’s leading contributor to climate change and that greenhouse gas emissions have been growing, not stabilizing, in recent years. Let us begin with some general numbers about national performance.

#### *1. Greenhouse Gas Emissions in the World*

The formal fact of ratification disguises a quite complex practice. Numerous nations are very far from their targets under the Kyoto Protocol. Begin with the European Union countries:<sup>240</sup>

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<sup>239</sup> This possibility is supported by the absence of any real sanctions for non-compliance.

<sup>240</sup> United Nations Framework Convention on Climate Change, KEY GHG DATA: GREENHOUSE GAS (GHG) EMISSIONS DATA FOR 1990–2003 SUBMITTED TO THE UNFCCC

FIGURE 5: CHANGE IN EMISSIONS FOR COUNTRIES IN THE  
EUROPEAN UNION

Country	Target	% Change in Emissions Between 1990 and 2003	Compliant?
Austria	-13%	16.50%	no
Belgium	-7.50%	1.30%	no
Denmark	-21%	6.80%	no
Finland	0	21.50%	no
France	0	-1.90%	yes
Germany	-21%	-18.20%	almost
Greece	25%	25.80%	almost
Ireland	13%	25.60%	no
Italy	-6.50%	11.50%	no
Luxembourg	-28%	-16.10%	no
Netherlands	-6%	1.50%	no
Portugal	27%	36.70%	no
Spain	15%	41.70%	no
Sweden	4%	-2.30%	yes
United Kingdom	-12.50%	-13%	yes

Note that compliance is not required until some time between 2008 and 2012 (with the precise date varying by country), so that widespread noncompliance in 2003 does not foreclose the possibility that the situation will be better when the actual due dates arrive. Nonetheless, most nations in the EU are very far from their targets under the Kyoto Protocol. The current numbers, and the existing trends, suggest that it is highly likely that a majority of EU nations will fail to meet their obligations. This is in contrast with the Montreal Protocol, which had nearly perfect compliance. To be sure, Sweden, France, the United Kingdom, Germany, and

Greece are below or close to their targets; we have seen the explanation for the United Kingdom and Germany.<sup>241</sup> The more important point is that the vast majority of nations are very far from what Kyoto requires, often showing increases where they should be showing reductions.

Now consider Annex I countries:<sup>242</sup>

FIGURE 6: CHANGE IN EMISSIONS FOR ANNEX 1 COUNTRIES

Country	Target	% Change in Emissions Between 1990 and 2003	Compliant?
Bulgaria	-8%	-50%	yes
Czech Republic	-8%	-24.20%	yes
EU	-8%	-1.40%	no
Estonia	-8%	-50.80%	yes
Latvia	-8%	-58.50%	yes
Liechtenstein	-8%	5.30%	no
Lithuania	-8%	-66.20%	yes
Monaco	-8%	30%	no
Romania	-8%	-46.10%	yes
Slovakia	-8%	-28.30%	yes
Slovenia	-8%	-1.90%	no
Switzerland	-8%	-0.40%	no
United States	-7%	13.34%	no—refuses to ratify
Canada	-6%	24.20%	no
Hungary	-6%	-31.90%	yes
Japan	-6%	12.80%	no
Poland	-6%	-34.40%	yes

<sup>241</sup> See *supra* Part II.A.

<sup>242</sup> UNFCCC, *supra* note 240, at 16–17.

Croatia	-5%	-6%	yes
New Zealand	0%	22.50%	no
Russian Federation	0%	-38.50%	yes
Ukraine	0%	-46.20%	yes
Norway	1%	9.30%	no
Australia	8%	23.30%	no—refuses to ratify
Iceland	10%	-8.20%	yes

The most remarkable fact presented here is that while the United States is one of only two Annex I nations that have declined to ratify the Kyoto Protocol, a number of countries show emissions increases comparable to or higher than those of the United States. These include Canada, New Zealand, Australia, Austria, Greece, Ireland, Portugal, Spain, and Italy. It is true that substantial reductions in greenhouse gas emissions can be found in Bulgaria, Estonia, Latvia, the Czech Republic, Lithuania, Hungary, Poland, Russia, Ukraine, Iceland, Luxembourg, the United Kingdom, Sweden, and Germany.<sup>243</sup> But most of these nations are in Central and Eastern Europe, which has suffered serious economic distress in the relevant period. That distress accounts for substantially lower levels of energy use and has led to lower levels of emissions, with the overall reductions amounting to 37% in the relevant period.<sup>244</sup>

Because of the latter figure, the good news is that from 1990 to 2003, greenhouse gas emissions from Annex I parties decreased by 5.9%, or a total of 1.1 billion tons—an average decrease in line with the Kyoto target.<sup>245</sup> But this figure is misleading. While it is true that the average decrease under Kyoto's target is 5.2%, Kyoto's distribution of targets among nations would produce far greater overall decreases than those captured by the immediately preceding table. The reason is that the decreases have occurred in nations with already low emissions rates, while the nations with high emissions rates, above all the United States, are generally increasing, not decreasing, their emissions. By 2010, overall emissions from wealthy nations may grow by as much as 17% from 2000.<sup>246</sup> In view of

<sup>243</sup> *See id.*

<sup>244</sup> One World, *Rich Countries' Greenhouse Gas Emissions Ballooning*, June 10, 2003, <http://www.commondreams.org/headlines03/0610-07.htm> (on file with the Harvard Environmental Law Review).

<sup>245</sup> UNFCCC, *supra* note 240, at 14.

<sup>246</sup> One World, *supra* note 244.

the likely increase in wealthy nations, and because the economies of Eastern European nations are recovering, Kyoto's goals are most unlikely to be met, and the ratifying nations as a whole might well fall far short of them.<sup>247</sup>

An important qualification to the figures just given: the behavior of nations is interdependent, and whether nations are willing to make significant reductions in greenhouse gas emissions might be endogenous to the behavior of the United States in particular. If the world's leading emitter is unwilling to make reductions, other nations might be reluctant to do so. We do not have a clear test of how nations would behave if the United States were willing to reduce its own emissions. Let us now turn to that issue.

## 2. Greenhouse Gas Emissions in the United States

For the United States, practices in the last decade will make compliance with Kyoto's goals, or anything like them, even more challenging than it would have been at an earlier stage. The reason is that by most measures, energy use has been moving in exactly the wrong direction.

Within the United States, greenhouse gas emissions increased by 15.8% between 1990 and 2004.<sup>248</sup> In 1990, carbon dioxide emissions were 5,002.3 million metric tons; in 2004, they were 5,973.0 million metric tons, a jump of 19%.<sup>249</sup> To be sure, greenhouse gas *intensity*—understood as emissions per unit of GDP—has been decreasing in the same period, with a significant decline of 21%.<sup>250</sup> But because of increased energy usage, per capita emissions have actually increased over this period by 1.2%—an increase that, alongside population growth, produced the increase in aggregate emissions.<sup>251</sup>

Fossil fuel combustion is by far the largest contributor to greenhouse gas emissions in the United States, accounting for well over 95% of total carbon dioxide emissions.<sup>252</sup> Greenhouse gas emissions from this source have been growing in most sectors.<sup>253</sup> The transportation sector, based on fossil fuels, accounts for over a quarter of emissions, and it is the most rapidly growing source.<sup>254</sup> While methane emissions decreased by 10% in 2004, total greenhouse gas emissions increased by 1.7% in the same year, the largest increase on record from any nation.<sup>255</sup> The most important

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<sup>247</sup> *Id.*

<sup>248</sup> See GHG EMISSIONS 2004, *supra* note 149, at ix; *Record Increase in U.S. Greenhouse Gas Emissions Sparks Global Controversy*, Apr. 19, 2006, <http://environment.about.com/b/a/256722.htm> (on file with the Harvard Environmental Law Review).

