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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 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).[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 revenues[11]—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 data[21]:

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 million—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 Protocol[36]—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 decisions[50]:

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 Protocol[53]:

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 CO^2 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 losses[58]:

Figure 4: Damages Resulting From a 2.5 ºC 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 therefore 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

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.

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.

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).

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 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.[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 expense 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.

RESPONSE

The Worst of Times, or "It Wouldn't Be Cool"

by Daniel Barstow Magraw

Of Montreal and Kyoto: A Tale of Two Protocols (*Tale*)[1] includes several thought-provoking propositions and conclusions. I will discuss four: (1) winners and losers in climate change; (2) differences between the two Protocols; (3) the use of cost-benefit analysis; and (4) what motivates the United States (and other countries) regarding the Kyoto Protocol and other international issues.

I. Winners and Losers

Tale makes the important and somewhat discomforting assertion that there are winners and losers in climate change.[2] I learned this is an unpopular idea while helping organize a conference on that topic in Malta in 1990[3]; parts of the U.S. government were not pleased that the conference focused on that topic. The idea is important because it reveals an equity aspect of climate change, demonstrates the need to assist developing countries (which tend to be losers),[4] and suggests why some countries (perhaps including the United States) may be unwilling to make the effort that protecting humankind and our planet apparently requires. It may be misleading, however, because it masks the fact that some of the possible effects of climate change, e.g., a major shift in ocean currents, are so cataclysmic that they would seriously harm all countries, overcoming any meaningful distinction between winners and losers.

II. Differences Between Ozone Depletion and Climate Change

Tale accurately identifies several similarities and differences between the problems leading to the Montreal Protocol and the Kyoto Protocol.[5] One important difference is that climate change involves a much greater disparity between short-term winners and losers than depletion of the stratospheric ozone layer does, thus making international cooperation less likely regarding the former. Through its repeated emphasis on the comparison between the two Protocols, however, *Tale* downplays several critical distinctions between the problems of climate change and ozone depletion.

Tale virtually ignores the vastly greater uncertainty with respect to the phenomenon and effects of climate change. Although there was considerable scientific uncertainty at the time the Montreal Protocol was negotiated—as evidenced by the then-recent discovery of the Antarctic ozone hole and the perceived need for the Montreal Protocol's non-consensus adjustment mechanism[6]—that uncertainty pales in comparison to the multiple manifold uncertainties regarding the risks associated with climate change. Space does not allow a full catalogue here, but climate change uncertainties have included: the degree to which average global temperature will increase[7]; the role of various substances in causing climate change (e.g., of so-called precursors[8] and of particular greenhouse gases (GHGs) such as hydrochlorofluorocarbons $(HCFC)_{22}$)[9]; the carbon storage potential of various sinks (e.g., the oceans); the extent and even net effect of various feedback loops (e.g., water vapor and clouds, which are created by global warming and which also trap heat in the atmosphere but also reflect energy back into space); the likelihood of reaching tipping points leading to cataclysmic events (e.g., cessation of the Gulf Stream); and effects on a local scale (as distinguished from the global scale). Significant uncertainty also exists about mitigation and adaptation measures, for example, regarding the rates of economic growth and of technological change regarding energy production, eco-efficiency, and carbon sequestration.

These uncertainties, many of which persist, are heightened by the dynamic nature of climate change and they led to the formation of the Intergovernmental Panel on Climate Change (IPCC).[10] They also provide reasons or excuses for delay by those inclined to move slowly or not at all, complicate policymaking for those who do want to address the problem, and are a significant reason why cost-benefit analysis cannot meaningfully be applied to climate change and to related activities such as ratifying the Kyoto Protocol (as is discussed further below).

Tale also underestimates the importance of the realities that a much broader set of activities leads to climate change and a much larger range and depth of mitigation and adaptation measures are necessary to deal with it. These realities

