

ENFORCING INTERNATIONAL LAW: IMPLICATIONS FOR AN EFFECTIVE GLOBAL WARMING REGIME

DAVID G. VICTOR*

SUMMARY

Collective management often requires formal commitments as well as mechanisms for enforcing compliance. Current efforts to slow global warming have focused on commitments and given scant attention to enforcement. They have followed the “standard model” when creating international environmental treaties: set commitments first, defer procedures for enforcement until later, and rely on “soft” (or nonexistent) measures for enforcing compliance. However, the evidence that supports use of the “standard model” is misleading and does not apply to global warming. In most international environmental agreements, it has been possible to defer or ignore enforcement procedures because nearly all commitments have been modest and enforcement has not been necessary. What little wisdom exists on the design of enforcement procedures is based heavily on the experience in the Montreal Protocol on Substances that Deplete the Ozone Layer. But a close look at that experience shows that deferring the creation of enforcement procedures—in particular, the Protocol’s “Non-Compliance Procedure”—until after most commitments were in place severely weakened the procedures, because countries that feared strong enforcement would consent only to a soft mechanism. The few countries that have brazenly violated the agreement (*e.g.*, Russia) are changing their behavior only in response to incentives—especially large compensation programs and threats of trade

* Robert W. Johnson, Jr., Senior Fellow in Science and Technology, Council on Foreign Relations, Washington, D.C. This article was presented at the Fourth Annual Cummings Colloquium on Environmental Law, Duke University, *Global Markets for Global Commons: Will Property Rights Protect the Planet?* (Apr. 30-May 1, 1999). The author thanks Robert Keohane and Jonathan Wiener for comments and Rebecca Weiner for editorial assistance. Please direct questions or comments to dvictor@cfr.org. This article is also available at <http://www.law.duke.edu/journals/10DELPFVVictor>.

sanctions—that are actually *external* to the Protocol's enforcement system. By itself the Protocol's hobbled enforcement process has been able to handle only relatively minor violations for which its small carrots and sticks are adequate.

The design of an effective global warming regime must focus on enforcement mechanisms as well as commitments. Failure to do so will only perpetuate the shallowness of international environmental law—commitments that appear bold but have little direct impact on a country's behavior except where changes in behavior are in the country's self-interest. This article reviews the record of compliance with and enforcement of international environmental agreements. It also examines the prospects for enforcement under major alternative types of commitments that might be included in a global warming regime. A system of tradable permits is most vulnerable to unraveling if cheating is rampant, but a trading system in which permit-holders are liable for noncompliance (“buyer liability”) is the easiest to enforce because the market would impose enforcement with price signals. Flaky permit sellers would command a lower price than trustworthy vendors. However, the concept of emission trading, which is included in the 1997 Kyoto Protocol on global warming, will be still-born because it requires the impossible task of distributing permits worth trillions of dollars. That leaves other alternatives, such as coordination of carbon taxes or other national policies, which are not easily enforced.

Policymakers are thus in a quandary. If they focus on setting prices or quantities of emissions, they must overcome a huge hurdle—enforcement—for which prior experience with international environmental law (*e.g.*, the Montreal Protocol) is an imperfect guide and conventional wisdom is worse than no guide at all. Mechanisms much more powerful than those offered by the “standard model” will be needed. Policymakers could focus commitments on “liberal states” in which internal public pressure, for example, from environmental groups, and robust legal systems make it possible to enforce international commitments from inside (ground-up) rather than the outside (top-down). But international cooperation on prices and quantities that is restricted to such nations is unlikely to slow global warming by much, because those states account for a declining fraction of the emissions that cause global warming.

One partial solution is based on the fact that the liberal nations, which are most likely to comply with demanding commitments, are also the major centers of technological innovation. Carbon-intensive

energy is the most important source of global warming. Over a period of five decades and beyond—the time-scale that is most relevant for global warming—technological change can eliminate emissions of greenhouse gases, probably at remarkably low cost because that time scale is longer than the turnover of capital stock. A regime that coordinates efforts to promote development and deployment of new energy technologies could focus on these liberal nations, and the resulting new technologies could spread worldwide from this innovative core through the normal operation of private markets. Some rules on quantities and prices would also be needed to promote diffusion, but they would be complements rather than central elements of international collective action on global warming and less needy of strong enforcement. Such a regime is not as elegant as coordinating world prices or quantities—which, in principle, would be economically most efficient—but it has an attribute that pure price and quantity approaches probably lack: *it could work*.

I. INTRODUCTION

Studies of cooperation typically find that enforcement is necessary when parties have an interest in defecting.¹ That presents a serious problem for international relations because truly solving many international problems would require demanding agreements that are prone to defection.² Yet the mechanisms for enforcing international agreements are typically weak.³ This article considers three topics in

1. See, e.g., Kenneth A. Oye, *Explaining Cooperation Under Anarchy: Hypotheses and Strategies, Theories and Method*, in COOPERATION UNDER ANARCHY 1, 24 (Kenneth A. Oye et al. eds., 1996).

2. Truly solving most international environmental problems would require substantial and costly interventions in the economy that would affect competitiveness of firms and give firms and governments an incentive to skirt their obligations. For example, stabilizing the atmospheric concentration of greenhouse gases, necessary to stop global warming, could cost trillions of dollars if required over the next several decades. There is little precedent revealing how international agreements work when the stakes are so high. However, the imperfect record of compliance with trade agreements suggests that high stakes lead to incentives to defect. See ROBERT E. HUDEC, *ENFORCING INTERNATIONAL TRADE LAW: THE EVOLUTION OF THE MODERN GATT LEGAL SYSTEM* 362 (1993). Furthermore, the long history of suspicions about noncompliance with arms control agreements illustrates the concern that governments have about noncompliance. For a review of the compliance literature, see J.H. Ausubel & D.G. Victor, *Verification of International Environmental Agreements*, 17 ANN. REV. ENERGY & ENV'T 1 (1992). For more theoretical treatments of the issues, which lead to the conclusion that incentives to defect are strong when stakes are high and reciprocal enforcement is not available (which is often true when managing public goods like environmental quality), see Oye, *supra* note 1, at 19-20; George W. Downs et al., *Is the Good News about Compliance Good News about Cooperation?*, 50 INT'L ORG. 379 (1996) [hereinafter Downs et al., *Good News?*].

international environmental politics that are related to that problem. First, if enforcement mechanisms are poor, why does the record of compliance with international environmental agreements show that compliance is high? Second, in the few cases where compliance has not been perfect, what has been learned about the effectiveness of mechanisms for enforcement? Third, what does the historical experience with international environmental agreements imply for the creation of an effective regime to limit the effects of global warming?

The discussion is based mainly on evidence developed in a large-scale research project at the International Institute for Applied Systems Analysis (IIASA)⁴ and a new project on global warming and technology at the Council on Foreign Relations (CFR).⁵

3. Only two of the major multilateral environmental agreements have functioning and active compliance mechanisms: the Convention on International Trade in Endangered Species of Wild Fauna and Flora, Mar. 3, 1973, art. VIII, 27 U.S.T. 1087, 1101-03, 993 U.N.T.S. 243, 250-51 (the "infractions reports" system) [hereinafter CITES]; and the Montreal Protocol on Substances that Deplete the Ozone Layer, Sept. 16, 1987, art. 8, 26 I.L.M. 1550, 1556 (entered into force Jan. 1, 1989) (the "Non-Compliance Procedure") [hereinafter Montreal Protocol]. For an overview of the field of international environmental law that comes to this conclusion, see the authoritative study prepared for the secretariat of the United Nations Commission on Environment and Development [hereinafter UNCED]: THE EFFECTIVENESS OF INTERNATIONAL ENVIRONMENTAL AGREEMENTS: A SURVEY OF EXISTING LEGAL INSTRUMENTS 8-14 (Peter H. Sand ed., 1992) [hereinafter EFFECTIVENESS OF ENVIRONMENTAL AGREEMENTS]. This survey also identifies the European Community's (EC's) directives on environment as multilateral and, of course, environmental, and also subject to the European Union enforcement procedure. See *id.* at 14. However, the EC is a special case precisely because of the existence of powerful EC institutions and is not generalizable to other areas of international law. Since the 1992 study, the Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution on Further Reduction of Sulphur Emissions, June 14, 1994, 33 I.L.M. 1540 (not yet entered into force) [hereinafter 1994 Sulfur Protocol] has been negotiated and includes provisions for a non-compliance procedure. Furthermore, the United Nations Framework Convention on Climate Change, May 9, 1992, art. 13, 31 I.L.M. 849, 866 (entered into force March 21, 1994) [hereinafter Climate Change Convention], available at <<http://www.unfccc.de/resource/conv/index.html>>, also includes a "multilateral consultative process" that, in part, is intended as a mechanism for reviewing compliance. The design of both draws heavily on the Montreal Protocol's Non-Compliance Procedure, which is widely seen as a success and is the most recent "model" available to diplomats when they sit down to craft a new procedure. The Non-Compliance Procedure thereby replicates itself, though remarkably little attention is given to whether and why the Montreal "model" has been successful and whether and how it might be applied in other situations. For additional review and discussion, see DAVID G. VICTOR, THE EARLY OPERATION AND EFFECTIVENESS OF THE MONTREAL PROTOCOL'S NON-COMPLIANCE PROCEDURE (Int'l Inst. for Applied Sys. Analysis Executive Report ER-96-2, 1996) [hereinafter VICTOR, EARLY OPERATION] available at <<http://www.iiasa.ac.at/Publications/Documents/ER-96-002.html>>.

4. See THE IMPLEMENTATION AND EFFECTIVENESS OF INTERNATIONAL ENVIRONMENTAL COMMITMENTS: THEORY AND PRACTICE ix (David G. Victor et al. eds., 1998) [hereinafter INTERNATIONAL ENVIRONMENTAL COMMITMENTS].

5. See David G. Victor, *Energizing Prometheus: Technological Innovation for a Carbon-Free Economy* (visited on Feb. 1, 2000) <<http://www.cfr.org/public/resource.cgi?pub!3245>> (summarizing the CFR project).

II. THE RECORD OF COMPLIANCE

More than 140 multilateral environmental agreements govern behavior related to dozens of international environmental issues.⁶ Scholars have examined closely only a fraction of these agreements and issue-areas, but most studies have uncovered a common puzzle: despite the rarity of enforcement mechanisms, generally countries have complied with their international environmental commitments.⁷

At first glance, the outlook for international environmental cooperation seems dismal. Solving environmental problems would require a demanding collective effort. The needed international commitments would be costly to implement, and incentives to defect would be high.⁸ Yet, nearly every international environmental agreement lacks a formal mechanism for rigorous monitoring of com-

6. The business of counting international agreements yields wildly varying estimates, principally for three reasons: (1) most counts include nonbinding agreements, which are practically innumerable and not well-classified and thus the total count is more of a guess than a real count; (2) some counts include the international environmental directives of the EU, which are also numerous (as mentioned above, *supra* text accompanying note 3, the EC is a special case that yields much stronger law than is possible in the rest of the international system); (3) some studies include the many bilateral agreements that pertain to environment, although bilateral agreements have a quite different character from multilateral ones because bilateral pacts are easier to negotiate and easier to enforce through reciprocity and thus do not expose many of the most difficult problems of crafting and maintaining effective multilateral environmental law; and (4) counts vary in the way they include agreements that were not principally negotiated for environmental purposes, such as the 1992 Treaty on European Union (“Maastricht Treaty”) or the 1969 Vienna Convention on the Law of Treaties, which obviously affect behavior and legal interpretations that, in turn, affect the environment. The author’s count of 140 is of the main multilateral environmental agreements, of which about two dozen have been the subject of nearly all serious analysis. In this article, the term “agreement” is used generally to mean any agreement—binding, nonbinding, explicit, or tacit. There are essentially no tacit agreements that govern multilateral environmental behavior because the behavior that causes multilateral environmental problems is so complex and nontransparent that it is not conducive to the emergence of tacit agreements. Moreover, because the field is heavily legalized, norms are typically and quite rapidly legalized into some form of explicit agreement. For more on the conditions that are favorable to tacit cooperation, see ROBERT M. AXELROD, *THE EVOLUTION OF COOPERATION* (1984); GEORGE W. DOWNS & DAVID M. ROCKE, *TACIT BARGAINING, ARMS RACES, AND ARMS CONTROL* (1990). The World Conservation Union (IUCN) also maintains a list of agreements which numbered 430 as of March 1, 1997. The Consortium for International Earth Science Information Network (CIESIN) has developed a subset of that list that includes agreements related to one of nine global environmental issues. That subset numbers 328. For more information, see CIESIN’s computerized treaty resource at *ENTRI Treaty Texts* (last modified Nov. 23, 1999) <<http://sedac.ciesin.org/entri/texts-home.html>>.

