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OF TWO PROTOCOLS

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Montreal versus Kyoto: A Tale of Two Protocols

Cass R. Sunstein*

Abstract

*Over the last thirty years, climate change and depletion of the ozone layer have been widely believed to be the world's largest environmental problems. The two problems have many similarities. Both involve global risks created by diverse nations, and both seem to be best handled through international agreements. In addition, both raise serious issues of intergenerational and international equity. Future generations stand to lose a great deal, whereas the costs of restrictions would be borne in the first instance by the current generation; and while wealthy nations are largely responsible for the current situation, poorer nations, above all Africa and India, are anticipated to be quite vulnerable in the future. But an extraordinarily successful agreement, the Montreal Protocol, has served largely to eliminate the production and use of ozone-depleting chemicals, while the Kyoto Protocol has spurred only modest steps toward stabilizing greenhouse gas emissions. What accounts for the dramatic difference between the two protocols? Part of the explanation lies in the radically different self-interested judgments of the United States; part of the explanation lies in the very different payoff structures of the two agreements. Influenced by the outcome of a purely domestic cost-benefit analysis involving reductions in ozone-depleting chemicals, the United States enthusiastically supported the Montreal Protocol. Influenced by the very different outcome of cost-benefit analyses for reductions in greenhouse gas emissions, the United States aggressively opposed the Kyoto Protocol. An examination of the two protocols suggests that neither agreement fit the simple structure of a prisoner's dilemma, in which a nation gains from an enforceable agreement, gains even more if it is the only nation not to comply while all others do, and loses most if it, and everyone else, pursue their own national self-interest. For the United States, at least, compliance with the Montreal Protocol would have been justified even if **no** other country had complied; for the United States, and for several other countries, compliance with the Kyoto Protocol would not have been justified even if **all** other parties had complied. An understanding of the judgments that surround the two protocols indicates that even though moral considerations require the United States to spend a great deal to protect citizens in other nations, and even though such considerations can influence behavior, the nation is unlikely to act in response solely to those considerations. A general implication is that any international agreement to control greenhouse gases is unlikely to be effective unless the United States believes that it has*

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more to gain than to lose. An illuminating wrinkle, also suggestive of the role of domestic self-interest, is that some European nations, above all the United Kingdom, initially contended that ozone depletion was a greatly exaggerated problem while later calling for strong controls on greenhouse gases. For an international accord, an exceedingly serious problem lies in the fact that while the United States and China would have to bear the lion's share of the cost of emissions reductions, both nations are projected to lose relatively less from climate change.

“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 14th 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 Reagan¹

“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. Bush²

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 climate change are so similar that many Americans are unable to distinguish between them.³ 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 theoretical paper in 1974.⁴ The risks of climate change have a much longer history, with an

¹ See http://www.findarticles.com/p/articles/mi_m1079/is_n2135_v88/ai_6495606

² See <http://www.whitehouse.gov/news/releases/2001/03/20010314.html>

³ See Andrew Dessler and Edward Parson, *The Science and Politics of Global Climate Change* 10-11 (2006)

⁴ See Robert Percival et al., *Environmental Regulation* 1047 (2003).

- early paper in 1896,⁵ but the current scientific consensus is very much a product of the 1990s.⁶
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 risks are difficult to reverse; even with action that is both immediate and aggressive, the underlying problems will hardly be eliminated all at once.⁷ This point has significant implications for issues of timing.
 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, certainly not in the long run.⁸ Because of the diversity of contributors, both problems seem to be best handled through international agreements.⁹
 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

⁵ 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 edition 2004).

⁶ Dessler and Parson, *supra* note, at 64-66. I refer to a scientific consensus, but there are dissenting voices. See, e.g., Nir 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 Shaviv and J. Veizer, *Celestial driver of Phanerozoic climate?*, 13 *GSA Today*, 4 (2003). A reply is Stefan Rahmstorf et al., *Cosmic Rays, Carbon Dioxide and Climate*, in *Eos, Transactions of the American Geophysical Union* (January 27, 2004).

⁷ For ozone depletion, see Barrett, *supra* note; for climate change, the point is emphasized and explored in Richard Posner, *Catastrophe* 161-63 (2004).

⁸ 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*. 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.

⁹ 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 below; James Murdoch and Todd Sandler, *The Voluntary Provision of a Public Good: The Case of Reduced CFC Emissions and the Montreal Protocol*, 63 *J Public Economics* 331 (1997).

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.¹⁰ The importance of the United States lies not only in its wealth and power; it also lies in the fact that the United States has been an extremely significant source of both ozone-depleting chemicals and greenhouse gases.¹¹

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).¹² At last count, 183 nations have ratified the Montreal Protocol.¹³ Nations are complying with their obligations; global emissions of ozone-depleting chemicals have been reduced by over 95%; and atmospheric concentrations of such chemicals have been declining since 1994.¹⁴ By 2050, the ozone layer is expected to return to its natural level.¹⁵ 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,¹⁶ but to American companies as well, which stood in the forefront of technical innovation leading to substitutes for ozone-depleting chemicals.¹⁷

With climate change, the situation is altogether different. To be sure, an international agreement, produced in Kyoto in 1997, did go into force in 2005, when Russia ratified it¹⁸; the Kyoto Protocol has now been ratified by over 130 nations.¹⁹ But numerous nations are not complying with their obligations under the Kyoto Protocol,²⁰ and 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.²¹ Between 1990 and 2004, the United

¹⁰ On ozone depletion, see Robert Percival et al., *Environmental Regulation 1048* (2003) (United States accounted for almost one-half of global CFC use in the mid-1970s); *Record Increase in U.S. Greenhouse Gas Emissions Reported* (2006), available at <http://www.ens-newswire.com/ens/apr2006/2006-04-18-02.asp> (United States accounts for about 25% of the world's greenhouse gas emissions).

¹¹ See *id.*

¹² For the text of the Montreal Protocol, as amended, see <http://www.unep.org/ozone/Montreal-Protocol/Montreal-Protocol2000.shtml>

¹³ Scott Barrett, *Environment & Statecraft* 239 (2005).

¹⁴ See *id.*

¹⁵ *Id.*

¹⁶ See Edward Parson, *Protecting the Ozone Layer* 252-53 (2003).

¹⁷ See Percival et al., *supra* note, at 1051; Edward Parson, *Protecting the Ozone Layer* 126-27, 176-77, 180-82 (2003).

¹⁸ See Andrew Dessler and Edward Parson, *The Science and Politics of Global Climate Change* 129 (2006).

¹⁹ See Al Gore, *An Inconvenient Truth* 282-83 (2006).

²⁰ See below.

²¹ See George Pring, *The United States Perspective*, in *Kyoto: From Principles to Practice* 185, 195-97 (Peter Cameron and Donald Zillman eds. 2001).

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.²² 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 are increasingly 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.²³

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. 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.²⁴ 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, the monetized benefits of the Kyoto Protocol appeared to be dwarfed by the monetized costs.²⁵ If the United States complied with the Kyoto Protocol on its own, 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. Hence 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 cost-benefit assessments, 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.

There is a more general point. For the United States, and for other key nations as well, the payoff structures of the two agreements were fundamentally different. For some

²² See below.

²³ See *infra*.

²⁴ See Parson, *supra* note, at 228.

²⁵ See William Nordhaus and Joseph Boyer, *Warming the World* (2000); below. In the Clinton Administration, certain studies suggested low costs from compliance with Kyoto, see Pring, *supra* note, 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 Barrett, *supra* note.

nations, most prominently including the United States, unilateral compliance with the requirements of the Montreal Protocol was justified, even if *no* other nation complied. It would be impossible to make this point about the Kyoto Protocol. Indeed, it is plausible to suggest that for the United States, and for some other nations including China in particular, 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; and in fact, many nations engaged in such action.²⁶ 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 provisions of course must be specified). But for the United States, and for at least some other nations as well, the Kyoto Protocol did not solve the prisoner's dilemma, because it led to an outcome even 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 material incentives.²⁷ If this point generalizes, we might think of it as suggesting a kind of individual rationality constraint, or at least constraining factor, operating at the level of nations.²⁸ The different cost-benefit assessments help to explain other apparent anomalies as well. For example, they illuminate the pattern 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.²⁹ They also help explain the fact that American companies strongly supported the Montreal Protocol

²⁶ See Murdoch and Sandler, *supra* note.