<sup>249</sup> GHG EMISSIONS 2004, *supra* note 149, at x, xii.

<sup>250</sup> *Id.* at xii.

<sup>251</sup> *Id.*

<sup>252</sup> Roughly 98% of anthropogenic carbon dioxide emissions in the U.S. come from fossil fuel combustion. *Id.* at 19.

<sup>253</sup> *Id.*

<sup>254</sup> EPA, GREENHOUSE GAS EMISSIONS FROM TRANSPORTATION AND OTHER MOBILE SOURCES (2006), available at <http://www.epa.gov/otaq/greenhousegases.htm>.

<sup>255</sup> See GHG EMISSIONS 2004, *supra* note 149, at 35; *Record Increase*, *supra* note 248.

conclusion of this capsule summary is that if the United States were to attempt to meet the target set by the Kyoto Protocol—a 7% reduction in emissions since 1990—it would have to impose exceedingly aggressive regulatory restrictions, for the simple reason that existing emissions are substantially in excess of 1990 levels, and growing every year.<sup>256</sup>

### III. LESSONS AND IMPLICATIONS

What follows from an understanding of the extraordinary success of the Montreal Protocol and far more mixed picture of the Kyoto Protocol? There are only two data points here, and it is therefore important to be careful in drawing general conclusions. But it is noteworthy that the Montreal Protocol was produced and ratified under a Republican President, not known for his commitment to environmental protection, and that a unanimous Senate voted for ratification. It is noteworthy as well that the Kyoto Protocol produced an ambivalent reaction under a Democratic President, who sought less ambitious targets than those favored by other nations, and that the Senate was unanimously opposed to it.

A possible response is that if Vice President Gore had won the presidency in 2000—and of course he was very close to doing so—the United States might well have ratified the Kyoto Protocol, and hence that the material interest of the United States, as reflected in the numbers I have given, would not necessarily have been determinative. Counterfactual history is full of speculation, but there is every reason to believe that no American president would have been able to persuade the Senate to ratify the Kyoto Protocol in the initial years of the twenty-first century. Recall that no member of the United States Senate publicly supported ratification. Recall too that even as Vice President, Al Gore was pressed to say that the Clinton Administration would not ask the Senate to ratify the treaty without “meaningful participation” by developing countries.<sup>257</sup> Of course leadership matters, and we cannot entirely exclude the possibility that an aggressive and agile president, firmly committed to the Kyoto Protocol, might have persuaded the nation to accept it. But at the very least, it can be said that such a president would have faced an extremely difficult uphill battle. The unanimous opposition of the Senate in the relevant period speaks volumes.

For these reasons, both tales are legitimately taken as exemplary. They fit with other accounts in domains that are both related<sup>258</sup> and quite

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<sup>256</sup> To be sure, apparently significant steps are being taken at the state level. For a brief overview, see Cass R. Sunstein, *On the Divergent American Reactions to Terrorism and Climate Change*, COLUM. L. REV. (forthcoming 2007) [hereinafter Sunstein, *Divergent Reactions*].

<sup>257</sup> See *supra* Part II.A.

<sup>258</sup> See generally BARRETT, *supra* note 5.

different;<sup>259</sup> those accounts emphasize the centrality of domestic self-interest in national judgments with respect to whether to join, or to comply with, international obligations. Nothing in the discussion here demonstrates that domestic self-interest is the sole motivation for government behavior; but there is no question that it plays a significant role.<sup>260</sup> As revealing evidence, consider the fact that a “revealed preference” study of American laws suggests that a non-American life is valued at 1/200 of an American life.<sup>261</sup>

We can sharpen the distinction between the two protocols by offering a more general point. Some international agreements can solve prisoner’s dilemmas, by enabling nations to make binding promises to undertake mutually beneficial action that no individual nation, or few individual nations, would undertake on their own.<sup>262</sup> A possible virtue of some such agreements is that they have this feature. At first glance, the problems of ozone depletion and climate change might seem to have the structure of a prisoner’s dilemma. Indeed, a sensible agreement to control climate change might well solve such a dilemma.<sup>263</sup> But neither the Montreal Protocol nor the Kyoto Protocol can be understood in these terms. As we have seen, unilateral compliance with the requirements of the Montreal Protocol was in the interest of the United States, and probably many other nations as well. Hence the United States and many others would rationally do as the Montreal Protocol required even if no other nation did so. By contrast, prominent analyses suggested that compliance with the requirements of the Kyoto Protocol would probably have made Americans worse off, even if such compliance ensured that all other parties complied as well.<sup>264</sup> It is possible to imagine an agreement that would make all or most nations better off,<sup>265</sup> but the Kyoto Protocol was not that agreement.

If all of the relevant figures are taken as a whole, however, it would be possible to offer the following objection to my emphasis on the importance of domestic self-interest to the decisions of the United States. Nei-

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<sup>259</sup> See KEOHANE, *supra* note 26, at 217–40; see GOLDSMITH & POSNER, *supra* note 30, at 4–14, 23–43; Jack Goldsmith, *Liberal Democracy and Cosmopolitan Duty*, 54 STAN. L. REV. 1667 (2003).

<sup>260</sup> See Maxwell & Weiner, *supra* note 36, at 37–38.

<sup>261</sup> See Wojciech Kopszuk et al., *The Limitations of Decentralized World Redistribution: An Optimal Taxation Approach*, 30 EUR. ECON. REV. 1051, 1075 (2005).

<sup>262</sup> See GOLDSMITH & POSNER, *supra* note 30, at 29–32.

<sup>263</sup> See STERN REVIEW, *supra* note 8, at 450–65.

<sup>264</sup> I put to one side the possibility that the Kyoto Protocol could be defended as starting a process toward a better agreement, or that aggressive technology-forcing on the part of the United States might create innovation that would greatly help with greenhouse gas emissions.

<sup>265</sup> See NORDHAUS & BOYER, *supra* note 26, at 175 (suggesting an international carbon tax, starting in the near term at under \$15 per ton); Cline, *supra* note 39, at 37 (suggesting a higher carbon tax, starting at \$150 per ton and increasing to \$600 by 2100); STERN REVIEW, *supra* note 8, at 449–568 (sketching possible routes to international cooperation). See generally STERN REVIEW, *supra* note 8, for extensive and illuminating remarks, and for a suggestion that significant controls would produce benefits far in excess of costs. For an overview, see STERN REVIEW, *supra* note 8, at vi–ix.

ther the Montreal Protocol nor the Kyoto Protocol presented a clear example of a case in which the interests of the United States sharply diverged from the interests of the world. The Montreal Protocol was strongly in both the national and international interest. According to some of the most influential numbers in the relevant period, the Kyoto Protocol was neither in the nation's interest nor in the world's interest.<sup>266</sup> It would therefore seem consistent with American behavior in the two areas to say not that the United States follows its own domestic analysis, but that the United States will not sign a costly agreement that is not in the world's interest. On that view, the two tales do not speak to the importance of domestic self-interest. They are consistent with the view that the United States operates as a kind of global altruist.

It is true that neither protocol was a case in which the United States based its decision on a self-interested domestic judgment even though a different result would have been reached if approached from the interests of the world as a whole. But the deliberations that led to both decisions demonstrate the centrality of the domestic calculation. We have seen that for the Montreal Protocol, a purely domestic analysis by the Council of Economic Advisers played a crucial role, and that low domestic costs, spurred by technical innovation, made the Montreal Protocol far more attractive than it would otherwise be. The economic analysis focused on the domestic costs and benefits, not the global costs and benefits.<sup>267</sup> We have also seen that the rejection of the Kyoto Protocol had everything to do with a perception of high domestic costs and low domestic benefits (as evidenced by the non-participation of developing nations). At the key points, American officials in the executive and legislative branches may not have been thinking solely of domestic consequences, but those consequences were the principal motivating force behind the different outcomes.

