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Present Efforts Will Not Make the Holes Disappear: International Efforts to Report the Ozone Layer

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PRESENT EFFORTS WILL NOT MAKE THE HOLES DISAPPEAR: INTERNATIONAL EFFORTS TO PROTECT THE OZONE LAYER

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I. INTRODUCTION

The ozone layer surrounds our planet and protects us from overexposure to the sun's ultraviolet rays.[1] Scientists warn that chlorofluorocarbons (CFCs) deplete the ozone layer allowing more ultraviolet radiation to reach the earth which could cause an epidemic of skin cancer, destroy the base of the marine food chain, and significantly harm animals and crops.[2] On January 1, 1989, the Protocol on Substances that Deplete the Ozone Layer (Montreal Protocol),[3] an unprecedented international agreement to protect the ozone layer by reducing CFCs, became effective.[4] The Montreal Protocol was the first international agreement to recognize that CFCs pose a danger to the

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1. Phillips, *Can Ozone Holes be Plugged in Time?*, CAN. GEOGRAPHIC, June-July 1989, at 9, 11. Ozone is the only atmospheric gas that shields us from potentially lethal exposure to ultraviolet radiation. *Id.*

2. Edelson, *The Man Who Knew Too Much*, POPULAR SCI., Jan. 1989, at 61.

3. *See generally* Montreal Protocol on Substances that Deplete the Ozone Layer, *opened for signature* Sept. 16, 1987, *reprinted in* 26 I.L.M. 1550 (1987) [hereinafter Montreal Protocol].

4. Goldbaum, Hunter, Mackerron, & Ushio, *A Treaty to Ground CFCs May Push Prices Upward*, CHEM. WK., Sept. 30, 1987, at 6. On September 16, 1987, 47 nations approved the agreement. Twenty-four nations, including the United States, Canada, Japan, and the 12-nation European Community, immediately signed the Montreal Protocol on Substances that Deplete the Ozone Layer. The Montreal Protocol purports to protect the ozone layer by freezing and then reducing the production and use of certain CFCs: CFC-11, -12, -113, -114, and -115, and halons which may pose more danger than CFCs. *Id. See* Edelson, *supra* note 2, at 60. *See also 47 Countries Sign Treaty to Protect Ozone From Damage by Chemicals*, Daily Rep. Executives (BNA) No. 179, Sept. 17, 1987, at A5 [hereinafter *47 Countries*]. *See generally Ozone Defense*, Info. Access Co. (Jan. 9, 1989).

world environment and to take action to reduce CFC production and use.[5]

The Montreal Protocol laid a strong foundation for future international efforts to protect the ozone layer. It set the stage for both government and private initiatives to reduce CFC production and use, promote CFC containment and recycling, encourage information transfer, and develop CFC substitutes. Although the Montreal Protocol represents a positive trend toward protecting the ozone layer, world leaders must concentrate more energy on the problem. The international community must continue to develop safe products and substitutes, as well as methods to transfer technology to developing nations, to impose a complete ban on ozone-damaging chemicals. These suggestions appear clearer by understanding the history of international efforts to protect the ozone layer.

II. Discovery of Ozone Depletion

The history of ozone layer destruction dates from 1930.[6] In 1930, Thomas Midgley, an American research engineer, developed CFCs as an alternative to the corrosive and toxic refrigerants used at that time.[7] Because CFCs are inert and nontoxic, industries started using them to manufacture many products including refrigerators, air conditioners, aerosol sprays, plastic foams, and semiconductors.[8] However, in 1973, Frank Sherwood Rowland, a University of California at Irvine professor, and Mario Molina, a post-doctoral associate, discovered that CFCs destroy the ozone layer which protects the earth from dangerous ultraviolet radiation.[9] The CFC industry, a two-billion-a-

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5. *47 Countries*, *supra* note 4. The Montreal Protocol was the first international agreement to recognize and act on an environmental threat. *Id.*

6. *See* Cahan, *Just When the Ozone War Looked Winnable . . .*, Bus. Wk., June 12, 1989, at 56. Researchers point to two other ozone depleting chemicals: methyl chloroform, a degreasing agent; and carbon tetrachloride, a chemical used to make CFCs, pesticides, and dyes. *Id. See also* Tourangeau, *The Montreal Protocol on Substances That Deplete the Ozone Layer: Can it Keep Us All From Needing Hat, Sunglasses, and Suntan Lotion?*, 11 Hastings Int'l & Comp. L. Rev. 509, 522-23 (1988). Halons have the greatest ozone destruction capacity of all man-made chemicals. If nations do not regulate this product, its use will double by the year 2000. *Id. See generally* Edelson, *supra* note 2, at 60.

