Pace Environmental Law Review

Volume 7
Issue 1 *Fall 1989*

Article 24

September 1989

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Recommended Citation
Louis P. Oliva, *The International Struggle to Save the Ozone Layer*, 7 Pace Envtl. L. Rev. 213 (1989)
DOI: https://doi.org/10.58948/0738-6206.1548
Available at: https://digitalcommons.pace.edu/pelr/vol7/iss1/24

The International Struggle to Save the Ozone Layer

I. Introduction

The ozone layer is vital to the survival of the Earth.[1] Chemical compounds known as chlorofluorocarbons (CFCs) and halons are destroying this protective atmosphere.[2] The Montreal Protocol on Substances That Deplete the Ozone Layer (Protocol),[3] which went into effect on January 1, 1989,[4] is the result of the international effort to reverse the deadly effects of stratospheric ozone depletion.

The Protocol has spurred further world action regarding ozone damage. In the United States, federal, state, and local governments have introduced an abundance of legislation and regulations concerning the use of ozone-depleting chemicals.[5] In addition, the private sector has intensified its efforts to develop safe chemical substitutes.[6]

Although these efforts are a positive step toward protecting the Earth's environment, much more is needed to protect the fragile ozone layer. This comment will review the problems and solutions associated with the struggle to save the ozone layer.

II. Atmospheric Ozone and Chlorofluorocarbons

A. *Stratospheric Ozone's Function*

Ozone, unlike other abundant atmospheric gases, repre-

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1. *See infra* notes 70-93.

2. *See infra* notes 27-69.

3. Montreal Protocol on Substances that Deplete the Ozone Layer, *opened for signature*, Sept. 16, 1987, *reprinted in* 26 I.L.M. 1541 (1987) [hereinafter Protocol] (Entry into force Jan. 1, 1989).

4. *International Ozone Treaty Goes Into Effect*, Chem. & Eng'g News, Jan. 2, 1989, at 25, col. 2 [hereinafter *Treaty*].

5. *See infra* notes 122-84 & 292-378.

6. *See infra* notes 235-74.

sents only a small percentage of the total atmosphere with an average concentration of about 300 parts per billion in volume.[7] If the ozone layer were compressed into a band of pure gas by the earth's surface pressure, it would be only one-eighth of an inch thick.[8] Yet the ozone layer's important function should not be judged by its size.

> While ozone found at ground levels contributes to smog, the gauzy layer in the stratosphere has two purposes, and both of them are beneficial to living things. First, ozone absorbs much of the sun's harmful ultraviolet light and is the only substance that does so. Second, by absorbing some of the sun's rays, ozone creates the stratosphere — a layer of the atmosphere in which temperatures rise with the altitude thereby regulating worldwide circulation patterns . . . .[9]

Stratospheric ozone is continually produced and destroyed in the upper atmosphere by complex natural forces.[10] The interaction of oxygen with sunlight results in the formation of stratospheric ozone.[11] The natural destruction of stratospheric ozone occurs when it recombines with atomic oxygen to form two diatomic oxygen molecules.[12] This delicate balance between natural formation and destruction maintains an adequate ozone shield.

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7. Oxygen and nitrogen are two abundant atmospheric gases. Rowland, *A Threat to Earth's Protective Shield*, 12 EPA J. 4 (Dec. 1986).

8. EPA, *Effects of Changes in Stratospheric Ozone and Climate, 1* OVERVIEW 69 (1986) [hereinafter *Effects*].

9. S. ROAN, OZONE CRISIS 7-8 (1989). The stratosphere also keeps weather confined to the troposphere, the atmospheric layer closest to the earth. *Id.* The stratosphere is directly above the troposphere, followed by the mesosphere and the ionosphere, which is the upper boundary of the atmosphere. *Id.* at 7.

10. Rowland, *supra* note 7. "Most of the ozone in the earth's atmosphere resides in . . . the stratosphere. The stratosphere extends from about [eight] km at the poles and [seventeen] km at the equator, to about [fifty] km above the earth's surface." *Effects*, *supra* note 8, at 69.

11. NAT'L ACAD. SCI., NAT'L ACAD. ENG'G & INST. OF MED., GLOBAL ENVIRONMENTAL CHANGE - RECOMMENDATIONS FOR PRESIDENT-ELECT GEORGE BUSH 8 (1988) [hereinafter ACADEMY].