What lessons might be drawn from these tales?

#### A. *Public Opinion and Consumer Behavior*

The first lesson is that public opinion matters greatly, at least if it is reflected in actual behavior. Recall that the problem of ozone depletion received massive attention in the United States, and that American consumers responded by greatly reducing their consumption of aerosol sprays containing CFCs. This action softened industry opposition to regulation,<sup>268</sup> in part because it made regulatory controls far less costly than they

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<sup>266</sup> See NORDHAUS & BOYER, *supra* note 28, at 100, 167–68.

<sup>267</sup> See DeCanio, *supra* note 33, at 302.

<sup>268</sup> Compare the public controversy over the pesticide Alar, which was used in apples and associated with an increased incidence of cancer among children. The controversy led to a substantial drop in apple consumption, and Alar was voluntarily withdrawn from the market. See PERCIVAL ET AL., *supra* note 4, at 387–93.

would otherwise be. In addition, market pressures fed by consumer behavior can spur technological innovation. If environmentally unfriendly products are unpopular in the market, industry is likely to respond with safer substitutes. In this sense, markets themselves can be technology-forcing in the environmental domain, as they are elsewhere. At the same time, public opinion put a great deal of pressure on public officials, affecting the behavior of legislators and the White House alike.

By contrast, there was no public pressure on those involved in CFC production and use in Europe, certainly in the early stages.<sup>269</sup> The absence of such pressure, combined with the efforts of well-organized private groups, helped to ensure that European nations would take a weak stand on the question of regulation, at least at the inception of negotiations. In the later stages, public opinion and consumer behavior changed radically in the United Kingdom and in Europe, and the change had large effects on the approach of the relevant political leaders.<sup>270</sup> Note that public opinion may or may not be justified by actual threats. In some domains, the public has been far more fearful than the facts warranted.<sup>271</sup> With respect to ozone depletion, public opinion did in fact track scientific understandings, or at least the understandings that turned out to be vindicated.

With respect to climate change, the attitude of the United States remains remarkably close to that of pre-Montreal Europe, urging an approach of “wait and learn” that favors research and voluntary action rather than emission reduction mandates.<sup>272</sup> It is true that between 1990 and the present, the media in the United States has focused a great deal of attention on the problem of climate change. But the public has yet to respond to that attention through consumer choices, and the best evidence suggests that American citizens are not, in fact, greatly concerned about the risks associated with warmer climates.<sup>273</sup> Notwithstanding the publicity given to climate change in recent years, Americans recently ranked the environment twelfth on a list of the most important problems—below immigration, health care, and gas and heating oil prices. Among environmental problems, climate change was ranked ninth, well below damage to the ozone layer.<sup>274</sup> Another recent poll found that strong majorities of Americans oppose an increase in taxes on electricity and gasoline as an attempt to reduce climate change.<sup>275</sup> Contrary to their behavior in the context of ozone

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<sup>269</sup> PARSON, *supra* note 16, at 43.

<sup>270</sup> See Maxwell & Weiner, *supra* note 36, at 32–33.

<sup>271</sup> See generally AARON WILDAVSKY, *BUT IS IT TRUE?* (1999); Timur Kuran & Cass R. Sunstein, *Availability Cascades and Risk Regulation*, 51 STAN. L. REV. 683 (1999).

<sup>272</sup> For a vigorous challenge to this approach, see Houghton, *supra* note 5, at 227–30.

<sup>273</sup> See Sunstein, *Divergent Reactions*, *supra* note 256.

<sup>274</sup> See Andrew C. Revkin, *Yelling ‘Fire’ On A Hot Planet*, N.Y. TIMES, Apr. 23, 2006, at 4-1.

<sup>275</sup> Environment, <http://www.pollingreport.com/enviro.htm> (last visited Sept. 30, 2006) (on file with the Harvard Environmental Law Review) (collecting polls of public opinion on the environment).

layer depletion, American consumers and voters are now putting little pressure on either markets or officials.

None of this means that public opinion is so firm and fixed that public officials have no room to maneuver. On the contrary, there is reason to think that public opinion is malleable on this topic, especially in light of general enthusiasm for the Kyoto Protocol.<sup>276</sup> Some evidence suggests that Americans are increasingly concerned about the problem of climate change.<sup>277</sup> If prominent public officials proclaimed that climate change posed serious risks, that those risks could be reduced without significant costs, and that morality required the United States to protect future generations from those risks, more aggressive action might well be possible. It is noteworthy here that some states and localities have acted in response to climate change, and there has evidently been public pressure to do so, especially but not only in California.<sup>278</sup>

But with respect to greenhouse gases, the passive posture of the United States government at the national level has been consistent with the attitudes of American citizens. A vivid incident—a kind of September 11 for climate change—might be sufficient, and perhaps necessary, to change those attitudes.<sup>279</sup> Recall in this connection that public opinion with respect to ozone depletion was affected by the salience of skin cancer and by the discovery of an ozone “hole” over Antarctica. To date, there is no analogue in the context of climate change. Behavioral factors, and not a simple engagement with costs and benefits, can drive public opinion in new directions. If climate change could be associated with a cognitively “available” event, the availability heuristic might well lead to a substantial increase in concern.<sup>280</sup>

### B. American Benefits, American Costs

The second lesson is that many international agreements for global environmental problems will be ineffective without the participation of the United States, and the United States is likely to participate only if the domestic benefits are perceived to be at least in the general domain of the domestic costs. In international law generally, the latter point is hardly novel,<sup>281</sup> though it is disputed in its strongest forms.<sup>282</sup> My modest suggestion here is that for global environmental problems, above all climate change, no

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<sup>276</sup> See Sunstein, *Divergent Reactions*, *supra* note 256.

<sup>277</sup> See *Doing It Their Way*, *ECONOMIST*, Sept. 9–15, 2006, at 22 (reporting a shift in American opinion).

<sup>278</sup> See Sunstein, *Divergent Reactions*, *supra* note 256, for a summary.

<sup>279</sup> For more detailed discussion, see SUNSTEIN, *WORST-CASE SCENARIOS*, *supra* note 215.

<sup>280</sup> See SUNSTEIN, *LAWS OF FEAR*, *supra* note 34, for a general discussion.

<sup>281</sup> See GOLDSMITH & POSNER, *supra* note 30.

<sup>282</sup> See generally Hathaway & Lavinbuck, *supra* note 34.

international agreement is likely to be effective unless the United States can be persuaded that it will not lose much more than it will gain.

It is true that the United States accounts for only about one-fifth of global greenhouse gas emissions—a stunning per capita figure, but one that is not high enough to derail international action if other nations are willing to go forward without the United States. If the world were able to make significant cuts in what is 80% of total emissions, it could do a great deal about climate change. The problem is that if the United States stands to one side, it is almost certain that coordinated, aggressive action will be impossible. At Kyoto, China and India showed an unwillingness to commit to cuts even when the United States suggested that it would participate. Those nations, and other developing countries, will likely be reluctant to confer benefits on industrialized nations, including the United States, unless there is a degree of reciprocity and perhaps significant side payments as well (as in the Montreal Protocol).<sup>283</sup>

My emphasis throughout has been on the United States. But as we shall soon see, China will be the world's largest contributor to greenhouse gases by 2025 at the latest, and according to more recent projections as soon as 2009.<sup>284</sup> It would be surprising if China showed a willingness to make significant cuts without the participation of the United States.<sup>285</sup> China's attitude would likely change if, in the future, it found itself in something like the same position with respect to climate change as the United States occupied with respect to the ozone layer—gravely threatened by the very emissions from which it profits. If China perceives itself as seriously endangered by climate change, it might well be willing to scale back its emissions for its own domestic self-interest.<sup>286</sup> But this is unlikely. Let us now see why.