7. See Kal Raustiala & David G. Victor, *Conclusions, in* INTERNATIONAL ENVIRONMENTAL COMMITMENTS, *supra* note 4, at 659, 661 (“[A]lmost all countries comply with almost all of their binding international commitments.”); ABRAM CHAYES & ANTONIA HANDLER CHAYES, *THE NEW SOVEREIGNTY: COMPLIANCE WITH INTERNATIONAL REGULATORY AGREEMENTS* 3-4 (1995).

8. See *supra* text accompanying note 2.

pliance.⁹ Most agreements require countries to report data on their own activities (“self-reporting”), which in principle makes it possible to assess levels of compliance.¹⁰ Yet in practice, studies have shown that the quality of self-reported data is rarely checked closely, and in most cases little is done with the data.¹¹ Even if compliance problems were spotted, practically none of the multilateral environmental agreements has formal provisions to apply tough enforcement responses, such as sanctions.¹² In spite of these conditions, compliance with binding international environmental commitments, where it has been measured, is high—often perfect.¹³

Three factors explain such puzzling high levels of compliance: (1) the shallowness of international environmental cooperation; (2) self-enforcement; and (3) inducements including compensation and sanctions.

A. *The Shallowness of International Cooperation*

George Downs *et al.* have already given the chief explanation for the puzzle of compliance: high compliance is the consequence of shallow cooperation.¹⁴ Truly solving the main issues on the international environmental agenda would require deep cooperation, with attendant incentives for defection and the need for monitoring and

9. See EFFECTIVENESS OF ENVIRONMENTAL AGREEMENTS, *supra* note 3, at 8-14.

10. See Ausubel & Victor, *supra* note 2, at 17-18; see also U.S. GEN. ACCOUNTING OFFICE, Rep. No. GAO/RCED-92-43, INTERNATIONAL ENVIRONMENT: INTERNATIONAL AGREEMENTS ARE NOT WELL MONITORED 2 (1992).

11. For an overview of the current situation—including the lack of use of data and, consequently, generally low attention to data quality—see Raustiala & Victor, *supra* note 7.

12. As has already been stated, *supra* text accompanying note 3, few agreements have any provision for scrutinizing compliance or handling noncompliance. Of those that do have such provisions, such as CITES and the Montreal Protocol, the powers available to the procedure are minimal—mainly exhortation. Formal sanctions are not available to either of those agreements, although they can recommend sanctioning activity. There are some examples where sanctions have been applied in CITES. See Peter H. Sand, *Commodity or Taboo? International Regulation of Trade in Endangered Species*, GREEN GLOBE Y.B., 1997, at 19, 21-22 (discussing temporary sanctions, for example, applied against Italy). And there are examples of threats of sanctions used very effectively against Russia for noncompliance with the Montreal Protocol. See VICTOR, EARLY OPERATION, *supra* note 3, at ¶ 1. But these examples are few, and in the ozone layer case the threats were not actually delivered by the formal Non-Compliance Procedure, which does not have such powers. Efforts to give the Procedure such powers were scuttled by Parties that worried that the powers might be used against them; for more discussion on this topic, see David G. Victor, *The Operation and Effectiveness of the Montreal Protocol's Non-Compliance Procedure*, in INTERNATIONAL ENVIRONMENTAL COMMITMENTS, *supra* note 4, at 137, 140-42 [hereinafter Victor, *Operation and Effectiveness*].

13. See Raustiala & Victor, *supra* note 7, at 661; CHAYES & CHAYES, *supra* note 7, at 3-4.

14. See Downs *et al.*, *Good News?*, *supra* note 2, at 387-97.

enforcement.¹⁵ As Arild Underdal showed nearly two decades ago in his study of fisheries agreements, international cooperation often follows the “law of the least ambitious program:”¹⁶ the lowest common denominator prevails.

Empirical evidence broadly supports the view that international environmental cooperation is shallow. Although scores of agreements are in force, few of the issues on the environmental agenda seem to be solved; commitments reflect what countries are already doing rather than what is needed to address the problem at hand. In Europe, for example, the first targets for cutting the emissions that led to acid rain were signed in 1985 and required only a 30% cut (below 1980 levels) in SO₂ emissions.¹⁷ These commitments typified shallow cooperation—for many countries they cost little (at the margin) to implement and did not affect competitiveness, and for most countries they had little effect on behavior.¹⁸ Although eight years were allowed for compliance, several countries had complied when the ink on the 1985 Sulfur Protocol was barely dry because they were already regulating SO₂ emissions as a leading cause of urban air pollution.¹⁹ The sulfur commitments codified programs that governments and firms already had under way.²⁰

Similarly, the 1972 London Dumping Convention,²¹ which is famous for banning ocean dumping of high-level (and now also low-level) radioactive materials, was spearheaded by the United States because the US had already passed national legislation to halt such dumping. For the US and scores of other countries that had no inten-

15. *See id.* at 395-97.

16. ARILD UNDERDAL, *THE POLITICS OF INTERNATIONAL FISHERIES MANAGEMENT: THE CASE OF THE NORTHEAST ATLANTIC* 17, 36 (1980).

17. *See* Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution on the Reduction of Sulphur Emissions or Their Transboundary Fluxes by at Least 30 Per Cent, July 8, 1985, 1480 U.N.T.S. 215 [hereinafter 1985 Sulfur Protocol]; Marc A. Levy, *International Co-operation to Combat Acid Rain*, GREEN GLOBE Y.B., 1995, at 59, 60 (1995) [hereinafter Levy, *International Co-operation*].

18. For analysis of the actual effects of the sulfur agreement, see Marc A. Levy, *European Acid Rain: The Power of Tote-Board Diplomacy*, in *INSTITUTIONS FOR THE EARTH: SOURCES OF EFFECTIVE INTERNATIONAL ENVIRONMENTAL PROTECTION* 75, 115-31 (Peter M. Haas et al. eds., 1993) [hereinafter Levy, *European Acid Rain*]; Levy, *International Co-operation*, *supra* note 17.

19. *See* Levy, *International Co-operation*, *supra* note 17, at 60.

20. *See id.*

21. *See* Final Act of the Intergovernmental Conference on the Dumping of Wastes at Sea, Dec. 29, 1972, 26 U.S.T. 2403 [hereinafter London Dumping Convention].

tion of dumping waste into the seas, the treaty yielded symbolic benefits while requiring no change in behavior.²²

In part, the lack of serious ambition in international environmental agreements is a consequence of environmentalism as a mass movement. Especially in liberal democracies, where public opinion is both fickle and essential to political survival, governments are constantly on the prowl for actions that have low short-term costs and high symbolic value. When under pressure to deal with an international environmental problem that could have high short-term costs and distant international benefits, politicians are politically wise to sidestep by signing a treaty that is superficially significant but actually requires little action.

In the terms of game theory, cooperation has been focused on problems that are easy to solve—games of harmony or simple coordination.²³ In practice, international environmental cooperation has rarely attempted real collaboration, where commitments are demanding and defections are common, unless they face strong penalties (enforcement) or inducements (compensation) to implement costly measures and sustain the collective effort.²⁴ Many such collaboration problems are on the international agenda, but international agreements result only when the problem has been re-framed as a less ambitious collective effort. Analysts have too quickly equated the type of problem that is the subject of cooperation (*e.g.*, protection of the ozone layer or protection of endangered species) with a specific type of cooperation game—such as harmony, coordination, or deadlock.

In reality, every environmental issue has within it a myriad of cooperation games. For example, the effort to protect wetlands spans a spectrum of cooperation games from a game of harmony (*e.g.*, governments agree to declare their intention to protect wetlands) to one of coordination (*e.g.*, governments agree to focus wetland protection

22. The treaty also established a backstop against future dumping, although it remains unclear whether that is a benefit or a curse. By removing ocean floor disposal as an option, the ban has forced land-based solutions to radioactive waste disposal; yet, disposal in the oceans may be environmentally superior to keeping waste on land.

23. See Oye, *supra* note 1, at 2.

24. For an example of a rare attempt, see Montreal Protocol, *supra* note 3, at art. 8. The existence of the Non-Compliance Procedure is, in part, evidence of that serious attempt. The negotiators also created an exemption for “essential uses” so as to avoid cooperation in areas where costs would be extremely high because ozone-benign substitutes did not exist. See RICHARD ELLIOT BENEDICK, OZONE DIPLOMACY: NEW DIRECTIONS IN SAFEGUARDING THE PLANET 204-05 (2d ed. 1998).

efforts on wetlands along bird migration corridors) to deep collaboration (*e.g.*, every government agrees to costly measures that, collectively, ensure protection of bird migration routes) and finally to a game of deadlock (*e.g.*, governments agree not to alter wetlands from their natural state and to forfeit \$1 billion in escrow if they do not comply). The global 1971 Ramsar Convention,²⁵ which is the focus of international legal efforts to protect wetlands, is at the harmony end of the spectrum. A country can comply with the Ramsar provisions by listing one wetland site and making minimal efforts to protect it; there is no legal penalty for noncompliance. Other regional agreements that affect wetlands attain more toward coordination and collaboration. In Western Europe, transborder wetland protection agreements are particularly strong. In Central America an effort is under way to create a biodiversity corridor from South America to Mexico that, if successful, would become among the few examples of serious multilateral collaboration on wetlands.²⁶ Efforts at deadlock, by definition, do not lead to agreement—although even in those cases, diplomats often find a symbolic agreement they can adopt to indicate the effort was not for naught.

The multiplicity of problems helps to explain why there are so many treaties. As soon as an issue appears on the international agenda, an effort is almost immediately launched to negotiate an agreement. If the treaty-making process were focused on reaching agreements to *solve* the environmental problem at hand, treaty registers would be practically empty. International environmental cooperation would be focused on collaboration, which requires sophisticated agreements and powerful institutions for enforcement, and thus is difficult to achieve. Instead, the negotiating process is more of an effort to identify the problem type that can earn agreement. Willingness to pay is often low when negotiations begin, but failure to reach agreement yields symbolic costs; thus, the negotiation process is often a joint effort to discover an agreement marked by harmony or simple coordination. Unsurprisingly, many agreements result, participation in those agreements is high, the lowest common denominator reigns,

25. See Convention on Wetlands of International Importance Especially as Waterfowl Habitat, Feb. 2, 1971, T.I.A.S. No. 11,084, 996 U.N.T.S. 245 [hereinafter Ramsar Convention].