²⁷ A helpful, supportive discussion, which also requires a qualification, is Stephen J. DeCanio, *Economic Analysis, Environmental Policy, and Intergenerational Justice in the Reagan Administration*, 3 *International Environmental Agreements: Politics, Law and Economics* 299 (2003). The support stems from the fact that the core analysis came from “projected health risks to the U.S. population from stratospheric ozone depletion.” *Id.* at 302. The qualification is that the choice of a relatively low discount rate, for the future, can be taken to suggest a degree of altruism toward future generations, through a principle of intergenerational neutrality. See *id.* Note, however, that these were future generations of Americans.

²⁸ The point is emphasized more generally in Jack Goldsmith and Eric Posner, *The Limits of International Law* (2005). An evident problem with rational actor models, for both individual and states, is that such models are powerless to explain decisions without 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, wherever they might be found. In the context of the Montreal and Kyoto Protocols, I shall emphasize the role of purely material concerns, including of course concerns about the health and wealth of American citizens.

²⁹ See Murdoch and Sandler, *supra* note, at 347.

while sharply opposing the Kyoto Protocol. They help explain why China and India refused to participate 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, while European nations, above all the United Kingdom, have been quite aggressive in reacting to the problem of climate change.

For the future, the implications of these points are simple. With respect to international agreements in general, the participation of the United States, and of other nations as well, is greatly affected by perceived domestic consequences.³⁰ To say this is not to deny that moral judgments may play some role and perhaps 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,³¹ 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. But if the United States is spending much more than it receives, it is unlikely to be an enthusiastic participant.

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. There is a 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 large emitters in the near future,³² and they are most unlikely to participate if the United States does not. The case of China is particularly important. China will soon be the world's leading emitter of greenhouse gases, and both the United States and China are in the position of having relatively less to lose from climate change and relatively much to lose from controls on greenhouse gases. These points have large implications for the prospects for and contents of a successful agreement, to which I shall turn in due course.

The remainder of this Article comes in three parts. Part II explores the Montreal Protocol and the role of scientific evidence, European caution, American enthusiasm, and cost-benefit analysis in producing it. Part III examines the Kyoto Protocol and American

³⁰ This is an explicit theme of James H. Maxwell and Sanford L. Weiner, *Green Consciousness or Dollar Diplomacy? The British Response to the Threat of Ozone Depletion*, 5 *International Environmental Affairs* 19 (1993).

³¹ See Congressional Research Service, *Foreign Aid: An Introductory Overview of U.S. Programs and Policy* (January 19, 2005) (reporting, among other things, \$7.35 billion for development assistance, *id.* at 4, and \$2.68 billion in humanitarian assistance, *id.* at 6).

³² See James Houghton, *Global Warming: The Complete Briefing* 244-45 (3d ed. 2004) (noting that between 1990 and 2000, China saw a nineteen percent increase in greenhouse gas emissions, and India a sixty-eight percent increase).

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 particularly low benefits, expected for the United States. Part IV 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.³³ In the decades that followed, CFCs were found to have numerous cooling applications, prominently including air-conditioning. But CFCs came to be used most significantly as propellants in aerosol spray cans.³⁴ CFCs and related chemicals, prominently including halons, acquired widespread commercial and military uses,³⁵ 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.³⁶ 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.³⁷ Rowland and Molina specified the “catalytic chain by which the chlorine atoms released would destroy ozone.”³⁸ The potential consequences for human health were clear, for Rowland and Molina wrote only two years after the loss of ozone had been linked with skin cancer.³⁹ In 1971, it had been prominently suggested that a one percent ozone loss would cause an additional 7000 cases of skin cancer each year.⁴⁰ 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 percent of global CFC use.⁴¹ A great deal of theoretical and empirical work was done within the scientific community; the National Academy of Sciences and many others made contributions.⁴² Much of the relevant research was supportive of the initial claims by Molina and Rowland.⁴³ At the same time, industry attempted to conduct and publicize its own research, mounting an aggressive

³³ See Parson, *supra* note, at 20.

³⁴ *Id.* at 21.

³⁵ *Id.* at 22.

³⁶ See Percival et al., at 1047.

³⁷ *Id.* at 1047-49.

³⁸ Parson, *supra* note, at 23.

³⁹ *Id.* at 24.

⁴⁰ *Id.* at 25.

⁴¹ See Benedick, *supra* note, at 26.

⁴² Benedick, *supra* note, at 11.

⁴³ Parson, *supra* note, at 33.

public relations campaign to discredit the association between CFCs and ozone depletion.⁴⁴ A senior executive at DuPont, the world's largest producer, testified before a Senate panel that the "chlorine-ozone hypothesis is at this time purely speculative with no concrete evidence . . . to support it."⁴⁵ At the very least, industry representatives suggested no harm would come from each year's delay and that costly regulation should not be imposed until further research had been established that real risks were involved.⁴⁶

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.⁴⁷ The same public concern spurred domestic regulation. In 1977, Congress amended the Clean Air Act to permit the Administrator of the Environmental Protection Agency (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."⁴⁸ In 1978, EPA used the Toxic Substances Control Act⁴⁹ to ban the use of CFCs as aerosol propellants in nonessential applications and defined criteria for exemptions of "essential uses."⁵⁰ As a result of the ban, aerosol production in the United States fell by nearly 95 percent.⁵¹ 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.⁵²

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 seem 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.⁵³ 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 in the context of climate change.

⁴⁴ Benedick, *supra* note, at 12.

⁴⁵ *Id.*

⁴⁶ Parson, *supra* note, at 33.

⁴⁷ Benedick, *supra* note, at 28, 31.

⁴⁸ 42 USC 7457(b).

⁴⁹ 15 USC 2605.

⁵⁰ 43 Fed Reg 11301 (1978).

⁵¹ Benedick, *supra* note, at 24.

⁵² Parson, *supra* note, at 40.

⁵³ See Cass R. Sunstein, *Laws of Fear: Beyond the Precautionary Principle* (2005).

Despite the flurry of domestic activity, no international agreement was in sight. In fact the effort to produce international cooperation was at first “an unmitigated failure.”⁵⁴ 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.⁵⁵ 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.⁵⁶ Heavily influenced by private groups with an economic stake in the outcome, most European nations resorted to symbols rather than regulatory restrictions.⁵⁷ Such symbols included voluntary emissions codes, unaccompanied by regulatory requirements of any kind.⁵⁸ 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.⁵⁹ The result of the disparity in reactions, and a source of continuing tensions between the United States and Europe, was a significant shift from American to European dominance in emissions of CFCs.⁶⁰

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.”⁶¹ 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.⁶² The British government was heavily influenced by Imperial Chemical Industries, among the largest CFC producers in the world.⁶³ But facing significant public concern, and regulatory restrictions, major American producers began the process of finding effective substitutes.⁶⁴ 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.⁶⁵ 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 1982.⁶⁶ In 1982, in fact, members of the U.S. delegation to an international negotiations indicated if they had known in 1977 what they now knew, they would have declined to ban aerosols.⁶⁷

⁵⁴ Id. at 44.

⁵⁵ Benedick, *supra* note, at 24.

⁵⁶ Parson, *supra* note, at 43.

⁵⁷ Id. at 24.

⁵⁸ Id. at 25.

⁵⁹ Id.

⁶⁰ Id. at 26-27.

⁶¹ Id. at 33.

⁶² Id. at 38-39.

⁶³ See James H. Maxwell and Sanford L. Weiner, Green Consciousness or Dollar Diplomacy? The British Response to the Threat of Ozone Depletion, 5 *International Environmental Affairs* 19, 21 (1993).

⁶⁴ Parson, *supra* note, at 53.

⁶⁵ Id. at 57-58.

⁶⁶ Id. at 58-59.