### *C. Contributors and Victims*

Who has the most to lose from reductions in greenhouse gases, and who has the most to gain from such reductions? To understand the prospects for some kind of parallel to the Montreal Protocol, it is necessary to answer this question. Four possibilities can be imagined: some nations might both contribute substantially to the problem and stand to lose a great deal from it; some might contribute little while standing to lose little; some might contribute a great deal while standing to lose little; and some might contribute little while standing to lose a great deal. The most promising

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<sup>283</sup> See BARRETT, *supra* note 5, at 335–54.

<sup>284</sup> Keith Bradsher, *China to Pass U.S. in 2009 in Emissions*, N.Y. TIMES, Nov. 7, 2006, at C1.

<sup>285</sup> Zhiguo Gao, *The Kyoto Protocol and the International Energy Industry: Legal and Economic Implications of Implementation, The Chinese Perspective*, in KYOTO: FROM PRINCIPLES TO PRACTICE 275 (Peter D. Cameron & Donald Zillman eds., 2001).

<sup>286</sup> See STERN REVIEW, *supra* note 8, at 106 (noting significant vulnerability in China).

situation for an international accord would be one in which those who contribute most to the problem also have the most to lose. If so, they would face a strong incentive to scale back their emissions. The least promising situation would be one in which the major contributors have little to lose. If so, they would have a weak incentive to do anything about the problem.

Here as elsewhere, any particular figures must be taken as mere estimates and inevitably controversial estimates at that. But in order to begin discussion, here is a prominent projection of anticipated losses:<sup>287</sup>

FIGURE 7: DAMAGES RESULTING FROM A 2.5 °C WARMING AS A PERCENTAGE OF GDP

Country	Percent Loss of GDP
India	4.93
Africa	3.91
OECD Europe	2.83
High Income OPEC	1.95
Eastern Europe	0.71
Japan	0.50
United States	0.45
China	0.22
Russia	-0.65

It is important to underline the fact that these figures assume a 2.5 °C warming. With a higher number, the damages would undoubtedly be higher as well. Indeed, higher damages are possible even with a 2.5 °C warming. Whether or not these particular numbers are right, it is readily apparent that some nations are far more vulnerable than others.<sup>288</sup> Strikingly, Russia stands to be a net gainer, with substantial benefits to agriculture.

<sup>287</sup> NORDHAUS & BOYER, *supra* note 28, at 91 tbl.4.10 (noting that positive numbers represent damages, while negative numbers represent benefits).

<sup>288</sup> Cline, *supra* note 39, at 18–19; Ackerman & Finlayson, *supra* note 28 (offering a picture of more serious monetized damage from climate change). Note, however, that Nordhaus and Boyer find that China and the United States are vulnerable to catastrophic climate change, with an expected GDP loss of 22.1% for both nations. NORDHAUS & BOYER, *supra* note 28, at 90. A comprehensive treatment can be found in STERN REVIEW, *supra* note 8, 104–06, 128–29.

India is particularly vulnerable, primarily because it is expected to suffer devastating losses in terms of both public health and agriculture. African nations also stand to lose a great deal as a result of effects on public health, with a massive anticipated increase in climate-related diseases.<sup>289</sup> In light of these figures, we might therefore expect that Russia would not be especially enthusiastic about controls of greenhouse gas emissions, except, perhaps, if an emissions trading system that ensured financial gain to Russia from those controls was established (as the Kyoto system in fact does). The United States faces limited threats to agriculture and health. Like Russia, China is projected to benefit in terms of agriculture, and while it will suffer health losses, they are relatively modest, far below those expected in Africa and India.<sup>290</sup> We might therefore expect that the United States and China would be unlikely to take a particular interest in reducing greenhouse gas emissions, at least on these figures. As shown above, their behavior is consistent with that prediction.

As I have said, these numbers are speculative. The world's economy is interdependent, and if many nations suffer serious adverse effects, the United States and China will be affected. But the central point is clear. The largest current contributor, the United States, ranks toward the bottom in terms of anticipated losses. The largest future contributor, China, ranks even lower. Note in this regard the striking fact that the citizens of China and the United States are less concerned about climate change than are the citizens of Japan, France, Spain, India, Britain, and Germany.<sup>291</sup>

But how much do nations stand to lose from reductions? We have seen that the costs of the Kyoto Protocol would be especially high for the United States. To see why, consider the following table, offering a snapshot of global contributors of greenhouse gas in 2000:<sup>292</sup>

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<sup>289</sup> NORDHAUS & BOYER, *supra* note 28, at 91.

<sup>290</sup> *Id.*; STERN REVIEW, *supra* note 8, 104, 106.

<sup>291</sup> See *Doing It Their Way*, ECONOMIST, *supra* note 277, at 22 (citing a 2006 poll conducted by the Pew Research Center).

<sup>292</sup> KEVIN BAUMERT ET AL., WORLD RES. INST., NAVIGATING THE NUMBERS: GREENHOUSE GAS DATA AND INTERNATIONAL CLIMATE POLICY 12 fig.2.1 (2005).

FIGURE 8: CARBON DIOXIDE CONTRIBUTORS AS A PERCENTAGE OF  
TOTAL GLOBAL CARBON DIOXIDE EMISSIONS AS OF 2000

Country	Percent of Emissions
United States	20.6
China	14.7
EU-25	14.0
Russia	5.7
India	5.6
Japan	3.9
Germany	3.0
Brazil	2.5
Canada	2.0
United Kingdom	1.9
Italy	1.6
South Korea	1.5
France	1.5
Mexico	1.5

It is possible, of course, that the largest contributors may not have the most to lose from reduction requirements. Perhaps the United States or China could innovate in a way that would make compliance less costly. But historic levels of emissions at least suggest that significant reductions would be burdensome.

An important question, of course, involves trends over time. Significant contributors in the past may not be significant contributors in the future. The existing data suggest that the largest contributors are likely to continue to qualify as such, but that there will be important shifts—above all, with respect to emissions growth in China and India and emissions reductions in Russia and Germany.<sup>293</sup>

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<sup>293</sup> *Id.* at 15 fig.2.8.

FIGURE 9: CARBON DIOXIDE EMISSIONS GROWTH CHANGES, 1990–2002

Country	Percent Growth
China	49
United States	18
India	70
South Korea	97
Iran	93
Indonesia	97
Saudi Arabia	91
Brazil	57
Spain	44
Pakistan	60
Poland	-17
EU-25	-2
Germany	-13
Ukraine	-48
Russia	-23

With these trend lines, we can project changes by 2025. At that time, the developing world is expected to show an 84% increase in total emissions, accounting for 55% of the world's total.<sup>294</sup> At that time, the United States is expected to be well below China. Consider the figures for anticipated growth:<sup>295</sup>

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<sup>294</sup> *See id.* at 17–18.

<sup>295</sup> *Id.* at 18 fig.3.2.

FIGURE 10: PROJECTED GROWTH IN CARBON DIOXIDE EMISSIONS BY 2025

Country	Percent Increase
India	73–225
Mexico	68–215
China	50–181
Brazil	84–165
South Korea	43–117
EU	–1–39
United States	20–52
World	33–93

In terms of aggregate contributions, these changes mean that there will be significant shifts among contributors:<sup>296</sup>

FIGURE 11: RELATIVE CONTRIBUTIONS OF ANNUAL CARBON DIOXIDE EMISSIONS BY COUNTRY/REGION (APPROXIMATE PERCENTAGE OF WORLDWIDE EMISSIONS)

Country/ Region	1990	2003	2010	2015	2020	2025	2030
United States	23.4	22.8	21.0	20.0	19.4	18.9	18.6
Europe	28.0	21.4	19.1	18.2	17.4	16.8	16.3
China	10.6	14.1	19.3	20.8	22.2	23.3	24.5
India	2.7	4.1	4.5	4.7	4.9	5.0	5.0
Japan	4.8	4.8	4.05	3.6	3.3	3.0	2.8
Africa	3.1	3.6	3.9	4.0	4.0	4.0	4.0

<sup>296</sup> See ENERGY INFO. ADMIN., U.S. DEP'T OF ENERGY, DOE/EIA 0484, INTERNATIONAL ENERGY OUTLOOK 2006 93 tbl.A10 (2006), available at [http://www.eia.doe.gov/oiarf/ieo/pdf/ieorefTab\\_10.pdf](http://www.eia.doe.gov/oiarf/ieo/pdf/ieorefTab_10.pdf).