26. See National Aeronautics and Space Administration & Central American Commission on Environment and Development, *The NASA/CCAD Mesoamerican Biological Corridor Project* (visited Feb. 1, 2000) <<http://ghrc.msfc.nasa.gov/ccad/english/index.html>>.

and compliance is nearly perfect.²⁷ Thus, issues that arrive on the environmental agenda can quickly yield a stable, shallow agreement.

Over the last 25 years—from the 1972 Stockholm Conference to the present—the efficiency of this search for shallowness has seemed to increase as participants and institutions have learned how to play the game. It has become easier to agree on formats and language because models can be adapted from the scores of precedents. Institutionalization has facilitated further institutionalization. Indeed, it is remarkable that although ever-more complicated issues arrive on the international environmental agenda, the time required to negotiate treaties has remained relatively constant and short, typically about two years from the start of formal negotiations to adoption. The contrast with international trade diplomacy is striking: as more complex issues have appeared on the trade agenda, such as regulating non-tariff trade barriers, it has become increasingly difficult to reach agreement. The latest expansion of the General Agreement on Tariffs and Trade (GATT)—which created a package of 22 agreements on a wide range of topics, including enforcement and the World Trade Organization (WTO)—required eight years of nearly constant negotiation to achieve.²⁸ One reason for the difference may be that environmental cooperation must play to a mass public that demands visible progress—symbolic actions are better than inaction.²⁹ In other

27. See Downs et al., *Good News?*, *supra* at 2, at 379-80.

28. The exact number of agreements depends upon the definition of “agreement.” For this total, the Agreement Establishing the World Trade Organization is included, as well as the 21 agreements listed in the four annexes to that WTO agreement. A smaller number (18) is obtained by excluding plurilateral agreements, which are agreements not adopted by all parties. A larger number results if the list were to include the six agreements related to interpretation of the 1994 GATT. For example, the following treaties relating to 1994 GATT can be considered as separate agreements: the Marrakesh Agreement Establishing the World Trade Organization, Apr. 15, 1994, 33 I.L.M. 1125 (entered into force Jan. 1, 1995); the General Agreement on Tariffs and Trade 1994, with Understandings (6), and Marrakesh Protocol, Apr. 15, 1994, 33 I.L.M. 1154 (entered into force Jan. 1, 1995); and the General Agreement on Tariffs in Services, Apr. 15, 1994, 33 I.L.M. 1167 (entered into force Jan. 1, 1995).

29. Of course, the conclusion is stated baldly. It seems that, over time, the stringency of commitments also has increased, mainly for three reasons. First, stakeholders have become more confident that they can meet commitments in a given issue-area as they gain experience, and technological change has made it cheaper to do so. The Montreal Protocol, for example, has strengthened over time in part because technological innovation has made benign substitutions for ozone-depleting substances available to the market. See BENEDICK, *supra* at 24, at 218. In other terms, games that were previously viewed as “collaboration” or difficult “coordination” problems have shifted to easier problems. Second, the willingness to pay for environmental protection has increased generally, and with that the willingness to pay for specific environmental problems has also increased. The main factor that explains this shift is the spread of democratic institutions and environmental values, which is discussed *infra* Part II.B. Third, some innovations in international environmental institutions have made it possible to negotiate agreements

areas of international cooperation, such as trade and banking, the need for symbolic acts may be lower and thus the supply of codified agreements may match more closely the willingness to implement significant actions. Perhaps commercial markets take less solace in symbolic agreements.

B. *Liberal States and Self-Enforcement*³⁰

Shallowness is not the only reason for high levels of compliance. In some cases countries agree to and implement costly actions they would not undertake in the absence of an international agreement. Governments are under pressure from their own populations to address international environmental problems. This internal pressure to comply is strongest in advanced industrialized democracies, or “liberal” states, where, typically, three factors are present.³¹ One is that they are wealthy and have tackled more pressing environmental problems, such as providing clean, piped water and basic sanitation.³² They perceive that they can afford to spend resources on the environment and can worry about uncertain distant risks that are characteristic of the issues on the international environmental agenda.

Second, these societies are also typically open and democratic. Freedom of association makes it possible for non-governmental organizations (NGOs) to translate new ideas into political action. In closed and undemocratic societies, new ideas yield action only at the pace by which insulated elites discover and embrace new ideas. Openness spreads and refines new ideas across political borders. The result is a synchronicity in the international environmental agenda among liberal states as ideas diffuse rapidly through networks of individuals and NGOs. The power centers of those networks are typically in the advanced industrialized countries—leading some NGOs in the developing world to lament that the “international” environmental agenda is actually captured by an elite of northern NGOs and backed

that better capture the willingness of parties to conclude agreements. In particular, the development of compensation and other incentive mechanisms has been crucial. See discussion *infra* Part II.C. The reader should not conclude that all of international environmental politics is the search for shallowness and symbols.

30. Much of this section is based on the analysis in Raustiala & Victor, *supra* note 7. In his thinking about the role of “liberal” states, the author is especially grateful to the analysis of Anne-Marie Slaughter. See Anne-Marie Burley, *Toward an Age of Liberal Nations*, 33 HARV. INT’L. L.J. 393, 393-405 (1992) (defining “liberal” states and analyzing their role).

31. See Raustiala & Victor, *supra* note 7, at 689-90.

32. See *id.* at 689.

by their governments.³³ The combination of openness and democratic polities eases the transmission of these ideas into the political decision-making process. Liberal states, having similar values, are loosely synchronized in their willingness to tackle new environmental concerns as they arise.

Third, liberal societies have independent judiciaries and other institutions for checking the actions of government. Successful campaigns to put environmental ideas into action often result in legislative decisions that can be judicially enforced if politicians and administrators fail to live up to legislative mandates. And when judicial strategies fail, other avenues—media campaigns, lobbying, and boycotts—are available to encourage compliance. More work is needed to unravel the mechanisms at work and the conditions under which they are most effective. For example, in principle the courts are often available to enforce compliance with international treaties—especially in countries whose constitutions give international law priority over domestic rules.³⁴ In practice, that power is rarely used. Media-based strategies appear to be effective when the issue can be translated into one of mass concern, which is not always possible or efficient when detailed technical issues of compliance are at stake. And in some liberal nations—notably the United States—it is increasingly difficult to discern “government” from “non-government” because the elites often cycle between official and non-official roles. It is therefore increasingly difficult (and perhaps meaningless) to distinguish public from private action.

None of these three mechanisms is automatic or perfect, but together they provide pressure from within countries to propose, adopt, and implement international environmental commitments. The latter two factors discussed, openness and democratic decision-making, and independent judiciaries—the hallmarks of “liberal states”—are seemingly the most important factors. Material wealth, though im-

33. For example, the headquarters of the NGOs that have been most active on international environmental issues are all in industrialized countries. These NGOs are Greenpeace International (Amsterdam), Environmental Defense (New York), Natural Resources Defense Council (New York), and Friends of the Earth (London). For more on patterns and problems of NGO influence, see P.J. Simmons, *Learning to Live with NGOs*, FOREIGN POL’Y, Fall 1998, at 82.

34. See J.G. STARKE, INTRODUCTION TO INTERNATIONAL LAW 87 (10th ed. 1989) (noting that in Germany “general rules of public international law . . . form part of federal law, and . . . take precedence over the laws of and create rights and duties directly for the inhabitants of the federal territory”). For a discussion of the relationship between international and domestic law, see HANS KELSEN, PRINCIPLES OF INTERNATIONAL LAW 553-88 (Robert W. Tucker ed., 2d ed. 1966).

portant, is often over-emphasized. The problem, of course, is that all these causal factors are correlated, and it is difficult to analyze each variable independently.

The power of liberalism largely explains why every advanced industrialized country has complied with its obligations to phase out the most noxious ozone-depleting substances, as required under the Montreal Protocol.³⁵ Most Organisation for Economic Co-operation and Development (OECD) countries are phasing out ozone-depleting substances even more rapidly than required under the Protocol.³⁶ There remain, however, some areas where action has been imperfect—notably, smuggling of ozone-depleting substances has proven difficult to regulate.³⁷ But these are symptomatic of the difficulty that governments have in regulating illicit substances in any society that is open to the world; they do no worse in tackling these problems than in trying to stem the flow of illegal drugs.³⁸ In the absence of the Montreal Protocol, it is doubtful that the advanced industrialized countries would have banned essentially all of the most noxious ozone-depleting substances so quickly. Once in place, however, the Protocol was self-enforcing due to reputation costs. No government of a major industrialized country wanted to be caught—by its own public, not some international police force—failing to do its part to tackle a threat that animated the public.

The power of mass opinion helps to explain why some issues lead to action while others do not. Limited attention budgets favor issues that are easily grasped and which generate fears of catastrophe. The combination of the depletion of the ozone layer and increased fears of cancer probably helped to push democratic governments to agree to limit ozone-depleting substances. Of course other factors, notably scientific assessments, were also important—rarely is environmental science so clear-cut as was the proof that the ozone hole is caused by humankind.³⁹ Also, environmental values lead to contagion effects.

35. See Montreal Protocol, *supra* note 3, at art. 2.

36. See Victor, *Operation and Effectiveness*, *supra* note 12, at 147 (“Most OECD countries are phasing out ODS more rapidly than is required by the Protocol’s commitments.”).

37. See DUNCAN BRACK, INTERNATIONAL TRADE AND THE MONTREAL PROTOCOL 105-14 (1996) (describing the illegal trade in Russian ozone-depleting substances (ODS) in the U.S., Asia, and Europe).

38. On the general failures of border control in regulating drugs, see Stephen E. Flynn, *The Global Drug Trade versus the Nation-State: Why the Thugs are Winning*, in BEYOND SOVEREIGNTY: ISSUES FOR A GLOBAL AGENDA 44 (Maryann K. Cusimano ed., 1999).

39. See J.G. Anderson et al., *Ozone Destruction by Chlorine Radicals Within the Antarctic Vortex: The Spatial and Temporal Evolution of ClO-O₃ Anticorrelation Based on In Situ ER-2*

It probably helps advance the cause of greenhouse gas regulation that many people confuse global warming with the depletion of the ozone layer, which is now widely viewed as a proven problem. But contagion and misunderstanding cut both ways. Many of the most vitriolic attacks on the science of global warming are driven, in fact, by fear that the global warming agenda is but one installment in a left-wing plot to regulate the economy. For those infected with that contagion, every new environmental issue is viewed, first, as a regulatory threat.

The spread of liberalism—and with it, values and pressures for action—thus helps to explain why few efforts to govern environmental problems have ever confronted the strong pressure to defect. Compliance has been high not only because international cooperation has been built on trivial commitments but also because liberal states have undertaken most of the non-trivial commitments.⁴⁰ Cooperation has been effective, in part, because the countries that have agreed to undertake onerous commitments have been those for which the spread of environmental values and political pressures has been most pervasive and thus the internal incentives to comply have been greatest.⁴¹ International agreements are a yardstick against which liberal forces can assess whether countries are doing their part to solve a problem of public concern—in Marc Levy's terms, a visible "tote-board" on which countries can post their intentions, measure progress, and suffer scorn when they fall short.⁴²

C. *Inducements: Compensations and Sanctions*

Shallowness probably explains the high supply of treaties with high levels of compliance. And over the long run, the liberal theory of international relations probably best explains the spread of more serious efforts to address international environmental issues. However, nature does not always cooperate. Tackling many problems—especially global ones—requires actions by countries that are neither liberal nor wealthy. And in some cases those nations have adopted and implemented stringent commitments.⁴³ The explanation for this

Data, 94 J. GEOPHYSICAL RES. 11,465, 11,465 (1989) (providing the results from measurements in the ozone hole from a converted U-2 spy aircraft).