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1. Cass R. Sunstein, *Of Montreal and Kyoto: A Tale of Two Protocols*, 38 ELR (Envtl. L. & Pol'y Ann. Rev.) 10566 (Aug. 2008) (a longer version of this article was originally published at 155 U. Pa. L. Rev. 1605 (2007)).
2. *Id.*
3. *See* United Nations Environment Program (UNEP) & Nat'l Center for Atmospheric Research, Report of the Workshop on Assessing Winners and Losers in the Context of Global Warming (1990).
4. Intergovernmental Panel on Climate Change (IPCC), Climate Change 2007: Synthesis Report §3.3.1 (Rajendra K. Pachauri eds., 2007) [hereinafter IPCC Synthesis].
5. Montreal Protocol on Substances That Deplete the Ozone Layer, Sept. 16, 1987, 1522 U.N.T.S. 3 [hereinafter Montreal Protocol]; Kyoto Protocol to the United Nations Framework Convention on Climate Change, Dec. 10, 1997, 37 I.L.M. 22 (1998) [hereinafter Kyoto Protocol].
6. Montreal Protocol, *supra* note 5, art. 2, ¶ 9.
7. For example, the IPCC predicts a global temperature increase of 1.8 to 4.0 degrees Celsius (°C) by the end of this century. IPCC Synthesis, *supra* note 4, §3.2.
8. *Id.* §3.1.
9. *See, e.g.*, Guss J.M. Velders et al., *The Importance of the Montreal Protocol in Protecting Climate*, 104 Proc. Nat'l Acad. Sci. 4814 (2007); Keith Bradsher, *Push to Fix Ozone Layer and Slow Global Warming*, N.Y. Times, Mar. 15, 2007, at C3.
10. The IPCC was formed in 1988 by the World Meteorological Organization and the UNEP. It has three working groups (science, impacts and adaptation, and mitigation). It issued its fourth set of reports in 2007.

can paralyze policymakers and, in any event, make domestic and international policymaking much more difficult than it was with respect to ozone depletion.

III. Cost-Benefit Analysis

The logic and conclusions of *Tale* are based in large part on assumptions about the existence, veracity, and effect of cost-benefit analyses as they relate to the ratification of the Kyoto Protocol (and other measures designed to combat climate change). *Tale* provides specific cost-benefit analyses for the United States and the globe, and concludes that the United States has not ratified the Kyoto Protocol because a cost-benefit analysis by prominent analysts indicated that the United States had more to lose than to gain from ratification.[11] *Tale* makes a similar claim regarding China.[12] *Tale* includes disclaimers, such that it does "not mean to suggest that all relevant officials . . . based their decision on a formal cost-benefit calculation of any kind," and it refers to an "intuitive" sense that the United States had more to lose than to gain, and that the cost-benefit analysis cannot offer an "unimpeachable point estimate"[13]; but *Tale*'s analysis depends to a remarkable degree on the usefulness and credibility of cost-benefit analyses.

Unfortunately for that approach, cost-benefit analysis figures regarding ratifying the Kyoto Protocol specifically and climate change generally are subject to serious challenge. Substantial literature exists detailing difficulties of cost-benefit analysis, particularly with respect to health, safety, and the environment. It is not surprising, therefore, to find that the well-known difficulties of cost-benefit analysis are present with respect to climate change generally and the Kyoto Protocol specifically; and there are other characteristics of the science, ethics, and politics of climate change and the Kyoto Protocol that make cost-benefit analysis even less appropriate and reliable in these contexts. The following discussion summarizes several of these difficulties.

A. Massive Uncertainty, Including Regarding Tipping Points and Cataclysmic Outcomes

Cost-benefit analysis depends on accurate predictions regarding probable effects of action and inaction. As described above, however, climate change is characterized by massive uncertainties of many types. The presence of these uncertainties means that cost-benefit analysis estimates are extraordinarily speculative.

One particular type of uncertainty is potential tipping points and non-marginal, cataclysmic and irreversible outcomes, such as a shift or cessation of the Gulf Stream. Neither their likelihood nor probable effects can be accurately predicted, and they further exacerbate the speculative nature of cost-benefit analyses regarding climate change.

B. Impossibility of Valuing and Monetizing Relevant Interests, Including Ethical Considerations

Cost-benefit analysis depends on numerical and monetized figures for its comparisons, and yet these comparisons are fundamentally flawed in areas like climate change because many relevant considerations cannot be meaningfully monetized. For example, climate change will have widespread effects on nature's ability to provide the ecosystem services that are the real infrastructure of society.[14] Many of these effects cannot be meaningfully monetized. Climate change will have other profound impacts, not only on economic activity, but also on environments, societies, human health, cultures, religious practices, social justice, and political fortunes (some of which can be considered as aspects of ecosystem services) around the world. These impacts cannot be meaningfully factored into cost-benefit analysis, yet no responsible decisionmaker will ignore them.