We can now see a real obstacle to an international agreement to control greenhouse gases. The United States and China are the largest emitters, and according to prominent projections, they also stand to lose relatively less from climate change. In terms of their own domestic self-interest, these projections weaken the argument for stringent controls. The nations of Africa stand to lose a great deal, but they are trivial greenhouse gas emitters. India is even more vulnerable, and its contribution, while not exactly trivial, is modest.

The analysis has an additional layer of complexity. Some nations, above all China and India, might reasonably object that their own contribution is smaller than the aggregate figures suggest. In assessing relative contributions, we might be interested in cumulative emissions rather than annual emissions.<sup>297</sup> The overall stock might matter, not the current flow. Here is the relevant data:<sup>298</sup>

FIGURE 12: CUMULATIVE PERCENTAGE OF WORLD CARBON DIOXIDE EMISSIONS, 1850–2002

Countries	Percentage of Carbon Dioxide Emissions
United States	29.3
EU-25	26.5
Russia	8.1
China	7.6
Germany	7.3
United Kingdom	6.3
Japan	4.1
France	2.9
India	2.2
Ukraine	2.2

<sup>297</sup> See Jiahua Pan, *Common But Differentiated Commitments: A Practical Approach to Engaging Large Developing Emitters Under L20 3* (Sept. 20–21, 2004) (Commissioned Briefing Notes for the CIGI/CFGS L20 Project) (referring to cumulative emissions but emphasizing the time period, 1990 to 2000, when consequences were widely known).

<sup>298</sup> BAUMERT ET AL., *supra* note 292, at 32 fig.6.1.

Even if China's emissions rates pass those of the United States by (say) 2020, it might well insist that it should not bear the same economic burden as a nation that is responsible for a much larger percentage of aggregate emissions. Undoubtedly the purely domestic calculus of costs and benefits will play a significant role in any nation's decisions, but fairness judgments, attending to cumulative contributions, are unlikely to be entirely irrelevant.<sup>299</sup>

#### D. Normative Issues

These are descriptive points, and none of them should be taken to suggest that the domestic cost-benefit analysis ought to be decisive in principle. In fact, it should not be. If one nation imposes significant harms on citizens of another, it should not continue to do so even if, or because, a purely domestic analysis suggests that emissions reductions are not justified from the point of view of the nation that is imposing those harms. As I have suggested, the problems of ozone depletion and climate change stem disproportionately from the actions of wealthy nations, above all the United States—actions from which citizens of wealthy nations, above all the United States, have disproportionately benefited. It is even possible to see the emission of greenhouse gases as a kind of tort, producing damage for which emitters, and those who gained from their actions, ought to pay.<sup>300</sup> For example, energy and gasoline prices in the United States have been far lower than they would have been if those prices had included an amount attributable to the increased risks of climate change—risks that are most serious, and that threaten to impose devastating harm on people in other countries.<sup>301</sup>

Whether nations as such should be held responsible, and what such responsibility should specifically entail, are complicated questions. But in view of the fact that Americans have gained so much from activities that impose risks on citizens of other nations, it seems clear that they have a special obligation to mitigate the harm, or to provide assistance to those who are likely to suffer. The assistance might take the form of financial or technological aid, making it easier to meet emissions targets, or monetary amounts designed to ease adaptation to hotter climates.

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<sup>299</sup> See generally Pan, *supra* note 297.

<sup>300</sup> See Dale Jamieson, *Adaptation, Mitigation, and Justice*, in PERSPECTIVES ON CLIMATE CHANGE: SCIENCE, ECONOMICS, POLITICS, ETHICS, *supra* note 217, at 217, 229; Julia Driver, *Ideal Decision Making and Green Virtues*, in PERSPECTIVES ON CLIMATE CHANGE: SCIENCE, ECONOMICS, POLITICS, ETHICS, *supra* note 217, at 249.

<sup>301</sup> See STERN REVIEW, *supra* note 8, at 92–115; NORDHAUS & BOYER, *supra* note 28, at 134; J. TIMMONS ROBERTS & BRADLEY C. PARKS, A CLIMATE OF INJUSTICE (forthcoming 2007) (on file with the Harvard Environmental Law Review).

There is an additional problem. The citizens of Africa and India, the most vulnerable regions, are also disproportionately poor. The citizens of China, standing to lose a great deal from significant restrictions on greenhouse gases, are also relatively poor, and economic growth is contributing to significant reductions in their poverty. It is certainly plausible to think that the issue of relative wealth and poverty should play a role in distributing the costs of emissions reductions.<sup>302</sup>

The moral issues raise many questions, and they must be seriously engaged as part of both domestic discussions and international negotiations.<sup>303</sup> The Montreal Protocol holds out some hope here. Recall that judgments about moral responsibility and capacity to pay played a serious role in various provisions. We have also seen that incipient steps to help poor nations have been made in the context of climate change as well.<sup>304</sup> But the evidence catalogued here raises doubts about the claim that by themselves, moral obligations will provide sufficient motivation in the face of a palpably unfavorable cost-benefit analysis.

Let us return to simpler matters. With respect to the United States, the lesson of the Montreal Protocol can be captured in a single sentence: *Where the domestic assessment strongly favors unilateral action, and where the same assessment suggests that a nation is likely to gain a great deal from an international agreement, that nation will favor such an agreement—unless, perhaps, well-organized private groups are able to persuade it not to do so.* For the Kyoto Protocol, the lesson is equally simple: *Where the domestic assessment suggests that unilateral action makes little sense, and where the same assessment suggests that a nation will lose a great deal from an international agreement, that nation is unlikely to favor such an agreement—unless, perhaps, the public is willing to demand that it do so.* In light of these simple lessons, the two protocols present easy cases at opposite poles.

### E. Future Prospects

Nothing said here is inconsistent with the claim that an agreement to control greenhouse gases might be appealing or at least acceptable to the United States even if the cost-benefit calculation were fairly close, or perhaps mildly unfavorable to the deal. The Montreal Protocol and the Kyoto Protocol were at opposite extremes. Technocrats, both scientists and economists, seemed to demonstrate that the Montreal Protocol was a terrific bargain for the United States, while the Kyoto Protocol presented a much

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<sup>302</sup> See Pan, *supra* note 297, at 4 (“Countries with higher levels of national income and a higher rank on the HDI index would be expected to carry a higher burden of mitigation.”)

<sup>303</sup> See Driver, *supra* note 300, at 249; STERN REVIEW, *supra* note 8, at 23–53; ROBERTS & PARKS, *supra* note 301.

<sup>304</sup> See *supra* Part II.A.

less favorable picture. The overwhelming votes in the Senate are at least suggestive on this count.

But for both agreements, the overall assessment would have been far more difficult if the relevant numbers had suggested a closer call—if the scientific and economic judgments, working together, suggested that reasonable people could differ. Even if the United States was a modest net loser, perhaps moral considerations might have tipped, or might in the future tip, the national calculus in favor of an agreement to control climate change. But it should be clear that in order for such an agreement to be acceptable to the United States, a method must be found to drive down the costs and to increase the benefits.<sup>305</sup> Such a method would make the relevant agreement far more attractive to the world as well—and hence increase the likelihood of compliance by nations that are now skeptical about controls on greenhouse gases.