40. See Raustiala & Victor, *supra* note 7, at 696-97.

41. See *id.*

42. See Levy, *European Acid Rain*, *supra* note 18, at 77.

43. For example, the developing countries in the Montreal Protocol have undertaken to phase out most ozone depleting substances by 2006. See *infra* note 47 for the compliance schedule on the Montreal Protocol.

behavior—action without the internal pressure that liberal, advanced industrialized countries face—is almost always compensation.

Countries that face little internal incentive to change their behavior can be induced to action if others pay the bill. Thus it is now customary for global environmental accords to include funds to pay the extra cost of compliance.⁴⁴ To date, the biggest success has been the Montreal Protocol's Multilateral Fund (MLF), which is distributing nearly \$1 billion to compensate developing countries for the cost of phasing out ozone-depleting substances.⁴⁵ Without the Fund, few of those countries would be members of the Montreal Protocol and even fewer would be undertaking significant actions to meet the Protocol's commitments.⁴⁶ Developing countries must phase out the most noxious ozone-depleting substances ten years after the industrialized countries completed their phase-out—that is, by 2006.⁴⁷ Interim assessments show that the developing countries are generally on track

44. Earlier multilateral environmental agreements included either no funding mechanism (*e.g.*, the CITES) or only ambiguous promises to fund environmental protection on an *ad hoc* basis (*e.g.*, the Ramsar Convention). In contrast, all three of the multilateral environmental treaties that emerged from the 1992 UNCED include legal provisions for an institutionalized financial mechanism. See Climate Change Convention, *supra* note 3, at art. 11; Convention on Biological Diversity, June 5, 1992, art. 20, 31 I.L.M. 818, 830 (entered into force Sept. 29, 1993) [hereinafter Biological Diversity Convention]; Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa, Sept. 21, 1994, Part III, arts. 20, 21, 33 I.L.M. 1328, 1347-50 [hereinafter Desertification Convention]. The Desertification Convention was concluded long after UNCED but is properly viewed as a direct product of that conference. At this writing, the only other new major global environmental treaty to be concluded since UNCED concerns trade in chemicals and pesticides: 1998 Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade, Jan. 1999, 38 I.L.M. 1 [hereinafter PIC Convention or Rotterdam Convention]. The PIC Convention does not include a financial mechanism, but for good reasons: the fundamental purpose of PIC is to shift responsibility for regulating trade in hazardous chemicals and pesticides from importers (developing countries) to exporters (industrialized countries). Thus, its main objective—in addition to helping to build up the capacity of developing countries to regulate these substances within their borders—is to build capacity by changing trade regulation and only to a lesser degree through funding of activities within developing countries. For more on financial mechanisms, see INSTITUTIONS FOR ENVIRONMENTAL AID: PITFALLS AND PROMISE (Robert O. Keohane & Marc A. Levy eds., 1996) [hereinafter INSTITUTIONS FOR ENVIRONMENTAL AID].

45. For more on the MLF, see Elizabeth R. Desombre & Joanne Kauffman, *The Montreal Protocol Multilateral Fund: Partial Success Story*, in INSTITUTIONS FOR ENVIRONMENTAL AID, *supra* note 44, at 89.

46. See *id.* at 94-96 (giving their assessment that the fund was crucial to getting the developing countries on board). In particular, a coalition led by India refused to agree to strengthen the Protocol in 1990 unless a compensation fund was established.

47. For a summary of the phase-out schedule, see United Nations Environmental Programme, *Phase Out Schedule* (last modified May 8, 2000) <<http://www1.unep.org/ozone/Phase-Out-Schedule-4-Art-5.htm>>.

to achieve this goal and that the elimination of large quantities of ozone-depleting substances can be traced directly to projects sponsored by the Multilateral Fund.⁴⁸

The Montreal Protocol's Fund was created in 1990; nearly every major global environmental treaty adopted since then has included a financial mechanism modeled on the Fund.⁴⁹ Typically, the deal is the same: industrialized countries compensate developing countries for the "agreed incremental costs" of compliance.⁵⁰ In theory, those funds should be distributed according to the implementing nation's propensity to comply—more liberal nations should get less while stubborn, illiberal, and poor countries would reap fuller compensation. Putting such a scheme into practice, however, would be fantastically difficult; it would only encourage stubbornness and would require subtle political decisions for which global institutions such as the United Nations are not famous. Thus, compensation packages typically are offered to all developing countries on equal terms.

The coin of compensation has another side: coercion. In some cases, threats of trade sanctions have helped to induce countries to meet international commitments.⁵¹ Often compensation and sanctions are implemented in tandem. The Montreal Protocol, for example, threatens trade sanctions against countries that do not join the regime and rewards the developing countries that do join with compensation.⁵² Faced with those external incentives, no smart government would stay outside. Indeed, nearly every nation on Earth has joined the Protocol—the 157 members include even the rogue nation

48. The Multilateral Fund now has approved country programs in 98 countries, which represent 95% of all consumption of ozone-depleting substances by eligible (Article 5) countries. For a review of its progress in eliminating ozone-depleting substances, see United Nations Environmental Programme, *Report of the Executive Committee to the Tenth Meeting of the Parties to the Montreal Protocol* ¶¶ 21-25 (last modified May 29, 2000) <<http://www.unep.org/ozone/OzL.Doc-10.6.htm>>.

49. In particular, see the three new global environmental treaties that emerged from the UNCED process referred to *supra* note 44: the Climate Change Convention, the Biological Diversity Convention, and the Desertification Convention. The other new, major global environmental agreement, the PIC Convention, was not a direct result of UNCED.

50. For the origin of this language, see Montreal Protocol, *supra* note 3, at art. 10.1.

51. For example, the threat of trade sanctions against Iceland for its whaling activities. See Steinar Andresen, *The Making and Implementation of Whaling Policies: Does Participation Make a Difference?*, in INTERNATIONAL ENVIRONMENTAL COMMITMENTS, *supra* note 4, at 431, 456-62.

52. For the sanctions against joiners, see Article 4 of the Montreal Protocol, *supra* note 3; for the reward, see Article 10 of the Montreal Protocol, *supra* note 3.

North Korea (joined in 1995); Iraq is among the very few non-members.⁵³

III. ENFORCEMENT: SYSTEMS FOR IMPLEMENTATION REVIEW

Thus, the history of international environmental cooperation is studded with cases in which external enforcement has not been necessary to achieve high levels of compliance. Historically, cooperation has been present under conditions where enforcement is not necessary (shallow or empty cooperation), where pressure to comply is internal to the member states (especially in liberal states), and where inducements have eliminated the incentive to defect.

Governments could create enforcement mechanisms and make deeper cooperation possible, but many have been wary of empowering institutions to impose obligations.⁵⁴ The function of enforcement is typically discussed as vital during the negotiation of international environmental agreements; but just as typically such mechanisms are left on the cutting room floor when agreements are finalized.⁵⁵ Formal mechanisms, where they exist at all, are eviscerated of any real power.⁵⁶ It has become customary to defer the design of any compliance procedure until after the treaty itself is established, rather than

53. For the list of signatories to the Montreal Protocol, see United Nations Environmental Programme, *Status of Ratification/Accession/Acceptance/Approval of the Agreements on the Protection of the Stratospheric Ozone Layer* (visited Feb. 1, 2000) <<http://www.unep.org/ozone/ratif.htm>>.

54. See generally Victor, *Operation and Effectiveness*, *supra* note 12 (providing the story of the development of the Montreal Protocol's Non-Compliance Procedure, which was weakened by countries wary of being held accountable in front of the procedure).

55. A poignant example is the development of enforcement procedures in the Climate Change Convention, *supra* note 3. The early negotiations included the design of elaborate procedures, but in the end all were stripped away because some parties feared being held accountable. All that remains is a short Article 13, entitled "Multilateral Consultative Process," which, in essence, deferred creation of an enforcement mechanism until later. That time is now. A weak Article 13 system, modeled on the Montreal Protocol's Non-Compliance Procedure, is under active discussion. On the early discussions related to compliance mechanisms in the Climate Change Convention, see Jo Elizabeth Butler, *The Establishment of a Dispute Resolution/Noncompliance Mechanism in the Climate Change Convention*, 91 PROC. AM. SOC'Y INT'L L. 250 (1997).

56. The only active mechanisms are the system of infractions reports under CITES and the Montreal Protocol's Non-Compliance Procedure. Both have had significant effects on behavior; they have been effective not because of their formal powers, however, but rather because their existence can mobilize stronger informal powers. For an assessment of the CITES system, see EFFECTIVENESS OF ENVIRONMENTAL AGREEMENTS, *supra* note 3; Sand, *supra* note 12. For an assessment of the Montreal Protocol system, see Victor, *Operation and Effectiveness*, *supra* note 12.

to view compliance control as an integral part of negotiating commitments.⁵⁷

Because cooperation has been shallow and compliance high, it has been difficult to determine which enforcement strategies work best against noncompliance in different situations.⁵⁸ The record is too thin to resolve with empirical tests the debate between Downs *et al.*—who argue that enforcement, including sanctions, is needed to deter and reverse noncompliance when cooperation is demanding⁵⁹—and Chayes and Chayes—who argue that noncompliance is rarely willful and thus best managed with incentives and pressure rather than sanctions.⁶⁰ At stake is not only a theory of compliance, but also dramatically different policy prescriptions for how to design effective mechanisms for addressing noncompliance.

To the extent that either view can be tested, the evidence suggests that both warrant some support. Because cooperation has been shallow, Chayes and Chayes are correct in claiming that noncompliance is mainly the result of miscalculation and unplanned changes in circumstances.⁶¹ Under those conditions, the *managerial approach*⁶² they advocate does seem to be effective (perhaps because stronger measures are often unavailable). Countries sign up to commitments only when they think they can comply; thus, noncompliance is the result of misjudgment and circumstances beyond the control of the country.⁶³ The search for shallowness means that most cases of noncompliance fall into the category of non-willful violations for which the Chayes and Chayes remedies are most appropriate.

However, the fact that managerial techniques have been the common formal response to noncompliance problems is not incompatible with the Downs *et al.* claim that hard measures, such as sanctions, are needed when cooperation is more demanding and incen-

57. None of the three UNCED treaties nor the PIC Convention, *supra* note 44, include a developed compliance mechanism. The PIC Convention is typical in its brevity on the matter: “The Conference of the Parties shall, as soon as practicable, develop and approve procedures and institutional mechanisms for determining non-compliance with the provisions of this Convention and for treatment of Parties found to be in non-compliance.” *Id.* at art. 17.

58. See Raustiala & Victor, *supra* note 7, at 661.

59. See Downs et al., *Good News?*, *supra* note 2, at 387.

60. See CHAYES & CHAYES, *supra* note 7, at 22-28 (“[T]he principal source of noncompliance is not willful disobedience but the lack of capability or clarity or priority, [thus] coercive enforcement is as misguided as it is costly.”).

61. See *id.* at 10, 22.

62. See *id.* at 22-28; Downs et al., *supra* note 2, at 379 (referring to the empirical work of Chayes and Chayes and others as the “managerial” school).

63. See CHAYES & CHAYES, *supra* note 7, at 10.

tives to defect are higher.⁶⁴ A study performed at IIASA systematically analyzed how international environmental institutions respond to poor implementation and noncompliance.⁶⁵ It examined how institutions performed four functions: (1) obtaining information on the implementation of existing commitments; (2) reviewing that information to assess the extent of implementation efforts; (3) responding to cases of inadequate implementation; and (4) reviewing the adequacy of existing commitments.⁶⁶ The IIASA team examined these functions together, as a system, because they expected (and found) that the functions would be closely linked. Information used to assess implementation, for example, could also be used to probe the adequacy of existing commitments to meet certain collective goals.

