The Greenhouse Effect: Available and Needed Laws and Treaties

I.
INTRODUCTION*

The greenhouse effect is the common name for the physical processes by which energy from the sun penetrates the Earth's atmosphere and is reflected back, but is trapped and cannot escape.[1] These processes raise the Earth's average temperature by approximately sixty degrees Fahrenheit.[2] The most important of the gases that cause this process is carbon dioxide.[3]

The scientific community has for almost a century been aware of the theoretical possibility of an increase in global temperature due to an increase in the carbon dioxide concentration in the atmosphere.[4] However, there is considerable scientific controversy about the extent of the greenhouse effect.[5] Since 1988, U.S. and world interest in the greenhouse effect has increased dramatically,[6] due to an increased awareness that the major consequences of the phenomenon would include flooding of coastal plains as a result of the Arc-

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1. Rind, *A Character Sketch of Greenhouse*, 15 EPA J. 4 (Jan./Feb. 1989).

2. OFFICE OF POLICY, PLANNING AND EVALUATION, EPA [EXECUTIVE SUMMARY] POLICY OPTIONS FOR STABILIZING GLOBAL CLIMATE CHANGE 1 (Draft Report to Congress Feb. 1989) [hereinafter POLICY OPTIONS]; *see also* Morrison, *Global Climate Change* 3 (Congressional Research Service Issue Brief) (Nov. 27, 1989) [hereinafter *CRS Report*].

3. The other gases involved in the process, in order of importance, are methane, chlorofluorocarbons (CFCs) and nitrous oxide. POLICY OPTIONS, *supra* note 2, at 11.

4. *See* Arhennius, *On the Influence of Carbonic Acid in the Air upon the Temperature on the Ground*, 41 PHIL. MAG. 237 (1896). This article was the first to raise the possibility of the Greenhouse Effect. Maranto, *Are We Close to the Road's End?*, DISCOVER 28, 30 (January 1986); *see also* Mintzer, *A Matter of Degrees: The Potential for Controlling the Greenhouse Effect* 1 n.1 (World Resources Institute Research Report No. 5, (Apr. 1987).

5. A number of respected scientists argue that there may be no such thing as the greenhouse effect. Interview with T. Harris, Deputy Executive Secretary of the Domestic Policy Council, from 1985 to 1987. (December 20, 1989) [Hereinafter T. Harris Interview]. *See generally* GEORGE C. MARSHALL INSTITUTE, SCIENTIFIC PERSPECTIVES ON THE GREENHOUSE PROBLEM (1989) [hereinafter MARSHALL INSTITUTE REPORT].

6. Brooks, *The Global Warming Panic*, FORBES, Dec. 25, 1989, at 96, 98.

tic and Antarctic icecaps melting,[7] drought,[8] mass extinction of flora and fauna,[9] and economic dislocation.[10]

This paper will focus upon carbon dioxide emissions. Over the past 100 years, carbon dioxide emissions have contributed to the documented temperature increase more than any other source.[11] Carbon dioxide emissions are estimated to have contributed half of the total change during the 1980s.[12] The primary human-created source of carbon dioxide emissions is the combustion of fossil fuel.[13] Thus, generation of carbon dioxide emissions may be easily monitored and controlled. The other gases contributing to the greenhouse effect are either already subject to international agreements and regulations,[14] or are not presently understood or controllable.[15]

Holding all other things constant, a doubling of the carbon dioxide concentration in the Earth's atmosphere would increase world temperature by about two degrees Fahrenheit.[16] However, the known interactions of carbon dioxide and the other greenhouse gases could triple that increase.[17] Empirical evidence shows an increasing concentration of carbon dioxide[18] and an average temperature change consistent with current theories about the greenhouse

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7. Maranto, *supra* note 4, at 31.

8. U.S. COUNCIL ON ENVIRONMENTAL QUALITY, GLOBAL ENERGY FUTURES AND THE CARBON DIOXIDE PROBLEM 8 (Jan. 1981) [hereinafter CEQ REPORT].

9. Maranto, *supra* note 4, at 30.

10. CEQ REPORT, *supra* note 8, at 23.

11. POLICY OPTIONS, *supra* note 2, at 12.

12. *Id.*

13. Deforestation is also a source of carbon dioxide. However, estimates of carbon dioxide emissions from this source range from zero to 2.6 billion tons per year (studies seem to indicate that one billion tons per year is the best estimate) compared with fossil fuel emissions known to contribute approximately 6 billion tons of carbon per year. *See* M. GRUBB, THE GREENHOUSE EFFECT: NEGOTIATING TARGETS 6 (1989).

14. Chlorofluorocarbons (CFCs) are subject to regulations under the Montreal Protocol of Substances that Deplete the Ozone Layer, Sept. 16, 1987, *reprinted in* 26 I.L.M. 1550 (1987).

15. Methane is produced primarily by decaying organic matter, although a considerable amount of methane reaches the atmosphere as a result of the venting of waste natural gas into the atmosphere in oil fields. POLICY OPTIONS, *supra* note 2, at 11-13. Nitrous oxide sources are not well enough characterized to be studied usefully. *Id.* at 13.

16. Rind, *supra* note 1, at 4. The difference between this increase and the 60-degree difference mentioned in the text accompanying note 2, *supra*, is explained by the relationship between greenhouse gases, clouds, the oceans and other different factors, not all of which are fully understood. The 60-degree figure is a calculation of what the Earth's average temperature would be without any global warming effect.

17. Rind, *supra* note 1, at 4.

18. *Id.* at 4.

effect.[19]

This paper examines the domestic and international implications of the increased carbon dioxide concentration. Section II discusses the potential consequences of the greenhouse effect, as well as the regional sources of the carbon dioxide emissions. Section III addresses the existing and proposed U.S. laws and policies. Section IV analyzes international proposals by different nations for preventing or mitigating the impacts of the greenhouse effect. Finally, Section V explores the implications for the legal practitioner of the laws and treaties identified in Sections III and IV.

II.
BACKGROUND

There is no controversy about the beneficial effect of naturally occurring "greenhouse gases." Without them the Earth's surface temperature might be as much as sixty degrees Fahrenheit cooler.[20] There is, however, considerable scientific debate over the contribution to any greenhouse effect from human sources. Theoretical calculations indicate that the recorded increase in atmospheric carbon dioxide concentration should result in an average increase in the Earth's temperature of about one-half degree Centigrade.[21]

The impact of increased levels of carbon dioxide in the atmosphere can be calculated with considerable accuracy under the assumption that all other variables remain constant. However, this assumption fails.[22] The interplay of the different greenhouse gases (water vapor, carbon dioxide, methane, CFCs and nitrous oxides) is extremely complicated and not clearly understood.[23] Scientists also

19. *Id.* at 6.

20. *CRS Report*, *supra* note 2, at 3.

21. MARSHALL INSTITUTE REPORT, *supra* note 5, at 16. Empirical evidence shows that concentrations of carbon dioxide in the Earth's atmosphere have increased by almost 25 percent over the last century. Ambient carbon dioxide concentration has risen from 280 parts per million (ppm) in 1860 to 346 ppm in 1986. J. SIMON & H. KAHN, THE RESOURCEFUL EARTH 290 (1984); *see also* 1 POLICY OPTIONS, *supra* note 2, ch. II, at 8. Empirical evidence also indicates that this increase is substantially greater than any increase in thousands of years. *Id.* ch. II, at 9-10. Finally, there is evidence that the rate of increase in carbon dioxide concentration is itself increasing. J. SIMON & H. KAHN, *supra*, at 290; *see also* POLICY OPTIONS, *supra* note 2, ch. II, at 11 (Figure 2.2); Rind, *The Greenhouse Effect: An Explanation*, 12 EPA J. 13 (Dec. 1986).