⁶⁷ 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.⁶⁸ 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,⁶⁹ 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.⁷⁰ While the government maintained its position in the face of these objections, continuing negotiations produced an international stalemate through 1984.⁷¹

In 1985, the United States emphasized that a new theory indicated that truly catastrophic harm was possible, stemming from a sudden collapse of ozone concentrations. Because of the worst-case scenario, immediate action would be desirable.⁷² 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”⁷³ and that “Americans had been panicked into ‘over-hasty measures.’”⁷⁴ Strikingly, the British government played an important role in steering public opposition to regulatory controls.⁷⁵ 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.”⁷⁶ Because of European skepticism, an international agreement seemed highly unlikely, with industry favoring the European position.⁷⁷

B. The Road to Montreal

A great deal changed as a result of the emergence of strengthened scientific consensus, suggesting 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, one that had grown to the size of the United States.⁷⁸ A paper published in 1985 suggested that between 1957 and 1984, there had been a 40 percent depletion in levels of total column ozone over Antarctica.⁷⁹ The discovery of the Antarctica hole “dramatically transformed the politics of the international negotiations as

⁶⁸ Percival et al., *supra* note, at 1048. The shift in American policy appears to have had something to do with the replacement of Ann Gorsuch, as Administrator of the Environmental Protection Agency, with William Ruckelshaus. See Parson, *supra* note, at 115.

⁶⁹ Parson, *supra* note, at 116-17.

⁷⁰ *Id.* at 117.

⁷¹ *Id.* at 121.

⁷² Benedick, *supra* note, at 43.

⁷³ *Id.*

⁷⁴ Benedick, *supra* note, at 33.

⁷⁵ Percival, *supra* note, at 1050.

⁷⁶ Maxwell and Weiner, *supra* note, at 21.

⁷⁷ Parson, *supra* note, at 125.

⁷⁸ Percival at 1048.

⁷⁹ See Maxwell and Weiner, *supra* note, at 26.

well as the science.”⁸⁰ A significant role was played by the sheer vividness of the discovery, which “captured the public’s imagination.”⁸¹

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.⁸² 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.⁸³ These conclusions, generally taken as authoritative, helped to pave the way toward the negotiations that led 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.⁸⁴ While arguing that CFCs produced no imminent hazard, DuPont supported an international freeze on CFC emissions, seeing that step as a justified precautionary measure⁸⁵ after the discovery of the Antarctic ozone hole.⁸⁶ Indeed, DuPont and other producers pledged to phase out production by an early date and also supported international controls.⁸⁷ 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.⁸⁸ 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.⁸⁹ In support of this hypothesis, consider the companies’ 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.”⁹⁰ It is noteworthy in this regard that 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.”⁹¹

In December 1986, the international negotiations became increasingly serious. Within the United States, there was mounting disagreement within the executive branch, as some officials agreed with the industry suggestion that a freeze might be justified, but not emissions reductions.⁹² But the legislative view was unambiguous. By a vote of 80-2,

⁸⁰ Id.

⁸¹ Id.

⁸² See Parson, *supra* note, at 251.

⁸³ Id. at 252.

⁸⁴ Id. at 127.

⁸⁵ Id. at 126.

⁸⁶ See James Hammitt, Stratospheric-Ozone Depletion, in *Economic Analyses At EPA 131, 157* (Richard Morgenstern ed. 1997).

⁸⁷ Id.

⁸⁸ Id.

⁸⁹ Id.

⁹⁰ Scott Barrett, *Environment & Statecraft* 234 (2005).

⁹¹ Hammitt, *supra* note, at 157.

⁹² Id. at 133.

the Senate voted in 1987 to ask President Reagan to take aggressive action to protect the ozone layer.⁹³ The relevant 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.”⁹⁴

What followed was a period of intense discussions within the Reagan Administration,⁹⁵ with sharp differences between the Office of Management and Budget, skeptical of aggressive controls, and the Environmental Protection Agency, favorably disposed to such controls.⁹⁶ 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.⁹⁷ 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.”⁹⁸ This conclusion was generally in line with the EPA’s own analysis of the problem, in the sense that both were highly supportive of aggressive controls.⁹⁹ In particular, both EPA and the Council of Economic Advisers concluded that the ozone layer depletion would cause a “staggering” increase in the number of deaths from skin cancer—over five million by 2165.¹⁰⁰

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.”¹⁰¹ Recall in this connection that skin cancer is a salient harm, one that is likely to energize citizens and officials alike. The association between skin cancer and cherished leisure activities—such as lying on the beach—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.”¹⁰² Concerned about the economic position of Imperial Chemical Industries, the United Kingdom rejected an aggressive approach.¹⁰³ The United States took the lead in endorsing stringent additional controls; it was joined by several other nations, including Canada, New

⁹³ Benedick, *supra* note, at 61-62.

⁹⁴ Congressional Record, June 5, 1987, at p. S57759.

⁹⁵ Benedick, *supra* note, at 62-65.

⁹⁶ Parson, *supra* note, at 135-36.

⁹⁷ See Barrett, *supra* note, at 227-30.

⁹⁸ See Benedick, *supra* note, at 63.

⁹⁹ See Hammitt, *supra* note, for a general discussion.

¹⁰⁰ See DeCanio, *supra* note, at 302.

¹⁰¹ Hammitt, *supra* note, at 155.

¹⁰² See Hammitt, *supra* note, at 68.

¹⁰³ See Maxwell and Weiner, *supra* note, at 27.

Zealand, Finland, and Norway.¹⁰⁴ 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.”¹⁰⁵

Many months of discussions led to the decisive meeting in Montreal, starting on September 8, 1987 and including over 60 countries, more than half of them developing.¹⁰⁶ 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 1992.¹⁰⁷ 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.”¹⁰⁸ 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.¹⁰⁹

A knotty question involved the treatment of developing countries. While CFC consumption was low in those countries, their domestic requirements were increasing,¹¹⁰ and a badly designed agreement could 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, who were responsible for the problem in the first place. India and China emphasized that nations with less than 25 percent of the world’s population had been responsible for over 90 percent of the world’s CFCs.¹¹¹ This claim was meant by several 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 percent reduction for the next ten years. In addition, a funding mechanism was created by which substantial resources—initially \$400 million—were transferred to poor countries.¹¹² These provisions have been criticized as unduly vague, essentially a way of deferring key questions¹¹³; but they provided an initial framework, one that has turned out to work exceedingly well.

¹⁰⁴ See Hammitt, *supra* note, at 69.

¹⁰⁵ *Id.*

¹⁰⁶ *Id.* at 74.

¹⁰⁷ Parson, *supra* note, at 240.

¹⁰⁸ *Id.* at 143.

¹⁰⁹ Hammitt, *supra* note, at 155-56.

¹¹⁰ Benedict, *supra* note, at 93.

¹¹¹ Percival et al., *supra* note, at 1052.

¹¹² See *id.*; see also Bowser, History of the Montreal Protocol’s Ozone Fund, 14 *Intl Env Rep* 636 (1991).

¹¹³ Parson, *supra* note, at 146.

C. Costs and Benefits

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 Advisors, 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 the Environmental Protection Agency, of the costs and benefits of the Montreal Protocol¹¹⁴:

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	1,363
Costs	—	21	21
Net benefits	—	3,554	1,352

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 200,000 and two million, respectively, by a 50% CFC reduction.¹¹⁵ Of course it is possible to question these numbers; the science does not allow uncontroversial point estimates here, and perhaps the 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 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, including more than five million cancer deaths, by 2100.¹¹⁶ 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.¹¹⁷

One of the most noteworthy features of the ozone depletion problem is that over time, the United States was anticipated to be a decreasingly large contributor to that problem. By 2050, no controls were expected to mean 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, no controls were expected to mean a 50% decrease; unilateral action a 49% decrease; and the international agreement a 1.2% decrease.¹¹⁸ In the short-run, aggressive action by the United States

¹¹⁴ See Barrett, *supra* note, at 228.

