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NEWS & ANALYSIS

Of Montreal and Kyoto: A Tale of Two Protocols

by Cass R. Sunstein

Editors' Summary: Prof. Cass Sunstein compares the relative ease with which the United States adopted the Montreal Protocol against its rejection of the Kyoto Protocol to conclude that the perceived costs versus perceived benefits of climate change action will have to significantly improve before the United States adopts an international climate change treaty. Daniel Magraw suggests that the comparison between the problems of ozone depletion and climate change downplays the significant differences between the two problems and criticizes the use of cost-benefit analysis as a reliable analytical method. In addition, he writes that actual governmental decisions about climate may be motivated by considerations beyond relative costs and benefits. Peter Orszag and Terry Dinan, on the other hand, note that Professor Sunstein's recommendations to increase the benefits of an international climate change treaty would be unlikely to motivate the United States to enter into such an agreement because his approaches would serve to increase domestic costs while doing little to change perceptions of domestic benefits, that the difficulties in implementing a global system to address climate change are understated, and that an insurance perspective against catastrophic consequences of climate change may be more likely to spur U.S. action.

I. Introduction

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.¹ 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 are anticipated to be quite vulnerable in the future.

Notwithstanding these similarities, there is one obvious difference between the two problems. An international agree-

ment, 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).² 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 1994.³ By 2050, the ozone layer is expected to return to its natural level.⁴ 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 Montreal Protocol, but to American companies as well, which stood in the forefront of technical innovation leading to substitutes for ozone-depleting chemicals.⁵

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 it.⁶ The Kyoto Protocol has now been ratified by 180 nations,⁷ but numerous nations are not likely to comply with their ob-

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1. See ANDREW DESSLER & EDWARD PARSON, THE SCIENCE AND POLITICS OF GLOBAL CLIMATE CHANGE 10-11 (2006).

2. Montreal Protocol on Substances That Deplete the Ozone Layer, Sept. 16, 1987, 1522 U.N.T.S. 3 [hereinafter Montreal Protocol].

3. SCOTT BARRETT, ENVIRONMENT AND STATECRAFT 239 (2005).

4. *Id.*

5. See EDWARD PARSON, PROTECTING THE OZONE LAYER 252-53 (2003).

6. DESSLER & PARSON, *supra* note 1, at 129.

7. United Nations Framework Convention on Climate Change (UNFCCC), *Kyoto Protocol*, http://unfccc.int/kyoto_protocol/items/2830.php (last visited May 22, 2008).

ligations under the Kyoto Protocol.⁸ Some of the ratifying nations, including China, have no obligations under the Kyoto Protocol at all, despite their significant emissions of greenhouse gases (GHGs). 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 GHG emissions, and have insisted that the costs of regulation are likely to be prohibitive.⁹

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. 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 reservations, with special emphasis on the possibility that the agreement would deliver low benefits for the world and impose significant costs—with particularly high costs and low benefits expected for the United States. Part IV explores the lessons and implications of the two tales.

II. Ozone and the Montreal Protocol

The idea that chlorofluorocarbons (CFCs) posed a threat to the ozone layer was initially suggested in an academic paper in 1974, written by Sherwood Rowland and Mario Molina.¹⁰ According to Rowland and Molina, CFCs—chemicals with widespread commercial and military uses producing billions of dollars in revenues¹¹—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.¹² 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.¹³ Hence the finding by Rowland and Molina indicated that significant health risks might well be created by emissions of CFCs.

In the immediately following years, depletion of the ozone layer received widespread attention in the United States, which was the world's leading contributor to the problem, accounting for nearly 50% of global CFC use.¹⁴ The intense media coverage of 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 one-half, thus dramatically affecting the market.¹⁵

By the time the international community met in Montreal on September 8, 1987, to finalize a new protocol for international regulation of CFCs, the United States had adopted an aggressive posture with respect to international CFC controls. In contrast, the European Community, led above all by France, Italy, and the United Kingdom, urged caution and a strategy of “wait and learn.”¹⁶ Concerned about the economic position of Imperial Chemical Industries, the United Kingdom rejected an aggressive approach.¹⁷