The system approach also revealed something more surprising: much more monitoring and enforcement of obligations occurs than is evident from reading treaty texts and observing the dismal history of efforts to use self-reporting and other procedural requirements to review implementation.⁶⁷ While the community of legal scholars, especially in Europe, tends to focus on treaty texts and formal obligations and procedures, only a *system* perspective really explains how monitoring and enforcement occur. The IIASA team found that much of the system is, in fact, external to the legal regime;⁶⁸ these studies suggest that not only is that factually true, it is probably also more effective than if the procedures were formalized.⁶⁹ A look at treaty texts is depressing for those who want the serious attention to implementation that is needed to solve environmental problems; a closer look reveals, in every case, an active and vibrant system for implementation review (SIR).⁷⁰ Moreover, the informal procedures were disproportionately responsible for applying the tough enforcement measures that Downs *et al.* predicted would be necessary for cooperation.⁷¹ In every case examined, if cooperation went beyond simple coordination

64. See Downs et al., *Good News?*, *supra* note 2, at 380.

65. See INTERNATIONAL ENVIRONMENTAL COMMITMENTS, *supra* note 4, at Part I.

66. See *Systems for Implementation Review*, in INTERNATIONAL ENVIRONMENTAL COMMITMENTS, *supra* note 4, at 47, 48.

67. See *id.* at 50-53.

68. See *id.* at 50; see also Raustiala & Victor, *supra* note 7, at 661-63.

69. See Raustiala & Victor, *supra* note 7, at 685 (“Conventional wisdom holds that the most effective international commitments are legally binding. Yet our cases point to many instances where non-binding agreements have had greater influence on behavior . . .”).

70. See *id.* at 694-95.

71. See *id.* (describing how informal procedures do the heavy lifting); see also Downs et al., *Good News?*, *supra* note 2, at 380.

and harmony, then tougher “enforcement” elements of a SIR also emerged.⁷² Often these were not used against liberal states—whose own internal pressure was strong—but they proved vital when dealing with the poor implementation and noncompliance of illiberal nations.⁷³

The best example is the Montreal Protocol, which is rare among multilateral environmental agreements in that it has a mechanism—the Non-Compliance Procedure—to handle cases of poor implementation.⁷⁴ Most multilateral environmental agreements have provisions for dispute resolution which have never been used in practice.⁷⁵ Yet, even in the case of the Montreal Protocol—where formal procedures are most likely to play a major role—the ability of the institution to deter and reverse noncompliance has depended upon a blend of formal and informal powers. Early in the Non-Compliance Procedure’s existence, the Implementation Committee (IC)—a standing committee that manages the Procedure—sought to identify which countries were not reporting the data that each party to the Protocol is obliged to supply.⁷⁶ That task was easy, but efforts to improve reporting by cajoling, pressuring, and discussing data reporting with the delinquent parties—in essence, the managerial approach advocated by Chayes and Chayes⁷⁷—were effective only when parties found it easy to comply.⁷⁸ In tougher cases, data were supplied only when the IC could link performance to other benefits of the Protocol—in extreme cases, expulsion from the Protocol’s Multilateral Fund (MLF) that compensates developing countries for the cost of complying with the Protocol.⁷⁹ In other instances, the IC has been effective only when it was able to link performance to sticks, not just the withdrawal of existing carrots.⁸⁰ As noted earlier, sanctions can be applied against countries that are not parties to the Protocol—but those countries can escape

72. See Raustiala & Victor, *supra* note 7, at 694-95.

73. See *id.* at 693.

74. See Owen Greene, *The System for Implementation Review in the Ozone Regime*, in INTERNATIONAL ENVIRONMENTAL COMMITMENTS, *supra* note 4, at 89, 91; Victor, *Operation and Effectiveness*, *supra* note 12, at 137.

75. See PATRICA W. BIRNIE & ALAN E. BOYLE, INTERNATIONAL LAW AND THE ENVIRONMENT 180 (1992).

76. See Victor, *Operation and Effectiveness*, *supra* note 12, at 143.

77. See CHAYES & CHAYES, *supra* note 7, at 22-28.

78. For a comparison of the management and enforcement approaches, see Victor, *Operation and Effectiveness*, *supra* note 12, at 149; David G. Victor et al., *Introduction and Overview*, in INTERNATIONAL ENVIRONMENTAL COMMITMENTS, *supra* note 4, at 1, 19.

79. See Victor, *Operation and Effectiveness*, *supra* note 12, at 152.

80. See *id.* at 153.

sanctions if they demonstrate that their national actions are in compliance with the Protocol.⁸¹ The IC did case-by-case evaluations to put that provision of the Protocol into practice;⁸² its judgments were extremely influential because they were backed by the credible threat of sanctions. As Downs *et al.* predicted, strong incentives, including sanctions and other instruments of enforcement, are needed when deep cooperation creates strong incentives to defect.

The above are examples of situations where the IC's actions have been influential because of links to other aspects of the Montreal Protocol regime. But in its most difficult case to date, the noncompliance by Russia and other former centrally planned states, the key linkages were formally external to the Montreal Protocol. The Soviet Union had negotiated a special provision in the original Montreal Protocol to make it easier to comply,⁸³ but at that time (1987) it did not anticipate the collapse and dismemberment of the Union that would leave the central government unable to command the resources and control over private firms that would be needed to comply with the Protocol.⁸⁴ As Chayes and Chayes anticipated, a change in circumstances, rather than an intention from the beginning, led to noncompliance.⁸⁵ But, as Downs *et al.* have argued, strict enforcement measures have been a necessary part of the solution.⁸⁶

By late 1994, it was clear that Belarus, Russia, and Ukraine would not comply with the January 1, 1996, deadline for fully phasing-out the most noxious ozone-depleting substances.⁸⁷ Bulgaria and Poland also feared noncompliance but were in a different situation and have managed to comply.⁸⁸ Some countries supplied data that clearly showed noncompliance was imminent; a group of experts found the same after convening to examine the special problems associated with compliance by these "countries in economic transition (CIETs)."⁸⁹ Russia, the largest producer of ozone-depleting substances in the region, did not itself supply any data and resisted diplomatic pressure and other managerial techniques that attempted to

81. *See id.* at 144.

82. *See id.*

83. *See* BENEDICK, *supra* note 24, at 276-85.

84. *See id.* at 276-78.

85. *See* CHAYES & CHAYES, *supra* note 7, at 10, 15.

86. *See* Downs *et al.*, *Good News?*, *supra* note 2, at 397-99.

87. *See* Victor, *Operation and Effectiveness*, *supra* note 12, at 155-56.

88. *See id.*

89. *See* Greene, *supra* note 74, at 111; Victor, *Operation and Effectiveness*, *supra* note 12, at 147-48.

extract even estimated data from the Russian republic.⁹⁰ Other former Soviet republics also had problems supplying data because the historical archives from which they might derive estimated consumption were held by Moscow.⁹¹ Unable to assure that a major producer (Russia) and significant consumers (Belarus, Russia, and Ukraine) would comply, a train wreck for the Montreal Protocol was on the horizon.

Because these transition countries were not “developing countries,” they were not eligible for MLF assistance to defray the costs of compliance.⁹² In fact, all were expected to pay into the MLF, although none did.⁹³ Into this void stepped the Global Environment Facility (GEF) with an offer to pay much of the cost of compliance.⁹⁴ The GEF made its resources conditional upon proper handling of these cases through the Non-Compliance Procedure and thus empowered the IC to act as its agent in reviewing compliance plans and tracking progress.⁹⁵ Only with this power in hand was the IC able to induce Russia to supply the required data on its (non)compliance and, eventually, to submit a verifiable plan for bringing its behavior into compliance.⁹⁶ The IC was further empowered by a non-official threat from Western nations to sanction Russia and other countries if they undermined the Montreal Protocol.⁹⁷ Still, GEF is paying only part of the cost of compliance.⁹⁸ Although the West might not have compelled Russia to change its behavior without the incentive of GEF funding, even with such compensation it has been far from costless for Russia to comply with the Protocol.⁹⁹

Looking at the legal texts—the Montreal Protocol and the formal Decisions of the Protocol’s supreme decision-making body (the Meeting of the Parties) that created the Non-Compliance Procedure and the IC—nowhere in evidence are the links to the MLF and GEF

90. See Victor, *Operation and Effectiveness*, *supra* note 12, at 155-57.

91. See *id.*

92. See Montreal Protocol, *supra* note 3, at art. 5. For further detail on eligibility, see Victor, *Operation and Effectiveness*, *supra* note 12, at 171 n.27.

93. See Victor, *Operation and Effectiveness*, *supra* note 12, at 147, 148.

94. See *id.* at 149-50; Greene, *supra* note 74, at 116.

95. See Victor, *Operation and Effectiveness*, *supra* note 12, at 164.

96. See *id.*

97. See *id.* at 150.

98. See *id.* at 160.

99. See, e.g., Greene, *supra* note 74, at 114-18; Victor, *Operation and Effectiveness*, *supra* note 12, at 160; VICTOR, EARLY OPERATION, *supra* note 3, at ¶ 4.

that have, in practice, made the Procedure and IC effective.¹⁰⁰ A link to the MLF is now codified in one Decision, which was created as the participants in the system for implementation review learned what types of links between MLF funding and country performance might be useful and were politically feasible to adopt.¹⁰¹ Inside the Montreal Protocol system no link between the Procedure and the GEF was formalized until after it *de facto* existed.¹⁰² When the Procedure was designed, some countries had attempted to create specific links between compliance with the Protocol and specific penalties and rewards that might be marshaled by the Non-Compliance Procedure.¹⁰³ But they were rebuffed by others who feared the creation of a strong enforcement mechanism in the Non-Compliance Procedure.¹⁰⁴ Since significant decisions under international law require nearly unanimous consent, only a weaker procedure was adopted.¹⁰⁵ The Russia case shows that a procedure with only the managerial tools at its disposal will not influence behavior when compliance is highly inconvenient. Rather, a solution to the problem of CIET noncompliance is being worked out through a mixture of the Chayes and Chayes managerial strategy and the Downs *et al.* enforcement approach.¹⁰⁶

In sum, the SIR in the Montreal Protocol is a combination of formal, dedicated procedures and *ad hoc*, informal ones. It is focused on the IC and the Non-Compliance Procedure, but in difficult cases these formally established means of handling noncompliance have been effective only because they were linked to other mechanisms for delivering rewards and sanctions. The IC and the Procedure provided an institutional context, but the SIR would have had little influence on behavior in the cases that matter most if it had been restricted only to these formal institutions and powers. Today, more countries are reporting data, more non-parties are complying with the Protocol, and even the former centrally planned countries are in bet-

100. See Victor, *Operation and Effectiveness*, *supra* note 12, at 159; Victor et al., *supra* note 78, at 18.

101. See Victor, *Operation and Effectiveness*, *supra* note 12, at 145-46 (describing Decision VI/5).

102. See *id.* at 149.

103. See *id.* at 140-42.

104. See *id.*

105. See *id.*

106. See *id.* at 138-39.

ter shape for future compliance than they would be without the Protocol's SIR.¹⁰⁷

The Montreal Protocol's SIR is one example of many such systems. Other studies have shown how SIRs have emerged and operate in international regimes to regulate pollution in the Baltic Sea,¹⁰⁸ protect wildlife,¹⁰⁹ and regulate trade in hazardous chemicals and pesticides.¹¹⁰ Studies have also examined the uses of data in SIRs and long-term trends in how SIRs have been codified into international law.¹¹¹ Overall, the concept of a SIR is both a normative argument and an accurate description of how international institutions assess implementation and handle implementation failures. Compared with fully formalized approaches, SIRs appear to be a robust means of addressing the perennial problem of enforcement of international law. The effectiveness of SIRs is in part due to their informal and decentralized attributes, which help to fill part of the need for monitoring and enforcement.¹¹² They are effective, but jerry-rigged, and some attributes of SIRs pose problems for international cooperation.