7. Edelson, *supra* note 2, at 62. Chlorofluorocarbons are inert, noncorrosive, nontoxic, and transparent molecules containing chlorine, fluorine, and carbon. CFCs replaced the previously used refrigerants, sulfur dioxide and ammonia, which are corrosive and toxic. *Id.*

8. *Id.* In 1973, world production of CFCs reached nearly one megaton per year. *Id.*

9. *Id.* at 62-63. Ozone destruction results when CFCs break down in the upper atmosphere. Because CFCs are transparent, they do not absorb visible sunlight; because CFCs are insoluble in water, rain does not wash them away; and because CFCs are inert, they do not react to oxidants. CFCs, therefore, drift up to the stratosphere, the upper atmosphere, where ultraviolet

year business, soon criticized Rowland and Molina's discovery by revealing that their original calculations produced widely divergent results.[10]

The National Academy of Sciences (NAS) issued a report in 1976 supporting the Rowland and Molina theory but giving some deference to the CFC industry position.[11] In 1978, the United States acted on the report by banning CFCs in aerosol sprays; Canada, Sweden, and Norway soon followed suit.[12] In 1979, leaders from around the world met and signed the Geneva Convention on Long Range Transboundary Air Pollution, in which the parties agreed to make broad recommendations about the ozone layer.[13] Although later scientific studies continued to support the ozone depletion theory, further regulation came to a halt.[14] Aside from the CFC ban on aerosol sprays, from 1973 to 1985, the world moved slowly in protecting the ozone layer because Japan needed CFCs for its electronics industry, and the European Community feared a U.S. plot to monopolize the CFC substitute market.[15] The ozone hole discovery, however, dramatically changed the world view.

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radiation releases chlorine atoms from the CFC molecules. The chlorine atoms then start a chain reaction which destroys the ozone molecules comprising the ozone layer. *Id.*; Kindt & Menefee, *The Vexing Problem of Ozone Depletion and International Environmental Law and Policy*, 24 TEX. INT'L L.J. 261, 264 (1989).

10. Edelson, *supra* note 2, at 65. The CFC industry exploited the preliminary results of the ozone depletion testing. Scientists, however, corrected the divergent results by properly simplifying computer models. The original calculations failed to account for the sun not shining at night and ultraviolet radiation reflecting from clouds and the earth's surface. *Id.*

11. *Id.* at 64-5. Rowland and Molina narrowly estimated that ozone depletion reached between 7-13%, while the NAS, in a study released in the fall of 1976, broadly estimated that the depletion reached between 2-20%. Thus, Rowland and Molina predicted that the world should ban CFCs immediately, while the NAS report predicted that the world did not need the ban for a year or two. *Id.*

12. *Id.* at 65. Only the United States, Canada, Norway, and Sweden banned CFCs in aerosol sprays at that time. *Id. See generally* Lobos, *Thinning Air, Better Beware: Chlorofluorocarbons in the Ozone Layer*, 6 DICK. J. INT'L L. 87 (1987) (The author broadly discusses the United States Environmental Protection Agency's limited ban on use of CFCs, by the United States' Clean Air Act, Canadian Environmental Contaminants Act, Sweden's total ban on aerosols made with CFCs, and West Germany's plan to reduce CFC use by 25% through government and industry cooperation.). *Id.*

13. *See generally The Geneva Convention on Long Range Transboundary Air Pollution*, Nov. 13, 1979, 18 I.L.M. 1442.

14. Edelson, *supra* note 2, at 65. Although further regulation came to a halt, the United States Congress acted by calling for NASA to study and report on the problem. *Id.*

15. *Id.* at 102. The Japanese could not see how their electronics industry could survive without CFC-113, which functions as an electronics solvent. *Id.*

In 1985, British scientists discovered an ozone hole over the Antarctic, which exemplified the need for immediate preventative action.[16] The world soon acted. By 1985, international concern had increased, resulting in the Vienna Convention for the Protection of the Ozone Layer.[17] In 1987, forty-seven nations approved and twenty-four nations immediately signed the Montreal Protocol which provided the foundation for modern international efforts to protect the ozone layer.[18]

In 1988, after the parties passed the Montreal Protocol, The National Aeronautical and Space Administration (NASA) gave official recognition to the ozone problem over the Antarctic.[19] In the same year, researchers also found ozone depletion over the Arctic circle.[20] Although Arctic ozone loss is not as extensive as Antarctic loss, similar weather conditions occur over both areas.[21] Another recent study showed ozone thinning over heavily populated areas of the world.[22] Although the Arctic hole and the thinning around the world does not yet rival ozone loss over Antarctica, any loss in concentration increases harm to life on earth.[23] These recent discoveries reveal the importance of the Montreal Protocol.