¹¹⁵ See DeCanio, *supra* note, at 302. See *id.* for more information on how these harms were turned into monetary equivalents and in particular for discussion of the choice of a low discount rate.

¹¹⁶ Barrett, *supra* note, at 146.

¹¹⁷ *Id.* at 231.

¹¹⁸ *Id.*

alone was amply justified by the domestic cost-benefit calculus. In the long-run, the United States would do much better with global cooperation, especially from developing nations, which would be 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.

There is no full accounting of the costs and benefits of the Montreal Protocol for the world. But if we build on a 1997 study in Canada, we can generate the following numbers as a rough approximation¹¹⁹:

Global Benefits and Costs of Montreal Protocol, 1987–2060

Avoided cases of skin cancer	20,600,000
Avoided cases of 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 about)	\$459 billion
Monetized benefits in terms of 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 contentious assumptions.¹²⁰ But the conclusion is that the Montreal Protocol was an extraordinary bargain for the world in general, as well as for the United States in particular. Its success had everything to do with these facts.

This point raises an obvious question: 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, sufficient to justify large reductions in such emissions.¹²¹ If so, an international accord might not be required at all. It is true that the United States made substantial reductions on its own, as did other nations, and that still more nations might have done so without the Montreal Protocol.¹²² But an agreement was nonetheless

¹¹⁹ Barrett, *supra* note, at 237.

¹²⁰ For example, the economic value of a human life is highly controversial, as is the adoption of a uniform number. For discussion, see DeCanio, *supra* note, at 304-06; Cass R. Sunstein, *Laws of Fear: Beyond the Precautionary Principle* (2005).

¹²¹ See James Murdoch and Todd Sandler, *The Voluntary Provision of a Pure Public Good: The Case of Reduced CFC Emissions and the Montreal Protocol*, 63 *J Public Economics* 331 (1997).

¹²² Indeed, many nations did so. See *id.* at 347. 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 spurred this ahead-of-schedule reductions, and above-requirement reductions, in part because of the information the meetings and the protocol provided, in part because of the

important. As we have seen, the United States itself was much better off with agreement from other countries, and for many of those countries, the purely domestic cost-benefit calculus was 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. Perhaps it is relevant here that the skin cancer risks associated with ozone depletion primarily threaten light-skinned people,¹²³ and hence nations with mostly dark-skinned populations had relatively little to gain from the agreement. And in understanding why an agreement was necessary, it is relevant that American producers, such as DuPont, were more enthusiastic about the development of substitutes on the assumption that there would be an international market for them—and on the assumption that they would not be losing, and might even be gaining, in the global marketplace 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.

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.¹²⁴ 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, and at least some of the parties would not have reduced at all or as much on their own.

Perhaps it is relevant here that the skin cancer risks associated with ozone depletion primarily threaten like-skinned people, and hence nations with mostly dark-skinned populations had relatively little to gain from the agreement. On this count, the problem of climate change is altogether different.

technology-forcing role of the protocol, in part because of the symbolic value of early and substantial reductions both domestically and internationally.

¹²³ See DeCanio, *supra* note, at 302.

¹²⁴ *Id.* at 347.

D. Beyond Montreal

After the Montreal Protocol, restrictions on ozone-depleting substances have been rapidly strengthened,¹²⁵ to the point where a world-wide phase-out of fifteen different CFCs was accepted in London in 1990.¹²⁶ At that stage, the European Community, now convinced, sought a clear timetable for further reductions, leading to an agreement for total elimination of CFC use and production by 2000.¹²⁷ Imperial Chemical Industries, an original source of the British and hence 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.”¹²⁸

Remarkably, the European Community announced that it would phase out CFCs by 1997. Not to be outdone, the United States announced that it would do so by 1996. The accelerated action was spurred by evidence that the costs of the phase-out would be much lower than expected—and that the damage to the ozone layer was even greater. Action to control ozone-depleting chemicals has increased since that time, 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; and ozone concentrations are expected to return to natural levels by 2050.¹²⁹ 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 a distinctive and striking case study in a well-known phenomenon in the political science literature, which involves the provision of public goods by international powers, or “hegemons.”¹³⁰ 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.¹³¹ 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.

¹²⁵ An informative capsule summary can be found in Parson, *supra* note, at 240-41.

¹²⁶ Parson, *supra* note, at 235.

¹²⁷ On the British turnaround, see Maxwell and Weiner, *supra* note, at 32.

¹²⁸ *Id.* at 33.

¹²⁹ Parson, *supra* note, at 239.

¹³⁰ See Kris James Mitchener and Marc Weidenmier, *Empire, Public Goods, and the Roosevelt Corollary*, 65 *J Ec History* 658 (2005); Deepak Lal, *Globalization, Imperialism, and Regulation*, 14 *Camb Rev. International Aff.* 107 (2001); Charles Kindleberger, *Dominance and Leadership in the International Economy: Exploitation, Public Goods, and Free Rides*, 25 *International Studies Q.* 242 (1981).

¹³¹ 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.

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.¹³² 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.¹³³

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 toward regulatory controls, with the United Kingdom in the forefront.¹³⁴ 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.¹³⁵

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.¹³⁶ 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.¹³⁷ In fact the United States was the first industrialized nation to ratify the Framework Convention,¹³⁸ which set the stage for everything that has happened since.

¹³² For a helpful overview, see Pring, *supra* note.

¹³³ 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 Information Administration, *supra* note, at ES-1; <http://www.eia.doe.gov/oiaf/1605/1605a.html>; <http://yosemite.epa.gov/oar/globalwarming.nsf/content/ResourceCenterPublicationsGHGEmissionsUSEmissionsInventory2006.html>

¹³⁴ See Tony Blair, Foreword, in *Avoiding Dangerous Climate Change* (Hans Joachim Schellnhuber et al. eds. 2006).

¹³⁵ See Pring, *supra* note, at 201-05.

¹³⁶ Percival et al., *supra* note, at 1062.

¹³⁷ See Parson, *supra* note, at 368-69.

¹³⁸ See Pring, *supra* note, at 185.

Unlike the Montreal Protocol, the Framework Convention lacked quantitative limits for emissions reductions; the absence of such restrictions had everything to do with the posture of the United States, which strongly resisted them,¹³⁹ 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 general aspirations, calling in abstract terms for stabilization of emissions to prevent “dangerous interference” with global climate. 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.” The parties agreed to produce, at a latter stage, a legal instrument that would establish quantitative limits for developing countries. The Convention was ratified by the United States Senate in 1992 and 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 agree to a protocol that would embody those limits.¹⁴⁰ The Clinton Administration appeared to support the “Berlin Mandate,” asking industrialized nations to accept restrictions on greenhouse gas emissions. But other national leaders 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 “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.¹⁴¹ 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.”¹⁴² (Recall that a near-unanimous Senate had voted in favor of aggressive action to protect the ozone lawyer—and that a unanimous Senate voted to support a more rapid phase-out of CFCs than was required by the Montreal Protocol and its amendment.¹⁴³)

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 Protocol¹⁴⁴—this vote was essentially a suggestion that the United States should accept no commitments at all. It is worth underlining the bipartisan nature of the vote; no Democratic member of the Senate opposed it. As we shall see, the

¹³⁹ Parson, *supra* note, at 368.

¹⁴⁰ *Id.* at 369.

¹⁴¹ <http://www.opic.gov/GeneralOPIC/senateresolution98.htm>

¹⁴² *Id.*

¹⁴³ Barrett, *supra* note, at 369-70.

¹⁴⁴ See *supra*.

opposition of developing countries stemmed from a calculation overlapping with that of the Senate. To be sure, it was possible for such countries to urge that wealthy nations had been responsible for the problem in the first instance, and that they should not have to bear significant costs when wealthy nations had already benefited from the technologies that contribute to climate change. This argument – invoking corrective justice, but with a distributional component – was not made and could not be made by the United States. But developing countries also believed, not without reason, that they would lose more than they would gain from restrictions on greenhouse gases. As we shall see, China was and remains the most important actor here. China stands to lose relatively little from climate change, and it would have to spend a great deal to reduce greenhouse gases¹⁴⁵; hence China’s reluctance to participate in an international accord parallels the analysis of the United States.