12. Rowland, *supra* note 7.

B. *The Evolution of Chlorofluorocarbons*

Thomas Midgeley invented chlorofluorocarbons (CFCs) in 1930.[13] These compounds are versatile and, initially, were considered safe.[14] They easily transform from liquid to gas under low pressure.[15] The ability to change forms easily under low pressure has made CFCs a staple in the refrigeration industry. The chemical vaporizes when injected into low-pressure coils, absorbing heat and leaving the coils cold.[16]

CFCs, when kept under high pressure, can be used as an aerosol propellant.[17] The use of CFCs as a propellant began during the World War II battle against malaria.[18] Since the war, CFCs have been utilized as propellants in everything from hair spray to deodorant.[19]

In the 1950s, industries began to mix liquified CFCs with plastic resin, which was then blown into low-pressure chambers to form the plastic into various shapes.[20] This plastic, CFCs mixed with plastic resin, is known as polyurethane.[21] The use of CFCs in plastics is wide-reaching and varied: "Today, CFCs annually serve as blowing agents for three billion pounds of plastic raw material fashioned into building insulation, car seats and bumpers, bedding, egg cartons and picnic coolers. CFC-blown insulation is said to be twice as energy-efficient as Fiberglas."[22] In addition, the potential use of CFCs as a coolant began to be realized during the 1950s when home, business, and automobile air conditioning became widely available.

Today, electronics manufacturers use CFC-based solvents

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13. Gannes, *A Down-To-Earth Job: Saving the Sky*, FORTUNE, Mar. 14, 1988, at 133, 136.

14. *Id.*

15. Weisskopf, *CFCs: Rise and Fall of Chemical 'Miracle'*, Wash. Post, Apr. 10, 1988, at A18, col. 1.

16. This is the process used in home refrigerators. The same process also works in air conditioners, which blow air over the coils and into a room. *Id.*

17. *Id.*

18. *Id.*

19. *Id.*

20. *Id.*

21. *Id.*

22. *Id.*

to clean microchips and circuit boards, as well as to clean debris and excess solder off the microchips and electronic parts.[23] A CFC mixture produces a nonflammable gas that sterilizes a hospital's medical equipment.[24]

The United States has an enormous stake in the production of CFCs. United States' manufacturers produce thirty percent of the two billion pounds of CFCs produced annually worldwide and there is $13.5 billion invested in existing equipment which uses CFCs.[25] There are currently over one hundred million home refrigerators and ninety million auto air conditioners which use CFC technology.[26]

C. *The Chemical Interaction between CFCs and Ozone*

CFCs create havoc in the upper atmosphere. Their unique properties, chemical inertia and non-toxicity, make CFCs useful in industry and consumer products.[27] Yet, "[i]t is this very absence of chemical reactivity that makes CFCs so dangerous to the ozone layer. Unlike less inert compounds, CFCs are not destroyed or removed in the lower atmosphere by rainout, oxidation, or sunlight."[28] Instead, CFCs float into the stratosphere where their chlorine components are released into the atmosphere under the effects of ultraviolet radiation (UV).[29] Chlorine monoxide, a key chlorine compound, combines with itself to form chlorine dioxide, which acts as a catalyst in the rapid destruction of ozone.[30] Chlorine dioxide is broken down by ultraviolet light to form more chlorine atoms.[31] Each chlorine atom destroys about 100,000 molecules of ozone before the chain reaction is permanently ended.[32]

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23. Gannes, *supra* note 13.
24. *Id.*
25. Weisskopf, *supra* note 15. These figures are from 1988.
26. *Id.*
27. Rowland, *supra* note 7, at 5.
28. *Id.*
29. *Id.*
30. *Scientists Determine Specific Process By Which CFCs Destroy Antarctic Ozone*, 19 Env't Rep. (BNA) 1622, 1623 (Dec. 9, 1988) [hereinafter *Scientists*].
31. *Id.*
32. Rowland, *supra* note 7, at 5.