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16. *Id.* at 65, 102. NASA had been monitoring the Antarctic ozone layer but did not record any ozone depletion because it programmed its computers to disregard absurd readings. This fact exemplifies the proportion of ozone depletion above the Antarctic. The climate of the Antarctic fosters the rapid depletion of the ozone layer. Because the winter Antarctic atmosphere is much colder than anywhere else, water and ice droplets form in the clouds providing surfaces that facilitate CFC release of ozone-destructive chlorine atoms. When the sun appears in the spring, the warming increases the rate of chemical reaction. The chlorine atoms can then destroy the ozone layer at an alarming rate. Ozone destruction over the Antarctic continues with each new spring season. *Id.* Gribben, *More Holes Than One in the Ozone Layer?*, NEW SCIENTIST, May 5, 1988, at 2; Zurer, *International Effort to Examine Arctic Ozone Loss Gets Under Way*, CHEM. & ENG'G NEWS, Jan. 2, 1989, at 31.

17. *See generally Vienna Convention for the Protection of the Ozone Layer*, Mar. 22, 1985, 26 I.L.M. 1520.

18. Goldbaum, *supra* note 4. *See* Edelson, *supra* note 2, at 60; *see also 47 Countries*, *supra* note 4.

19. Edelson, *supra* note 2, at 102. The NASA Ozone Trends Panel issued the report on Mar. 15, 1988.

20. Zurer, *supra* note 16, at 30. The NASA Ozone Trends Panel Report estimates a 2-8% loss over the past 20 years. *Id.*

21. *Id.* at 31. In the last 30 years, only five or six winters were cold enough for the ice particle clouds to form. *Id.*

22. Shabekoff, *Study Shows Significant Decline in Ozone Concentration*, N.Y. Times, Mar. 16, 1988, at A25, col. 3. The ozone layer thins above part of the United States, Canada, Western Europe, Soviet Union, China, and Japan. NASA scientists, in a report released on Mar. 15, 1988, stated that they found a 2-3% loss from 1969-1986, after considering natural depletion. *Id.*

23. *Id.* NASA scientists estimate that "for every 1 percent decline in atmospheric ozone, 2 percent more ultraviolet radiation reaches the earth's surface." *Id.*

III. MONTREAL PROTOCOL

The Montreal Protocol became effective on January 1, 1989.[24] It remains binding on all parties.[25] The Montreal Protocol's key provisions include a ten-year phasedown schedule,[26] a limitation on trade with non-parties,[27] and a section on information exchange.[28]

First, the Montreal Protocol contains a phasedown schedule that requires parties' immediate action.[29] Gradual reductions require developed parties, within ten years, to cut CFCs[30] to fifty percent of 1986 production levels.[31] Within the same time frame, less developed countries may exceed the fifty percent level by fifteen percent.[32] The Montreal Protocol also requires developed parties to cut controlled halons[33] to 1986 levels.[34] Less developed countries' levels may remain ten percent above 1986 levels.[35] The Montreal Protocol does not mention the two other prevalent ozone depleting chlorine-based chemicals, methyl chloroform and carbon tetrachloride. The ban results in much less than a fifty percent overall reduction because the present plan allows less developed countries leeway in reductions and also allows one developed country, the Soviet Union, five years to complete its national economic plan.[36]

Second, the Montreal Protocol places restrictions on trade to encourage Montreal Protocol membership.[37] The Montreal Protocol dis-

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24. Montreal Protocol, *supra* note 3, art. 16, ¶ 1. Article 16 set the effective date of the Montreal Protocol as Jan. 1, 1989 provided at least 11 nations signed, representing at least two-thirds of global consumption. The parties met the criteria by the deadline. *Id. See also* Whitney, *80 Nations Favor Ban to Help Ozone*, N.Y. Times, May 3, 1989, at A13(L).

25. Montreal Protocol, *supra* note 3, art. 19. All parties bound themselves to the obligations under the treaty. Article 19 dictates withdrawal. A party may not withdraw within four years of assuming its control obligations. Withdrawal will take effect one year after the depository receives it, unless the withdrawing party specifies a later date. *Id.*

26. *Id.*, art. 2.

27. *Id.*, art. 4.

28. *Id.*, art. 9.

29. *Id.*, art. 2. Developing nations get a 10 year grace period. The Montreal Protocol has not yet defined "less developed countries," which could lead to problems in deciding where to draw the line. *Id.*

30. *Id.*, annex A, group I. That group consists of CFC-11, CFC-12, CFC-113, CFC-114, CFC-115. *Id.*

31. *Id.*, art. 2, ¶ 2.

32. *Id.*, art. 2.