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.¹⁴⁶ 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.¹⁴⁷ In the complex Kyoto negotiations in December 1997, the United States did support regulatory limits, but relatively modest ones, arguing against reductions in emissions levels and instead for stabilizing current levels.¹⁴⁸ (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.) 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. The United States also opposed mandatory “domestic measures,” such as energy taxes,¹⁴⁹ and sought ample mechanisms to ensure emissions trading, a sensible idea that would have the advantage driving down costs. The restrictions supported by the United States were distinctly less aggressive than those sought by the European Union and Japan.¹⁵⁰ 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; they refused.¹⁵¹

In fact many of the American positions were rejected during the negotiations. Ultimately, most of the major developed nations, including the United States, agreed to the Kyoto Protocol, which 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. The list was designed to ensure that taken as a whole, the nations would show a reduction of 5 percent over 1990 levels—a reduction that must

¹⁴⁵ See *infra*.

¹⁴⁶ Pring, *supra* note, at 196.

¹⁴⁷ *Id.* at 197.

¹⁴⁸ *Id.* at 198.

¹⁴⁹ *Id.* at 198-99.

¹⁵⁰ See Pervival et al., *supra* note, at 1063.

¹⁵¹ Percival et al., *supra* note, at 1063.

be met in the period between 2008 and 2012. For example, the United States was required to reduce emission by 7 percent; Japan by 6 percent; the European Union by 8 percent. Some nations were permitted to have increased emissions; these included Iceland, Norway, and Australia. Developing nations made no commitments at all, though 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.¹⁵² The point is most obviously true for developing nations. India's greenhouse gas emissions exceed Germany's; those of South Korea exceed France; next to the United States, China is the largest emitter of greenhouse gases in the world.¹⁵³ But none of these nations is controlled by the Kyoto Protocol. Russia was given a target of 100 percent of its 1990 emissions, but in 1997, its actual emissions were already merely 70 percent of that amount, because of economic difficulties. The trading system created by the Kyoto Protocol actually ensured a huge economic boon to Russia, as everyone was aware.¹⁵⁴ Germany appeared to accept a significant reductions requirement—8 percent by 2012—but in 1997, its own emissions were already 10 percent lower than 1990, as a result of reunification with the former East Germany, whose plummeting economy resulted in radical emissions decreases.¹⁵⁵ For the United Kingdom, the story is not altogether different. The target, a reduction of 8 percent, was less severe than it seemed, because state subsidization of natural gas had already led, in 1997, to a level 5 percent below that of 1990.¹⁵⁶ The real loser, in terms of the actual costs of mandatory cuts, was the United States.

It should therefore 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. 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 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.¹⁵⁷ 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.¹⁵⁸ Under intense international pressure, the United States signed the protocol on September 12, 1998.¹⁵⁹ 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 to use appropriations “to propose or issue rules, regulations, decrees or orders for the purpose of implementation, or in preparation for

¹⁵² See Richard Benedick, *Morals and Myths: A Commentary on Global Climate Policy*, WZB-Mittellungen Heft 108, at 15-16 (Sept. 2005)

¹⁵³ *Id.* at 16.

¹⁵⁴ *Id.* at 16.

¹⁵⁵ *Id.*

¹⁵⁶ *Id.*

¹⁵⁷ Pring, *supra* note, at 200-01.

¹⁵⁸ *Id.* at 205.

¹⁵⁹ *Id.* at 206.

implementation” of the Kyoto Protocol.¹⁶⁰ At this point, Vice President Gore himself indicated that the protocol would not be submitted for ratification without meaningful participation by developing nations.¹⁶¹ 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.”¹⁶²

The Bush Administration offered no such ambivalent picture. 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 percent of the world, including major population centers such as China and India, from compliance, and would cause serious harm to the U.S. economy.”¹⁶³ In fact the United States attempted to persuade other nations, above all Japan and Russia, to reject the protocol as well.¹⁶⁴ 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.¹⁶⁵ One of the nation’s principal goals is an 18% improvement in greenhouse gas intensity between 2002 and 2012,¹⁶⁶ with intensity measured as emissions per unit of gross domestic product (GDP). But the goal is an aspiration, not a requirement,¹⁶⁷ and in any case significant reductions in greenhouse gas intensity can be accompanied by extremely large increases in greenhouse gas emissions.¹⁶⁸

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 nonratifiers. In

¹⁶⁰ Id.

¹⁶¹ Id. at 207.

¹⁶² See Benedick, *Morals and Myths*, supra note, at 16.

¹⁶³ See note supra.

¹⁶⁴ Percival et al., supra note, at 1071.

¹⁶⁵ For overviews, see <http://www.state.gov/g/oes/rls/fs/46741.htm> and <http://www.epa.gov/globalwarming/>, in particular the reports mentioned at <http://yosemite.epa.gov/oar/globalwarming.nsf/content/actions.html>; <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 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 <http://commerce.senate.gov/newsroom/printable.cfm?id=214305>; for an analysis, see Sergey Paltsev et al., *Emissions Trading to Reduce Greenhouse Gases in the United States: The McCain-Lieberman Proposal*, available at <http://web.mit.edu/globalchange/www/reports.html>.

¹⁶⁶ For a helpful outline, see http://www.pewclimate.org/policy_center/analyses/response_bushpolicy.cfm

¹⁶⁷ See id.

¹⁶⁸ 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 Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2004* at xii (2005).

2001, the Marrakech accords led to further innovations, in which developing countries were made beneficiaries of funds to assist with technology transfer.¹⁶⁹ Although the level of the funds remain unspecified, donors led by the European Union pledged to grant \$410 million annually.¹⁷⁰ 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?

Begin with the United States, focusing on the cost side. At the time of ratification, this was a much-disputed question. An early analysis in the Clinton Administration found “modest” costs from the Kyoto Protocol, producing a mere \$.04 to \$.06 increase in the price of gasoline, and an annual increase in the average family’s energy bill of \$70-\$110 by 2010.¹⁷¹ 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 percent to 86 percent increases in the price of electricity by 2010.¹⁷² Compare in this regard an industry-funded study done at the Wharton School, which projected costs far in excess of these projections¹⁷³—including a loss of 2.4 million jobs and \$300 billion in the nation’s GDP, with an average annual cost of \$2700 per household, including a 65 cent per gallon increase in the price of gasoline and a near-doubling of the price of energy and electricity.¹⁷⁴

These figures are almost certainly inflated. One of the most careful, objective, and influential analyses comes from William Nordhaus and Joseph Boyer.¹⁷⁵ 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.¹⁷⁶ 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.¹⁷⁷ According to Nordhaus and Boyer, the worst-case scenario for the Kyoto Protocol, involving no effective trading, would produce total costs of \$852 billion in present value.¹⁷⁸ The best case, involving global trading, would involve a cost of \$91

¹⁶⁹ See *id.* at 1072-73; Vespa, *Climate Change 2001: Kyoto at Bonn and Marrakech*, 29 *Ecol. L. Q.* 395 (2002).

¹⁷⁰ Percival et al., at 1073.

¹⁷¹ Pring, *supra* note, at 194.

¹⁷² *Id.* at 196.

¹⁷³ <http://www.epa.gov/globalclimate/wefastateimpacts.htm>

¹⁷⁴ *Id.*

¹⁷⁵ Nordhaus and Boyer, *supra* note.

¹⁷⁶ *Id.* at 155-162.

¹⁷⁷ See above.

¹⁷⁸ *Id.* at 159.

billion.¹⁷⁹ The most likely figure is \$325 billion, involving trading among the Annex 1 nations.¹⁸⁰

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.¹⁸¹ The reason is that many nations, especially those in Eastern Europe, would receive a great deal of money from permit sales, and hence 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.¹⁸² 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, the worldwide costs of the protocol are in the hundreds of billions of dollars.