This is a cyclical reaction since chlorine monoxide is formed when chlorine atoms destroy ozone.[33]

CFCs are the main source of chlorine monoxide and chlorine in the upper atmosphere.[34] The durability of CFCs in the atmosphere also compounds the problem. Many CFCs will remain in the atmosphere for several decades:[35] "The atmospheric lifetimes for the most commonly used CFC compounds (CFC-11, CFC-12, and CFC-13), in fact, have been estimated to be from 75 to 110 years."[36] This longevity will prolong the cycle of ozone depletion well into the next century even if the use of all CFCs ends today.

In 1974, Dr. Mario Molina and Dr. Sherwood Rowland showed that CFCs are not destroyed in the troposphere (the lower atmosphere), and that they remain intact for many decades, slowly drifting up into the stratosphere.[37] The majority of CFCs, that have been released since the 1930s, are still in the lower atmosphere.[38] Thus, ozone depletion will intensify in the future.[39]

There are many sources of these ozone-destroying compounds. Industries using CFCs in manufacturing processes, such as plastic insulation manufacturing, emit significant amounts of CFCs into the atmosphere. CFCs also enter the atmosphere when they leak from discarded air conditioners and refrigerators or when foam products in landfills disintegrate.[40]

Another group of chemicals, the halons, are widely used

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33. *Scientists*, *supra* note 30, at 1623. Chlorine monoxide is made up of one atom of chlorine and one atom of oxygen. *Id.* at 1622-23.

34. *Id.*

35. Rowland, *supra* note 7, at 5.

36. *Id.*

37. Molina & Rowland, *Stratospheric Sink for Chlorofluoromethanes: Chlorine Atomic-Atalysed Destruction of Ozone*, 249 NATURE 810 (1974).

38. S. ROAN, *supra* note 9, at 10. The two chemists' theories have now gained wide acceptance. *Study Shows Significant Decline in Ozone Layer*, N.Y. Times, Mar. 16, 1988, at A25, col. 1 [hereinafter *Decline*].

39. S. ROAN, *supra* note 9, at 10; *Decline*, *supra* note 38.

40. Lemonick, *The Heat Is On*, TIME, Oct. 19, 1987 at 58, 59, 62. CFCs leak from air conditioners and refrigerators which are not working properly. Also, automobile repair shops release CFCs from automobile air conditioners during repairs. Yet, some repair shops do recycle CFCs. *See* 8 NRDC NEWSLINE 5 (1990).

in fire extinguishers and contribute to the destruction of stratospheric ozone.[41] Halons are produced in far smaller quantities than CFCs and there is little information regarding worldwide halon production and use.[42] One fact regarding halons is known: they are substantially more potent than CFCs in the ozone-depleting cycle.[43]

D. *Discovering the Problem*

The most important result of early research on CFCs and ozone depletion is the more intense scrutiny of the problem it engendered. The United Nations Environmental Programme[44] assembled a panel of experts to study the problem in 1977.[45] Periodic workshops were held and new information regarding ozone destruction was formulated.

Since 1957, scientists from the British Antarctic Survey[46] have routinely measured the ozone layer from ground-based observations above the Antarctic.[47] In May 1985, these scientists discovered that the ozone levels during the time period from September to mid-November (the Antarctic spring) had fallen considerably.[48] The data showed that a forty percent loss in total ozone had occurred since the 1960s over Halley

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41. EPA, CFCs AND STRATOSPHERIC OZONE 1 (Dec. 1987) [hereinafter OZONE]; The Natural Resources Defense Council recently demanded a ban on methyl chloroform (MC), claiming it causes sixteen percent of ozone depletion. MC is currently used as an interim substitute for CFCs, primarily to remove grease from metals. *NRDC Demands Ban On Methyl Chloroform; Claims It Causes 16 Perecent of Ozone Loss*, 13 Chem. Reg. Rep. (BNA) 1333 (Jan. 19, 1990); *Phase-Out of Methyl Chloroform Use Called For by NRDC To Protect Ozone Layer*, 20 Env't Rep. (BNA) 1629 (Jan. 19, 1990).

42. *Ozone*, *supra* note 41, at 3.

43. *Id.* Bromine in halons is more potent in destroying ozone than chlorine. *Id.* at 1, 3.

44. The United Nations Environmental Programme is a United Nations office which researches, discusses and studies environmental problems. S. ROAN, *supra* note 9, at 101.