### 1. Benefits

Recall that in one analysis, the Kyoto Protocol was projected to decrease global mean temperatures by a mere 0.03 °C.<sup>306</sup> This difference is less trivial than it sounds, because it is projected to produce tens of billions in monetized benefits,<sup>307</sup> but it is nonetheless a relative drop in the bucket. Developing countries are projected to account for over half of total global emissions by 2020 at the latest.<sup>308</sup> We have seen that a broader agreement, including China and India in particular, would significantly increase the benefits of greenhouse gas reduction and hence make domestic controls far more appealing to both the United States and the world.<sup>309</sup> The trick is to make such an agreement sufficiently attractive to developing nations to make it possible for them to participate.

A useful step would involve a clear distinction between stocks and flows.<sup>310</sup> To come to terms with past contributions, nations might participate in the creation of some kind of fund for climate change damages, with their participation reflecting their contributions to the total existing stock of emissions. India and China need not contribute much to such a fund; the United States and Europe would be required to contribute a great deal. A step of this kind would be a sensible response to the fact, shown

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<sup>305</sup> I have touched only lightly on complex enforcement problems. It may be that the Montreal Protocol is not a good model in this regard. For a discussion, see BARRETT, *supra* note 5, at 391–98; DAVID G. VICTOR, *THE COLLAPSE OF THE KYOTO PROTOCOL AND THE STRUGGLE TO SLOW GLOBAL WARMING* 109–16 (2001).

<sup>306</sup> NORDHAUS & BOYER, *supra* note 28, at 152.

<sup>307</sup> *See id.* at 162–67.

<sup>308</sup> *See* Sheila M. Olmstead & Robert N. Stavins, *An International Policy Architecture for the Post-Kyoto Era*, 96 AM. ECON. REV. (PAPERS & PROC.) 35, 35–36 (2006).

<sup>309</sup> *See supra* Part II.A; BARRETT, *supra* note 5, at 379.

<sup>310</sup> *See* the excellent brief discussion in Jagdish Bhagwati, *A Global Warming Fund Could Succeed Where Kyoto Failed*, FIN. TIMES, Aug. 16, 2006, at 9, on which I draw here.

by the above table<sup>311</sup> of CO<sub>2</sub> emissions, that different nations have added dramatically different amounts to the current situation.

A separate step would involve the response to existing flows. Perhaps a “polluter-pays” principle could be made a part of an international agreement, so that nations would pay an amount to reflect their continuing contributions.<sup>312</sup> In short, greenhouse gas emissions might be taxed, with the hope that the tax would lead to reductions. It would be easy to do something of this kind domestically, and an international agreement might form the basis for the imposition of greenhouse taxes. Alternatively, an understanding of past contributions and current emissions rates might be built into a structure closer to that of the Montreal Protocol, helping to serve as the foundation for both reduction requirements and economic transfers. In particular, the transfers might be designed to compensate for past and future contributions to the problem. If high contributors make significant cuts, perhaps their transfers need not be so large. If they continue to be high contributors, their transfers might be very high. If the goal is to ensure significant benefits, steps of this sort would be the place to start.

It is also possible that the overall benefits of greenhouse gas reductions are greater, domestically and for the world, than suggested by the most prominent analyses from several years ago.<sup>313</sup> If the perceived damage from climate change increases, and if steps can be taken to reduce that damage, then the likelihood of a firm domestic response will of course increase.

## 2. Costs

On the cost side, two steps would be highly desirable. The first is to create an ambitious and reliable system for fully global emissions trading, which could make the cost-benefit ratio far more favorable for any agreement. The second is to produce better targets and requirements in a way that allows stringency to increase over time.

Consider emissions trading first. In the context of acid deposition, the United States was able to reduce the cost of aggressive regulation by billions of dollars through an ambitious trading system.<sup>314</sup> For climate change, such a system would decrease the need for expensive regulation, by allowing American companies to “buy” emissions credits from greenhouse gas producers in other nations. For the Kyoto Protocol, a system of global trading would reduce domestic costs from \$325 billion to \$91 billion—and it would reduce worldwide costs from \$217 billion to \$59 billion.<sup>315</sup> The like-

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<sup>311</sup> See *supra* note 298 and FIGURE 12 *supra*.

<sup>312</sup> See *id.*

<sup>313</sup> See STERN REVIEW, *supra* note 8, at i–xviii; Cline, *supra* note 39, at 18; Ackerman & Finlayson, *supra* note 28.

<sup>314</sup> See A. DENNY ELLERMAN ET AL., MARKETS FOR CLEAN AIR (2000).

<sup>315</sup> See NORDHAUS & BOYER, *supra* note 28, at 159.

likelihood that China would participate in an international agreement would certainly increase with an emissions trading system. Perhaps China, India, and other poor nations could be subsidized with high allocations of trading rights, so as to come to terms with their relatively low past contributions, general poverty, and overall needs.

The emissions reductions targets in the Kyoto Protocol are both rigid and arbitrary, at least from the standpoint of sensible policy. The key terms of that Protocol involve an apparently random baseline year (1990) and ask nations to produce apparently random percentage reductions from that year.<sup>316</sup> As we have seen, there is a method, or at least domestic self-interest, behind this apparent madness, but the method has no connection with sensible policy.<sup>317</sup> A better approach would include carbon taxes or emissions reduction requirements that grow over time as technology advances.<sup>318</sup> For ozone-depleting chemicals, as for lead, the United States followed a phase-down policy, one that allowed time for the development and marketing of adequate substitutes.<sup>319</sup> No one is proposing the complete elimination of greenhouse gases. Increasing restrictions over time would make a great deal of sense.<sup>320</sup>

### 3. *The Puzzle of California in 2006*

In terms of achieving cost reductions, there is also an argument for experiments in technology-forcing, designed to test the question whether the expense of emissions reductions have been inflated. This point raises a serious puzzle, that might also be developed into a challenge to my argument thus far.

In 2006, California enacted a statute<sup>321</sup> that would, by 2020, stabilize the state's emissions at 1990 levels—a step that would call for a 25% reduction under a “business as usual” approach.<sup>322</sup> This enactment raises many questions. As a first approximation it will, by itself, contribute nothing to reductions in climate change by 2050, 2100, or any other date. Recall that the Kyoto Protocol would have produced only a modest reduction in warming by 2100; if California embarked on a reduction to 1990 levels on its own, without any action by any other state or nation, there would be no discernable impact on the world's climate. At the same time, a 25% reduction in greenhouse gases would almost certainly impose significant costs on the citizens of California. Hence there is a positive question: Why did

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<sup>316</sup> *See id.*

<sup>317</sup> *See id.*

<sup>318</sup> *Id.*

<sup>319</sup> *See* CASS R. SUNSTEIN, *RISK AND REASON* (2002).

<sup>320</sup> A counterargument is presented in POSNER, *supra* note 7, on the ground that a sudden regulatory “shock” might be necessary and desirable as a way of spurring innovation.

<sup>321</sup> California Global Warming Solutions Act of 2006, Assemb. B. No. 32, (to be codified at CAL. HEALTH & SAFETY CODE § 38500 (2006)).

<sup>322</sup> *See* Barringer, *supra* note 232.

California vote for a program that would appear to produce no benefits while imposing real costs? There is also a normative objection, which is that California should not, in fact, impose real costs on its own citizens without also delivering benefits to those citizens, or at least to the world.