Related to the preceding point is the fact that cost-benefit analysis excludes ethical considerations. Climate change, however, is rife with equitable issues, both intergenerational and intragenerational. Countries differ markedly in terms of their contribution to climate change, both historically and currently (whether measured by absolute emissions, per capita emissions, or emissions per unit of gross domestic product), their ability to mitigate or adapt to climate change, and the extent to which they will be harmed or benefitted by climate change. Even disregarding the moral imperative of considering factors such as these, they can have important political implications for dealing with climate change and thus cannot be treated as irrelevant.

C. Externalities

Climate change is an externality relating to the emission of GHGs and precursors; but cost-benefit analysis cannot take account of externalities, because it primarily relies on market prices. Indeed, there is something surreal in relying on such prices when trying to assess the largest market failure in history. The use of a "global cost-benefit analysis" does not cure this deficiency.

D. Long-Term Discount Rates

Critical to the issue of intergenerational equity is the use of discount rates in cost-benefit analysis to determine the present value of future costs and benefits. The usual difficulty of selecting such a rate is greatly exacerbated in the case of climate change because of the dynamic and possibly non-marginal aspects of climate change. The very long time frames involved in measuring the future harms associated with climate change present a particular difficulty, for example calculating the benefits of mitigation efforts. This difficulty may not apply to specific short-term activities relating to climate change, but it certainly applies to the Kyoto Protocol, which is part of a long-term process.[15]

11. Sunstein, *supra* note 1, at 10569.

12. *Id*.

13. Cass R. Sunstein, *Of Montreal and Kyoto: A Tale of Two Protocols*, 31 Harv. Envtl. L. Rev. 1, 35, 33 (2007). These quotations were in large part removed from the condensed version of Prof. Cass Sunstein's article published in this issue, although the general ideas remain.

14. *See* Millennium Ecosystem Assessment, Ecosystems, and Human Well-Being: Synthesis 40 (2005).

15. Nicholas Stern, The Economics of Climate Change: The Stern Review 23, 44-48, 52 (2007).

E. Human Rights

Climate change arguably implicates human rights because it affects individual's property, culture, livelihood, and standard of living, and even can result in loss of life.[16] Cost-benefit analysis cannot account for a country's obligation to protect human rights; and it cannot trump the obligation to protect human rights.

F. Multi-Step Process and Demonstration Effect

The Kyoto Protocol was correctly viewed as just one stage in a multi-step process involving serial international instruments. Attempting cost-benefit analysis with respect to the Kyoto Protocol thus must take into account the likely characteristics and outcomes of the future steps, which adds yet another set of uncertainties to those identified above.

A peculiar aspect of the Kyoto Protocol, not present with the Montreal Protocol, is that developing countries refused to accept any binding reduction targets until the industrialized countries demonstrated that they would, in fact, reduce their emissions.[17] This attitude owes its strength to the facts that GHG emissions from industrialized countries (including particularly the United States) caused the current climate change crisis, and that those GHG emissions were important in achieving the high standards of living in industrialized countries, thus leading to a virtually unanimous sense of inequity on the part of developing countries. Accounting for this "demonstration effect" in a cost-benefit analysis of the Kyoto Protocol, raises yet another challenge, not only to the cost-benefit analysis itself, but also to assertions that the Kyoto Protocol can or should be analyzed in isolation without reference to its effect in leading to future climate change commitments by developing countries in new international instruments.

Taken together, the preceding difficulties demonstrate that cost-benefit analyses of the Kyoto Protocol are so speculative and incomplete as to be meaningless.[18] The Stern Commission was only slightly more forgiving, concluding that: "Standard externality and cost-benefit approaches have their usefulness for analyzing climate change, but, as they are methods focused on evaluating marginal changes, and generally abstract from dynamics and risk, they can only be starting points for further work."[19] Cost-benefit analysis thus should not be used as a basis for deciding what action to take on the Kyoto Protocol or any other major action with respect to climate change.[20]

IV. "It Wouldn't Be Cool" and Other Factors That Contributed to Kyoto's Failures

Based on my own experience as a government official during much of the relevant time period (March 1992-December 2001), I believe it is also the case that, as an empirical matter, a commonly accepted cost-benefit analysis (or a set of cost-benefit analyses) did not play a strong role in setting U.S. policy toward the Kyoto Protocol or toward climate change generally. This is partly the case because of the nature of governmental decisionmaking.