What would the United States and the world receive in return for these costs? Here too there is a great deal of uncertainty.¹⁸³ In its 2001 report, the Intergovernmental Panel on Climate Change projected an increase of between 1.4 and 5.8 degrees Centigrade by 2001¹⁸⁴—and an increase of 1.4 degrees would cause far less damage than an increase of 5.8 degrees. 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.¹⁸⁵ If climate change is abrupt, the cost will be far higher than otherwise; abrupt climate change may lead to worldwide catastrophe.¹⁸⁶ The magnitude of the risk of catastrophe is disputed, and any such risk must be made part of the overall analysis.¹⁸⁷ In addition, 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.¹⁸⁸

¹⁷⁹ *Id.*

¹⁸⁰ *Id.*

¹⁸¹ *Id.*

¹⁸² *Id.* at 162.

¹⁸³ For valuable overviews, see *Avoiding Dangerous Climate Change* (Hans Joachim Scellnhuber et al. eds 2006); Richard Tol, *The Marginal Damage Costs of Carbon Dioxide Emissions: An Assessment of the Uncertainties*, 33 *Energy Policy* 2064 (2005); Nordhaus and Boyer, *supra* note.

¹⁸⁴ Percival et al., *supra* note, at 1058.

¹⁸⁵ See Tol, *supra* note; Houghton, *supra* note.

¹⁸⁶ See Richard A. Posner, *Catastrophe* (2005); *Avoiding Dangerous Climate Change*, *supra* note.

¹⁸⁷ See Nordhaus and Boyer, *supra* note (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* 55, 61 (projecting a risk of abrupt climate change, which is potentially catastrophic, at 30-40 percent).

¹⁸⁸ For relevant discussion, see DeCanio, *supra* note (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* 99 (Walter Sinnott-Armstrong and Richard Howarth eds. 2005).

According to an influential estimate, however, the present worldwide cost of climate change is projected to be in the vicinity of four trillion dollars.¹⁸⁹ 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.¹⁹⁰ But four trillions dollars is a great deal, and even that figure may be far too low if climate change is abrupt.¹⁹¹ According to other estimates, climate change will reduce the GDP of developed nations by one or two percent, and reduce the GDP of developing nations by five percent or more.¹⁹² 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 the agreement would actually have a meager effect, reducing anticipated warming by a mere 0.03 C by 2100.¹⁹³ The reason 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. There are three points here. First, China, India, and other developing countries—now substantial contributors to climate change, and anticipated to be larger contributors in the near future—are not included in 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? The initial point is that the most serious damage from climate change is most unlikely to be felt in the United States.¹⁹⁴ On some estimates, American agriculture will actually be a net winner as a result of climate change.¹⁹⁵ On other estimates, Americans will be net losers, but not nearly to the same extent as other nations.¹⁹⁶ In this light, we can offer a plausible if rough projection of the costs and benefits of the Kyoto Protocol for the United States alone¹⁹⁷:

¹⁸⁹ See Nordhaus and Boyer, *supra* note, at 130-32 (\$4 trillion): see also Posner, *supra* note, at 44 (noting but raising doubts about estimates of \$4 trillion or \$5 trillion).

¹⁹⁰ See Posner, *supra* note, at 44.

¹⁹¹ *Id.*

¹⁹² See Houghton, *supra* note, at 188.

¹⁹³ Nordhaus and Boyer, *supra* note, at 152.

¹⁹⁴ See Nordhaus and Boyer, *supra* note, at 96-97.

¹⁹⁵ See Olivier Deschenes and 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/publications/abstract.php?pid=1031>; compare the suggestion in Nordhaus and Boyer, *supra* note, at 97, that “the economic impact of gradual climate change (that is, omitting catastrophic outcomes) is close to zero for a moderate (2.5 degree C) global warming.” Note that this conclusion does not come to terms with the economic effects on the United States that would come from the very fact of serious economic harms in other nations.

¹⁹⁶ See Nordhaus and Boyer, *supra* note.

¹⁹⁷ Compiled on the basis of Nordhaus and Boyer, *supra* note, at 156-67.

Costs and Benefits of Kyoto Protocol for the United States (in billions of 2000 dollars):

	No Controls	Kyoto Protocol	Unilateral Action to Comply with Kyoto Protocol
Benefits	—	12	0 ¹⁹⁸
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, significant unilateral action to comply with the Kyoto Protocol may well produce no benefits at all, and 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. To say this is not to say that unilateral action would have no rationale.¹⁹⁹ 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. As we have seen, something of this sort did happen with ozone depletion, as substitutes developed more rapidly, and more cheaply, than anyone expected.²⁰⁰ But for climate change, any such strategy would be a gamble, and it would not be the simplest to defend in conventional terms.

The larger point is that for the United States, the perceived values presented a very different picture for the Kyoto Protocol than for the Montreal Protocol. The costs of the Kyoto Protocol were much higher than the costs of the Montreal Protocol (by some \$313 billion), and the benefits of the former were much lower than the benefits of the later (by some \$3,562 billion!). 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:

Costs and Benefits of Kyoto Protocol for the World (in Billions of 2000 Dollars)

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

To be sure, these numbers must be taken with many grains of salt, depending as they do 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. Reasonable people might expect the costs to be significantly lower or offer a significantly higher estimate of

¹⁹⁸ 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 – and that any such effect might be counteracted by benefits.

¹⁹⁹ See Richard A. Posner, *Catastrophe* (2005).

²⁰⁰ See Percival et al., *supra* note, 1051.

the benefits. If climate change is abrupt, or if temperatures raise more sharply than anticipated, the benefits of the Kyoto Protocol will be higher than these numbers suggest. 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.

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 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 uniquely unfavorable for the United States. Many nations undoubtedly had more to gain than to lose (consider Eastern European nations, which 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. 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, in the end, 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, in fact, prove to be binding. 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 Annex1 nations except the United States and Australia. But this simple fact is insufficiently informative. 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 EEC countries²⁰¹:

²⁰¹ All data taken from: UNFCCC, Key GHG Data: Greenhouse Gas (GHG) Emissions Data for 1990--2003 submitted to the UNFCCC, at 16-17 (November 2005)

EEC Countries			
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%	almost

Note that compliance is not required until some time between 2008 and 2012 (with the precise date varying by country); hence widespread noncompliance does not foreclose the possibility that the situation will be better when the actual due dates arrive. Nonetheless, Sweden and France (with its heavy reliance on nuclear power) are the only nations in the EEC that have already met their targets under the Kyoto Protocol. The current numbers, and the existing trends, suggest that it is highly likely that a majority of EEC nations will fail to meet their obligations. There is a large contrast here with the Montreal Protocol, for which compliance is essentially perfect. To be sure, the United Kingdom, Germany, and Greece are close to their targets; we have seen the explanation for the first two. 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 countries²⁰²:

Annex 1 Countries			
Country	Target	% Change in Emissions between 1990 and 2003	Compliant?
Bulgaria	-8%	-50%	yes
Czech Republic	-8%	-24.20%	yes
EEC	-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
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 1 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.²⁰³ But most of these nations are in Central and Eastern Europe, which has suffered serious

²⁰² Id.

²⁰³ See UNFCCC, Key GHG Data: Greenhouse Gas (GHG) Emissions Data for 1990-2003, submitted to the UNFCCC, at 16-17 (November 2, 2005).

economic distress in the relevant period. That distress accounts for substantially lower levels of energy use and hence lower levels of emissions, in fact an overall reduction of 37 percent in the relevant period.²⁰⁴

Because of the latter figure, the good news is that from 1990 to 2003, greenhouse gas emissions from Annex I parties did decrease by 5.9 percent, or a total of 18.4 billion tons—an average decrease in line with the Kyoto target.²⁰⁵ But it is important to be careful with this figure. It is true that the average decrease, under that target, is 5.2 percent, but 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 2000.²⁰⁶ In view of 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.²⁰⁷

An important qualification to the figures just given: The behavior of nations might well be 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 clean test of how nations would behave if the United States were willing to alter its own practices. Let us now turn, in that light, to those practices.

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 directions.