The American position was based in part on increasingly alarming scientific data that suggested immediate action would be desirable.¹⁸ The position of industry within the United States began to shift in 1986, apparently as a result of significant progress in producing safe substitutes for CFCs.¹⁹ Most importantly, an ongoing disagreement within the Reagan Administration between the Office of Management and Budget, skeptical of aggressive controls, and the U.S. Environmental Protection Agency (EPA), favorably disposed to such controls, was resolved after a careful cost-benefit analysis from the President's Council of Economic Advisers suggested that the costs of controls would be far lower than anticipated, and the benefits far higher.²⁰ This conclusion was generally in line with the EPA's own analysis of the problem, which yielded the following data²¹:

Figure 1: Costs and Benefits of Montreal Protocol to the United States (in billions of 1985 dollars)

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

8. See UNFCCC, KEY GHG DATA: GREENHOUSE GAS EMISSIONS DATA FOR 1990-2003 SUBMITTED TO THE UNFCCC 16-17 (2005), available at http://unfccc.int/files/essential_background/background_publications_htmlpdf/application/pdf/key_ghg.pdf.

9. See George Pring, *The U.S. Perspective*, in *KYOTO: FROM PRINCIPLES TO PRACTICE* 185, 195-97 (Peter Cameron & Donald Zillman eds., 2001).

10. Mario J. Molina & F.S. Rowland, *Stratospheric Sink for Chlorofluoromethanes: Chlorine Atom-Catalysed Destruction of Ozone*, 249 NATURE 810 (1974).

11. PARSON, *supra* note 5, at 21-22.

12. Molina & Rowland, *supra* note 10.

13. PARSON, *supra* note 5, at 68.

14. See RICHARD E. BENEDICK, *OZONE DIPLOMACY: NEW DIRECTIONS IN SAFEGUARDING THE PLANET* 26 (enlarged ed. 1998).

15. *Id.* at 27-28, 31.

16. *Id.* at 68.

17. See James H. Maxwell & Sanford L. Weiner, *Green Consciousness or Dollar Diplomacy? The British Response to the Threat of Ozone Depletion*, 5 INT'L ENVTL. AFF. 19, 27 (1993).

18. BENEDICK, *supra* note 14, at 43.

19. See PARSON, *supra* note 5, at 126.

20. For detailed descriptions of the interagency conflicts and the role of cost-benefit analysis, see BENEDICK, *supra* note 14, at 62-65; PARSON, *supra* note 5, at 135-36.

21. BARRETT, *supra* note 3, at 228; see also OFFICE OF AIR & RADIATION, U.S. EPA, *REGULATORY IMPACT ANALYSIS: PROTECTION OF STRATOSPHERIC OZONE* 5, ES-2 (1988).

These figures were generated by a projection of over five million skin cancer deaths by 2165, together with over 25 million cataract cases by that year—figures that would be cut to 200,000 and two million, respectively, by a 50% CFC reduction.²² Of course it is possible to question these numbers; the science does not allow uncontroversial point estimates here, and perhaps EPA had an interest in showing that the agreement was desirable. What matters, however, is the perception of domestic costs and benefits, and in the late 1980s, no systematic analysis suggested that the Montreal Protocol was not in the interest of the United States. It should be clear that on these numbers, even unilateral action was well-justified for the United States, because the health benefits of American action would create substantial gains for the American public. But if the world joined the Montreal Protocol, the benefits for the United States would be nearly tripled, because it would prevent 245 million cancers by 2165, including more than five million cancer deaths.²³ 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.²⁴

The key part of the resulting Montreal 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 1992.²⁵ The most important factor behind this aggressive step “was the promotion by an activist faction of U.S. officials of an extreme negotiating position and its maintenance through several months of increasingly intense domestic and international opposition.”²⁶ 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.²⁷

A knotty question during the negotiations involved the treatment of developing countries. While CFC consumption was low in those countries, their domestic requirements were increasing,²⁸ 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, which were responsible for the problem in the first place. Under Article 5 of the Montreal Protocol, developing countries are authorized to meet “basic domestic needs” by increasing to a specified level for 10 years, after which they are subject to a 50% reduction for the next 10 years.²⁹ In addition, a funding mechanism was created by which substantial resources—initially \$240 mil-

lion—were transferred to poor countries.³⁰ These provisions have been criticized as unduly vague, essentially a way of deferring key questions.³¹ But they provided an initial framework that has since worked out exceedingly well.