One problem is that SIRs depend on synergies with existing institutions that are not formally charged with servicing international agreements. While that can be efficient and effective, it also creates an institutional system whose actions are driven by external interests. For example, many observers have argued that oversight by public interest NGOs is vital to international environmental cooperation, but the IIASA research found that often public interest groups have not performed that function because they have had few incentives to build up the capacity to do so.¹¹³ Membership organizations must appeal to their membership, which often responds to visible results. Thus, enforcement actions have been plentiful when whaling ships and clandestine toxic trade by multinational corporations are the tar-

107. For more information, see United Nations Environmental Programme, *Reports* (visited Feb. 1, 2000) <<http://www.unep.org/ozone/reports2.htm>>.

108. See, e.g., Greene, *supra* note 74.

109. See, e.g., John Lanchbery, *Long-term Trends in Systems for Implementation Review in International Agreements on Flora and Fauna*, in INTERNATIONAL ENVIRONMENTAL COMMITMENTS, *supra* note 4, at 57.

110. See, e.g., David G. Victor, "Learning by Doing" in the Nonbinding International Regime to Manage Trade in Hazardous Chemicals and Pesticides, in INTERNATIONAL ENVIRONMENTAL COMMITMENTS, *supra* note 4, at 221.

111. See, e.g., Juan Carlos di Primio, *Data Quality and Compliance Control in the European Air Pollution Regime*, in INTERNATIONAL ENVIRONMENTAL COMMITMENTS, *supra* note 4, at 283; Lanchbery, *supra* note 109, at 60.

112. See Raustiala & Victor, *supra* note 7, at 677.

113. See *id.* at 667.

gets, but not so abundant when they concern less tangible, often chronic implementation failures.¹¹⁴ Moreover, the line between political action and enforcing the rule of law is blurry or nonexistent when legal institutions rely on outsiders to monitor and enforce compliance. Boycotts against whaling nations organized by public interest groups, and threats of sanctions issued by the U.S., have been abundant even when there has been no formal situation of noncompliance.¹¹⁵ Rather, such unilateral threats are attempts to make wildlife regulation more effective, which is not the same as objectively enforcing international laws on the books.

In principal, scientific institutions could provide some functions of implementation review in many areas of international environmental cooperation. Often, the task of assessing the adequacy of commitments draws upon the data collection and analytical capacity built up in the scientific community.¹¹⁶ Yet in this respect also, external actors will not automatically provide even-handed monitoring and enforcement of international obligations. The task of regular monitoring of national behavior is boring and expensive and unlikely to attract scarce scientific funding and talent. Only rarely does the task of verifying national emissions inventories, for example, yield scientific advance. Despite the huge public interest in stratospheric ozone depletion, only one scientific group has attempted to assess the veracity of data reported on the consumption of chlorofluorocarbons, and then only on a regional basis (which is of little use to the Montreal Protocol, for which compliance is determined on a country-by-country basis).¹¹⁷

An oft-cited example of science in the service of international environmental governance is use of the “critical load” concept in the 1994 “second sulfur protocol” that limits acid rain in Europe.¹¹⁸ The first sulfur protocol, discussed earlier, merely set across-the-board targets with little attention to ecological or economic effects.¹¹⁹ In the second protocol, scientific models were used to focus negotiations on strengthening sulfur regulations in a way that would be environmen-

114. *See id.*

115. *See id.*

116. *See id.* at 680; Victor et al., *supra* note 78, at 18.

117. *See* Dona Hartley & Ronald Prinn, *Feasibility of Determining Surface Emissions of Trace Gases Using an Inverse Method in a Three-Dimensional Chemical Transport Model*, 98 J. GEOPHYSICAL RES. 5183, 5183 (1993).

118. *See* 1994 Sulfur Protocol, *supra* note 3, at art. 1.

119. *See* 1985 Sulfur Protocol, *supra* note 17; Levy, *International Co-operation*, *supra* note 17, at 60; Levy, *European Acid Rain*, *supra* note 18, at 91-94.

tally most effective—that is, by focusing emission controls on the sources that led to the greatest pollution above the level that ecosystems could tolerate (*i.e.*, above the “critical load”).¹²⁰ However, this example is not an illustration of science autonomously providing this capacity. Rather, the investments that made the critical load concept viable for policy were the result of a conscious strategic decision by regulators. Over nearly two decades, transport matrices and atmospheric monitoring networks were built up in Europe (and funded since 1984 by a special protocol to the Framework Convention on European transboundary air pollution).¹²¹ Without those matrices and data, and models built on them, the novel critical load concept could not have been implemented.¹²² Building the scientific capacity that is needed for broad-based and comprehensive SIRs takes decades of sustained investment; the European acid rain regime is one of the few examples.

Another problematic aspect of SIRs is that they operate principally in ‘fire alarm’ mode. As suggested above, the alarm sounds when violations correspond with the interests of external actors, which may not always coincide with the common interest in even-handed regulation. In addition to that worry, theoretical studies of optimal monitoring and enforcement strategies suggest that some regular monitoring and enforcement is needed even when most enforcement activity is mobilized for problem cases.¹²³ Thus, while the decentralized and *ad hoc* approach to SIRs may be politically expedient, especially for the sensitive tasks related to enforcement of commitments, in nearly every case proper monitoring and enforcement probably requires a substantial formal and dedicated institutionalized capacity.

IV. APPLICATION TO GLOBAL WARMING

The story of international environmental cooperation is not encouraging for the current effort to tackle global warming. It would be easy to generate global warming agreements with modest commitments that yield high levels of compliance—indeed, there is one: the Climate Change Convention. But conventional wisdom is that modest commitments will not get the job done—deep cuts in emissions

120. See Levy, *International Co-operation*, *supra* note 17, at 61.

121. See Levy, *European Acid Rain*, *supra* note 18, at 88.

122. See di Primio, *supra* note 111, at 288.

123. See CLIFFORD S. RUSSELL ET AL., ENFORCING POLLUTION CONTROL LAW 220-23 (1986).

will be needed to slow global warming, and they could be costly.¹²⁴ It would be possible to restrict demanding cooperation to the liberal states where concern about global warming and the capacity to enforce obligations are high, but an agreement that is restricted to the OECD nations would be meaningless. Significant levels of emissions are from the non-liberal world (the former Soviet Union and developing nations),¹²⁵ and globalization makes all nations quite sensitive about differential obligations. No doubt cuts in the emissions from industrialized nations must be earlier and more costly than in the rest of the world, but a regime that is focused on the emissions from the liberal world is unlikely to survive politically.¹²⁶ A compensation scheme could entice others to participate, but significant cuts in emissions will be costly. Unless the advanced industrialized countries are convinced that the costs of climate change will be severe and unavoidable, it is unlikely that they would be willing to pay for a scheme to compensate the *full* incremental cost (as in the Montreal Protocol's MLF). To date, the Montreal Protocol's MLF has required about \$1 billion in contributions and is on track to eliminate the problem of ozone depletion. A climate fund could require tens or hundreds of billions of dollars only to slow the rate of warming. Yet, if reluctant participants do not receive the full incremental cost of changing their behavior, they will have an incentive to defect. Even liberal states will face incentives to defect if costs are high and their commitment to action varies—as surely it will over the many decades of sustained action that would be needed to make a dent in the global warming problem.¹²⁷ Maintaining cooperation will require an enforcement mechanism. Yet, experience with shallow commitments and cooperation restricted among the liberal nations—in which compliance has been achieved without much enforcement, and SIRs have filled the few enforcement gaps that do exist—says little about how to ensure

124. See INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 1995: THE SCIENCE OF CLIMATE CHANGE 25-26 (J.T. Houghton et al. eds., 1996) (providing an explanation of the need for deep cuts—perhaps more than 50 percent below current levels for some gases—to stabilize concentration levels) [hereinafter CLIMATE CHANGE 1995]. For more on issues that determine the cost of achieving such stabilization, see also T.M.L. Wigley et al., *Economic and Environmental Choices in the Stabilization of Atmospheric CO₂ Concentrations*, 379 NATURE 240, 241 (1996).

125. See GLOBAL ENERGY PERSPECTIVES 140 (Nebojsa Nakicenovic et al. eds., 1998).

126. See David G. Victor, *After Kyoto* 2-3 (Sept. 15, 1999) (unpublished mimeograph, on file with author) [hereinafter Victor, *After Kyoto*].

127. The long time frame is dictated by the long atmospheric lifetime of the main anthropogenic greenhouse gas, carbon dioxide. For more on the science, see CLIMATE CHANGE 1995, *supra* note 124, at 25-26.

that nations keep commitments when there are strong incentives to defect.

At least two routes appear to lead out of this morass. One, an international emission trading system, is today's anointed choice;¹²⁸ but in reality, it is only a path to a fantasyland and will not work. The other, government policies that focus on technological innovation, appears to be inefficient or even crazy but is worth a closer look, certainly given the dearth of acceptable alternatives. The former is often touted as a model case where market forces could be harnessed to lower the cost of abatement;¹²⁹ the latter is seen as inappropriate government intervention into free markets.¹³⁰ But in the practical world, exactly the opposite could be true: international emission trading may be a theoretical ideal that is not ready for the real challenge of global warming, and the technology policy could be an effective second-best solution to the problem of global warming.

A. *International Emission Trading*

Emission trading offers what appears to be an elegant solution to the enforcement problem. The idea is to allocate property rights in the form of emission allowances, track their origin, and make buyers of these permits liable for noncompliance.¹³¹ Thus, if Russia sells one ton of permits to an American firm, that firm is able to use the full value of the permits only if Russia complies with its global warming treaty obligations. The predictable result is elegant and powerful: the market will price the risk of noncompliance, and sellers will have an incentive to stay in line. Because the largest markets of buyers will be in the liberal world, at least for the next few decades, strong national legal institutions in those nations can enforce compliance.¹³² Thus, emission trading could solve one of the thorniest problems of international cooperation: enforcement.

This would be a persuasive approach if it were realistic to implement. But trading is hobbled by other problems that probably

128. See Kyoto Protocol, Dec. 10, 1997, art. 6, 37 I.L.M. 22, 35 (not yet in force) (84 signatories and 22 Parties as of Jan. 20, 2000) (envisioning a trading system), available at <<http://www.unfccc.de/resource/docs/cop3/107a01.htm>>.

129. See, e.g., Jonathan Baert Wiener, *Global Environmental Regulation: Instrument Choice in Legal Context*, 108 YALE L.J. 677, 763-71 (1999).

130. See Jeffrey S. Banks et al., *The Politics of Commercial R&D Programs*, in THE TECHNOLOGY PORK BARREL 53, 54 (Linda R. Cohen & Roger G. Noll eds., 1991).

131. See Victor, *After Kyoto*, *supra* note 126, at 2.

132. See *id.* at 3.

make it infeasible. The author has reviewed these problems in detail elsewhere,¹³³ but in brief they amount to the following:

- *Allocation of permits.* The Kyoto Protocol sets emission targets and allows emission trading,¹³⁴ and thus potentially allocates emission permits that are worth perhaps \$2.3 trillion.¹³⁵ As countries discover what is at stake the deal will unravel; already the intense gaming over rules for emission trading can be viewed as an effort to adjust the allocation.¹³⁶ And, of course, the allocation will be scrutinized closely as legislatures decide whether to ratify the deal. In the West, especially the United States, it will not go unnoticed that the Kyoto targets allocate probably about a \$100 billion windfall to Russia and Ukraine.¹³⁷ That windfall—and its political liabilities—is but

133. *See id.* at 1.