22. Rind, *supra*, note 21, at 12.

23. "EPA recognizes that major scientific uncertainties remain." *Global Climate Change: EPA Oversight Hearings before the House Comm. on Appropriations, Subcomm. on Foreign Operations, Export Financing, and Related Programs* 101st Cong., 1st. Sess. (1989) (testimony of Linda J. Fisher, Assistant Administrator for Policy, Planning and Evaluation, EPA) (available from EPA).

lack full understanding of the effect of clouds, the ocean, and the polar icecaps on weather patterns.[24] Additionally, the computer models currently in use, called General Circulation Models (GCMs), are conceded to be, at best, crude instruments on which to base policy decisions.[25]

The general unreliability of the scientific forecasts produces a significant problem: If the "losers" and "winners" from the consequences of any global warming that might occur cannot be determined accurately, there is no way to justify assistance from one group to the other on the basis of the consequences of global warming. This factor is important in explaining the difficulty in reaching international agreements discussed in Section IV *infra*. Nonetheless, because the phenomenon may span many generations, decisions may not await scientific certainty.[26]

A. *Possible Consequences of Global Climate Change*

The most serious environmental effects expected from increased temperatures[27] as a result of the greenhouse effect are changes in

24. Rind, *supra* note 21, at 12. Some scientists suggest that there may be alternative explanations for the observed increase in temperature rise. Brooks, *supra*, note 6, at 98-102. One suggestion is that the sun, for inexplicable reasons, has increased its luminosity enough to warm the Earth. MARSHALL INSTITUTE REPORT, *supra* note 5, at 23. The same change occurs in other stars similar to the sun. *Id.* at 23-27. Another suggestion is that the Earth has a natural, 200 year cycle of warming and cooling and that we are entering a warming period. *Id.* at 21-22. (The report cites a 100 year computer run.) In addition, the scientists arguing that dramatic action is inappropriate suggest that the computer models are too primitive and scientific understanding of feedback effects so limited that *any* action taken at this time has an equal probability of being the wrong one. *Id.* at 4-15.

25. *CRS Report*, *supra* note 2, at 5. While useful for calculating the global warming effect of a change in atmospheric carbon dioxide concentration on the planet as a whole, GCMs cannot make regional predictions at all. If they do try to make these predictions, the "small regions" are so large as to be useless. In at least one model, the smallest region for which it can predict is a square 500 miles on a side. Such a region would embrace the area from Richmond, Virginia, to Boston, Massachusetts and west to Toledo, Ohio. Similarly, current GCMs make no provision for different climates as a result of height above sea-level. MARSHALL INSTITUTE REPORT, *supra* note 5, at 8-9.

26. T. Harris Interview, *supra* note 5.

27. The most recent forecasts of temperature changes due to carbon dioxide are in the range of 1.5 to 3.0 degrees Centigrade. This is roughly equivalent to a change of 2.7 to 5.9 degrees Fahrenheit. CEQ REPORT, *supra* note 8, at 8; *see also* OFFICE OF POLICY, PLANNING AND EVALUATION, OFFICE OF RESEARCH AND DEVELOPMENT, EPA [EXECUTIVE SUMMARY] THE POTENTIAL EFFECTS OF GLOBAL CLIMATE CHANGE ON THE UNITED STATES 2 (Draft Report to Congress) (June 1989) [hereinafter POTENTIAL EFFECTS]. The most recent computer calculations seem to be producing results in the lower half of the range. *See* Brooks, *supra* note 6, at 97; Booth, *New Models Chill Some Predictions of Severely Overheated Earth*, Wash. Post, Jan. 29, 1990, at A3, col. 1.

These predictions are heavily dependent upon assumptions about the behavior of

rainfall patterns,[28] shifts in agriculturally productive areas,[29] higher sea levels,[30] and changes in forests and fisheries.[31]

The U.S. Council on Environmental Quality believes that "[i]f significant changes were to take place, they would in turn lead to serious impacts on a broad range of human activities— economic, social, and political."[32] Coastal flooding as a result of the melting Antarctic icecap would result in significant population dislocation.[33] In addition, any alterations in the climate would affect pro-

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ocean thermal currents and clouds. CEQ REPORT, *supra* note 8, at 8. The temperature changes that might occur as a result of the other contributors to the Greenhouse Effect may also increase these forecasts by up to 40 percent. *Id.* at 13; *see also supra* notes 20-25 and accompanying text (discussing unreliability of forecasts).

The dependence of the temperatures predicted upon assumptions of uncertain scientific validity make all these forecasts little more than imprecise, albeit educated, guesses.

28. Although it is difficult to predict exactly how rainfall patterns would shift, general predictions indicate that the central United States, Europe, Northern Africa and the Soviet Union would suffer reduced precipitation, while India and the Middle East would receive increased precipitation. There is insufficient data to predict what would occur in South America, Africa south of the Sahara, and the rest of Asia. CEQ REPORT, *supra* note 8, at 16-17.

29. As a result of the change in precipitation plus the lengthened growing season, crop yields in the United States, Canada and the Soviet Union might decrease. For example, a combined increase of 1° Centigrade and 10 percent decrease in precipitation could reduce crop yields by 20 percent. On the other hand, other nations might benefit from the longer growing season due to regional increases in rainfall. The increased ambient concentration of carbon dioxide may also produce some beneficial effect on plant growth. *Id.* at 18-20. "Thus, specific impacts of elevated CO_2 concentrations on the potential for global agricultural production are uncertain. But, overall, if atmospheric concentrations of CO_2 substantially increase, there could be significant geographical shifts in the location of agriculturally favorable and unfavorable areas." *Id.* at 20-21.

30. The CEQ REPORT suggested that:

> [s]ignificantly increased atmospheric CO_2 levels might result in higher sea levels, primarily from the disintegration of the West Antarctic ice sheet. This ice sheet is grounded below sea level and would be susceptible to breakup and melting if the floating ice shelves buttressing it were to break up .... Even though temperature changes in the Antarctic region would be expected to be less than those in the Arctic, a doubling of atmospheric CO_2 might be sufficient to lead to disintegration of the ice sheet. It is estimated that the sea level might rise an average of 5 meters . . . following the deglaciation of West Antarctica, which could have profound effects on the shorelands of the world. The likelihood of such an event . . . is uncertain and controversial. If it were to occur, disintegration might begin within a few years of a significant Antarctic warming and might take a few decades to a few centuries for completion.

Id. at 21.

31. *Id.* at 14. Because of the enormous complexities of the world's ecosystems, these effects are difficult to estimate. *Id.* at 22.

32. *Id.* at 24.

33. "[A] 5-meter rise would flood areas in the United States occupied by 11 million people, about 5 percent of the population." *Id.* at 24-25. The impact of the dislocation is, at least partially, a function of the speed with which the sea rises. A rapid rise,

duction of food grains.[34] "If climactic changes were very gradual, the global agricultural system would have a better chance to adapt . . . but rapid change in climate is likely to produce [more problems than benefits]."[35] Furthermore, while recent evidence suggests that these effects will be concentrated in the Earth's Northern Hemisphere,[36] most of the stress would fall upon those nations least able to bear it.[37]

In sum, three general conclusions about the consequences of the greenhouse effect may be made:

1) The rate of temperature increase may be the most important factor. The faster the Earth's temperature increases, the harder the adaptations and the greater the dislocations.[38]
2) A managed system is more resilient; however, management costs a great deal of money.[39]
3) A major industrialized nation like the United States can probably afford to adapt to the new situations that will arise, but it will be very expensive. The adaptability of poorer nations will be more limited.[40]

B. *Major Human Activities Contributing to Greenhouse Gases*

Energy use and production from carbon-based fuels has been the largest single factor affecting greenhouse gas emissions, accounting for fifty-seven percent of the total contribution to global warming.[41] Between 1950 and 1985, annual global energy consumption and carbon dioxide emissions more than tripled.[42] Emissions have been relatively stable over the past decade, but atmospheric concentra-

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occurring over a period of a few years or decades will have considerably different consequences from one which takes a substantially longer time. *Id.* at 25.

Up to one-third of Bangladesh would be inundated by a one to three meter rise in sea level. BANGLADESH CENTRE FOR ADVANCED STUDIES, GLOBAL WARMING AND BANGLADESH: IMPLICATIONS AND RESPONSES 3 (S. Huq & A. Rahman, presented at the International Workshop on Responding to the Threat of Global Warming, (June 21-27, 1989)) (available from U.S. Dep't of State).

34. CEQ REPORT, *supra* note 8, at 26.

35. *Id.* at 27.