III. Climate Change and the Kyoto Protocol

Concern about GHGs 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, both the most important agent behind the Montreal Protocol and among the chief obstacles to an international agreement to govern GHGs.³² For their part, European nations were significant obstacles to international regulation of ozone-depleting chemicals, favoring an approach of “wait and learn”; on climate change, they have been favorably disposed toward regulatory controls, with the United Kingdom in the forefront.³³ 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 (EU) as more committed to environmental goals. Nor is it adequate to portray the American position on GHGs 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.³⁴

The American position on the Kyoto Protocol was heavily influenced by the unanimously adopted 1997 Senate Resolution 98, which asked President William J. Clinton not to agree to limits on GHG emissions if the agreement would injure the economic interests of the United States or if it would not “mandate new specific scheduled commitments to limit or reduce greenhouse gas emissions for Developing Country Parties within the same compliance period” as for the United States.³⁵ Because such commitments from developing countries were highly unlikely—indeed, no commitments “within the same compliance period” had been made even for the Montreal Protocol³⁶—this vote was essentially a suggestion that the United States should accept no commitments at all. The Clinton Administration took an equivocal approach to this resolution and indeed to the Kyoto Protocol negotiations in general. In the complex negotiations in December 1997, the United States did support regulatory limits, although relatively modest ones, arguing against reductions in emissions levels and instead for stabilizing current levels.³⁷ 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 10-year delay; and a base year of 1995 rather than 1990, making quantitative limits less stringent.³⁸

22. See Stephen J. DeCanio, *Economic Analysis, Environmental Policy, and Intergenerational Justice in the Reagan Administration: The Case of the Montreal Protocol*, 3 INT'L ENVTL. AGREEMENTS: POL'Y, L. & ECON. 299, 302-11 (2003) (providing more information on how these harms were turned into monetary equivalents and discussing the choice of a low discount rate).

23. BARRETT, *supra* note 3, at 228.

24. *Id.* at 228, tbl. 8.1.

25. PARSON, *supra* note 5, at 228.

26. *Id.* at 143.

27. See James Hammitt, *Stratospheric-Ozone Depletion*, in ECONOMIC ANALYSES AT EPA 131, 155-56 (Richard Morgenstern ed., 1997).

28. BENEDICK, *supra* note 14, at 93.

29. Montreal Protocol, *supra* note 2, art. 5, ¶ 1.

30. ROBERT V. PERCIVAL ET AL., ENVIRONMENTAL REGULATION: LAW, SCIENCE, AND POLICY 1054 (5th ed. 2006); see also Rene Bowser, *History of the Montreal Protocol's Ozone Fund*, 14 INT'L ENVTL. L. REP. 636 (1991).

31. PARSON, *supra* note 5, at 146.

32. See generally Pring, *supra* note 9.

33. See Tony Blair, *Foreword*, in AVOIDING DANGEROUS CLIMATE CHANGE (Hans Joachim Schellnhuber et al. eds., 2006).

34. See Pring, *supra* note 9, at 201-05.

35. S. Res. 98, 105th Cong. (1997).

36. See *supra* text accompanying notes 29-30.

37. Pring, *supra* note 9, at 198.

38. *Id.*

Many of the key American positions were rejected during the negotiations. Ultimately, most of the major developed nations, including the United States, agreed to the Kyoto Protocol, which sets forth firm quantitative limits on GHG emissions. Specified reductions were listed for, and limited to, the “Annex 1” nations—those bound by the Kyoto Protocol.³⁹ The list was designed to ensure that taken as a whole, the nations would show a reduction of 5% over 1990 levels—a reduction that must be met in the period between 2008 and 2012.⁴⁰ For example, the United States was required to reduce emissions by 7%; Japan by 6%; the EU by 8%. Some nations were permitted to have increased emissions; these included Australia, Iceland, and Norway.⁴¹ 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.⁴² Contrary to a widespread perception, it is simply not true that most of the world’s nations were willing to sacrifice greatly in order to deal with climate change, while the United States ultimately refused to do so. The point is most obviously true for developing nations, none of whom are controlled by the Kyoto Protocol. Indeed, many of the nations that accepted specified reductions actually promised to do little or nothing beyond what had already been done as a result of economic developments. The largest loser, in terms of the actual costs of mandatory cuts, was the United States.