Within any U.S. administration, important positions are typically reached as a result of an intense interagency process. Agencies' positions typically depend on their mandate, values, and legal constraints. The U.S. Environmental Protection Agency (EPA), the U.S. Department of State and the U.S. Department of Energy, to mention just three agencies that participated in the climate change debate, differ markedly in these respects and certainly do not approach cost-benefit analysis in the same way. For example, the Clean Air Act[21] prohibits EPA from making decisions on the basis of cost-benefit analysis. Similarly, negotiations between Congress and the current Administration on climate change reflect differing perspectives, roles, and interests. Even the U.S. Senate and the U.S. House of Representatives (both would need to pass implementing legislation if the United States were to ratify the Kyoto Protocol) approach climate change issues through different lenses.

In addition, it was the worst of times in the United States for taking strong action on climate change generally and for ratifying the Kyoto Protocol specifically. This was the case not because of a commonly accepted cost-benefit analysis, but for several other reasons:

- Implementation of the Kyoto Protocol would undoubtedly demand nonvoluntary measures, which would in turn require serious domestic regulatory activity. The 1997-2006 Congresses, however, were fiercely anti-regulatory, as is the current Administration.
- Climate change is viewed as an "environmental" problem,[22] but this Administration has not viewed protecting the environment as a priority, and indeed has taken many steps to reduce environmental protections.[23]
- Climate change requires a coordinated multilateral effort, but this current Administration has been opposed to multilateral approaches in many arenas, including the environment.[24]
- The Kyoto Protocol constitutes binding international law, but this Administration has been hostile toward international law and institutions in many

16. *See* United Nations Human Rights Council Draft Resolution on Human Rights and Climate Change, U.N. Doc. A/HRC/7/L.21/Rev.1 (Mar. 26, 2008); The Malé Declaration on the Human Dimension of Climate Change (Nov. 14, 2007), *available at* http://www.ciel.org/Publications/Male_Declaration_Nov07.pdf; Martin Wagner & Donald M. Goldberg, An Inuit Petition to the Inter-American Commission on Human Rights for Dangerous Impacts of Climate Change (Dec. 15, 2004) (paper presented at the 10th Conference of the Parties to the Framework Convention on Climate Change in Buenos Aires, Arg.), *available at* http://www.ciel.org/Publications/COP10_Handout_EJCIEL.pdf.
17. Sunstein, *supra* note 1, at 10570.
18. Douglas A. Kysar, *Climate Change, Cultural Transformation, and Comprehensive Rationality*, 31 B.C. Envtl. Aff. L. Rev. 555, 562-90 (2004).
19. Stern, *supra* note 15, at 23.
20. By this, I do not mean to suggest that policymakers should not carefully attempt to determine the economic, social, and environmental implications of such actions; the question is what role cost-benefit analysis should play.
21. 42 U.S.C. §§7401-7671q, ELR Stat. CAA §§101-618.
22. Sunstein, *supra* note 1, at 10566 (referring to climate change in the same way).
23. *See, e.g.*, Natural Resources Defense Council, Inc., *NRDC: The Bush Record*, http://www.nrdc.org/bushrecord/default.asp (last visited June 3, 2008).
24. *See* Winston P. Nagan & Craig Hammer, *The New Bush National Security Doctrine and the Rule of Law*, 22 Berkeley J. Int'l L. 375, 401 (2004) (discussing the Bush Administration's general adherence to unilateralism).

instances, preferring instead voluntary activities, e.g., regarding mercury pollution.[25]

- Climate change has significant implications for fossil fuels, but this Administration has strong ties to the oil industry, and powerful members of Congress are strong supporters of the use of coal.
- Ratifying the Kyoto Protocol requires concurrence of two-thirds of the U.S. senators present,[26] but the Senate has been notoriously unwilling to consent to ratifying environmental treaties from the mid-1990s to the present time, e.g., the Senate has not approved ratification of the United Nations Convention on the Law of the Sea despite the support of the security establishment, industry, the environmental community, and both Presidents William J. Clinton and George W. Bush.[27]
- Finally, implementing the Kyoto Protocol would require important legislative action, but the U.S. political climate has been bitterly partisan almost continuously since 1997, making passage of that magnitude of legislation extremely unlikely.

It is not exactly clear what motivated U.S. policy toward the Kyoto Protocol, of course. At a White House ceremony in 2001 to sign the Stockholm Convention on Persistent Organic Pollutants, one of my staff asked President Bush why he was not willing to sign the Kyoto Protocol. The president responded: "It wouldn't be cool."[28] That response is consistent with the idea that the Kyoto Protocol would not be effective, but it also would be consistent with a more gut-level rejection of the Kyoto Protocol based on other reasons.