33. *Id.*, annex A, group II. That group consists of halon 1211, 1301, and 2402. *Id.*

34. *Id.*, art. 2.

35. *Id.*

36. Begley & Hagar, *An Exemplary Ozone Agreement*, NEWSWEEK, Sept. 28, 1987, at 8.

37. *Montreal Protocol*, *supra* note 3, art. 4, ¶ 1-2, at 1554-55.

courages[38] and sometimes prohibits[39] cooperation with non-parties. Parties may not import bulk CFCs and halons, but parties can avoid this provision by importing products made with the restricted chemicals.[40]

Third, the Montreal Protocol requires parties to cooperate to promote research, development, and exchange of information on controlled substances and CFC substitutes.[41] This section maximizes membership by enabling developing parties to obtain information that non-parties cannot obtain.[42] The exchange of new technological information provides the key to enable all parties to implement recycling and substitute technology to protect the ozone layer.

The founders of the Montreal Protocol provided reduction exemptions for developing nations to gain their acceptance.[43] Developing nations refused to sign the Montreal Protocol unless they could use products containing CFCs to meet their basic domestic needs.[44] Member nations feared that if developing nations did not sign the Montreal Protocol, then no one could control a significant increase in the total use of CFCs caused by developing nations.[45] The exemptions have both advantages and disadvantages.

The Montreal Protocol economically aids developing nations. Some advocates of the exemptions argue that since developing nations only recently started industrializing, any CFC restriction on them at this stage would unreasonably burden their weak economies.[46] This argument, however, fails to consider the global scope of the problem.

All nations throughout the world may suffer because of the exemptions. CFC pollution in one part of the world may affect the atmosphere

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38. *Id.*, art. 4, ¶ 5. This section discourages parties from exporting technology to non-parties for production and utilization of controlled substances. *Id.*

39. *Id.*, art. 4, ¶ 6. This section requires parties to refrain from transferring CFC technology to non-parties. *Id.*

40. *Id.*, art. 4, ¶ 1. This section forbids any party from importing any controlled substances from any non-party within one year of the Montreal Protocol effective date. *Id.*

41. *Id.*, art. 9, ¶ 1(b).

42. Capretta, *The Future's So Bright, I Gotta Wear Shades: Future Impacts of the Montreal Protocol on Substances That Deplete the Ozone Layer*, 29 VA. J. INT'L L. 211, 230-31 (1988). *But see* Montreal Protocol, *supra* note 3, art. 9, ¶ 1. In the area of substitutes, art. 4 of the Montreal Protocol does not discourage information exchange to any country. *Id.*

43. *47 Countries*, *supra* note 4. The Montreal Protocol limits CFC use by developing nations to 0.3 kilograms per capita per year. Developing nations currently consume an average of 0.2 kilograms per capita per year. *Id.*

44. *Id.*

45. *Id.*

46. Interview with Professor Dato (Dr.) Visu Sinnedurai, Commissioner of Law Revision Malaysia, Kuala Lumpur, and Visiting Professor at the University of Florida College of Law, Gainesville, Florida (Oct. 27, 1989) [hereinafter Interview].

in the rest of the world.[47] Because researchers have proven scientifically that CFCs destroy the ozone layer which likely will cause severe environmental problems,[48] every nation throughout the world must make every effort to solve the problem.

The exemptions may also have economic disadvantages. CFC reduction by a limited number of nations may result in severe economic discrimination.[49] To illustrate, Japan is a world leader in efforts to reduce CFCs[50] and the only Pacific Rim nation to sign the Montreal Protocol.[51] Japan is also the leading foreign investor in Malaysia, the world's leading exporter of air conditioners and certain semi-conductors[52] which involve the use of CFCs.[53] To avoid possible economic discrimination, parties should discourage Japan from investing in Malaysia's air conditioner and semi-conductor industry.

This example suggests that nations may possibly skirt CFC regulations by investing in CFC industries in the exempted developing nations.[54] Therefore, all nations throughout the world must cooperate in reducing CFC production and use in order to protect the ozone layer. The international community took steps in the right direction in 1989 by transcending the Montreal Protocol requirements and starting new projects to stop ozone destruction.

IV. Efforts to Protect the Ozone Layer

Present projects and proposals fall into the four main areas of bans, containment and recycling, information transfer, and substitutes. First, the international community proposed complete bans on CFCs. In March 1989, Montreal Protocol parties met in Helsinki to discuss further bans on ozone-depleting chemicals.[55] The parties unanimously approved a total phaseout of CFCs and halons.[56] Members will vote

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47. Kirwin, Chi. Tribune, Feb. 18, 1989, at C4, col. 1.

48. *See* Edelson, *supra* note 2, at 62-63.