Under intense international pressure, the United States signed the Kyoto Protocol on September 12, 1998.⁴³ But it is an understatement to say that the signing was not well-received in Congress, which added a proviso to the 1999 EPA Appropriations Act banning the Agency from using appropriations “to propose or issue rules, regulations, decrees or orders for the purpose of implementation, or in preparation for implementation” of the Kyoto Protocol.⁴⁴ At this point, Vice President Albert Gore himself indicated that the Kyoto Protocol would not be submitted for ratification without meaningful participation by developing nations.⁴⁵ 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.”⁴⁶

For the United States, the perceived value of the Kyoto Protocol presented a very different picture from the Montreal Protocol. According to prominent projections, the most serious damage from climate change is not likely to be felt in the United States, even if the United States is at significant risk.⁴⁷ On some estimates, American agriculture will actually be a net winner as a result of climate change.⁴⁸ On other estimates, Americans will be net losers, but not nearly to the same extent as other nations.⁴⁹ In this light, we can offer a projection of the costs and benefits of the Kyoto Protocol for the United States alone. This projection is not designed to offer anything like an unimpeachable point estimate, but instead to describe what prominent analysts projected when the United States was making its key decisions⁵⁰:

Figure 2: Costs and Benefits of Kyoto Protocol for the United States (in billions of 1990 dollars)

	No Controls	Kyoto Protocol	Unilateral Action to Comply With Kyoto Protocol
Benefits	—	12	0 ⁵¹
Costs	—	325	325
Net Benefits	—	-313	-325

39. Kyoto Protocol to the United Nations Framework Convention on Climate Change art. 3, Dec. 10, 1997, 37 I.L.M. 22 (1998), available at http://unfccc.int/essential_background/kyoto_protocol/items/1678.php [hereinafter Kyoto Protocol].

40. *Id.* art. 3, ¶ 1.

41. *Id.* Annex B.

42. See Richard E. Benedick, *Morals and Myths: A Commentary on Global Climate Policy*, WZB-MITTEILUNGEN, Sept. 2005, at 15 [hereinafter Benedick, *Morals and Myths*].

43. Pring, *supra* note 9, at 206.

44. *Id.*

45. *Id.* at 206-07.

46. Benedick, *Morals and Myths*, *supra* note 42, at 16.

47. For illuminating discussions on the disputable nature of any calculation of the costs and benefits of climate change, see WILLIAM NORDHAUS & JOSEPH BOYER, *WARMING THE WORLD: ECONOMIC MODELS OF GLOBAL WARMING* (2000); William Cline, *Climate Change*, in *GLOBAL CRISES, GLOBAL SOLUTIONS* 13 (Bjorn Lomborg ed., 2004); Frank Ackerman & Ian J. Finlayson, *The Economics of Inaction on Climate Change: A Sensitivity Analysis* (Global Dev. & Env’t Inst., Working Paper No. 06-07, 2006), available at <http://ase.tufts.edu/gdae/Pubs/wp/06-07EconomicsInaction.pdf>.

48. See OLIVIER DESCHENES & MICHAEL GREENSTONE, *THE ECONOMIC IMPACTS OF CLIMATE CHANGE: EVIDENCE FROM AGRICULTURAL OUTPUT AND RANDOM FLUCTUATIONS OF WEATHER* (2006), available at <http://www.aei-brookings.org/admin/authorpdfs/page.php?id=1237>. Cf. NORDHAUS & BOYER, *supra* note 47, at 97 (suggesting that “the economic impact of gradual climate change, *i.e.* omitting catastrophic outcomes, is close to zero for moderate (2.5 °C) global warming.”). Note that this conclusion does not come to terms with the economic effects on the United States that would come from the very fact of serious economic harms in other nations.

49. See NORDHAUS & BOYER, *supra* note 47, at 96-97; NICHOLAS STERN, *THE ECONOMICS OF CLIMATE CHANGE: THE STERN REVIEW* 130 (2007) (noting possible effects ranging from a loss of 1.2% gross domestic product (GDP) to a gain of 1% GDP from 3 °C warming and emphasizing that this assessment does not take full account of the effects of extreme weather events such as hurricanes).

50. See NORDHAUS & BOYER, *supra* note 47, at 157-67.

51. 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.

It should be immediately clear that if these numbers are correct, the Kyoto Protocol is not a good bargain for the United States. It is difficult to doubt the proposition that the Kyoto Protocol would be worthwhile if it would eliminate the total cost of climate change. But according to a prominent estimate by William Nordhaus and Joseph Boyer, the agreement would actually have a meager effect, reducing anticipated warming by a mere 0.03 degrees Celsius (°C) by 2100.⁵² The reason for this low estimate is that climate change is a function of aggregate emissions of GHGs, and the Kyoto Protocol would have only a small effect on those aggregate emissions. And whether or not this particular estimate is right, there is no question that the Kyoto Protocol would have only a small effect in reducing anticipated warming.