Tale concludes with an observation that in order to achieve successful participation by the United States and other countries, the international community must devise a regime that gives those countries reasons to believe that they will gain more from participating than they will lose.[29] This observation has some merit if two things pertain. First, the evaluation will not solely turn on cost-benefit analysis: politicians are too savvy for that and governments are too complicated for that. Second, "gain" must be understood as meaning more than economic gain: myriad considerations enter into politicians' and countries' evaluations of what is in their interest.

Indeed, there is even ground for hope that *Tale*'s concluding thought is too cynical. Just as a business may engage in enlightened self-interest and undertake activities that do not actually increase net profit or the value of shares in any measurable way, so politicians and countries are sometimes motivated by grand factors. They are, of course, sometimes motivated by petty factors too.

It is one of the lessons of environmentalism that the biosphere, including human society as a whole, is interdependent. Without question, globalization reinforces that interdependence—environmentally, economically, culturally, and politically. It is possible that the threat to human civilization posed by climate change will cause countries to understand that their own interests and survival are inextricably tied with those of other countries—just as World War II caused countries to view the aggressive use of force from a global humanitarian perspective rather than from their narrow self-interest—and thus that concern for the common good will strongly influence decisions regarding climate change.

25. *See* Press Release, Michael Bender, Executive Dir., Mercury Policy Project, U.S. Plans to Thwart Global Mercury Treaty Talks, Document Shows (Jan. 27, 2003), *available at* http://www.mercurypolicy.org/new/documents/BanHgRelease012703.pdf (discussing U.S. efforts to block a binding international treaty on mercury).

26. U.S. Const. art. II, §2, cl. 2.

27. Contrary to Sunstein, *supra* note 1, at 10568, the Senate has not expressed its opposition to or rejected the Kyoto Protocol, nor has the Senate even had the opportunity to consider it since it was not sent to the Senate by either President Clinton or Bush.

28. I have heard accounts of this exchange from three people who were present. The accounts of the precise wording of President Bush's response differ, but each includes the idea that becoming a Party to the Kyoto Protocol would not be "cool."

29. Sunstein, *supra* note 1, at 10574.

RESPONSE

Comment on *Of Montreal and Kyoto: A Tale of Two Protocols*

by Peter R. Orszag and Terry M. Dinan

In *Of Montreal and Kyoto: A Tale of Two Protocols*,[1] Prof. Cass Sunstein compares the political economy dynamics leading up to the signing and ratification of the Montreal Protocol (governing substances that deplete the ozone layer) and the Kyoto Protocol (governing substances that contribute to global warming). He observes that the United States was a strong and early supporter of the control of ozone-depleting substances but has generally opposed binding controls on greenhouse gases (GHGs). In contrast, Britain was significantly more reluctant to agree to limits on ozone-depleting substances but has actively supported restrictions on GHGs. Professor Sunstein attributes that contrast to differences in the two nations' perceptions of domestic benefits and costs from environmental action, and he concludes that the key to obtaining a global agreement on GHGs will involve raising perceived benefits within the United States from such an agreement while reducing its perceived domestic costs. He suggests that motivating developing countries to agree to emission limits and achieving such reductions through an incentive-based global approach—such as a global tax on carbon dioxide (CO_2) emissions or a global cap-and-trade program—are the most promising approaches to altering U.S. perceptions of domestic benefits and costs.

It is undoubtedly correct that perceptions of domestic benefits and costs are important determinants of countries' willingness to enter into international agreements (including those about limits on global pollutants).[2] As we discuss in Section I below, however, if one accepts Professor Sunstein's perspective and measures of the domestic benefits of GHG emissions reductions, his proposed approaches would be unlikely to motivate the United States to enter into such agreements. Specifically, those approaches would actually serve to increase costs to the United States while doing little to increase its perception of domestic benefits (based on the benefits measures that Professor Sunstein uses). While incentive-based approaches are likely to be important components of a cost-effective approach to reducing GHG emissions, we point out in Section II that Professor Sunstein does not give sufficient attention to the serious implementation challenges that would be associated with a global cap-and-trade program. Finally, we suggest in Section III that the measures of domestic benefits that Professor Sunstein presents do not adequately incorporate a primary motivation for agreeing to GHG restrictions: reducing the possibility that the buildup of those gases could lead to extremely large, potentially even catastrophic, damage that could not easily be allocated among countries.[3]