Within the United States, greenhouse gas emissions increased by no less than 15.8 percent between 1990 and 2004.²⁰⁸ 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 percent.²⁰⁹ To be sure, greenhouse gas *intensity*—understood as emissions per unit of Gross Domestic Product—has been decreasing in the same period, with a significant decline of 21%.²¹⁰ 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.²¹¹

²⁰⁴ <http://www.commondreams.org/headlines03/0610-07.htm>

²⁰⁵ Id at 14.

²⁰⁶ <http://www.commondreams.org/headlines03/0610-07.htm>

²⁰⁷ Id.

²⁰⁸ See Energy Information Administration, *supra* note, at ix; Record Increase in U.S. Greenhouse Gas Emissions Sparks Global Controversy (2006), available at <http://environment.about.com/b/a/256722.htm>

²⁰⁹ Energy Information Administration, *supra* note, at x, xii.

²¹⁰ Id.

²¹¹ Id. at xii.

Fossil fuel combustion is by far the largest contributor to greenhouse gas emissions in the United States, accounting for well over ninety-five percent of total carbon dioxide emissions. Greenhouse gas emissions from this source has been growing in most sectors, with a 1.7% increase between 2003 and 2004.²¹² The transportation sector, based on fossil fuels, accounts for over a quarter of emissions, and it is the most rapidly growing source.²¹³ While methane emissions were reduced by 10% in 2004, total greenhouse gas emissions increased by 1.7% in the same year, the largest increase on record from any nation.²¹⁴ The most important 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 percent 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.

III. Lessons and Implications

What follows from an understanding of the extraordinary success of the Montreal Protocol and substantial failure 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. For these reasons, both tales are legitimately taken as exemplary. They fit with other accounts in domains that are both related²¹⁵ and quite different²¹⁶; 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.²¹⁷ As suggestive evidence, consider the fact that a “revealed preference” study of American laws suggests that a non-American life is valued at 1/2000 an American life.²¹⁸

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 action that no individual nation, or few

²¹² Id.

²¹³ <http://www.epa.gov/otaq/greenhousegases.htm>

²¹⁴ See Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2004* (2005); Record Increase in United States Greenhouse Gases Reported (2006), <http://www.ens-newswire.com/ens/apr2006/2006-04-18-02.asp>

²¹⁵ See Barrett, *supra* note.

²¹⁶ See Jack Goldsmith and Eric A. Posner, *The Limits of International Law* (2005); Jack Goldsmith, *Liberal Democracy and Cosmopolitan Duty*, 54 *Stan L Rev* 1667 (2003).

²¹⁷ See Maxwell and Weiner, *supra* note, at 37-38.

²¹⁸ See Wojciech Kopszuk et al., *The Limitations of Decentralized World Redistribution: An Optimal Taxation Approach*, 30 *European Economic Review* 1051 (2005).

individual nations, would undertake on their own.²¹⁹ At first glance, the problems of ozone depletion and climate change might seem to have this structure. But neither the Montreal Protocol nor the Kyoto Protocol solves a prisoner's dilemma. 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, the Kyoto Protocol solved no prisoner's dilemma for the United States. On the contrary, compliance with the requirements of the Kyoto Protocol would probably make Americans worse off, even if such compliance ensured that all other parties complied as well.²²⁰

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. Neither 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, the Kyoto Protocol was neither in the nation's interest nor in the world's interest. 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 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 presented an example of a case in which the United States based its decision on domestic consequences even though global consequences argued for a very different outcome. 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.²²¹ 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 (because of the nonparticipation 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?

²¹⁹ See Goldsmith and Posner, *supra* note, at 29-32.

²²⁰ 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.

²²¹ See DeCanio, *supra* note, at 302.

A. Public Opinion and Consumer Behavior

The first lesson is that public opinion greatly matters, at least if it is reflected in actual behavior.²²² 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,²²³ in part because it made regulatory controls far less costly than they would otherwise be. In addition, market pressures fed by consumer behavior can spur technological innovation. If environmentally unfriendly products are not popular 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 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.²²⁴

By contrast, there was no public pressure on those involved in CFC production and use in Europe, certainly in the early stages. 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 were radically transformed in the United Kingdom and in Europe, and the transformation had large effects on the approach of political leaders in the United Kingdom and Europe as well.²²⁵ Note in this regard 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 warrant.²²⁶ 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,” above all through research and voluntary action, rather than through emission reduction mandates.²²⁷ It is true that between 1990 and the present, the problem of climate change has received a great deal of media attention in the United States. 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.²²⁸ 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

²²² See Benedick, *supra* note.

²²³ Cf. the public controversy over the pesticide Alar, which was used in apples and associated with an increase in 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.

²²⁴ See Benedick, *supra* note.

²²⁵ See Maxwell and Weiner, *supra* note, at 32-33.

²²⁶ See Aaron Wildavsky, *But Is It True?* (1999); Timur Kuran and Cass R. Sunstein, *Availability Cascades and Risk Regulation*, 51 *Stan L Rev* 683 (1999).

²²⁷ For a vigorous challenge to this approach, see Houghton, *supra* note, at 227-30.

²²⁸ See Cass R. Sunstein, *On the Divergent American Reactions to Terrorism and Climate Change*, *Colum L Rev* (forthcoming 2007).

environmental problems, climate change was ranked ninth, well below damage to the ozone layer.²²⁹ 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.²³⁰ Unlike in the context of depletion of the ozone layer, American consumers and voters are 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. But with respect to greenhouse gases, the unaggressive posture of the United States government has been consistent with the attitudes of American citizens. A salient incident—a kind of 9/11 for climate change—might be sufficient to change those attitudes; perhaps it is necessary as well.²³¹ 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.

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,²³² though it is disputed in its strongest forms.²³³ My modest suggestion here is that for global environmental problems, above all climate change, no 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 of 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 percent 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).²³⁴

²²⁹ See the summary and overview in *The New York Times*, April 23, 2006, at 14.

²³⁰ <http://www.pollingreport.com/enviro.htm>

²³¹ For more detailed discussion, see Sunstein, *supra* note.

²³² See Goldsmith and Posner, *note supra*.

²³³ See Oona Hathaway and Ariel Lavinbuck, *Rationalism and Revisionism in International Law*, 119 *Harv L Rev.* 1404 (2006).

²³⁴ On side payments in general, see Barrett, *supra* note, at 335-353.

As we shall soon see, China will be the world’s largest contributor to greenhouse gases by 2025, and it would be surprising if China showed a willingness to make significant cuts without the participation of the United States.²³⁵ The only possibility is if China, in the future, finds 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, because domestic self-interest might so require. 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 see 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 great deal. The most promising 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 also have little to lose. If so, they would have a weak incentive to do anything about the problem.

Here is a relevant estimate of anticipated losses²³⁶:

Damages of a 2.5 Degree Warming as a Percent 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 readily apparent that some nations are far more vulnerable than others. Strikingly, Russia stands to be a net gainer, with substantial benefits to agriculture. India

²³⁵ 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 Cameron and Donald Zillman eds. 2001).

²³⁶ Nordhaus and Boyer, *supra* note, at 91.

is particularly vulnerable; nations in Africa also stand to lose a great deal. A central reason is that India is expected to have devastating losses in terms of both health and agriculture; for Africa, the major problem involves health, with a massive anticipated increase in climate-related diseases.²³⁷ In light of these figures, we might therefore expect that Russia would not be especially enthusiastic about controls of greenhouse gas emissions—except, perhaps, is an emissions trading system ensured that Russia would gain a great deal of money from those controls (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.²³⁸ We might therefore expect that the United States and China would be unlikely to be particularly interested in reducing greenhouse gas emissions, at least on these figures; and as we have seen, their behavior is consistent with that prediction. To be sure, these numbers are speculative. They depend on anticipated warming of 2.5 C; perhaps that number is understated. 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 – and that the largest future contributor, China, ranks even lower.

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 in a recent year (limited to carbon dioxide, the leading greenhouse gas):

*Carbon Dioxide Contributors as of 2000*²³⁹

Countries	
United States	20.6
China	14.7
European Union—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

²³⁷ Id.

²³⁸ Id.

²³⁹ Keith Baumert et al., *Navigating the Numbers 12* (2005).