There are three points here. First, emissions from China, India, and other developing countries—whose substantial contributions to climate change are expected to grow much larger in the near future—are not regulated by the agreement at all. Second, past emissions of GHGs 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.

For the world as a whole, the picture is better, but not particularly good, and not nearly as good as that for the Montreal Protocol⁵³:

Figure 3: Costs and Benefits of Kyoto Protocol for the World (in billions of 1990 dollars)

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

These numbers are rough estimates, and they depend on contentious assumptions about the degree of emissions trading, about technological innovation, about discount rates, about the likelihood of abrupt or catastrophic warming, and about the valuation of life and health. With a lower discount rate, and modest changes in underlying assumptions, the benefits of GHG reductions can grow dramatically.⁵⁴ Reasonable people might expect the costs to be significantly lower or offer a significantly higher estimate of the benefits.⁵⁵ There is an even more important point. 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.

IV. Lessons and Implications

What follows from an understanding of the extraordinary success of the Montreal Protocol and far more mixed picture of the Kyoto Protocol? With respect to the United States, the lesson of the Montreal Protocol can be captured in a single sentence: *Where the domestic assessment strongly favors unilateral action, and where the same assessment suggests that a nation is likely to gain a great deal from an international agreement, that nation will favor such an agreement—unless, perhaps, well-organized private groups are able to persuade it not to do so.* For the Kyoto Protocol, the lesson is equally simple: *Where the domestic assessment suggests that unilateral action makes little sense, and where the same assessment suggests that a nation will lose a great deal from an international agreement, that nation is unlikely to favor such an agreement—unless, perhaps, the public is willing to demand that it do so.*

In light of these simple lessons, both the Montreal Protocol and the Kyoto Protocol present polar cases, and actually fairly easy ones. A still more general lesson is that many international agreements for global environmental problems will be ineffective without the participation of the United States. It is true that the United States accounts for only about one-fifth of global GHG emissions—a stunning per capita figure, but one that is not high enough to derail international action if other nations are willing to go forward without the United States. If the world were able to make significant cuts in what is 80% of total emissions, it could do a great deal about climate change. The problem is that if the United States stands to one side, it is almost certain that coordinated, aggressive action will be impossible. At Kyoto, China and India showed an unwillingness to commit to cuts even when the United States suggested that it would participate. Those nations, and other developing countries, will likely be reluctant to confer benefits on industrialized nations, including the United States, unless there is a degree of reciprocity, and perhaps significant side payments as well (as in the Montreal Protocol).⁵⁶

China is now the world's largest contributor of GHGs, and it would be surprising if China showed a willingness to make significant cuts without the participation of the United States.⁵⁷ 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 for its own domestic self-interest. But the picture here is complicated. Let us now see why.

52. NORDHAUS & BOYER, *supra* note 47, at 152.

53. These figures were calculated on the basis of NORDHAUS & BOYER, *supra* note 47, at 145-64.

54. See Ackerman & Finlayson, *supra* note 47.

55. Cline, *supra* note 47, at 31 (suggesting that the Kyoto Protocol would deliver worldwide benefits in excess of costs, but that it accomplishes relatively little in reducing warming).

56. On side payments in general, see BARRETT, *supra* note 3, at 335-54.

57. Press Release, Netherlands Environmental Assessment Agency, China Now No. 1 in CO₂ Emissions; USA in Second Position (June 19, 2007), available at <http://www.mnp.nl/en/service/pressreleases/2007/20070619Chinanowno1inCO2emissionsUSAinsecondposition.html>.

A. Contributors and Victims

To understand the prospects for some kind of parallel to the Montreal Protocol, it is necessary to determine who has the most to lose, and who has the most to gain from reductions in GHGs. Here as elsewhere, any particular figures must be taken as mere estimates and inevitably controversial estimates at that. But in order to begin discussion, one must first examine a prominent estimate of anticipated losses⁵⁸:

Figure 4: Damages Resulting From a 2.5 °C Warming as a Percentage of GDP

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

Although these figures are very speculative, they assume a 2.5 °C warming; with a higher number, the damages would undoubtedly be greater. And even on the specified assumption, higher damages are possible. But whether or not these particular numbers are right, it is readily apparent that some nations are far more vulnerable than others.⁵⁹ Strikingly, Russia stands to be a net gainer, with substantial benefits to agriculture. India is particularly vulnerable as it is expected to have devastating losses in terms of both health and agriculture. Nations in Africa also stand to lose a great deal; there the major problem involves health, with a massive anticipated increase in climate-related diseases.⁶⁰

In light of these figures, we might therefore expect that Russia would not be especially enthusiastic about controls of GHG emissions, except, perhaps, if an emissions trading system ensured that Russia would gain a great deal of money from those controls (as the Kyoto system in fact does). Compared to many other nations, 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.⁶¹ We might there-

fore expect that China and the United States would be unlikely to be particularly interested in massive reductions in GHG emissions, at least on these figures; and as we have seen, their behavior is consistent with that prediction.