I. Distribution of Costs and Benefits in a Global Emissions-Reductions Scheme

Any effort to make meaningful reductions in global emissions of GHGs would have to involve the world's five major emitters: (1) the United States; (2) China; (3) the European Union (EU); (4) Russia; and (5) India (see Table 1). As Professor Sunstein points out, available estimates of the damage that China and the United States would incur (inadequately accounting for the uncertain possibility of catastrophic outcomes, as discussed below) as a result of a 2.5 degrees Celsius (°C) increase in average global temperature may provide an insufficient incentive for either the United States or China to agree to incur significant costs to reduce emissions.[4] Further, China may be less willing to shoulder even more modest costs given its low per capita income. Among those five top emitters, India is predicted to benefit the most from reduced warming, but like China, it has far fewer economic resources to devote to the problem than either the United States or the EU. Among the key players, the countries in the EU stand out as likely to benefit significantly from reduced warming (again, in expected value terms and without accounting for very uncertain but potentially very large damage), having sufficient per capita income so that reasonable levels of emission reductions would not pose undue hardship, and having contributed significantly to the stock of emissions in the past.

Professor Sunstein observes that changing the dynamics of international negotiation would require a method of increasing perceived benefits and reducing perceived costs for some of the major emitters. He suggests that a global tax or cap-and-trade program might help achieve such an outcome. We agree that a global incentive-based approach would lower the aggregate cost of reducing emissions and could lead to greater total reductions. It would be much less likely, however, to alter the *distribution* of potential benefits (as indicated by the distribution of expected damage pre-

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1. Cass R. Sunstein, *Of Montreal and Kyoto: A Tale of Two Protocols*, 38 ELR (Envtl. L. & Pol'y Ann. Rev.) 10566 (Aug. 2008) (a longer version of this article was originally published at 31 Harv. Envtl. L. Rev. 1 (2007)).

2. This observation holds regardless of which level of government adopts the policy intervention. For a discussion of how the distribution of costs and benefits among states affects the likelihood of reaching an agreement on the control of tropospheric ozone, see Terry Dinan & Natalie Tawil, *Solving Environmental Problems With Regional Decision-Making: A Case Study of Ground-Level Ozone*, 56 Nat'l Tax J. 123 (2003). We also note that many analyses that consider emissions restrictions from a global perspective suggest that well-designed policy actions to slow climate change would produce larger benefits than costs.

3. While Professor Sunstein has written extensively about the role that concern about catastrophic outcomes plays in shaping climate policy, the expected value measures of damage that he presents here do not adequately represent those outcomes. *See* Cass R. Sunstein, Worst-Case Scenarios (2007) [hereinafter Sunstein, Worst-Case Scenarios].

4. In reality, the increase in the average global temperature resulting from unchecked emissions may be much larger than 2.5 °C. Further, preventing an increase of 2.5 °C may not be feasible given the emissions that have already occurred. However, the pattern of relative damage across countries is likely to provide insight into the pattern of relative benefits for policies that restrict emissions.

sented in Table 1), which is independent of where and how emission reductions occur.[5]

Professor Sunstein also suggests that major emitters with sufficient means could increase the benefits that China would receive from restricting emissions by paying it to undertake reductions, and that such payments could be built into a global cap-and-trade program through the allocation of allowances (that is, rights to emit).[6] If China were given enough allowances to cover its anticipated growth in emissions, any reductions in its emissions relative to that baseline would free up allowances that it could sell at a profit. However, giving China enough allowances to provide it with unrestricted growth potential would mean that other major emitters, such as the United States, would need to receive far fewer allowances than their business-as-usual baseline. The result would, therefore, essentially transfer income from the United States to China—improving the benefit-to-cost ratio for China but worsening it for the United States.

II. Implementation Challenges of a Global Cap-and-Trade Program

Linking the cap-and-trade programs of various countries could help minimize the overall cost of reducing emissions but could also create significant concerns. Competitive forces would equalize the price of allowances among countries, a desirable outcome in that it is a necessary condition for global cost-minimization. However, countries would have to give up sovereignty over the price of allowances traded in their programs as well as control over the standards governing emissions reductions. Lax monitoring or enforcement by any one country would lessen the incentive to cut emissions in other participating countries and could undermine the integrity of the whole system. Including developing countries in a cap-and-trade program could increase the likelihood of that outcome since such nations may lack the institutional structures necessary for successful monitoring and enforcement.[7]

A harmonized tax—implemented in different countries at an agreed-upon rate—could avoid one of the potential problems of a linked cap-and-trade program: lax monitoring and enforcement in one country would not undermine the integrity of the tax system in other countries.[8] If such a tax were agreed to by developed countries, some of the revenue proceeds could be used to fund emission reductions in developing countries in ways that would depend less on the ability of the country to monitor and enforce an incentive-based policy.[9] For example, China could agree to require new electricity-generating facilities to meet certain efficiency standards, which would be funded by proceeds from the tax on CO_2 emissions in developed countries.