36. Booth, *Computer Predictions of 'Greenhouse Effect' Have a Northern Accent*, Wash. Post, Dec. 7, 1989, at A13, col. 1.

37. *Id.*

38. POLICY EFFECTS, *supra* note 27, at 8.

39. *Id.*

40. *Id.*

41. POLICY OPTIONS, *supra* note 2, at 55. (estimated contribution to greenhouse warming for the 1980s, based upon energy's share of greenhouse gas emissions, weighted by the gas's contribution to global warming).

42. *Id.* at 56.

tions have continued to rise steadily since emissions substantially exceed the absorption ability of the oceans and other sinks.[43]

Global primary energy consumption[44] is expected to double by 2025 and to increase almost fivefold by 2100.[45] Demand for energy is expected to almost double by 2025 and almost quadruple by 2100.[46] As a result, carbon dioxide emissions could multiply two to five times during the next century if no mitigating actions are taken.[47] In particular, heavy reliance upon coal will lead to large increases in greenhouse gas emissions.[48]

C. *Regional Contributions to Greenhouse Gases*

Along with the almost quadrupled consumption of global energy since 1950 came a fundamental shift of the regional distribution of that consumption.[49] In 1950 the nations belonging to the Organization for Economic Cooperation and Development (OECD) consumed about seventy-five percent of all commercial energy supplies, the Soviet Union, China and their allies consumed nineteen percent and the developing nations consumed only six percent.[50] By 1985 the OECD[51] was consuming only slightly under half the global energy supplies, while the European centrally-planned nations were consuming twenty-two percent.[52] Developing nations and Asian centrally-planned economies were consuming about twenty-five percent.[53]

Future growth in energy consumption is expected to come from non-OECD nations.[54] The OECD's share of world energy consumption may drop to as little as twenty-five percent by 2100 according to some forecasts.[55] The developing nations' share of greenhouse gas emissions could increase to fifty percent by 2025 and

43. *Id.*
44. Primary energy includes conversion losses such as those in electricity and synthetic fuels production. *Id.* at 57.
45. *Id.* at 58-59.
46. *Id.*
47. *Id.*
48. *Id.*
49. *Id.* at 56.
50. Id.
51. Today the members of the OECD are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom, and the United States. Yugoslavia is also associated with the OECD.
52. Policy Options, *supra* note 2, at 56.
53. *Id.*
54. *Id.* at 57.
55. *Id.*

sixty percent by 2100.[56] Thus, in the long run, the cooperation and participation of the developing nations is crucial.[57]

D. *The Instability of the Present Situation*

At present, ambient levels of greenhouse gases are increasing.[58] Since their removal may take decades or more even if global emissions were stabilized at 1985 levels, "the greenhouse effect would continue to intensify for more than a century."[59] Simply to stabilize the atmospheric concentration of carbon dioxide would require a reduction in carbon dioxide emissions of fifty to eighty percent.[60] In fact, even if all carbon dioxide emissions were completely eliminated, it would take at least fifty years, and possibly a century, before concentration levels returned half way to preindustrial levels.[61]

Such a significant decrease in annual carbon dioxide emissions would require a proportionate decrease in the use of fossil fuels.[62] Projections of future fossil fuel use vary significantly, but virtually all show developing nations using increasing amounts of fossil fuels.[63] Even the most "low-energy" forecast available[64] would fall short of the necessary requirement of stabilizing atmospheric concentrations of carbon dioxide.[65] Grubb suggests that "[e]ven if the technical obstacles and economic costs of limiting carbon emissions are not great . . . the institutional, social and political obstacles to forcing a decline in the scale of fossil fuel industries in the industri-

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56. *Id.* at 40.

57. Individually, the nations Indonesia, India, China and Brazil are very important, because, together they generate almost half of all the greenhouse gases emitted by the developing countries—over sixteen percent—and each is expected to have an expanding economy. M. GRUBB, THE GREENHOUSE EFFECT: NEGOTIATING TARGETS 17-18 (Figures 4, 5a+5b)(1989).

58. POLICY OPTIONS, *supra* note 2, at 13.

59. "Carbon dioxide concentrations would reach 440-500 parts per million (ppm) by 2100, compared with about 350 ppm today, and about 290 ppm 100 years ago." *Id.*

60. *Id.* at 13-15.

61. *Id.* at 13.

62. This is because fossil fuel use is the predominant source of carbon dioxide. *See supra* note 13 and accompanying text.

63. GRUBB, *supra* note 57, at 13.

64. *Id.*, (citing J. GOLDENBURG, TOWARDS AN ENERGY STRATEGY FOR A SUSTAINABLE WORLD (1987)).

65. The Goldenburg study would allow developing nations a 10% increase in carbon dioxide emissions while reducing developed nations' carbon dioxide emissions by 50%. However, even this draconian reduction in carbon dioxide emissions was inadequate to achieve stabilized ambient carbon dioxide concentrations. To be successful, carbon dioxide emissions would need to be reduced between fifty and eighty percent. GRUBB, *supra* note 57, at 13.

alized world are formidable."[66]

III.
U.S. POLICIES AND PROGRAMS, EXISTING LAWS AND REGULATIONS, AND PROPOSED LEGISLATION

A. *U.S. Policies and Programs*[67]

The policy of the United States executive branch toward the global warming issue has six principles:

- Take aggressive action on those issues on which scientific consensus exists.
- Assess the state of the *science* on issues where *no* scientific consensus exists, and identify areas for further inquiry.
- Where scientific uncertainty exists, move forward with those measures that make sense on other grounds, e.g., efficiency and reducing CFCs.
- Consider the costs and benefits of any response measures suggested.
- Link responses to scientific and technical information.
- Determine how to evaluate and share technological responses with developing countries.[68]

The scientific uncertainties described in Section II drive this policy. The preferred U.S. strategy, therefore, is flexible. It is designed to accommodate new information and direction as knowledge is enhanced by additional research on emissions, their interaction with the biosphere, and the ultimate effect of increasing greenhouse gas emission levels on mankind and the atmosphere's environment.[69]

Time is another factor influencing the decision to proceed slowly and cautiously.

> [M]ajor increases in the atmospheric concentrations of some greenhouse gases seem likely to take several decades — perhaps twice as long — to exert significant impacts on our lives. So it would probably be wise to exercise caution about taking immediate steps that might

66. *Id.*

67. *See infra* notes 118-21 and accompanying text for a discussion of existing U.S. programs that affect international interests, such as Agency for International Development funds, technology export programs, etc.

68. Testimony of Admiral James D. Watkins, Sec'y of Energy before the Senate Committee on Energy and Natural Resources, July 26, 1989. (available from the U.S. Department of Energy) (emphasis in original).

69. Testimony of Linda J. Fisher, Assistant Administrator for Policy, Planning and Evaluation, EPA before the House Committee on Appropriations, Subcommittee on Foreign Operations, Export Financing, and Related Programs (Feb. 21, 1989).

seriously disrupt the economy and people's lives.[70]

Therefore, President George Bush has asked Congress to increase funding for the U.S. Global Climate Change Research Program by nearly sixty percent in Fiscal Year 1991, to over one billion dollars.[71] The President has also announced "a major reforestation initiative to plant a billion trees a year on the private land across America,"[72] budgeted at $175 million in Fiscal Year 1991.[73] Finally, in Fiscal Year 1991 the Department of Energy will spend $336 million on renewable energy research, including enhancements to energy efficiency.[74]

B. *Existing U.S. Laws and Regulations*

The Environmental Protection Agency stated that "[t]he Federal government already has extensive regulations and regulatory programs that limit greenhouse gas emissions, such as air pollution control laws, . . . and regulation of investments and rates charged by utilities. . . . These programs could be modified to further reduce greenhouse gas emissions."[75] Since 1977, as a result of mandatory and voluntary energy efficiency programs, the electric utility industry has reduced demand by an amount equivalent to the output of more than twenty-one large (1000 megawatt) power plants.[76] The electric industry expects to save an amount equal to an additional twenty-four large power plants by 2000.[77]

The EPA "already regulates [some greenhouse gases] as air pollutants because of their effects on human health and welfare. Under the Clean Air Act, EPA sets uniform ambient standards for emissions of [pollutants] and uniform technology-based standards for

70. Office of Basic Energy Sciences, Office of Energy Research, U.S. Dep't of Energy, Atmospheric Carbon Dioxide and The Greenhouse Effect 13 (May 1989).