49. Interview, *supra* note 46.

50. *See generally Summit to Highlight Japan's Role in Ozone Protection*, Kyodo News Serv. (July 13, 1989) [hereinafter *Summit*]. The Japanese government began to cut CFC use and to research CFC substitutes and technology to decompose existing CFC gases. Private Japanese industry also started to develop and cope with CFC substitutes. *Id.*

51. *Ozone Defense*, *supra* note 4.

52. Interview, *supra* note 46.

53. *Ozone Defense*, *supra* note 4.

54. *47 Countries*, *supra* note 4.

55. *Summit*, *supra* note 50; *Japan to Support U.N. Ozone Protection Plan*, Jiji Press Ticker Serv. (Mar. 6, 1989).

56. O'Sullivan, *International Gathering Plans Ways to Safeguard Atmospheric Ozone*, Chem. & Eng'g News, June 26, 1989, at 33.

to make the Helsinki proposal legally binding at the next Protocol meeting in 1990.[57] As long as parties do not place unreasonable time constraints on producers to rush the development of substitutes, the plan should effectively protect the ozone layer.

West Germany suggested further bans in a proposal for a worldwide phaseout of carbon tetrachloride and methyl chloride, two ozone-depleting chemicals that the Montreal Protocol ignores.[58] The electronics industry uses methyl chloride as a substitute for a damaging CFC compound.[59] A ban will force industry leaders to switch to an already available ozone-friendly cleaner.[60]

Similarly, in the United States, the city of Irvine, California passed an ordinance, effective July 1, 1990, that dramatically transcends the Protocol by almost completely prohibiting CFCs.[61] The ordinance forces the community to use available substitutes for CFCs by banning the sale and use of foam packaging and building insulation from producers that use CFCs to manufacture their products.[62] Because the Irvine ordinance affects only one city instead of the entire world, it has unique advantages and disadvantages.

Some advantages of the ordinance are that it may promote rapid CFC reductions because other cities and nations may follow Irvine's lead.[63] It may also result in a more favorable long-term business outlook for Irvine because local industries will have to develop and use CFC alternatives immediately.[64] The ordinance further treats private business fairly because it allows CFC use in areas where CFC alternatives do not yet exist.[65]

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57. *Id.* at 33-34. *See also* Dickson & Marshall, *Europe Recognizes the Ozone Threat*, SCIENCE, Mar. 1989, at 1279. The European Economic Community imposed an 85% ban on Protocol controlled chemicals to take place as soon as possible and a total ban to take place by the year 2000. *Id.*

58. Cahan, *supra* note 6, at 56.

59. *Id.*

60. *See* Reinhold, *Frustrated by Global Efforts, City Fights Ozone on Its Own*, N.Y. Times, July 19, 1989, at A1, col. 5.

61. *Id.* The Irvine Ordinance will prohibit almost all CFC use, including halons, methyl chloroform, and carbon tetrachloride. Exceptions to the ban include use in refrigerator systems and automobile air conditioners, the manufacture of drugs and medical devices, and when military specifications calling for the chemicals. *Id.*

62. *Id.*

63. *Id.*, at A9, col. 5. *Ozone-Depleting Chemicals*, CHEM. & ENG'G NEWS, Sept. 4, 1989, at 53. The North American Congress of Local Governments for a Stratospheric Protection Accord, made up of 24 American and Canadian cities, followed the lead of Irvine, California, by agreeing to ban the use of ozone depleting compounds by 1992, except where no alternative exists. *Id.*

64. Reinhold, *supra* note 60, at A9, col. 5.

65. *Id.*

Some disadvantages are that the ordinance may undermine the smooth phaseout of CFCs under the Montreal Protocol's specific timetable.[66] It also fails to provide a reasonable transition period for private business to phase out CFCs because the law will take effect on July 1, 1990, regardless of the availability of alternatives.[67] Some economic disadvantages are that smaller businesses must invest a higher proportion of their capital than larger businesses to accommodate the change to CFC substitutes.[68] The ordinance might also detrimentally affect the economy of Irvine if businesses simply travel to other cities to produce or consume CFCs.[69] Moreover, if many U.S. cities immediately banned CFCs without a phaseout period, then the U.S. might suffer a comparative economic disadvantage in the world market because other countries would have the benefit of providing a reasonable transition period for private business to phaseout CFCs.[70]

Second, the international community developed containment and recycling programs. The Irvine ordinance also regulates containment and recycling procedures. It requires service stations to purchase units that contain and recycle CFCs.[71] The city chose to charge consumers a few extra dollars to service their automobile air conditioners rather than to release damaging chemicals into the atmosphere.