A similar outcome could be achieved through a system of harmonized domestic cap-and-trade programs. In that case, countries could agree to adopt equivalent domestic cap-and-trade programs (with similar expected allowance prices), sell a share of the allowances, and use some of the auction proceeds to fund emission reductions in developing countries.[10]

Either the harmonized tax and transfer—or the harmonized cap-and-trade and transfer—policy described above could reduce the problem of system integrity associated with a global cap-and-trade program, but neither would create a more favorable benefit-to-cost ratio for the United States, based on the distribution of expected damage (and, thus, potential benefits) presented in Table 1. Those measures do not, however, reflect the fundamental uncertainties associated with climate change and, as a result, may not adequately capture a primary motivation for limiting GHG emissions.

III. The Uncertain Possibility of Catastrophic Consequences

Estimating the damage that might result from unrestrained growth in emissions of GHGs is complicated by several factors. Once emitted, GHGs can linger for a very long time in the atmosphere (for example, each ton of CO_2 generates a rise in the average global temperature that peaks about 40 years after the CO_2 is emitted and then dissipates slowly, with a half-life of about 60 years), and the damage that they create could be irreversible.[11] Further, analysts face profound uncertainties about baseline emissions, the physical processes leading to changes in the average global temperature, the resulting changes in regional climates, and ecological and human responses to changes in regional climates.[12] Potential outcomes from unrestricted emissions include a much larger temperature increase than the 2.5 °C value on which the Table 1 damage estimates are based; a weakening of the Gulf Stream, resulting in a much colder climate in Europe; rapidly rising sea levels, with resulting land losses; and far more rapid warming than anticipated (making adaptation much more difficult) as a result of strong positive feedback effects, such as the release of large quantities of

5. A global incentive-based approach could affect the distribution of benefits only if it led to much larger emission reductions than would have occurred under non-linked programs. In that case, adopting a global approach could alter the types of damages that would be avoided and, as a result, the distribution of benefits.

6. Others have suggested a similar approach. *See*, *e.g.*, Robert Stavins, Brookings Institution, *A U.S. Cap-and-Trade System to Address Global Climate Change* (Hamilton Project Discussion Paper No. 2007-13, 2007), *available at* http://www.brookings.edu/~/media/Files/rc/papers/2007/10climate_stavins/10_climate_stavins.pdf.

7. See Table 1, for a cross-country comparison of governance indicators.

8. In addition, countries would have a greater incentive to enforce a harmonized tax than a global cap-and-trade program. For a discussion of this point, see William D. Nordhaus, *To Tax or Not to Tax: Alternative Approaches to Slowing Global Warming*, 1 Rev. Envtl. Econ. & Pol'y 26, 33 (2007).

9. *See* Joseph E. Aldy et al., *Climate Change: An Agenda for Global Collective Action* (paper prepared for the Pew Center on Global Climate Change Workshop on the Timing of Climate Change Policies, Oct. 11–12, 2001), *available at* http://www.sbgo.com/Papers/Aldy-Orszag-Stiglitz_5.pdf; Joseph E. Aldy et al., *Thirteen Plus One: A Comparison of Global Climate Change Policy Architectures* (Kennedy Sch. Gov't Working Paper Series, Paper No. RWP03-012; FEEM Working Paper No. 64.2003, 2003), *available at* http://ssrn.com/abstract=385000.

10. Assuring that emitters face similar incentives to reduce their emissions would be more difficult under a system of harmonized cap-and-trade programs than under a harmonized tax, however, because allowance prices would fluctuate with changes in underlying market conditions in individual countries.

11. *See* William A. Pizer, *Combining Price and Quantity Controls to Mitigate Global Climate Change*, 85 J. Pub. Econ. 416 (2002).