With respect to the positive question, the particular electoral dynamics of California undoubtedly played a key role. Many residents of California are greatly concerned about climate change, evidently for moral reasons, and the state's governor, at the time anticipating a serious battle for reelection, likely benefited from showing his own commitment to the problem. This is an illustration of a situation in which an energized citizenry may produce an outcome that is not justified solely by a consideration of material costs and benefits. Perhaps the citizenry was motivated not only by moral considerations, but also by a perception of costs and benefits that was not accurate; perhaps the citizens, and some of the supportive officials, wrongly believed that California's action would by itself have a significant effect. But there is another possibility, and it bears on the normative question as well.

On that question, a plausible, if hopeful view is that California's action might spur additional reductions, both domestically and internationally, while also leading to technological changes that drive down the costs of emissions reductions. Whether the response is persuasive will depend of course on empirical questions. But perhaps legislators and citizens believed that California's initiative will send an important signal to other states and nations, in a way that will produce large global benefits. If technology-forcing in California produces low-cost options, as in the case of ozone depletion, the likelihood of high benefits and reduced costs will increase. Of course California is taking a gamble. But it might well be expected that if low-cost substitutes do not emerge, the mandates in the statute will be relaxed. Hence it remains to be seen whether those mandates are as firm as they appear to be.

The California legislation thus provides a valuable challenge to my account here. In a sense, California is in the same position as the United States was with respect to the Kyoto Protocol, exploring an option that would apparently produce small benefits at a significant cost—yet California was willing to select that option. As I have said, the political dynamics played a significant role. It is therefore natural to ask: Might something akin to the California statute be enacted at the national level? If an American president finds himself in a similar position to that of the California governor, facing similar political incentives, such an enactment certainly cannot be ruled out. Nothing said here excludes the possibility that even if the material effects of proposed national legislation are not entirely favorable to the United States—because its impact on climate change is expected to be small and its costs are expected to be real—its symbolic value and its potential effect on technological innovation and international

negotiations might enable it to obtain significant support in Congress and the White House.

Note, however, that in order for this to happen, the existing political dynamics must change substantially. In the last decade of the twentieth century, and for the first six years of the twenty-first, the nation as a whole has been very different from California on the particular subject of climate change. Citizens have been skeptical of the view that they themselves face significant risks,<sup>323</sup> and while they support the Kyoto Protocol in the abstract,<sup>324</sup> they are not willing to spend significant sums of money to reduce climate change.<sup>325</sup> At the national level, public officials are not under substantial pressure to act to reduce greenhouse gas emissions, and they are aware of a risk of public reprisal if they support a measure that substantially increases the price of energy, including the price of gasoline.<sup>326</sup> Without large shifts in public opinion, perhaps produced by salient climate-related incidents or the appearance or reality of reduced costs, the California legislation in 2006 is unlikely to find an analogue at the national level.

#### 4. *Per Capita Emissions, Per Capita Intensity, Allocations, and Payments*

I have emphasized the value of including an emissions trading system in any international agreement governing climate change. But what form would that system take? It is important to consider the allocation of emissions rights for any system of trading.

Of course nations would prefer substantial initial allocations, which will be quite valuable. The Kyoto Protocol in one sense favors high current contributors because it mandates reductions from a specified date (1990), when (for example) both the overall and the per capita emissions of the United States were quite high. We could easily imagine a plea for allocations that would operate on a per capita basis, rather than on the basis of aggregate emissions from some specified starting date. In 2003, the United States emitted roughly 19.8 metric tons of carbon dioxide per capita, highest among the large nations and tenth highest in the world.<sup>327</sup> By contrast, China emitted 3.2 metric tons per capita and India 1.2 tons, ranking 98th and 133rd respectively. Both China and India might well seek emissions rights that operate per capita, in such a way as to facilitate economic growth. A plea for per capita allocations might well fit with the interest, in developing countries, in a principle of “common but differentiated responsibil-

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<sup>323</sup> See Sunstein, *Divergent Reactions*, *supra* note 256.

<sup>324</sup> *See id.*

<sup>325</sup> *See id.*

<sup>326</sup> PRING, *supra* note 22, at 196–97.

<sup>327</sup> See U.N. MILLENNIUM DEVELOPMENT GOALS INDICATORS, CARBON DIOXIDE EMISSIONS (CO<sub>2</sub>), METRIC TONS OF CO<sub>2</sub> PER CAPITA (CDIAC), available at <http://mdgs.un.org/unsd/mdg/SeriesDetail.aspx?srid=751&crid>.

ity” that imposes the most serious burdens on nations that have contributed most to the problem and that are also wealthiest.<sup>328</sup> Per capita emissions rights might be defended on the basis of a principle that allows citizens of all nations to enjoy the same opportunities to achieve well-being.

It is a complicated question whether allocations per capita are, in principle, a place to start for a trading regime. What is not a complicated question is whether the United States would agree to such a regime. There is no doubt that the United States would refuse to enter into an agreement that would transfer such massive resources from itself to other countries—especially in view of the fact that the United States has relatively less to lose from climate change. The United States might well propose the following instead: We will participate in an international agreement to control climate change, but only if the nations of the world make it worth our while to do so. Perhaps the United States might accept a kind of international cap on emissions that insists on both global trading and significant emissions rights (perhaps rooted in current emissions rates).

To make these claims more plausible, the United States might emphasize the importance of attending not to per capita emissions, but to emissions intensity (as noted, greenhouse gas emissions per unit of GDP). In terms of intensity in 2002, the United States was approximately in the middle of the world’s nations (720 tons per million dollars GDP), behind the European Union as a whole (449 tons), but much better than China (1023 tons).<sup>329</sup> At the same time, China has enjoyed a dramatic 51% drop since 1990, far higher than the 17% drop of the United States.<sup>330</sup> Perhaps emissions permits might be allocated in a way that attends to intensity of emissions, instead of per capita emissions. Note that allocating permits in this way would be compatible with any particular global ceiling on total emissions.

However these issues might be resolved, it should be clear that notwithstanding the mixed picture provided by the Kyoto Protocol, some kind of international agreement would be in the world’s interest. China and the United States would be most likely to participate if the trading mechanism greatly reduced their costs. A distinction between stocks and flows would help to disentangle past and current contributions, and would therefore provide a helpful start toward agreements that are both fair and mutually advantageous.

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<sup>328</sup> See Pan, *supra* note 297; Lavanya Rajamani, *The Principle of Common but Differentiated Responsibility and the Balance of Commitments under the Climate Regime*, 2 RECIEL 120 (2000).

<sup>329</sup> See BAUMERT ET AL., *supra* note 292, at 26 fig.5.1.

<sup>330</sup> *Id.*

### 5. Manageability and Enforcement

There is an additional point bearing on the prospects for an effective international agreement and on the possible participation of the United States. The Montreal Protocol was negotiated by about thirty nations, while current climate negotiations involve nearly 200 nations.<sup>331</sup> The large number of parties makes an agreement far less manageable, and makes some nations fearful that others will not comply.<sup>332</sup> Suppose, as seems reasonable, that an imaginable agreement could solve an international prisoner's dilemma with respect to global climate change. The parties to such an agreement must be able to be confident that others will not cheat. With 200 nations, and the attendant difficulties with monitoring compliance, key nations might well be tempted to defect—or not to join in the first instance.<sup>333</sup>

This is not the place to outline the ingredients of an international agreement to respond to the risks associated with climate change.<sup>334</sup> The steps I have outlined would have to be accompanied by clear steps to promote monitoring and enforcement of any limits.<sup>335</sup>

### 6. Final Speculations

My topic here is the tale of two protocols, and I do not attempt to make any general or controversial claims about the foundations of national behavior in the domain of international politics. The minimal argument has been that domestic cost-benefit analysis played a significant role in the behavior of the United States. But because this claim has an evident connection to a more general literature about the wellsprings of national behavior, a few remarks may be in order.