Similarly, West Germany developed a national system to remove refrigerators and freezers from residents' homes and safely remove and dispose of the CFC refrigerants.[72] The program will either be available free of charge or at minimal cost to consumers.[73] Because cooperation will be voluntary, a larger number of residents will probably respond to the program if the government provides the service free of charge.

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66. *Id.* Goldbaum, *supra* note 4. The Montreal Protocol enunciates a timetable of specific reductions within a specific time frame. The Protocol, therefore, may have less meaning if countries disregard the timetable. *Id.*

67. Reinhold, *supra* note 58, at A9, col. 5. *See generally Summit*, *supra* note 50. Although the Program for Alternative Fluorocarbon Toxicity Testing (PAFT), an international CFC alternative testing organization, started to conduct tests on proposed alternatives for CFC-113 (the only CFC currently available with no alternative), the results of the test might not be disclosed before 1995. *Id.*

68. Reinhold, *supra* note 60, at A9, col. 5. *See* Goldbaum, *supra* note 4, at 6. Replacing CFCs may cost U.S. industry $5-10 billion over the next 20 years. Although both small business and big business must bear this burden, big business has more capital to accommodate the change. *Id.*

69. Reinhold, *supra* note 60, at A9, col. 5.

70. *See generally* Reinhold, *supra* note 60, at A1, col. 5.

71. *Id.*

72. *Germany to Collect Fridges for Recycling*, NEW SCIENTIST, Mar. 11, 1989, at 26.

73. *Id.*

In Britain, a retailer in the private sector implemented a recycling scheme in which the company will remove old refrigerators and freezers from the homes of those persons who purchase new systems from the company.[74] The operation creates goodwill for the company and simultaneously protects the ozone layer. Individual nations should also share project information with the rest of the world to effectively protect the ozone layer.

Third, world leaders presently stress information transfer between nations. The Helsinki proposal contains a provision that requires parties to make information, research, and training available to developing nations.[75] It also requires parties to explore funding for the transfer of technology and equipment.[76] Two developing non-parties, China and India, produce vast amounts of CFCs.[77] Before either nation will sign the Montreal Protocol, both require the Montreal Protocol's rich nations to fund the transfer of substitute technology to Montreal Protocol parties.[78] The information transfer issue also received attention from the rest of the world.

Recently, forty-six Commonwealth nations, including England, Canada, Australia, and many developing Asian and African nations, met in Malaysia to discuss important environmental problems, including ozone depletion.[79] The international group expressed concern about the use of CFCs and issued a declaration that all nations throughout the world should attempt to reduce CFC production and use.[80] The meeting recognized that developing nations together with industrialized nations must accept responsibility to reduce CFCs to protect the ozone layer.[81] The Commonwealth meeting exemplified the need to change certain provisions of the Montreal Protocol that exempt developing nations from the world effort to protect the ozone layer.[82]

Fourth, both government and private industry promote efforts to create CFC substitutes. The international community began to develop

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74. *Id.*

75. O'Sullivan, *supra* note 56, at 33.

76. *Id.*

77. Goldstein, *The Ozone Trap*, FAR E. ECON. REV., Apr. 13, 1989, at 45.

78. MacKenzie, *Countries Agree More Help for the Ozone Layer*, NEW SCIENTIST, May 6, 1989, at 25. These nations are in a unique position because of their growing population and expanding use and manufacture of CFCs. Their use and manufacture of CFCs present a danger to the ozone layer if these nations do not sign the Montreal Protocol which would commit them to control their use and to help find substitutes. *See also* Goldstein, *supra* note 77, at 45.

79. Interview, *supra* note 46. Heads of states came from England, Canada, Australia, New Zealand, Singapore, Malaysia, India, and many developing nations of Asia and Africa. *Id.*

80. *Id.*

81. *Id.*

82. *47 Countries*, *supra* note 4.

substitutes to fill the gap that the Montreal Protocol bans created. Japan began taking an agressive role in CFC substitute technology in 1989 by starting a four-year program to research and develop CFC substitutes.[83] Private Japanese manufacturers also started taking immediate action to develop and cope with CFC substitutes.[84] Further, Japan proposed to start research in 1990 to develop technologies capable of decomposing existing CFC gases.[85] Worldwide, a few major producers joined forces to create safe substitutes.[86] So far, substitutes are less effective and more expensive than presently used ozone damaging chemicals. These chemicals might also worsen the world's greenhouse effect.[87]

Producers usually follow one of two paths in substitute development. On the first path, producers vary the chemical structure of CFCs to make them less stable.[88] These chemicals break down at lower altitudes and usually do not reach the stratosphere.[89]

Besides alteration, producers may abandon CFCs in favor of chemicals that contain no ozone-damaging chlorine or bromine.[90] To illus-