71. Address by President George Bush, Intergovernmental Panel on Climate Change (Feb. 5, 1990), *reprinted in* 26 WEEKLY COMP. PRES. DOC. 177 (Feb. 12, 1990) [hereinafter Presidential address].

72. *Id.* at 178.

73. Lancaster, *Bush's Billion 'Points of Shade'*, Wash. Post, Feb. 12, 1990, at A9, col. 1.

74. Presidential address, *supra* note 71, at 178.

75. POLICY OPTIONS, *supra* note 2, ch. VIII at 23.

76. Edison Electric Institute, News Release 1-2 (October 4, 1989) (Quoting testimony given by Tom Morron to the U.S. House Committee on Banking, Finance, and Urban Affairs Subcommittee on Economic Stabilization) (available from EEI).

77. *Id.* at 2. A recent EEI study showed that proper use of new electrotechnologies could reduce industrial carbon dioxide emissions by 17.4% and the transportation sectors' carbon dioxide emissions by 8.2%. *Id.*

major new sources of these pollutants."[78] Although the EPA has the authority to do so, it has not set either an ambient air quality standard or an emission standard for carbon dioxide.[79]

Congress intended EPA's Administrator to list any pollutant "emissions of which, in his judgment, cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare."[80] Congress did not intend to prevent the EPA Administrator from listing any particular pollutants.[81] Thus, carbon dioxide could be added to the list of air pollutants by the Administrator during one of his periodic revisions of the list of air pollutants that meet the two criteria. In fact, should the Administrator find that carbon dioxide has an adverse effect on public health or welfare, he is obliged to list carbon dioxide.[82]

When the Administrator adds carbon dioxide to the list, the Clean Air Act requires simultaneous promulgation of primary and secondary emission standards to protect the public health and welfare.[83] The secondary standard must "specify a level of air quality the attainment and maintenance of which . . . is requisite to protect the public welfare from any known or anticipated adverse effects . . . ."[84] Promulgation of these standards, and their implementation by the states within a fixed schedule, is mandatory.[85] Thus, the Clean Air Act provides adequate legislative power to regulate the emission of carbon dioxide from stationary sources such as fossil fuel power plants.[86]

Federal and state utility regulation policies may also exert a significant influence on the amount of carbon dioxide emitted because non-fossil fuel electric generation[87] is located almost entirely in baseload power generation. Therefore, any policies to reduce peak demand or increase energy efficiency and conservation would also

78. POLICY OPTIONS, *supra* note 2, ch. VIII at 28 (citing 42 U.S.C.A. §§ 7401 - 7642).

79. *Id.*

80. 42 U.S.C. § 7408(a)(1)(A) (1988).

81. Natural Resources Defense Council v. Train, 411 F. Supp. 864 (S.D. N.Y. 1976) *aff'd*, 545 F.2d 320 (2d Cir. 1976).

82. 42 U.S.C. § 7408(a)(1)(A) (1988).

83. 42 U.S.C. § 7409(a)(2) (1988).

84. 42 U.S.C. § 7409(b)(2) (1988).

85. *See* Natural Resources Defense Council v. Train, 545 F.2d 320, 323 (2d Cir. 1976).

86. Support for this view may also be found in the absence of any proposed legislation by Congress that would give the EPA authority to regulate carbon dioxide. See the discussion of proposed legislation *infra*.

87. *E.g.*, nuclear power, hydroelectric power, and the assorted renewable electric generation technologies.

reduce carbon dioxide emissions. Both federal and state regulators have been implementing such policies for several years.[88]

Responses to the potential impact of global climate change on the United States have been studied extensively, albeit usually by analogy.[89] Studies concentrate on state and local government responses since they will shoulder the brunt of the burden, at least initially.[90]

The typical response is *ad hoc* as opposed to a planned approach.[91]

> This has not necessarily been a bad response but it is probably more costly in the long run than putting a long-term strategy together in order to cope with climate-related environmental changes.... [These] ad hoc decisions... have often built into the existing social structures an additional degree of rigidity that would in the long-term decrease society's ability to respond to changes.[92]

Thus, the principal flaw is the lack of long-term planning at the interstate, state, and local levels rather than any lack of legal authority.

C. *Proposed Legislation*

Thirty-two bills dealing with the greenhouse effect were introduced into the 100th Congress; an equal number are expected to be introduced into the 101st.[93] Some of the bills are only exhortative.[94] Others would establish specific emission reduction objectives for the United States,[95] and still others would mandate specific research programs, studies and organizational changes.[96]

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88. U.S. Department of Energy, Energy Security 129-61 (March 1987).

89. *See* POTENTIAL EFFECTS, *supra* note 27.

90. POTENTIAL EFFECTS, *supra* note 27, [Appendix J] at 1-3.

91. *Id.*

92. *Id.*

93. *CRS Report*, *supra* note 2, at 14.

94. *E.g.*, the National Global Warming Policy Act (H.J. Res. 207, 101st Cong., 1st Sess. (1989) and S.J. Res. 88, 101st Cong., 1st Sess. (1989)).

95. The National Energy Policy Act (S. 324, 101st Cong., 1st Sess. (1989)) would set a target of a 20% reduction in carbon dioxide emissions by 2000 and a 50% reduction by 2015. The Global Environmental Protection Act (S. 333, 101st Cong., 1st Sess. (1989)) is even more ambitious: It would have a 50% reduction in carbon dioxide emissions by 2000. The Global Warming Prevention Act (H.R. 1078, 101st Cong., 1st Sess. (1989)) would give a little more time: it mandates a 20% reduction in carbon dioxide emissions by 2005.

96. Global Environmental Research and Policy Act (H.R. 980, 101st Cong., 1st Sess. (1989) and H.R. 3332, 101st Cong., 1st Sess. (1989)); Global Environment and Change Assessment Act (S. 251, 101st Cong., 1st Sess. (1989)); National Global Change Research Act (S. 169, 101st Cong., 1st Sess. (1989)); Global Change Research Act (H.R. 2497, 101st Cong., 1st Sess. (1989)); and the World Environmental Policy Act (S. 201, 101st Cong., 1st Sess. (1989)). Some bills with other objectives also require research to

The specific goals for reducing carbon dioxide emissions in the bills are unrealistic.[97] The minimum time required to site, permit, and construct a major fossil-fuel power plant is between ten and fifteen years.[98] Thus, the number and type of central station electric power plants that will be operating in the United States as well as the amount of carbon dioxide that the United States will be emitting in 2000 are already known to a considerable degree of precision.[99] Thus, there will be no substantial reduction in carbon dioxide emissions by 2000.

The different research programs discussed in the bills are already being carried out.[100] The major point of the bills is to provide incremental funding authorizations for some favored projects.[101] This, however, does not determine how much money will be appropriated for the agencies to spend. The studies'[102] stated purpose is to inform Congress of how the executive branch[103] intends to meet congressional goals.[104]

The organizational changes mandated by the different bills would raise the political profile of the U.S. work on the greenhouse ef-

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be carried out; *e.g.*, the National Energy Policy Act (S. 324, 101st Cong., 1st Sess. (1989)), the Global Environmental Protection Act (S. 333, 101st Cong., 1st Sess. (1989)) and the Global Warming Prevention Act (H.R. 1078, 101st Cong., 1st Sess. (1989)).

97. *See supra* note 95.

98. The U.S. Department of Energy generally uses 10-15 years as the "normal" lead-time for a baseload electric generating powerplant. The electric utility industry generally looks at least ten years into the future. *See, e.g.*, NORTH AMERICAN ELECTRIC RELIABILITY COUNCIL, 1990 ELECTRICITY SUPPLY & DEMAND (Nov. 1990) (projecting supply and demand through 1999).

99. T. Harris Interview, *supra* note 5.

100. *See, e.g., supra* notes 71-74 and accompanying text.

101. *See e.g.*, S. 324, 101st Cong., 1st Sess. (1989) (The National Energy Policy Act of 1989) Titles III through XV (1989).