As I have said, these numbers are highly speculative. The world's economy is also interdependent, and if many nations suffer serious adverse effects, China and the United States will be affected. But the central point is clear. The historically largest contributor, the United States, ranks toward the bottom in terms of anticipated losses. The largest present and 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 understand why, consider that in 2000 the United States contributed 20.6% of global GHG emissions, compared to 14.7% from China and 14.0% from the EU (excluding Romania and Bulgaria, who had not yet joined).⁶² The existing data suggests that the largest contributors are likely to continue to qualify as such, but that there will be significant shifts among contributors—above all with emissions growth in China and India and emissions reductions in Germany and Russia.⁶³ Based on trends shown from 1990 to 2002, we can project changes by 2025.⁶⁴ At that time, the developing world is expected to show an 84% increase in total emissions, accounting for 55% of the world's total.⁶⁵ The United States is expected to be well below China, which, as noted, has already become the world's leading emitter.

We can now see a real obstacle to an international agreement to control GHGs. China and the United States are the largest emitters, and according to prominent projections, they also stand to lose relatively less from climate change. In terms of their own domestic self-interest, these projections weaken the argument for stringent controls. The nations of Africa stand to lose a great deal, but they are trivial GHG emitters.⁶⁶ India is even more vulnerable, and its contribution, while not exactly trivial, is modest.⁶⁷

The analysis has an additional complexity. Some nations, above all China and India, might reasonably object that their own contribution is smaller than these figures suggest. In assessing relative contributions, we might be interested in cumulative emissions rather than annual emissions.⁶⁸ The overall stock might matter, not the current flow. Data for the period from 1850 to 2002 show that the EU (again excluding Bulgaria and Romania) and the United States are collectively responsible for 55.8% of cumulative world GHG emissions (29.3% and 26.5%, respectively), compared to a

62. KEVIN BAUMERT ET AL., WORLD RESOURCES INST., NAVIGATING THE NUMBERS: GREENHOUSE GAS DATA AND INTERNATIONAL CLIMATE POLICY 12, fig. 2.1 (2005).

63. *Id.*

64. *Id.* at 15.

65. *Id.* at 17-18.

66. See ENERGY INFO. ADMIN., U.S. DEP'T OF ENERGY, INTERNATIONAL ENERGY OUTLOOK 2006, at 93, tbl. A10 (2006) (DOE/EIA-0484), available at [http://www.eia.doe.gov/oiaf/archive/ieo06/pdf/0484\(2006\).pdf](http://www.eia.doe.gov/oiaf/archive/ieo06/pdf/0484(2006).pdf).

67. *Id.*

68. See Jiahua Pan, *Common But Differentiated Commitments: A Practical Approach to Engaging Large Developing Emitters Under L20*, at 3 (Sept. 20-21, 2004) (commissioned briefing notes for the Center for International Governance Innovation/Center for Global Studies L20 Project) (referring to cumulative emissions but emphasizing the time period, 1990-2000, when consequences were widely known).

58. NORDHAUS & BOYER, *supra* note 47, at 91, tbl. 4.10 (noting that positive numbers represent damages, while negative numbers represent benefits).

59. Cline, *supra* note 47, at 18-19; Ackerman & Finlayson, *supra* note 47 (offering a picture of more serious monetized damage from climate change). Note, however, that Nordhaus and Boyer find that China and the United States are about equally vulnerable to catastrophic climate change, with an expected GDP loss of 22.1% for both nations. NORDHAUS & BOYER, *supra* note 47, at 90. A comprehensive treatment can be found in STERN, *supra* note 49, at 104-06, 128-29.

60. NORDHAUS & BOYER, *supra* note 47, at 91.

61. *Id.*; STERN, *supra* note 49, at 104, 106.