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83. *Summit, supra* note 50. Japan proposed to cut its output of the five fully halogenated CFCs, CFC-11, -12, -113, -114, and -115, by 30% following the requirements of the Montreal Protocol. *Id.*

84. *Id.* Of the five CFCs prohibited by the Montreal Protocol, world CFC producers have developed substitutes for four: CFC-11, -12, -114, and -115. In February 1989, Asahi Glass Co., a Japanese CFC producer, revealed two substitutes for CFC 113, which received only preliminary testing. PAFT might not disclose its official testing results before 1995. Also, Fujitsu, a Japanese electronic chip manufacturer, proposes to completely ban CFC use before 1996. *Id.*

85. *Id.*

86. *See* Doolittle, *Underestimating Ozone Depletion: The Meandering Road to the Montreal Protocol and Beyond*, 16 ECOLOGY L.Q. 407, at 415 (1989). Petroform and American Telephone and Telegraph have been collaborating to test a safe CFC product that the industry can use to clean electronic equipment. *Id. See also* Shabekoff, *Race for Substitutes to Help Save Ozone*, N.Y. Times, Mar. 31, 1988, at D1. Major CFC producers from around the world formed the PAFT consortium to expedite the search for substitutes and to avoid duplication of testing. *Id.* Jones, *ICI Edges Ahead in Race of Researchers Seeking Safer Substitutes*, NEW SCIENTIST, May 26, 1988, at 58. Two United States producers, Allied Signal and Atochem, pooled their efforts to develop substitutes. *Id.*

87. Goldstein, *supra* note 77, at 46. Less efficient chemicals require more energy to produce the intended result. In turn, the increased input of energy may depend on the burning of fossil fuels, which releases carbon dioxide, a major contributor to the global warming trend. *Id.*

88. Monastersky, *Decline of the CFC Empire*, SCI. NEWS, Apr. 9, 1988, at 235. Producers make CFCs less stable by adding a disruptive hydrogen atom. *Id.*

89. *Id.* Producers can use HCFC-22, an altered CFC, in air conditioners, but the chemical operates at a higher pressure than CFC-12. Thus, HCFC-22 systems require substantial redesign. HCFC-22 has a 0.05 ozone depletion level and CFC-12 has 1.0 ozone depletion level. *CFC Issue Tops ASHRAE's List of Worries*, AIR CONDITIONING, HEATING, AND REFRIGERATION NEWS, Mar. 13, 1989, at 12. HCFC-22 may replace the popular refrigerant CFC-12. *Id.*

90. Monastersky, *supra* note 88. Although not yet available, producers might use HFC-134a instead of HCFC-22 to replace the refrigerant CFC-12. HFC-134a operates with existing cooling

trate, Alpha Graphic Laminating, a New Zealand company, developed a method of lining cardboard with aluminum film for use in the packaging industry.[91] The product costs less and remains sturdier in transit than the foam packages the industry now uses.[92] These changes and proposals represent a positive trend toward protecting the ozone layer, but the world must continue to act.

V. Program to Combat Ozone Depletion

Because recent discoveries reveal that CFCs pose more of a danger than originally believed, the international community must amend the Montreal Protocol and develop new programs to protect the ozone layer. The discovery of the ozone hole above the Antarctic reveals that under special circumstances, CFCs can destroy the ozone layer extremely rapidly.[93] Moreover, the discovery of ozone depletion above the Arctic also reveals that the problem soon may affect heavily populated areas of the world.[94] Scientists warn that atmospheric changes caused by CFCs appear so clearly that the international community must act immediately to preserve the world environment.[95] Nations, therefore, must phase out ozone-depleting chemicals, contain and recycle the chemicals until replaced, and establish funds to transfer and implement new technology in less developed countries. Parties must do so before the Montreal Protocol becomes obsolete.

First, parties should amend the Montreal Protocol to require a total phaseout of all ozone-depleting chemicals. Professor Frank Sherwood Rowland, who first discovered that CFCs destroyed the ozone layer, predicted that the world could possibly ban CFCs completely by the year 2000.[96] Japan may help promote such a ban because Japan expressed hope that it can complete the development of CFC substitutes by the year 2000.[97]

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systems without substantial redesign. Producers also make BIOACT EC7 without chlorine or bromine. BIOACT EC7 may replace CFC-113 as an electronic equipment cleaner. Producers make the chemical from extracts of citrus fruit, pine trees, and other natural compounds. *Id.*

91. Gribben, *Cardboard Cuts Out Threat to Ozone Layer*, NEW SCIENTIST, Mar. 17, 1988, at 42. *But see* Monastersky, *supra* note 88. U.S. producers such as DuPont and Allied-Signal have developed other blowing agents for use in foam packaging and insulation. Pennwalt Corporation developed HCFC-141b, an altered CFC, which could be on the market by late 1990 to early 1991. *Id.*

92. Gribben, *supra* note 91.

93. *See* Edelson, *supra* note 2, at 65, 102.