102. Some of the studies that might be required are: a National Least-Cost Energy Plan (H.R. 1078, 101st Cong., 1st Sess. (1989)); a National Global Change Research Plan (H.R. 3332, 101st Cong., 1st Sess. (1989)); a study of all government subsidies of energy resources and technologies (H.R. 1078, 101st Cong., 1st Sess. (1989)); a report on recyclable materials and reduction of waste (H.R. 1078, 101st Cong., 1st Sess. (1989)); and a report on accelerating energy efficiency research and development by five years (H.R. 1078, 101st Cong., 1st Sess. (1989)) including cost estimates.

103. Specifically, the Department of Energy.

104. *See e.g.*, S.324, 101st Cong., 1st Sess. Title I (1989). There seems to be no logic to asking the executive branch to develop a plan that might differ in some way from its existing policy and programs. Furthermore, this bill, like the other bills, specifically enumerates what programs are to be favored with additional funds and priorities even before the study is carried out. Public choice economic theory would indicate that Congress is looking for *ex post* reasons for favoring certain projects. *See generally* Tollison, *Public Choice and Legislation*, 74 VA. L. REV. 339 (1988).

fect,[105] with the goal "to elevate the priority attached to climate change considerations"[106] in the executive branch. It is unclear what advantage this would produce. One disadvantage resulting from such a reorganization is the extra time and resources "old line" organizations would have to spend in renegotiating existing "power sharing" arrangements with the new organization.

The chief problem with all this proposed legislation is that the United States cannot solve the problem alone.[107] As shown in Section IV, *infra*, to induce the developing nations to address the issue will require commitments on financing and technology transfer that Congress is unlikely to make.[108]

IV.
INTERNATIONAL AGREEMENTS, PROGRAMS AND PROPOSALS

> The atmosphere has been exploited by all without reference to the possibility of ultimate degradation, or to the access rights for the different parties. It has been treated as a free and infinite resource, and humanity is now faced with the realisation (sic) that it is neither, and indeed that a portion of the reservoir has already been "used up".[109]

A. *Existing Agreements*[110] *and Institutions*

Existing agreements, either bi- or multi-lateral, enable the international community to accomplish a great deal even without a spe-

105. *E.g.*, S. 324, 101st Cong., 1st Sess. (1989) mandates creation of the Office of Climate Protection, headed by a presidential appointee, in the Dep't of Energy as opposed to the diffusion of groups working on global climate change in the Dep't of Energy at present. Similarly, H.R. 3497, 101st Cong., 1st Sess. (1989) would establish a separate commission for international scientific cooperation in the Executive Office of the President; S. 251, 101st Cong., 1st Sess. (1989) would establish an Interagency Taskforce on Global Climate Change and H.R. 980, 101st Cong., 1st Sess. (1989) would create a Council on Global Environmental Quality to supplement the Council on Environmental Quality.

106. S. 324, 101st Cong., 1st Sess. § 201 (1989).

107. "[T]he participation of developing countries is crucial for stabilizing greenhouse gases." POLICY OPTIONS, *supra* note 2, at 40.

108. The dialogue in which these negotiations are conducted is not conducive to acceptance. Developing nations frequently speak of a "special obligation" of the U.S. etc. *See infra* note 171 and accompanying text.

109. GRUBB, *supra* note 57, at 22.

110. *See* U.S. Dep't of State, International Agreements Potentially Relevant to Climate Change. The United States submitted this list to the Intergovernmental Panel on Climate Change (IPCC) at the 2d Session of IPCC Working Group III (Response Strategies Working Group) in Geneva, Switzerland October 2-6, 1989. (Available from the U.S. Dep't of State).

cific agreement on the greenhouse effect.[111] A framework for cooperation on research and weather observation,[112] and a number of bilateral agreements for the exchange of experts and information already exist.[113] Pollution control agreements already govern the emission of a number of greenhouse gases.[114] Additionally, energy-related agreements promote research, development and commercialization of new technologies.[115] However, "existing international [agreements] . . . are insufficient alone to meet the challenge of climate change."[116]

The United States has existing programs designed to make financial assistance available to the international community.[117] The Agency for International Development (AID) administers most of these programs. In addition, international financial institutions provide loans for development at special rates.[118] According to President Bush, the United States is "also working, through diplomatic channels with our colleagues in other countries and through innovative measures like debt-for-nature swaps, to do more than simply reduce global deforestation. We hope to reverse it, turn it

111. *See* Intergovernmental Panel on Climate Change (IPCC), Report of the Second Session of IPCC Working Group III/Response Strategies Working Group (RSWG) 14 (October 2-6, 1989) (available from the U.S. Dep't of State, the World Meteorlogical Organization, or the United Nations Environment Programme) [hereinafter RSWG Report].

112. World Meteorological Organization, Convention, Oct. 11, 1947, 1 U.S.T. 281, T.I.A.S. No. 2052, 77 U.N.T.S. 143.

113. *E.g.*, U.S.-U.S.S.R Agreement on Cooperation in the Field of Environmental Protection, May 23, 1972, 23 U.S.T. 845, T.I.A.S. No. 7345.

114. Convention on Long-Range Transboundary Air Pollution (LRTAP), Nov. 13, 1979, T.I.A.S. No. 10541, reprinted in 18 I.L.M. 1442 (1979); Protocol to the 1979 Convention on LRTAP on Financing the Monitoring and Evaluation of Air Pollutants in Europe, reprinted in 24 I.L.M. 484 (1985); Protocol to the 1979 convention on LRTAP Concerning the Control of Emissions of Nitrogen Oxides or Their Transboundary Fluxes ("Sofia Protocol") Oct. 31, 1988, reprinted in 28 I.L.M. 212 (1989); Vienna Convention for the Protection of the Ozone Layer, March 22, 1985, reprinted in 26 I.L.M. 1516 (1987); and the Montreal Protocol on Substances that Deplete the Ozone Layer, (Sept. 16, 1987) reprinted in 26 I.L.M. 1550 (1986).

115. *E.g.*, Agreement on an International Energy Program, Feb. 5, 1975, 27 U.S.T. 1685, T.I.A.S. No. 8278; and the U.N. Statute establishing the International Atomic Energy Agency, Oct. 26, 1956, 8 U.S.T. 1093, T.I.A.S. 3873, 276 U.N.T.S. 3.

116. RSWG Report, *supra* note 111, Report of the Topic Coordinators on Legal Measures at 14, ¶ 3.

117. Virtually all federal agencies have some sort of international program. The Agriculture, Commerce and Energy Departments and the Environmental Protection Agency all have substantial ones. Interview with T. Harris, Director, Office of Technology Policy, Office of Policy Planning and Analysis, U.S. Dep't of Energy, 1987 (January 21, 1990).

118. *See* U.S. Dep't of State, Summary of International Agreements Potentially Relevant to Climate Change, *supra* note 110, at 5.

around—not unilaterally, but by working with our international neighbors."[119]

B. *Proposed International Agreements*[120]

A framework convention (treaty) similar to the 1985 Vienna Convention on the Protection of the Ozone Layer should be developed[121] to overcome the inadequacies of existing international agreements.[122] The Response Strategies Working Group of the IPCC (RSWG) has developed a consensus that, at a minimum, any agreement should provide a legal and institutional framework for multilateral cooperation.[123] Furthermore, the agreement "should aim to attract the largest number and widest range of signatory countries."[124] RSWG representatives agree that, as quickly as possible,[125] ways to develop and transfer technology should be promoted using both the public and private sectors.[126] The RSWG Report recommends that preferred new technologies should "take account of social, environmental and economic variances among countries and regions."[127] Furthermore, "rapid transfer, on a preferential basis, to developing countries, of technologies which help to limit or adapt to climate change, without hindering their economic development is urgent . . . ."[128] This, the RSWG suggests, should be accomplished by providing additional funding, training, removal

119. Presidential address, *supra* note 71, at 178.

120. This section is heavily based on the RSWG Report, *supra* note 111. That report summarizes the results of the October 2-6, 1989, meeting of the Response Strategies Working Group of the Intergovernmental Panel on Climate Change (IPCC) in Geneva, Switzerland. The purpose of the meeting was to develop options to deal with potential global climate changes. The IPCC was established by the United Nations Environmental Programme and the World Meteorological Organization and was recognized by UN General Assembly Resolution 43/53 on Protection of Global Climate for Present and Future Generations of Mankind as the leading international organization addressing global climate change issues.