7.8% contribution from China.⁶⁹ Even as the world's leading emitter, China might well insist that it should not bear the same economic burden as a nation that is responsible for a much larger percentage of cumulative emissions. Undoubtedly the purely domestic calculus of costs and benefits will play a significant role in any nation's decisions, but fairness judgments, attending to cumulative contributions, are unlikely to be entirely irrelevant.⁷⁰

These are descriptive points, and none of them should be taken to suggest that the domestic cost-benefit analysis ought to be decisive in principle. In fact, it should not be. If one nation imposes significant harms on citizens of another, it should not continue to do so even if, or because, a purely domestic analysis suggests that emissions reductions are not justified from the point of view of the nation that is imposing those harms. As I have suggested, the problems of ozone depletion and climate change stem disproportionately from the actions of wealthy nations, above all the United States—actions from which citizens of wealthy nations, above all the United States, have disproportionately benefitted. 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.

There is an additional problem. The citizens of Africa and India, the most vulnerable regions, are also disproportionately poor. The citizens of China, standing to lose a great deal from significant restrictions on GHGs, are also relatively poor, and economic growth is contributing to significant reductions in their poverty. It is certainly plausible to think that the issue of relative wealth and poverty should play a role in distributing the costs of emissions reductions.⁷¹ These moral issues raise many questions, and they must be seriously engaged as part of both domestic discussions and international negotiations.⁷² The Montreal Protocol holds out some hope here; judgments about moral responsibility, and capacity to pay, played a serious role in various provisions.

B. Future Prospects

For both the Montreal Protocol and the Kyoto Protocol, the overall assessment would have been far more difficult if the relevant numbers had been perceived as 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 na-

tional 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.⁷³ 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 and Structures

Developing countries are projected to account for over one-half of total global emissions by 2020 at the latest.⁷⁴ We have seen that a broader agreement, including China and India in particular, would significantly increase the benefits of GHG reduction and hence would make domestic controls far more attractive to both the United States and the world.⁷⁵ The trick is to make such an agreement sufficiently attractive to developing nations to make it possible for them to participate. If such nations participate, the overall benefits of the agreement, to the United States and the world, would significantly increase. The initial step, then, is to ensure their participation.

A useful step would involve a clear distinction between stocks, or cumulative atmospheric concentrations, and flows, or annual emissions.⁷⁶ 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. China and India need not contribute much to such a fund; Europe and the United States would be required to contribute a great deal. A step of this kind would be a sensible response to the fact that different nations have historically added dramatically different amounts to the current situation.

A separate step would involve the response to existing flows. Perhaps a polluter-pays principle could be made a part of an international agreement, so that nations would pay an amount to reflect their continuing contributions.⁷⁷ In short, GHG 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 GHG taxes.

Alternatively, an understanding of past contributions and current emissions rates might be built into an international cap-and-trade system or 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 contri-

69. BAUMERT ET AL., *supra* note 62, at 32, fig. 6.1.

70. See generally Pan, *supra* note 68.

71. See *id.* at 4 ("Countries with higher levels of national income . . . would be expected to carry a higher burden of mitigation.").

72. See Julia Driver, *Ideal Decision Making and Green Virtues*, in *PERSPECTIVES ON CLIMATE CHANGE: SCIENCE, ECONOMICS, POLITICS, ETHICS* 249 (Walker Sinnott-Armstrong & Richard B. Howarth eds., 2005); STERN, *supra* note 49, at 23-53; J. TIMMONS ROBERTS & BRADLEY C. PARKS, *A CLIMATE OF INJUSTICE* (2007).

73. I have touched only lightly on complex enforcement problems. It may be that the Montreal Protocol is not a good model in this regard. For a discussion, see BARRETT, *supra* note 3, at 391-98; DAVID VICTOR, *THE COLLAPSE OF THE KYOTO PROTOCOL AND THE STRUGGLE TO SLOW GLOBAL WARMING* 109-16 (2001).

74. See Robert N. Stavins & Sheila M. Olmstead, *An International Policy Architecture for the Post-Kyoto Era*, *AM. ECON. REV. PAPERS & PROC.*, May 2006, at 35, 35-36.

75. See NORDHAUS & BOYER, *supra* note 47, at 123-44; BARRETT, *supra* note 3, at 379.

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

77. See BAUMERT ET AL., *supra* note 62, at 32, fig. 6.1.

butors make significant cuts, perhaps their transfers need not be so large. If they continue to be high contributors, their transfers might be very high. If the goal is to ensure significant benefits, steps of this sort would be the place to start.