It has become standard to say that national self-interest is the fundamental basis for the behavior of states in the international domain.<sup>336</sup> An evident problem with this claim is that the idea of “self-interest” needs to be specified; it does not speak for itself.<sup>337</sup> In brief, we need to know what is in the national utility function, and to know that, we need to know what nations care about.<sup>338</sup> The idea of cost-benefit analysis, based on the ma-

<sup>331</sup> See Benedick, *Morals*, *supra* note 176, at 320–32.

<sup>332</sup> See GOLDSMITH & POSNER, *supra* note 30, at 217.

<sup>333</sup> See BARRETT, *supra* note 5, at 393–97 for detailed discussion.

<sup>334</sup> The central points are that such an agreement is unlikely to be effective without the participation of the United States, and that such participation is unlikely without a much more favorable domestic cost-benefit ratio. Of course new information about the risks of climate change, suggesting that earlier projections are too optimistic, would inevitably help to alter the domestic equation. See AVOIDING DANGEROUS CLIMATE CHANGE, *supra* note 150, for a number of alarming projections.

<sup>335</sup> *Id.*; VICTOR, *supra* note 305, at 109–16.

<sup>336</sup> See KEOHANE, *supra* note 26; GOLDSMITH & POSNER, *supra* note 30.

<sup>337</sup> KEOHANE, *supra* note 26, at 111–32.

<sup>338</sup> GOLDSMITH & POSNER, *supra* note 30, at 6, refer to “the primary goal or goals the

terial payoffs, provides one such specification, but it would be most surprising if that analysis always or usually turned out to provide a complete understanding of the national utility function. At a minimum, both citizens and representatives are boundedly rational, and bounded rationality will mean that perceived national self-interest will not always track the outcome of some technocratic cost-benefit analysis.<sup>339</sup> In the domestic domain, national legislation emphatically reflects bounded rationality, including the use of identifiable heuristics, which can produce serious errors. For example, the availability heuristic can affect judgments about probability, producing environmental legislation that does not track cost-benefit analysis.<sup>340</sup> A salient incident, or a series of salient incidents, might lead a nation to favor measures that are not justified by that kind of analysis—just as an absence of such incidents might lead a nation to reject measures that are in fact so justified.

In addition, national officials care about their reputations, both domestically and internationally, and reputational concerns might lead to a departure from what is indicated by an emphasis on the particular costs and benefits of the measure in question.<sup>341</sup> We have seen that this explanation might help account for the enactment of aggressive regulation of greenhouse gases in California. Perhaps national officials might be willing to press for international commitments because of the desirable reputational consequences, even if domestic cost-benefit analysis, focused on a particular measure, suggests otherwise. And if citizens are willing to press their own moral commitments, officials are likely to respond, at least if they will face electoral retribution if they fail to do so.

On the basis of the tale of two protocols, we lack enough data to speculate about the prospects for such retribution in the context of climate change. Certainly it would not be shocking if national legislation ultimately imposed restrictions on emissions of greenhouse gases. The only point is that the domestic cost-benefit analysis can make such restrictions more or less likely—and the extent of such restrictions will undoubtedly be affected by perceived material consequences.

#### CONCLUSION

At first glance, the problems of ozone depletion and climate change seem exceedingly similar, and appear to present closely related challenges for the production of an international agreement to reduce the underlying risks. In both contexts, nations appear to have a great deal to gain from cooperative action. In both contexts, technological innovation is highly de-

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state seeks to achieve,” but it is hard to make predictions without a sense of what that goal or those goals may be; as Goldsmith and Posner are aware, primary goals vary with context.

<sup>339</sup> See the early treatment of bounded rationality in KEOHANE, *supra* note 26, at 111–13.

<sup>340</sup> See Kuran & Sunstein, *supra* note 271, at 683.

<sup>341</sup> KEOHANE, *supra* note 26, at 105–06.

sirable as a means of reducing the costs of regulation. In both contexts, intergenerational equity is a serious and complex issue. In both contexts, wealthy nations are responsible for the problem in the first instance, and poor nations have a plausible claim to compensation, both for harm done and in return for their willingness to reduce emissions in the future.

Notwithstanding the similarities, the Montreal Protocol has proved a stunning success, and the Kyoto Protocol seems to have failed. From one agreement to the other, the posture of many nations shifted, with European nations treating ozone depletion as a highly speculative theory, calling for further research, while later leading the call for aggressive regulation of greenhouse gases. The contrasting outcomes are best explained by reference to the radically different approaches taken by the United States—by far the most significant contributor, per capita, to both ozone depletion and climate change. It would be tempting to attribute those different approaches to the different political convictions of the relevant administrations. But the Reagan Administration, which pressed for the Montreal Protocol, was hardly known for its aggressiveness with respect to environmental policy, and the Senate showed no interest in the Kyoto Protocol during the Clinton Administration. The American posture, and hence the fate of the two protocols, was largely determined by perceived benefits and costs.

To the United States, the benefits of the Montreal Protocol were anticipated to be substantial in the short-term as well as the long-term. To the United States, the benefits of the Kyoto Protocol were perceived to be effectively zero in the short-term and modest in the long-term. The projected costs of the Montreal Protocol were relatively small—for the United States, \$21 billion, a small fraction of the benefits. The costs of the Kyoto Protocol were projected to be high—for the United States, \$325 billion, well in excess of the benefits. The picture was not altogether different for the world. The Montreal Protocol was a worldwide bargain, with costs a tiny percentage of benefits. By contrast, key analysts suggested that the Kyoto Protocol failed in cost-benefit terms, and the best that might be said is that the agreement provided an initial foundation for better and more inclusive ones. Of course the precise numbers are disputed, and legitimate questions can be raised about any particular account. Perhaps the Kyoto Protocol can be defended as a way of initiating a process that would produce higher benefits and lower costs.<sup>342</sup> What matters is that at the crucial times, the most authoritative accounts offered conflicting conclusions about the two agreements.

As we have seen, neither protocol fits the simple model of a solution to a prisoner's dilemma. The United States and many other countries ap-

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<sup>342</sup> Note that Cline, *supra* note 39, at 31, 37, finds that with zero pure time preference, the cost-benefit ratio for the Kyoto Protocol is positive for the world, though not for the developed nations.

pear to have had sufficient reason, from the standpoint of self-interest, to comply with the requirements of the Montreal Protocol even if *no* other country did the same. On the perceived numbers, the United States and some other countries might well have had no adequate reason, from the standpoint of self-interest, to comply with the requirements of the Kyoto Protocol even if *every* other country did the same. For this reason, the payoff structures of the two agreements were fundamentally different, and their different fates have a great deal to do with that fact.

To this point it must be added that developing countries, above all China and India, refused to accept any regulatory requirements in the Kyoto Protocol, in large part because the domestic cost-benefit analysis was perceived to be too unfavorable for them. While I have emphasized the judgments and behavior of the United States, the tale of the Kyoto Protocol could plausibly focus on China's refusal to accept regulatory requirements and interpret that refusal as helping to account for the decisions of the United States. China's future stance with respect to climate change may well be at least as important as that of the United States.

For those who are concerned about the risks of climate change, it would be possible and even right to emphasize that the United States has been a principal contributor to those risks, and that the nation's economic self-interest does not exhaust its moral obligations. To the extent that the citizens of the United States have benefited from activities that inflict significant harms on other nations, those citizens are properly asked to help—through reducing their own emissions, through paying other nations to reduce theirs, and through payments to ease adaptation. In addition, political pressure, including moral convictions, can play a role. But on the basis of the tales of the Montreal and Kyoto Protocols, it is best to assume that domestic self-interest will continue to act as an important motivating force. The position of the United States will not shift unless the domestic benefits of emissions reductions are perceived to increase or unless the perceived domestic costs drop, perhaps as a result of technological innovation. It follows that for the future, the task remains to devise an international agreement that resembles the Montreal Protocol in one critical respect: its signatories, including the United States, have reason to believe that they will gain more than they will lose.