121. *See* RSWG Report, *supra* note 111, Report of the Topic Coordinators on Legal Measures and Processes, § 4.1, at 14.

122. *See* RSWG Report, *supra* note 111, Introduction: Views on Workshop Topics; Legal and Institutional Measures at 1.

123. *Id.*

124. *Id.*

125. *See* RSWG Report, *supra* note 111, Report of the Topic Coordinators on Technology Transfer and Development at § 4.3.

126. *See* RSWG Report, *supra* note 111, Introduction: Views on Workshop Topics; Technology Development and Transfer.

127. *See* RSWG Report, *supra* note 111, Introduction: Views on Workshop Topics; Technology Development and Transfer, at 2.

128. *See* RSWG Report, *supra* note 111, Section II: Technology Transfer; A. Overview, at 5.

of legal barriers to transfer of technologies, and "constraints involving property rights."[129]

While all nations share a "common responsibility"[130] for dealing with global climate change issues, the RSWG Report recommends that "industrialized countries should show leadership by initiating domestic actions to limit and reduce emissions of carbon dioxide . . . and providing financial support to developing nations . . . ."[131] To accomplish the latter, some nations suggest strengthening existing financial institutions and expanding their mandates to address climate change.[132] Other nations want to develop new institutions or mechanisms.[133]

Finally, the RSWG agrees that economic and market mechanisms should be used to take into account environmental impacts:

> Economic instruments, through their encouragement of flexible selection of abatement measures, offer the possibility of achieving environmental improvements at a lower cost than regulatory instruments. Economic instruments also offer the opportunity for countries to introduce limitation/reduction and adaptation measures while more detailed regulatory or other measures are being formulated and implemented.[134]

Some of the instruments discussed are "regulations, tradeable emission permits, emission charges, subsidies and sanctions."[135] Developed[136] nations are also concerned that "clear assessments of the costs, benefits and resource implications [be made] . . . reflecting where possible the full value of natural resources."[137] It is unclear if many developing nations, with their more interventionist economic policies, share this concern.

In sum, all the nations argue that regulation of carbon dioxide and other greenhouse gases is necessary, that technological research and development should be promoted, that technologies should be

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129. *See* RSWG Report, *supra* note 111, Section II: Technology Transfer; B. Factors that Impede Transfer of Technologies and Suggested Solutions, at 6; *see also infra* notes 163-69 and accompanying text.

130. *Id.* RSWG Report, *supra* note 111, at 2.

131. *Id.*

132. *Id.*

133. *Id.*

134. *Id.* at 1.

135. *Id.*

136. By developed nations I refer to those known as the G-7: Canada, the Federal Republic of Germany, France, Italy, Japan, the United Kingdom, and the United States.

137. National Climate Program Office, *G-7 Nations Identify Environmental Issues as a Major Concern in Their Joint Communique*, 4 U.S. IPCC News ¶37 (August 1989) (emphasis deleted) (available from the U.S. Dep't of State).

transferred to developing nations on a priority basis, that the industrialized nations should lead the way, and that market mechanisms to accomplish these goals are preferable. Unfortunately, agreement at this level of generality masks considerable disagreement about specifics, since altering the amount of carbon dioxide generated has fundamental impacts upon a nation's lifestyle and economy.[138] Australia's representative to the RSWG stated that "[t]his has enormous significance for the highly industrialized developed countries and for the rapidly developing countries of Asia. The resultant changes will flow on to countries which at the moment are neither major producers nor consumers of energy."[139]

C. *Prospects for Agreement*

1. Emissions Limitations

As discussed in Section II, the long-term participation of the developing nations is crucial.[140] At present, per capita emissions of greenhouse gases in developing countries are very low.[141] However, their share of total emissions is forecast to grow substantially[142] as a result of expected population growth,[143] and increased per capita energy use[144] as these nations industrialize.[145] These nations are unwilling to curtail development[146] and forego improvements in their standard of living. They believe that:

> the first and largest response on the global warming threat should come from the industrial nations. They should not wait on international agreement to begin a major effort. . . . The industrial countries have the primary responsibilities for reducing the use of fossil fuels . . . and for committing major economic, technological and political resources to this issue.[147]

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138. G. Kretschmer, *Global Warming: Australian Impacts and Responses* 14 (1989) (available from the U.S. Dep't of State).

139. *Id. See also supra* note 26 and accompanying text (discussing the difficulties in determining "winners" and "losers" as a result of the greenhouse effect).

140. *See supra* notes 54-57 and accompanying text.

141. POLICY OPTIONS, *supra* note 2, at 87.

142. *See supra* notes 54-57 and accompanying text.

143. POLICY OPTIONS, *supra* note 2, ch. IV at 5-12.

144. POLICY OPTIONS, *supra* note 2, at 56-57.

145. GRUBB, *supra* note 57, at 18.

146. "The developing countries' contribution in response to the greenhouse challenge should be carried out in a way that enhances, rather than diminishes, development prospects. *Where these are in conflict, priority should be given to development* . . . ." TATA Energy Research Institute, Conference Statement from the International Conference on "Global Warming and Climate Change: Perspectives from Developing Countries" 8 (Feb. 21-23, 1989) (available from the U.S. Dep't of State) (emphasis added).

147. *Id.*

The difference in energy efficiency between nations compounds these problems.[148] Global emissions could be reduced by almost two-thirds if all nations were as energy efficient as Japan.[149] This situation could never be achieved in practice, however, because "high efficiency in energy use itself requires a degree of economic development."[150]

Differences in indigenous energy reserves must also be considered. Coal is the major fossil fuel used in most countries.[151] Some countries, however, such as the Soviet Union, have major natural gas reserves that could be used to displace coal and reduce carbon emissions relatively painlessly.[152] Brazil, China, India and Indonesia together emit almost as much fossil carbon as all other developing nations.[153] All four nations are expected to experience substantial increases in future demand for fossil fuel energy as their economies grow.[154] Only Indonesia has substantial natural gas reserves; the others all depend on indigenous coal reserves.[155] China alone is expected to increase its coal use fivefold by 2020, increasing world carbon emissions by fifty percent.[156]

Commentator Michael Grubb contends that "[t]hese variations rule out any [emission reduction] targets based upon equal percentage reductions as a practical and effective tool . . . ."[157] Not only would any agreement be hard to negotiate, it would also be economically inefficient.[158] An alternative would be for the nations to agree

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148. GRUBB, *supra* note 57, at 17.

149. *Id.*

150. The statistics are also magnified by exchange rate effects. *Id.*

151. *See* Energy Information Administration, U.S. Department of Energy, Annual Energy Review 1988 at 239-73.

152. GRUBB, *supra* note 57, at 18-19.

153. See chart, *id.* at 15.

154. *See* POLICY OPTIONS, *supra* note 2, ch. V at 25, 29-30, 36-37, 39. For a detailed discussion of expected economic growth in the different countries see World Bank, World Development Report 1987 (1987).

155. GRUBB, *supra* note 57, at 19.

156. *Id.* at 20.

157. Grubb suggests that

> [Japan might argue] that it cannot reduce emissions as much as other industrialized countries because it has already taken major measures to limit fuel use, during the 1970s. As a result, its emissions are substantially lower than any of the other developed countries. . . . By contrast, the US and the USSR both have relatively easy options for reducing emissions: neither uses energy very efficiently . . . and both have options for moving away from coal. . . .

Id. at 20.

158. This is because

> [s]ome nations—such as Japan—might incur substantial costs in achieving relatively modest reductions. Others might be able to reduce by much more for lesser costs. If

to an average reduction and then negotiate which nations should be above or below that average.[159] The only problem is that all the nations would be trying to reduce emissions by less than the average,[160] leaving economic inefficiencies.[161]

2. Technology Transfers

Technology transfer is a fundamental issue.[162] Today's developing countries cannot follow in the footsteps of those of yesterday. To confront the greenhouse effect successfully, "[t]hey will need to 'leapfrog' directly to more advanced and efficient technologies than would occur naturally in the course of development."[163] Despite considerable verbal support, and some indications that the developed nations would provide technology and some financial support, no progress has been made.[164]

Negotiations over technology transfer from developed to developing and undeveloped nations may never be successfully concluded, because developed and developing nations cannot agree about the desirability of transferring technology without strict protection of

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they were bound to equal targets, many relatively cost-effective options for reducing emissions could go unexploited.