It is also more than possible that the overall benefits of GHG reductions are greater, domestically and for the world, than suggested by the most prominent analyses from several years ago.⁷⁸ If the perceived damage from climate change increases, and if steps can be taken to reduce that damage, then the likelihood of a firm domestic response will of course increase. Attention to the risk of catastrophic harm would certainly alter the calculation of likely benefits.

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 ardent trading system.⁷⁹ For climate change, such a system would decrease the need for expensive regulation, by allowing American companies to buy American emissions credits from GHG 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.⁸⁰ 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 high allocations of trading rights, so as to come to terms with their relatively low past contributions, their general poverty, and their overall needs.

We have seen that the reductions targets in the Kyoto Protocol were arbitrary from the standpoint of sensible policy. A better approach would include carbon taxes or emissions reduction requirements that grow over time as technology advances.⁸¹ For ozone-depleting chemicals, as for lead, the United States followed a phase-down policy that allowed time for the development and marketing of adequate substitutes.⁸² No one is proposing the complete elimination of GHGs. But increasing restrictions over time would make a great deal of sense.⁸³

3. The Puzzle of California in 2006

In terms of achieving cost reductions, there is also an argument for experiments in technology-forcing, which is designed to promote innovation and to test whether the ex-

pense of emissions reductions have been inflated. In 2006, California enacted a statute that would, by 2020, stabilize the state's emissions at 1990 levels—a step that would call for a 25% reduction from 2020 emissions under a “business as usual” approach.⁸⁴ This enactment raises many questions. As a first approximation, the enactment will, by itself, contribute nothing to reductions in climate change by 2050, 2100, or any other date. At the same time, a 25% reduction in GHGs would undoubtedly impose significant costs on the citizens of California. Hence there is a positive question: why did California vote for a program that would appear to produce no benefits while imposing real costs? There is also a normative objection, which is that California should not, in fact, impose real costs on its own citizens without also delivering benefits to those citizens, or at least to the world.

A plausible answer to both questions is that California's action might spur additional reductions, both domestically and internationally, while also leading to technological changes that drive down the costs of emissions reductions. Of course California is taking a gamble. But it might well be expected that if low-cost substitutes do not emerge, the mandates in the statute will be relaxed. Hence it remains to be seen whether those mandates are as firm as they appear to be.

The California legislation thus provides a valuable challenge to my account here. In a sense, California is in the same position as was the United States with respect to the Kyoto Protocol—exploring an option that would apparently produce small benefits at a significant cost. However, it must be emphasized that California was willing to select that option. The particular electoral dynamics of California undoubtedly played a key role. Of course the national context is different, in part because the political dynamics are quite different, at least at the present time. But perhaps those dynamics will change—at least if the California experiment proves to be successful.

V. Conclusion

Notwithstanding the similarities between the problems of ozone depletion and climate change, the Montreal Protocol has proved a stunning success, and the Kyoto Protocol has largely failed. The American posture, and hence the fate of the two Protocols, was largely determined by perceived benefits and costs. For those who are concerned about the risks of climate change, it is worth pointing out 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 benefitted from activities that inflict significant harms on other nations, those citizens are properly asked to help—through reducing their own emissions, through paying other nations to reduce theirs, and through payments to ease adaptation. In addition, political pressure, including moral convictions, can play a role.

But on the basis of tales of the Montreal Protocol and the Kyoto Protocols, it is best to assume that domestic self-interest will continue to be an important motivating force. The position of the United States will not shift unless the perceived domestic benefits of emissions reductions increase

78. See STERN, *supra* note 49, at i-xviii; Cline, *supra* note 47, at 18; Ackerman & Finlayson, *supra* note 47.

79. See A. DENNY ELLERMAN ET AL., *MARKETS FOR CLEAN AIR* (2000).

80. NORDHAUS & BOYER, *supra* note 47, at 159.

81. See *id.*

82. See CASS R. SUNSTEIN, *RISK AND REASON* (2002).

83. A counterargument is presented in RICHARD POSNER, *CATASTROPHE* (2004), on the ground that a sudden regulatory “shock” might be necessary and desirable as a way of spurring innovation.

84. See Felicity Barringer, *California Taking Big Gamble, Tries to Curb Greenhouse Gases*, N.Y. TIMES, Sept. 15, 2006, at A1.

or the perceived domestic costs drop, perhaps as a result of technological innovation. 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.