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 emissions growth in China and India, and emissions reductions in Russia and Germany.

*Carbon Dioxide Emissions Changes, 1990–2002*²⁴⁰

Countries	
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 contribute no less than 84% of total emissions, with 35% coming from developed nations. At that time, the United States is expected to be well below China. Consider the figures for anticipated growth:

*Projected Growth in Carbon Dioxide Emissions by 2025*²⁴¹

India	73–225
Mexico	68–215
China	50–181
Brazil	84–165
South Korea	43–117
European Union	–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:

²⁴⁰ Kevin Baumert et al., *Navigating the Numbers* 15 (2005).

²⁴¹ *Id.* at 18.

Relative Contributions of Annual Carbon Dioxide Emissions by Country/Region (Approximate % of Worldwide Emissions)

	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%

Source: EIA, International Energy Outlook 2006, Table A10,
http://www.eia.doe.gov/oiaf/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; they also stand to lose relatively little from climate change. In terms of their own domestic self-interest, the argument for stringent controls is not easy to support. 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. Actually the analysis has an additional 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. The overall stock might matter, not the current flow. Here is the relevant data:

Cumulative CO2 Emissions, 1850–2002²⁴²

Countries	
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
India	2.2

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 irrelevant.

²⁴² Id. at 32.

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 is imposing 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 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.²⁴³ 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.²⁴⁴

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.

The moral issues raise many problems, and they must be seriously engaged as part of both domestic discussions and international negotiations.²⁴⁵ 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.²⁴⁶ (It may not be irrelevant, and it is certainly worth noticing, that the health risks of ozone depletion were faced mostly by light-skinned people, most vulnerable to skin cancer, whereas the most serious risks of climate change are faced by a group that prominently includes dark-skinned people, above all in Africa.) But the evidence catalogued here raises doubts about the claim that by themselves, moral obligations will provide enough motivation in the face of a palpably unfavorable cost-benefit analysis.

But 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*

²⁴³ See Dale Jamieson, *Adaptation, Mitigation, and Justice*, in *Perspective on Climate Change: Science, Economics, Politics, Ethics* 217 (Walter Sinnott-Armstrong and Richard Howarth eds. 2005); Julia Driver, *Ideal Decision Making and Green Virtues*, in *id.* at 249.

²⁴⁴ See Nordhaus and Boyer, *supra* note.

²⁴⁵ See Driver, *supra* note.

²⁴⁶ See note *supra*.

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 polar cases, and actually fairly easy ones.

E. Possible Worlds

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, in which the 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 less favorable picture. The overwhelming votes in the Senate are at least suggestive on this count. Recall the nearly unanimous call for a strong response to the ozone problem, contrasting with a unanimous call for steps that would effectively prevent United States participation in the Kyoto Protocol; recall too the unanimous Senate ratification of the Montreal Protocol under President Reagan, contrasting with the absence of any support, within the Senate, for the Kyoto Protocol under President Clinton.

But for both agreements, the overall assessment would have been far more difficult if the relevant numbers were closer—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.²⁴⁷ 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 showing unfavorable trends.

1. *Benefits.* Recall that the Kyoto Protocol was projected to decrease global mean temperatures by a mere 0.03 C. This difference is less trivial than it sounds, because it is projected to produce tens of billions in monetized benefits,²⁴⁸ but it is nonetheless a relative drop in the bucket. Developing countries are projected to account for over half of

²⁴⁷ 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 discussion, see Barrett, *supra* note; David Victor, *The Collapse of the Kyoto Protocol and the Struggle to Slow Global Warming* (2001).

²⁴⁸ See Nordhaus and Boyer, *supra* note.

total global emissions by 2020 and possibly before.²⁴⁹ We have seen that a broader agreement, including China and India in particular, would significantly increase the benefits of greenhouse gas reduction and hence would make domestic controls far more attractive to both the United States and the world.²⁵⁰ 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.²⁵¹ 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 by the table above, that different nations have added dramatically different amounts to the current situation.

A different step would involve the response to existing flows. Perhaps a “polluters pay” principle could be made a part of an international agreement, so that nations would pay an amount to reflect their continuing contributions.²⁵² 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.

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.²⁵³ For climate change, such a system would decrease the need for expensive regulation, by allowing American companies to “buy” American

²⁴⁹ See Sheila M. Olmstead and Robert N. Stavins, *An International Policy Architecture for the Post-Kyoto Era*, 96 *Am. Econ. Rev.* 35, 35-36 (Papers and Proceedings) (2006).

²⁵⁰ See Nordhaus and Boyer, *supra* note, at 123-44; Barrett, *supra* note, at 379.

²⁵¹ See the excellent brief discussion in Jagdish Bhagwati, *Global Warming Fund Could Succeed Where Kyoto Failed*, *Financial Times* (Aug. 16, 2006).

²⁵² See *id.*

²⁵³ See A. Denny Ellerman et al., *Markets for Clean Air* (1999).

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.²⁵⁴ The likelihood that China would participate in an international agreement would certainly increase with an emissions trading system. Perhaps China and India, and other poor nations, could be subsidized with especially high allocations of trading rights, so as to come to terms with their relatively low past contributions, their general poverty, and their 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.²⁵⁵ 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.²⁵⁶ A better approach would include carbon taxes or emissions reduction requirements that grow over time as technology advances.²⁵⁷ 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.²⁵⁸ No one is proposing the complete elimination of greenhouse gases; increasing restrictions over time would make a great deal of sense.²⁵⁹

3. Manageability and enforcement. There is an additional point, much 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; current climate negotiations involve nearly 200 nations.²⁶⁰ The large number of parties makes an agreement far less manageable, and reasonably makes some nations fearful that others will not comply.²⁶¹ 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 difficult issues of monitoring, key nations might well be tempted to defect—or not to join in the first instance.²⁶²

This is not the place to outline the ingredients of an international agreement to respond to the risks associated with climate change.²⁶³ The steps I have outlined would have to be accompanied by clear steps to promote monitoring and enforcement of any

²⁵⁴ See Nordhaus and Boyer, *supra* note, at 159.

²⁵⁵ See *id.*

²⁵⁶ See *id.*

²⁵⁷ *Id.*

²⁵⁸ See Cass R. Sunstein, *Risk and Reason* (2002).

²⁵⁹ A counterargument is presented in Posner, *supra* note, on the ground that a sudden regulatory “shock” might be necessary and desirable as a way of spurring innovation.

²⁶⁰ See Benedick, *Morals and Myths*, *supra* note.

²⁶¹ See Goldsmith and Posner, *supra* note, at 217.

²⁶² See Barrett, *supra* note, for detailed discussion.

²⁶³ See note *supra* for valuable discussion.

limits.²⁶⁴ 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.²⁶⁵

Conclusion

At first glance, the problems of ozone depletion and climate change seem exceedingly similar, and 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 desirable 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 has largely 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

²⁶⁴ See Barrett, *supra* note; Victor, *supra* note.

²⁶⁵ See *Avoiding Dangerous Climate Change*, *supra* note, for a number of alarming projections.

be raised about any particular account. 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, appear 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. The United States, and some other countries, appear to have had no adequate reason, from the standpoint of self-interest, to comply with the requirements of the Kyoto Protocol even if such compliance would help to ensure that *every* other country did the same. For this reason, the payoff structure 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 participate in the Kyoto Protocol, in large part because the domestic cost-benefit analysis was so unfavorable for them. For the future, a special problems lies in the distinctive incentives of the United States (the world's leading emitter of greenhouse gases) and China (soon to overtake the United States, which will still be far ahead on a per capita basis). Both nations would have to pay the lion's share of the cost of an agreement to limit emissions. At the same time, both nations appear to have disproportionately little to fear from climate change. Unless China and the United States can be convinced that the domestic cost-benefit is more favorable than it now appears, or that the requirements of morality call for significant emissions reductions, the prospects for their participation are limited.

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. But on the basis of tales of the Montreal and Kyoto Protocols, it is best to assume that domestic self-interest will continue to be an important motivating force. It follows that for the future, the task is 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.