Id.

159. Perhaps the most well known of these efforts is the proposed Princeton Protocol on Factors that Contribute to Global Warming by the Woodrow Wilson School of Public and International Affairs Policy Conference on the Global Environment. (December 14, 1988) (available from U.S. Dep't of State) (The Protocol would limit each nation's carbon emissions individually so as to take into account specific factors such as current level of emissions per capita, current level of development, available resources, etc. The objective was either to increase or decrease a nation's emissions so that, within 80 years, all nations would be emitting at the same per capita level.)

160. The United States is already laying the groundwork for this argument. GRUBB, *supra* note 57, at 20.

161. Some nations might be able to make substantial reductions inexpensively, while others might have to spend a lot. This alternative would not (apparently) allow nations to buy and sell emission rights, and it is too much to expect an agreement to determine the economically efficient balance. If the countries were allowed to buy and sell emission rights, an efficient solution would be achieved regardless of how the rights were allocated. *See* A. POLINSKY, AN INTRODUCTION TO LAW AND ECONOMICS 11-14 (2d ed. 1989); R. POSNER, ECONOMIC ANALYSIS OF LAW 43-45 (3d ed. 1986). *See also* Coase, *The Problem of Social Cost*, 3 J. L. & ECON. 1 (1960).

162. GRUBB, *supra* note 57, at 24.

163. *Id.*

164. At least part of the explanation of the lack of progress is that

> [n]o one has yet addressed a number of fundamental questions about this idea. It has not been suggested who would run such a fund; how it would operate; on what criteria its funds would be raised, and from whom, and what would happen if they did not contribute. Nor have we heard how it would be administered.

Id. (quoting Nicholas Ridley, UK Secretary of State for the Environment).

property rights such as patents.[165] The RSWG described the disagreement: "While some hold that a strict protection of property rights, patents, etc., will promote effective development and transfer of technology, others hold that the level of such protection should conform with overall economic and development policies of the recipient countries."[166] Agreement on this issue is critical to promote the effective transfer of technology.[167] Similar disputes about legal barriers and restrictive trade practices also affect the transfer of technology.[168]

3. Financial Arrangements

Developed nations and the rest of the world will likely not agree as to financial arrangements. All nations agree that existing, and possibly new, financial institutions must be strengthened to deal with this issue as well as the issue of national economic development. The Conference Statement from the International Conference on "Global Warming and Climate Change: Perspectives from Developing Countries" suggests:

> When [developing nations' economic] resources are inadequate for mounting programmes both for needed development of the poor and achieving globally desirable reduction of greenhouse gas emissions, developed countries should be asked to contribute the difference . . . *Having caused the major share of the problem and possessing the resources to do something about it, the industrial countries have a special responsibility to assist the developing countries in finding and financing appropriate responses.*[169]

Some nations express their views candidly. For example, "*India* clarified that it believes the central question is not existing versus new institutions, but of general U.S. dedicated funds. India supports the need for a dedicated fund, either within existing or new institutions."[170]

The United Kingdom and Japan have criticized plans for a binding commitment to transfer resources, but have offered few con-

165. RSWG Report, *supra* note 111, Subcommittee Report on Implementation Measures on Technology Development and Transfer Measures at 6.

166. *Id.* at 6.

167. *Id.*

168. *Id.*

169. TATA Energy Research Institute, Conference Statement from the International Conference on "Global Warming and Climate Change: Perspectives from Developing Countries" (Feb. 21-23, 1989) 8 (available from the U.S. Dep't of State) (emphasis in original).

170. RSWG Report, *supra* note 111, at 21 (emphasis in original).

structive alternatives.[171] There are two possible reasons why developed countries might favor transferring resources to developing countries. First, the economic health of the developing countries is increasingly important to the economic health of the developed countries.[172] Second, transferring resources dedicated to the use of advanced technology would increase market demand for goods and services in which developed countries have a comparative advantage.[173]

In sum, while all the participants agree on the need to limit carbon emissions, the possibility of any agreement similar to those proposed above is unlikely. Similarly, while the need for financial and technological assistance to developing nations is undisputed, any resolution of the issues will be difficult to achieve.

D. *Market-Based Alternatives*[174]

This section discusses three alternative market-based approaches to limiting greenhouse gas emissions and dealing with the resource requirements of the developing countries.

1. Carbon Taxes

In 1989 the concept of a carbon tax[175] was suggested as a method of raising funds to finance research and development and other programs to reduce carbon emissions.[176] A small tax, having little or no impact on relative energy prices or energy efficiency, would still yield substantial sums of money for such purposes.[177]

A tax large enough to have a substantial impact upon fuel choices has been estimated at 30 dollars per ton of carbon.[178] The total revenues from such a tax would be about $100 billion, or 100 times the current United Nations budget.[179] Agreement on allocating

171. GRUBB, *supra* note 57, at 24-25.

172. *Id.* at 25.

173. *Id.*

174. I am heavily indebted to Michael Grubb and Theodore H. Harris for all of this section.

175. This is not simply a tax upon coal. Oil contains approximately 80% the carbon of coal and natural gas contains about 55%. GRUBB, *supra* note 57, at 27. Thus, a tax on carbon emissions would also impact oil and gas prices.

176. *Id.*

177. A tax of $.40/tonne of carbon would raise over $300 million if applied only on carbon used in the European Community. It would raise over $2 billion if applied world-wide. *Id.*

178. *Id.* at 32.

179. *Id.*

these funds is unlikely.[180] Moreover, it is unlikely that such amounts could be raised, because domestic political pressures to minimize the tax would be overwhelming.[181] Furthermore, there would be great incentive to manipulate the exchange rate to minimize the payment.[182] For all these reasons, an agreement to tax carbon emissions is highly unlikely.

2. Production Limitations

Advocates of emission control suggest production limits in the form of permits. Such a permit system would increase the price of fuel.[183] While the advantage is that only producer nations would need to agree, the disadvantage is that they would be seen as an "energy cartel." The hostility of the United States towards the Organization of Petroleum Exporting Countries (OPEC) during the 1970s and early 1980s would probably be analogous to the attitudes user nations would hold should such an agreement be reached.

Other practical problems exist. Any system that provided substantial funds would face two key questions: Who gets the money? and Who decides? Furthermore, such a system essentially creates valuable property rights.[184] Who would get that value? How would it be enforced? There are no answers to these questions. Finally, it is unlikely that the regulators would be able to match demand to supply. Thus, there would be periodic surpluses and shortages of fuel. Accordingly, an agreement to limit carbon emissions through a production permit system should not be expected.

3. Tradeable Emission Permits

The key distinction between Tradeable Emission Permit (TEP) systems and those discussed *supra* is that TEPs may be bought and sold without any central direction. Rather than depend upon regulators, the market will equilibrate the supply and demand for fuel. Grubb describes the system as one that allows governments to negotiate a target global level of carbon emissions, taking into account costs, concerns about climate change and other factors.

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180. *Id.*

181. *Id.*

182. *Id.*

183. This is because the quota would prevent suppliers from producing enough to meet equilibrium demand. Thus, price would be bid up from the equilibrium price as buyers competed for the (relatively) scarce good.

184. For a discussion of the creation of property rights and efficiency see Calabresi & Melamed, *Property Rules, Liability Rules and Inalienability: One View of the Cathedral*, 85 HARV. L. REV. 1089 (1972).