134. *See* Kyoto Protocol, *supra* note 128, at arts. 3, 6. The first emission targets strive for reductions below 1990 levels within the budget period of 2008-2012.

135. Based on trades at \$50 per ton of carbon, with the asset value calculated using a yield of 8%. That is, this calculation assumes allocation into perpetuity. In reality, the assets will not be perfectly permanent and thus the effective yield will be higher and the assets will be less valuable. *See, e.g.,* Robert W. Hahn & Gordon L. Hester, *Marketable Permits: Lessons for Theory and Practice*, 16 *ECOLOGICAL L.Q.* 361, 379 (1989). However, assuming that the assets are permanent is a useful starting point for discussing the value of the assets, because budget periods subsequent to 2008-2012 will, in practice, almost certainly use the 2008-2012 allocation as a starting point for adjustment. *Cf., e.g.,* Annie Petsonk, *The Kyoto Protocol and the WTO: Integrating Greenhouse Gas Emissions Allowance Trading into the Global Marketplace*, 10 *DUKE ENVTL. L. & POL'Y F.* 185, 207 (1999) (explaining “allocation on the basis of historic emissions levels” and using 2008-2012 as the base-years). The \$2.3 trillion figure includes only carbon dioxide from fossil fuels; add perhaps one-quarter or one-half of that value to account for the other greenhouse gases.

136. As more countries realize the stakes, they realize their interest in particular rules. Already four East European countries have secured rules that allow them to use base-years prior to 1990 when their emissions were higher; those nonstandard base-years, in effect, increase those nations' permit allocations by about 14% (\$20 billion by the calculation in note 135). *See also* Victor, *After Kyoto*, *supra* note 126, at 8. For works pointing out that rent-seeking behavior is often associated with property rights allocation when the stakes are high enough, *see, e.g.,* Daniel H. Cole, *Clearing the Air: Four Propositions about Property Rights and Environmental Protection*, 10 *DUKE ENVTL. L. & POL'Y F.* 103, 122 & n.94 (1999); Terry L. Anderson & J. Bishop Grewell, *Property Rights Solutions for the Global Commons: Bottom-Up or Top-Down?*, 10 *DUKE ENVTL. L. & POL'Y F.* 73, 93-94 (1999) (“The process of *assigning* property rights has definite distributional consequences because property rights represent claims on rents. Therefore, political creation of property rights attracts rent-seeking efforts to influence their distribution that can be costly in themselves.”).

137. That calculation is based on the revenue flow for five years, not the sale of a permanent asset. No doubt this “hot air” will be stripped away in the next budget period, and thus it would be wrong to assume that it is a permanent asset for Russia and Ukraine. (The calculation in note 135 is based on the assumption that the asset allocation is permanent; hence, the value of the underlying assets is calculated by dividing the annual stream of revenues by the interest rate. Here, the value is simply the five-year stream of payments from the extra permits.) *See* Kyoto

one illustration of the general problem of allocating property rights under conditions of extreme uncertainty.

- *Adjustment and expansion.* What is known about global warming is that we do not know the proper level of control,¹³⁸ moreover, in the near future, regulation must expand to include the developing countries, from which the absolute levels of emissions will outstrip those of the industrialized world in the next few decades.¹³⁹ Without the developing world, a declining fraction of greenhouse gas emissions will be under control and the “global” regulatory regime will be increasingly meaningless and ineffective.¹⁴⁰ Thus, the emission trading system also must expand. However, adjustment, and especially expansion, will be difficult because property rights create interests that will be well organized against changes in the allocation. The long history of highly contested—often failed—efforts to adopt policies that reduce land values—“takings”—should give pause to those who want to create new property rights in a system where it is known with certainty that those rights must be reallocated.¹⁴¹ Indeed, as the trading system expands the developing nations will seek windfalls similar to allocations awarded to Russia and Ukraine in Kyoto. But remaining faithful to the objective of slowing global warming, which requires offsetting every new permit issued by retiring another, creates a zero-sum negotiation. Who will pay (in the form of accepting fewer permits) for the extra permits that will be needed to entice these new players into the regime?
- *Transaction costs.* The system as envisioned in the Kyoto Protocol covers not just CO₂ emissions from fossil fuel combustion

Protocol, *supra* note 128, at app. B (identifying the Russian and Ukrainian allocation); DAVID G. VICTOR ET AL., THE KYOTO PROTOCOL CARBON BUBBLE: IMPLICATIONS FOR RUSSIA, UKRAINE AND EMISSION TRADING 8 (Int'l Inst. for Applied Sys. Analysis Interim Report IR-98-094, 1998) (providing the allocation value for Russia and Ukraine).

138. Article 2 of the Climate Change Convention, *supra* note 3, states that its “ultimate objective” is “stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.” GLOBAL ENERGY PERSPECTIVES, *supra* note 125, at 139. However, it does not define what is “dangerous,” and various efforts to do so have not produced any unambiguous results.

139. See GLOBAL ENERGY PERSPECTIVES, *supra* note 125, at 244.

140. See *id.* at 140, 244.

141. Even if the legal problems of “takings” in an emission trading program can be solved—as they were in the 1990 Clean Air Act, which issued “allowances” to emit sulfur dioxide rather than durable property rights—the political problem remains. Owners of an existing asset know what they stand to lose from reallocation and will organize against it.

(which are easy to monitor accurately) but also five other gases.¹⁴² By far the most important of those other gases is methane, but anthropogenic methane emissions are very difficult to monitor accurately at the level of resolution (country- and firm-level) that is needed for an emission permit system.¹⁴³ That problem can be solved easily by restricting the trading system to fossil fuel CO₂ (although that would require renegotiating the Kyoto Protocol). Another transaction cost problem—enforcement—is not so easy to solve. Although emissions trading with buyer liability can be largely self-enforcing, it still requires strong institutions to ensure that the emission rights are secure and that buyers remain liable.¹⁴⁴ It helps that most buyers, at least initially, will be in liberal nations where legal institutions are strong and perhaps can play much of the needed enforcement role.¹⁴⁵ There will still be a need for public international institutions; yet, the international community has no experience with the types of efficient institutions that are most likely required. The WTO dispute panel system is one model that has been effective in handling major disputes.¹⁴⁶ However, the system is costly and cumbersome—poorly suited to the kind of quick and decisive action that is

142. See Kyoto Protocol, *supra* note 128, at app. A.

143. See Victor, After Kyoto, *supra* note 126, at 24-25. Of course, similar problems arise with other regulatory instruments; however, coordinated policies to control methane—rather than instruments such as trading, which require highly quantified emission estimates—are less demanding of accurate data on emissions and thus probably have much lower transactions costs.

144. See *id.* at 28-37.

145. Although emissions from developing countries are rising rapidly, most greenhouse gas emissions are from industrialized nations—in essence, the members of the OECD (liberal nations) and the former Soviet Union (non-liberal nations). Moreover, the Kyoto Protocol does not regulate emissions from developing countries (mostly non-liberal), so all the buying of emission permits will occur by the industrialized nations. As argued earlier, the Kyoto Protocol includes generous targets for Russia and Ukraine—indeed, those nations probably would not have joined the Protocol if the it had required them to undertake any costly actions. Russia and Ukraine will thus be net sellers of permits, and all the net buying will be by the advanced industrialized (liberal) nations of the OECD.

146. For an update on the disputes being handled in the WTO system, see World Trade Organization, *Dispute Settlement: List of Panel and Appellate Body Reports* (visited May 1, 2000) <http://www.wto.org/wto/english/tratop_e/dispu_e/distab_e.htm>. Assessing the effectiveness of the dispute system is difficult, but some indicators suggest that it is quite effective. First, the number of disputes since the system began (entered into force Jan. 1, 1995) has been large compared with the number of disputes handled under the previous GATT panel system. The large number is one indication that members are willing to undergo the cost of a WTO dispute. Second, nearly all disputes are resolved according to the rule of law. While today there are some lingering cases of noncompliance even after a dispute has been handled—notably, at this writing the European ban on meat hormones, which the WTO's Appellate Body has ruled is inconsistent with the WTO's Agreement on Sanitary and Phytosanitary Measures—those are the excep-

oorly suited to the kind of quick and decisive action that is needed to preserve an efficient market, especially when minor violations are detected. Failure to establish credible institutions could cause the emission trading system to unravel quickly; with trillions of dollars at stake and the cost of compliance extremely clear to permit-buyers, no country will stay inside the system for long if it senses that others are skirting compliance. Yet, having already capitalized their permits, no large permit-holder will want to discard the system before cashing out. The result, it seems, would be an odd mix of dissatisfaction, paralysis, and high stakes desperation for defection.

- *Fundamental incompatibility with the global warming problem.* Finally, there is a “prices vs. quantities” problem.¹⁴⁷ Global warming is caused mainly by the stock of long-lived CO₂ that accumulates slowly in the atmosphere.¹⁴⁸ Thus, the benefits of abatement, although uncertain, rise slowly over time. The costs of abatement are also uncertain, but they could rise quickly if emission limits are set over too short a time period. Forcing a modern economy to meet strict emission limits on a timetable that is more rapid than the turnover of the capital stock can require premature retirement of some stock (*e.g.*, power plants); this is very costly considering its small impact

tions rather than the rule. Third, many other issues have been resolved before going to a formal dispute panel because the parties know that the panels will uphold WTO rules.

147. For a detailed analysis of the “prices vs. quantities” problem, see Martin L. Weitzman, *Prices vs. Quantities*, 41 REV. ECON. STUD. 477 (1974).

148. See WILLIAM PIZER, CHOOSING PRICE OR QUANTITY CONTROLS FOR GREENHOUSE GASES 7 (Resources for the Future Climate Issues Brief No. 17, 1999) available at <http://www.rff.org/issue_briefs/PDF_files/ccbrf17.pdf>:

[C]limate change consequences generally depend on the *stock* of greenhouse gases in the atmosphere, rather than annual emissions. Greenhouse gases emitted today remain in the atmosphere for hundreds of years. It is not the level of annual emissions that matters for climate change, but rather the total amount of carbon dioxide and other greenhouse gases that have accumulated in the atmosphere.

Carbon dioxide (CO₂) is removed from the atmosphere by many processes, and thus CO₂ has many atmospheric lifetimes. A small fraction of CO₂ is removed quickly, but the processes that dominate the removal of CO₂ from the atmosphere occur over several decades, centuries, and millennia. Thus, high rates of emission of CO₂ into the atmosphere result in CO₂ build-up, with complete removal only over a long time scale. See also CLIMATE CHANGE 1995, *supra* note 127, at 14-17 (providing additional information on the carbon cycle). For a recent study suggesting that the efficiency of removal of CO₂ might deteriorate substantially, which would increase the rate at which the atmospheric stock builds up, see James F. Kasting, *The Carbon Cycle, Climate, and the Long-term Effects of Fossil Fuel Burning*, 4 CONSEQUENCES (last modified Feb. 17, 1999) <<http://gcric.org/CONSEQUENCES/vol4no1/carbcycle.html>>.

on the long-term problem of carbon accumulation. In these situations, a price instrument (*e.g.*, a carbon tax) is much preferred to restricting quantities (*e.g.*, emission targets and timetables, or emission trading).¹⁴⁹ The importance of that logic will grow as the effort to wean the economy from carbon intensifies. And if that is true then perhaps it is best to get started with price instruments (emission taxes) rather than restricting quantities (tradable permits).