94. *See id.* at 62-63. *See also* Shabekoff, *supra* note 22.

95. Edelson, *supra* note 2, at 102.

96. *Ban on Chlorofluorocarbons Possible*, Kyodo News Serv. (Apr. 7, 1989).

97. *Summit*, *supra* note 50.

The Protocol should immediately ban CFCs for all non essential uses. If parties impose a deadline for ozone-depleting chemicals, the deadline should be flexible to allow companies to perform thorough toxicity tests.[98] Instead of an absolute year, the deadline should relate to a specific time period after researchers determine the safety and feasibility of a substitute. The Protocol could require the total phaseout of replaced chemicals within one year from the time of availability, which would give producers and users time to replace equipment.

Additionally, all nations should tax CFC producers to encourage them to develop substitutes. The tax would apply to windfall profits, if any, from the increased demand for CFCs due to the Protocol's quota. All nations should earmark the tax money for grants to producers to promote substitute development.[99]

Second, the Protocol should require parties to use available methods to contain and recycle CFCs. If nations do not take the initiative, private businesses should do so on their own. Using containment and recycling units would help protect the ozone layer and at the same time would promote goodwill for the company. These units cost a few thousand dollars each,[100] but through government funding or consumer fees of a few extra dollars, nations could recycle instead of release dangerous CFCs into the air.

Third, the Protocol addresses the special needs of developing countries but should require developed nations to establish a fund to transfer information and technology to developing nations. Without a fund, non-party developing countries would take time to develop CFCs and would use their less expensive, damaging chemicals rather than more expensive substitutes from developed countries. Each nation should pay into the fund based on its own damaging chemical use level. The money could either come from an industry tax on windfall CFC profits or from other government resources. Nations that consume the most would pay the most. As levels drop, the funding would drop. By the time industries use only substitutes, less developed nations would have the technology to produce their own. This program, even if implemented today, would not immediately end ozone depletion.

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98. *See* Smart & Weber, *An Ozone Hole Over Capitol Hill*, BUS. WK., Apr. 4, 1988, at 35. During testing in the late 1970s, DuPont discovered that its promising substitute rendered rats sterile. *Id.*

99. Ogden, *The Montreal Protocol: Confronting the Threat to the Earth's Ozone Layer*, 63 WASH. L. REV. 997, 1013-14 (1988). Ogden proposes a four-step program which includes (1) a phase-out schedule for CFCs and halons based on scientific discoveries, (2) encouragement to recycle and conserve, (3) a fee on windfall profits, earmarked for research on substitutes, and (4) product labeling. *Id.*

100. Reinhold, *supra* note 60.

Existing CFC gases in the atmosphere will continue to threaten the world for future generations, even if all nations stop the release of CFC gases soon.[101] It could take up to one hundred years for the ozone layer to return to normal after CFC consumption ends.[102] These warnings suggest that the international community must cooperate to ban, contain and recycle, and transfer information and technology on CFCs, as well as develop technologies to dissolve existing atmospheric CFCs to successfully combat the ozone depletion problem.

VI. CONCLUSION

Governments and industry clearly understand that past treaties and the present Montreal Protocol will not solve the world's ozone depletion problem. Present international efforts to reduce CFCs do, however, show important progress in world cooperation to preserve our planet. These efforts prove that the international community can successfully exchange ideas and resources to solve a common problem. If world leaders continue to work together to create substitutes to effectively ban ozone depleting chemicals, then throughout the next century the earth's stratosphere will restore itself to its natural destruction and replenishing cycle. Today, however, the observer can summarize the outcome of international efforts to protect the ozone layer in one phrase: world cooperation.

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101. *Summit, supra* note 50. Existing CFCs floating in the atmosphere will pose a problem for future generations because CFCs may persist for many years, continually destroying the ozone layer. *Id.* To illustrate, CFC-11 has an atmospheric lifetime of 65 years; CFC-113, 90 years; and CFC-112, 120 years. *See* Ogden, *supra* note 99, at 1003 n.47.

102. *Advisory Group Wants Ozone Law*, Kyodo News Serv. (Feb. 19, 1989). The ozone layer cannot replenish itself for such a long time because CFCs already have destroyed a significant amount. Scientists predict that CFCs have destroyed 10% of the layer above the Antarctic. *Id.* Dietrich, *EC Joins Efforts to Protect World's Ozone Layer*, Reuter Lib. Rep. (June 16, 1988).