> [B]ut [governments] would not need to agree on specific national targets. *The primary [advantage] would be to decouple the international decision on acceptable levels of carbon emission from the tortuous process of trying to allocate these restrictions among countries.* Governments would also need to agree on the criteria for initially allocating permits. . . .[185]

Since governments would negotiate any agreement, some commentators suggest that permits be issued to the governments for lease as they see fit, subject to a covenant prohibiting the sale of the permits.[186]

The net effect of such "leases" of carbon rights would be to force the polluter to pay the cost of exploiting the common atmospheric resource.[187] Such a system would also allow sovereign governments to retain control over both the recipients of the permits and the nature of the resources exchanged for the permits.[188] Finally, such a system would reduce the need for a large administrative bureaucracy.[189]

A decision on how to allocate the permits among nations must be made in order to carry out either the production limitation or carbon emission permit alternative. Possible allocation criteria include: per capita GNP, land mass, and current emissions.[190] Each of these possibilities has implementation problems.[191] A viable alternative is to allocate the entitlements on the basis of "adult" population.[192] Allowing such permits to be leased only in exchange for technical assistance to the leasing nation would increase the likelihood of such an agreement.[193]

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185. GRUBB, *supra* note 57, at 34.

186. *Id.*

187. *Id.* at 41.

188. *Id.*

189. *Id.*

190. *Id.* at 36.

191. It is difficult to measure GNP, and many countries have informal economies that are considerably larger than the formal ones. Also, shifts in the exchange rate affect such comparisons. Finally, "less developed countries tend to use more energy per unit of GNP. Per GNP allocations would, for example, require India to finance carbon abatement programmes in the US." *Id.* at 36. Land area has no link to human activity. Some sparsely settled nations would receive large allowances, e.g., the Soviet Union, Canada, Brazil, Greenland and Australia. Allocation by current emission levels rewards today's polluters.

For a more detailed discussion, see *id.* at 36-40.

192. *Id.* at 41.

193. *Id.*

E. *Compliance and Enforcement*

A major issue is how to encourage reluctant participants to join in any agreement to limit carbon emissions.[194] The problem is that countries which choose not to participate could "free ride" and would still receive the benefit of an improved atmosphere.[195] Participating countries might even work harder to make up for the absence of the "free rider."[196] Thus, a "free riding" country could get the benefits without paying the price of limiting its carbon emissions.

To avoid this problem, participating nations must create incentives to join the agreement. Since the parties to any agreement would, in essence, be taxing themselves on their carbon emissions, a tax on goods imported from nonparticipating nations equal to the estimated carbon used in producing the goods could be imposed.[197] Similarly, a tax on fossil-fuel exports to nonparticipating countries would be necessary.[198]

V.
IMPLICATIONS FOR THE LEGAL PRACTITIONER

Inside the United States, a significant program to limit carbon dioxide emissions would affect electric utilities most directly. An emissions limitation would also affect other significant direct users of fossil fuel, such as the steel and cement industries. Technology-based standards for carbon emissions will likely result in lawsuits.[199] Efforts to transform the planning function of the electric utility industry may also result in litigation as the utilities attempt to comply with the new regulations imposed by both federal and state regulatory authorities.[200] Finally, there may be litigation over industry's compliance with more stringent energy efficiency

194. *Id.* at 43-45.

195. This is because the atmosphere is an example of a "common" resource, subject to free use by all. Any reduction in carbon emissions would benefit all.

196. This would occur if the participating countries were goal-oriented and the goal was a pre-determined level of carbon concentrations in the ambient atmosphere. The more countries participate, the lower the burden on any one of them.

197. GRUBB, *supra* note 57, at 45.

198. *Id.* There are trade and tariff implications for such taxes that would require either revised or new agreements. *See id.* for a more detailed discussion.

199. The sulfur oxide emission standards already required by the Clean Air Act under §§ 108-111 provide a useful analogy (42 U.S.C. §§ 7408-7411) (1989).

200. One possible result of these efforts would be a revitalization of the U.S. nuclear power industry as a substitute for baseload coal-fired power plants. Should this occur, new litigation created would increase significantly.

standards.[201]

If the United States ratified an international agreement that either imposed production limits or gave emission permits, considerable domestic and international litigation would result.[202] Some of the issues likely to be addressed are: Would existing emitters get all the permits, or would some be set aside for new users? Who should award these potentially valuable permits? Should the permits be sold to the highest bidder, or should equity factors also be considered? If the permits are sold, what should be done with the money? Could the individual permit holders sell the permits among themselves? Could the existing permit holders export the permits? Could the government limit the duration of the permits? Would the government be required to compensate the holders if the permits were not awarded? Has the government "taken" the right to emit carbon under the takings clause of the Fifth and Fourteenth Amendments? What if the permits were awarded and then not renewed?

How will the limitations be enforced? May other nations sue U.S. firms that exceed the limits? May other nations sue the United States or any individual state to enforce those limits? Should the compliance model be taken from the Clean Air Act or should some other model be used? How should the states plan for compliance when an accidental fire could void all plans.[203]

Were a carbon tax "fence" to be erected around countries participating in a carbon emission limitation agreement, other disputes would require resolution. How high a tax should be imposed?

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201. A useful analogy is the litigation surrounding the Corporate Automobile Fuel Economy (CAFE) standards mandated by Title V of the Motor Vehicle Information and Cost Saving Act, 15 U.S.C. § 2002a (1988). Another analogy is the litigation which surrounded the energy efficiency standards for Consumer Products (household appliances) and Industrial Energy Efficiency Improvement Targets mandated by §§ 321-39 and §§ 371-76 of the Energy Policy and Conservation Act of 1975, 42 U.S.C. §§ 6291-309 and §§ 6341-46 (1988) respectively.

202. A useful analogy might be the oil import allocation system created by the Emergency Petroleum Allocation Act of 1973 (15 U.S.C. § 751) as amended and later terminated by President Ronald Reagan in September 1981. Litigation resulting from that system is still ongoing. Interview with Jack Mason, Bode & Associates (January 27, 1990) (representing an anonymous defendant against the U.S. Dep't of Energy). Another analogy might be to the New Source Performance Standards of the Clean Air Act and the concepts of a "bubble" and offsetting reductions in emissions. *See e.g.*, Citizens Against the Refinery's Effects, Inc. v. EPA, 643 F.2d 183 (4th Cir. 1981); Natural Resources Defense Council, Inc. v. Gorsuch, 685 F.2d 718 (D.C. Cir. 1982), rev'd Chevron, U.S.A., Inc. v. Natural Resources Defense Counsel, Inc., 476 U.S. 837 (1984), *U.S. reh'g denied*, 468 U.S. 1227.

203. Such as in Yellowstone National Park several years ago.

Should the tax vary by product?[204] Should the tax vary by nation of origin? Should a nation be penalized a flat rate for not joining the agreement or should the penalty vary by the amount of carbon emitted? How should a nation that is a member of the agreement, but not complying fully, be treated? What organization should have jurisdiction? How should variations in the exchange rate be dealt with?

The development and transfer of technologies that reduce carbon emissions would also result in new and expanded opportunities for the legal profession. In addition to the existing "normal" issues involving international trade, there would be expanded questions about technology ownership and control. Protection of patent rights and licenses would likely be a key issue. Trading resources for technology would require resolution of valuation questions.

Questions of emissions monitoring and the accuracy and reliability of monitoring methodologies could also arise. Finally, there would be considerable debate about the validity of different forecasts of the impacts of the greenhouse effect and how that might affect national allocations of carbon rights. Should they be increased or decreased? By how much and when? Alternatively, there would be disputes among the individual governments about the treaties.

VI.
CONCLUSION

The Clean Air Act[205] provides the U.S. EPA with extensive authority to limit domestic carbon emissions. President Bush has also announced a major expansion of the U.S. Global Climate Change Research Program, including a major reforestation initiative.[206] The United States may also use various international programs, including debt-for-nature swaps to encourage other countries to limit carbon emissions.[207]

While international organizations are developing some fruitful ideas, achieving international agreements on emission limitations, technology transfer and financing face substantial obstacles because they will require the transfer of technological and financial resources from developed to developing countries. The somewhat

204. For example, an energy intensive product would have a higher carbon tax than a raw material.

205. 42 U.S.C. §§ 7401-7642 (1988).

206. Presidential address, *supra* note 71, at 177-178.

207. *Id.*

more promising approach, although not officially proposed, involving tradeable emission permits faces similar difficulties.

The alert legal practitioner may find increased opportunities in international technology transfer and defense of patent rights. Depending upon the international agreement reached, other opportunities may arise. Domestically, there is likely to be an expansion of environmental and public utility regulation and litigation as the government begins to control carbon emissions.

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