These are serious problems. The allocation problems seem so difficult to settle that they virtually assure that emission trading will not work. There is some hope that allocation will make permits easier to implement when compared with other systems because permits can be used to compensate reluctant participants.¹⁵⁰ But once the parties look seriously at allocation, they are likely to realize it is a zero-sum game. Such games are especially challenging when they allocate *de facto* assets (not just revenue flows) and when the interests of the main protagonists (the industrialized and developing countries) do not coincide.¹⁵¹ These problems are compounded by uncertainty and the fear of being hoodwinked. The future level of emissions from a country cannot be known; it is the same for the future value of permits. Aversion to risk will lead each country to overstate its future needs, with the result that negotiations over how to expand the permit system might actually have negative sum characteristics.¹⁵²

B. Alternatives

Of course, emission trading is not the only instrument available for slowing global warming. But most of the alternatives have problems of similar difficulty. A system for coordinating carbon taxes, for example, faces severe enforcement problems: unlike trading, the market in a carbon tax system does not automatically price the risk of noncompliance and thus the need for strong international institutions

149. See PIZER, *supra* note 148, at 7-8:

Even for those who believe the consequences of global warming will be dire and that current emission targets are not aggressive enough, price policies are still better. An aggressive policy designed to *eventually* stabilize the stock does not demand a strict limit on emissions before stabilization becomes necessary. Additional emissions this year are no worse than emissions next year. Why not abate more when costs are low and less when costs are high—exactly the outcome under a price mechanism?

150. See Wiener, *supra* note 129, at 763-66.

151. On the problem of divergent interests, see Richard N. Cooper, *Toward a Real Global Warming Treaty*, FOREIGN AFF., Mar.-Apr. 1998, at 66; Thomas C. Schelling, *The Cost of Combating Global Warming: Facing the Tradeoffs*, FOREIGN AFF., Nov.-Dec. 1997, at 8.

152. See Victor, *After Kyoto*, *supra* note 126, at 8.

is perhaps even greater than in a system of emission trading backed by buyer liability. A system for coordinating policies and measures, such as that proposed by the European Union, faces serious challenges of monitoring and enforcement since “policies and measures” must be defined, their effects must be estimated, and there have been no serious attempts to do so. Overcoming these hurdles is possible, but it will probably take a long time and will require greater willingness to vest powers in international institutions.

Thus, the prospects for cooperation on global warming seem to be bleak. Cooperation restricted to liberal nations will be too constrained because warming is a global problem with global sources. Cooperation on a global scale will be too difficult because efforts to build powerful international environmental institutions have been least effective when they involve the largest number of countries.¹⁵³

There is one aspect of the international response to global warming for which cooperation limited to industrialized countries could have a worldwide effect: technology. All of the major centers of innovation in energy technologies are in the industrialized world. Nearly all spending on basic research and development—and at least 85% of the scientific output—is from the advanced industrialized nations. Of those, a few—notably the United States, Germany, Japan, the United Kingdom, Canada, Switzerland, Sweden, and France—dominate energy-related innovation. The nations that have the greatest concern about global warming—and the highest willingness to pay for action—happen to be those where the technical solutions are most likely to emerge. In an ideal world, those nations would attempt to create a market-based approach that includes all nations—such as emission trading or a harmonized system of emission taxes. Politically, however, the experience with the Kyoto Protocol is proving that difficult. What if, instead, these countries could focus on innovation itself?¹⁵⁴

153. See George W. Downs et al., *Managing the Evolution of Multilateralism*, 52 INT'L ORG. 397, 398-99 (1998).

154. If one relies on the price mechanism (e.g., taxes or price incentives through the requirement to hold emission permits), then the response to the price is a combination of substitution and innovation—that is, changes along the production frontier and efforts to shift the frontier outward. Especially over the short run (decadal), it appears that the substitution effects are more important, and over the long run the most important effect is innovation. Since a pure price approach brings both factors into play, the need for broad participation in the regime is especially high—the effects on competitiveness are felt quickly. The hypothesis in this article—and in the author's research at the Council on Foreign Relations on technology policy—is that a strategy focused on innovation is an easier first move than determining prices and quantities.

In practice, if these nations collectively pursued a technology strategy, each would probably undertake a different blend of measures. However, the actions probably would have many common elements: incentives for energy-related basic research, lowering of market barriers for new efficient products, and programs to aid pre-commercial investment in novel technologies. Already there is some consensus on the need for incentives to increase upstream investment—without government intervention, society would under-invest in basic research and other activities that create public goods (e.g., knowledge).¹⁵⁵ With deregulation of energy markets, basic energy-related research is already in alarming decline in many industrialized countries and action is needed to halt this under-investment.¹⁵⁶ Downstream policies, such as public-private partnerships for development and demonstration of technologies, are more controversial because there is a greater risk that government policy will be based on inadequate information and thus interfere with the operation of the market.¹⁵⁷ But much has been learned about how to design downstream policies that, if applied, could yield both an effective and politically feasible technology strategy: examples include (1) broad investment portfolios, especially upstream, rather than prematurely “picking winners;” (2) independent expert review of investments; and (3) sunset provisions to ensure that government exits as technologies reach truly commercial markets. The lessons generally are not applied because legislators have given remarkably little attention to technology-related policies as a core element of environmental protection. Rather, technology has been viewed either as a “field of dreams”—a miracle of innovation that follows from stringent environmental targets (require it, and it will be developed)—or as another source of pork. A technology strategy, like any other public policy, will require a concerted political effort to take implementation seriously. And it does not make economic or political sense to focus actions entirely on technology. A tax on emissions of greenhouse gases

155. For more on public goods, see GLOBAL PUBLIC GOODS: INTERNATIONAL COOPERATION IN THE 21ST CENTURY (Inge Kaul et al. eds., 1999). For evidence that investment in the public good of energy-related knowledge is already too low, see J.J. Dooley, *Unintended Consequences: Energy R&D in a Deregulated Energy Market*, 26 ENERGY POL’Y 547, 547 (1998).

156. For more on the decline in energy-related basic research, see Dooley, *supra* note 155, at 548; M. Granger Morgan & Susan F. Tierney, *Research Support for the Power Industry*, 15 ISSUES SCI. & TECH. 81, 85-87 (1998).

157. See Banks et al., *supra* note 130, at 69-70.

would also be necessary to provide an additional incentive for the application of new technologies in the field.

A technology strategy could ease the problem of international cooperation because, initially, it requires significantly fewer nations to participate. However, some formal collective action would be needed because no nation would implement the strategy fully on its own. However, the style of international cooperation would be very different from the framework established in the 1992 United Nations Framework Convention on Climate Change¹⁵⁸ or the 1997 Kyoto Protocol.¹⁵⁹ The precise effects of national technology strategies would be difficult to measure. Rather than target quantities of emissions, the system may better resemble the Marshall Plan or the WTO system. Negotiations over the collective effort would evolve through a system of proposals and counter-proposals for the packages of measures that each nation would implement. Internal to each proposal would be benchmarks for assessing progress. After agreement is forged, mutual scrutiny and negotiation would continue through periodic reviews analyzing which measures are working and whether each nation is doing its part of the collective effort.

A concerted effort in these nations to support development and demonstration of new technologies would make it possible for those new technologies to diffuse worldwide through the normal operation of technology markets that are increasingly global and free from barriers. However, over time, additional incentives, such as a tax to limit greenhouse gas emissions, would be needed to ensure that a growing fraction of the world market faces the appropriate incentive and thus applies new technologies in the field. These additional incentives will require broader international cooperation, but a regime that begins with technology in the core centers of innovation will have three advantages over conventional approaches to addressing global warming.

First, there is a good theoretical basis for beginning a technology-oriented approach in the liberal nations—namely, they are the centers of innovation. Second, technological innovation will lower the cost of abatement and thus reduce the size of the tax that will ultimately be needed to spur these new technologies into field application elsewhere. Since the problems of international cooperation appear to grow exponentially with the size of the intervention and the number of countries, the practical political benefits of lower abatement costs

158. See Climate Change Convention, *supra* note 3.

159. See Kyoto Protocol, *supra* note 128.

are likely to be substantial. Third, for a technology-oriented strategy to be effective over the long run will require that all nations undertake market reforms—such as lowering market barriers and ensuring protection of intellectual property—which will make it easier for new technologies to enter the market. This could be a productive link between the efforts to slow global warming and the WTO, which already obliges many similar market-liberating policies on its members. It could also provide some political cover by giving developing countries something to do while not requiring arbitrary caps on their emissions.

A regime that is focused on the core, industrialized nations could be effective, but it may not earn the consent of the public and legislatures in those nations unless it is coupled with a visible effort elsewhere in the world. Since the non-liberal nations generally do not want to implement costly actions, a broader effort will be largely symbolic (unless it is fully compensated). With that sharp political constraint, it is perhaps best to get the symbols right and focus minds on free markets and diffusion of technology.

This proposal will initially seem bizarre and wrongheaded—and much less elegant than a pure carbon tax or a trading system. The new technology approach does not completely avoid the need to build international institutions to promote cooperation and monitoring. Yet, a new technology approach may be the only logical solution that justifies an intensive effort restricted to those countries that have demonstrated the greatest capacity to cooperate.

V. CONCLUSION

“Compliance” is a poor indicator of the effectiveness of international environmental cooperation. Often compliance has been high even when commitments have had little or no influence on behavior.¹⁶⁰ For scholars, this point suggests the need for great care in defining the dependent variable. For policymakers, this point lays bare a major barrier to deeper cooperation: today’s “standard model” for addressing international environmental issues, which focuses on cre-

160. Ironically, compliance with some non-binding commitments—such as in the North Sea—has been low, but the commitments have been highly effective. See Jon Birger Skjærseth, *The Making and Implementation of North Sea Commitments: The Politics of Environmental Participation*, in INTERNATIONAL ENVIRONMENTAL COMMITMENTS, *supra* note 4, at 327, 368-71. See generally David G. Victor, *The Use of Effectiveness of Nonbinding Instruments in the Management of Complex International Environmental Problems*, 1997 PROC. AM. SOC’Y INT’L L. 241.

ating binding international law, has been designed to yield high compliance. However, the good record of compliance is misleading. The record shows that cooperation is possible under some restrictive conditions. Cooperation has surmounted shallowness primarily when it has been limited to liberal nations that have strong legal institutions and policies that demand action to solve environmental problems. Cooperation has also been effective in changing behavior and solving environmental problems when reluctant parties are compensated.

Enforcement has been necessary in cases where countries have faced inconvenient commitments. The mode of enforcement has not been top-down and centralized; rather, a mixture of formal and informal procedures has been implemented. Typically, the most politically sensitive tasks are performed by mechanisms that are formally external to the international legal institutions created to handle compliance problems. This experience shows that enforcement is necessary, especially as international agreements yield more stringent commitments that countries will not implement purely on the basis of internal pressure and self-interest. The experience also suggests that the most effective institutions for performing such enforcement will not be entirely formalized; there appears to be a tradeoff between the extent of formalization and the power of the institution. That tradeoff need not hold if there is a consensus that strong institutions are needed, but it does suggest that efforts to develop international legal instruments that require strong enforcement also give close attention to how that enforcement will be supplied.

These observations do not bode well for efforts to slow global warming. They suggest that there is a need to develop institutions that will be capable of monitoring and enforcement—policymakers should not be overly encouraged about the good record of compliance in other areas of international environmental law because it is problem-solving, not legal compliance, that matters. Moreover, these observations suggest that there is a special advantage to focusing the most demanding international commitments on the advanced industrialized nations—that is, nations with strong legal institutions, a demanding and powerful public, and the best record of international environmental cooperation. Global warming is difficult to address in part because the majority of emissions comes from countries that are not in that “zone of law.” However, one approach—investment in technological innovation—makes sense when limited to the select group of nations that are most likely to cooperate effectively.