12. For an excellent discussion of how these factors, as well as uncertainty and irreversibility on the cost side, affect policymaking, see Robert S. Pindyck, *Uncertainty in Environmental Economics*, 1 Rev. Envtl. Econ. & Pol'y 45 (2007).

methane (a potent GHG) due to melting permafrost. Yet, scientists have been unable to determine what level of GHG buildup would trigger such outcomes, and the risk of them occurring is captured very imprecisely in the damage estimates presented in Table 1. Specifically, those highly uncertain but potentially extremely large losses are essentially translated into much smaller but certain losses.[13]

Critics of the damage estimates presented in Table 1 suggest that alternative ways of incorporating the profound uncertainties associated with climate change (methods that better reflect the variation in possible outcomes around expected outcomes) would result in far higher potential damage estimates.[14] In fact, some analysts suggest that reducing the risk of catastrophic outcomes is the primary motivation for restricting emissions.[15] Further, if damage in individual regions grew to very large levels, the spillover effects to other regions could be large, making the allocation of catastrophic damage across different countries more difficult.[16] If the uncertain possibility of extremely large losses was better accounted for and the potential for spillover effects was taken into account, the motivation for countries, such as the United States, to agree to emissions restrictions could be much greater than the damage estimates presented in Table 1.

Scientists will continue to work at improving their understanding of the conditions under which catastrophic outcomes might occur while analysts strive to develop better methods of incorporating uncertainty into analyses of the costs and benefits of restricting emissions. Meanwhile, policymakers must grapple with these uncertainties and understand the limitations of available damage estimates. Applying an insurance framework to policy decisions might be helpful—while imposing costs on the economy, restricting emissions could be viewed as a method of buying a reduction in the risk of triggering much larger losses than those presented in Table 1 (or of being in a position to reduce emissions more quickly should scientists judge that the concentration of emissions in the atmosphere was approaching a critical threshold that would trigger large losses). Adopting that insurance perspective could cause major emitters to revise their perceptions of domestic costs and benefits and provide a foundation for a global agreement.

Table 1. Factors Affecting Countries' Potential Willingness and Ability to Implement a Carbon Dioxide Tax or Cap-and-Trade Program

	Contributions to GHG Emissions[1] (Measured as a percentage of global emissions)			Governance Indicators[3] (Country's percentile rank)					
Country	Current (in 2000)	Future (projected for 2030)	Historic (1850 to 2002)	Damages From 2.5º C Warming (as a % of GDP)[1]	Per Capita GNI[2]	Government Effectiveness	Regulatory Quality	Rule of Law	Control of Corruption
United States	20.6	18.6	29.3	0.45	44,970	90th-100th	90th-100th	90th-100th	75th-90th
China	14.7	24.5	7.6	0.22	2,010	50th-75th	25th-50th	25th-50th	25th-50th
EU	14.0[4]	16.3[5]	26.5[4]	2.83[6]	34,149[7]	75th-80th[8]	75th-80th[8]	75th-80th[8]	75th-80th[8]
Russia	5.7	n.a.[9]	8.1	-0.65	5,780	25th-50th	0-25th	0-25th	0-25th
India	5.6	5.0	2.2	4.93	820	50th-75th	25th-50th	50th-75th	50th-75th

1. Measures used as reported in Sunstein, *supra* note 1. Additional data available in the original version, published at 31 Harv. Envtl. L. Rev. 1 (2007).
2. Gross national income (GNI) converted to U.S. dollars using the World Bank Atlas method. *See* World Bank, World Development Indicators 2007 (2007).
3. Daniel Kaufmann et al., *Governance Matters VI: Governance Indicators for 1996-2006* (World Bank Pol'y Research Working Paper No. 4280, 2007), *available at* http://ssrn.com/abstract=999979.
4. Includes countries in the EU with the exception of Bulgaria and Romania.
5. Includes all countries in Europe.
6. Includes all European countries in the Organization for Economic Co-operation and Development (OECD).
7. Includes all countries in the European Monetary Union.
8. Reflects average of European countries in the OECD.
9. Included in future emissions for all countries in Europe.

13. The potential for catastrophic losses of the type described above are represented as a single probability (derived from a survey of subjective probability estimates provided by experts) of a 25% loss in global income under a 2.5 °C increase in temperature. That aggregate loss was then distributed across countries on the basis of other damage estimates. *See* William D. Nordhaus & Joseph Boyer, Warming the World: Economic Models of Global Warming 87-88 (2000).

14. *See*, *e.g.*, Martin L. Weitzman, On Modeling and Interpreting the Economics of Catastrophic Climate Change (Feb. 8, 2008) (unpublished manuscript), *available at* http://www.economics.harvard.edu/faculty/weitzman/files/modeling.pdf.

15. Robert S. Pindyck, Uncertainty in Climate Change Economics, Presentation at the International Monetary Fund (Jan. 24, 2008) (slides on file with the *Environmental Law and Policy Annual Review*).

16. Professor Sunstein raises a related point, referred to as "social amplification of risk," in Sunstein, Worst-Case Scenarios, *supra* note 3, at 138.