45. *Id.*

46. The British Antarctic Survey is conducted by a small, relatively unknown group of researchers who have been measuring various gases in the Antarctic since 1957. *Id.* at 125-26.

47. *The Ozone Hole Over Antarctica*, 12 EPA J. 6 (Dec. 1986).

48. *Id.*

Bay.[49] These findings were very disturbing because the magnitude of the ozone hole was unexpected and unpredicted.[50] Satellite observations verified the findings of the British scientists.[51]

In March 1988, scientists reported a significant decline in protective ozone.[52] A broad consensus of government and academic scientists agreed that man-made chemicals were responsible for much of the ozone loss.[53] The scientists analyzed both ground-based and satellite data.[54] They found that the size of the Antarctic hole increases every year during September and the rate of loss accelerates each year.[55]

The more disturbing findings concern the Northern Hemisphere: "[A]fter discounting for natural causes of depletion, such as decreased solar activity, ozone in the range of 30 degrees to 60 degrees north latitude decreased 1.7 to 3 percent from 1969 to 1986."[56] A totally unpredicted six and two tenths percent loss was found at some latitudes during the wintertime.[57] This finding is significant because the most heavily populated areas of North America, Western Europe, the Soviet Union, China, and Japan lie between thirty degrees and sixty degrees north latitude.[58]

While the largest ozone depletion (fifty percent) occurs during the Antarctic springtime, the data indicated that in the southern hemisphere, ozone had decreased by more than five percent since 1979, at latitudes south of sixty degrees, throughout the entire year.[59] However, Dennis Hartmann of

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49. *Id.*

50. *Id.*

51. NATIONAL OCEANIC AND ATMOSPHERIC ADMIN., EXECUTIVE SUMMARY OF THE OZONE TRENDS PANEL, Mar. 15, 1988, at 18 [hereinafter EXECUTIVE]. Bob Watson of NASA organized the trends panel. S. ROAN, *supra* note 9, at 180.

52. *Decline*, *supra* note 38.

53. *Id.*

54. EXECUTIVE, *supra* note 51.

55. The largest ozone depletion occurs from September to December. *Id.*

56. *Decline*, *supra* note 38.

57. *Id.*

58. *Id.*

59. EXECUTIVE, *supra* note 51.

Total column ozone (at all latitudes south of 60 degrees) was lower in the Antarctic springtime [September through early December] in 1987 than in

the University of Washington found that the drastic fifty percent destruction of ozone over the Antarctic probably results due to conditions that are unique to the Antarctic.[60]

Some good news resulted from this research. "[A] cyclical increase in solar radiation, which stimulates the production of ozone in the atmosphere, from 1986 to 1991 is expected to offset ozone losses to man-made chemicals."[61] However, this is a short-term offset because after 1991, ozone depletion will once again increase as solar radiation declines.[62]

Despite the findings of ozone loss, eight National Weather Service Stations did not report an increase in ultraviolet (UV) radiation from 1974 to 1985.[63] This raises the possibility of an ozone shield in the lower atmosphere.[64] The many unknowns of ozone depletion make research even more critical. One unknown is the role of polar stratospheric clouds (PSCs) in the destruction of ozone.[65] There is very little scientific data regarding this phenomenon, yet, the scientific community believes that PSCs work in combination with CFCs in breaking down the ozone shield.[66] PSCs form during the winter; their formation has increased since 1984.[67] Much more research concerning PSCs' role in ozone depletion is needed. Even with many questions still remaining, 200 researchers reached a consensus in May, 1988 that CFCs are causing the ozone loss.[68]

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any previous year since satellite measurements began (late 1978). In October 1987, the monthly zonal mean amount of total ozone at latitudes 60, 70, and 80 degrees south was about 20%, 40%, and 50% lower, respectively, than in October 1979. In 1987, a region of low ozone over Antarctica lasted until late November/early December, which is the longest since the region of low ozone was first detected.

Id.

60. Williams, *Trouble in Store*, The Seattle Times, Mar. 21, 1988, at F1, col. 1.

61. *Decline*, *supra* note 38.

62. *Id.*

63. Williams, *supra* note 60, at F2, col. 3.

64. *Id.*

65. Monastersky, *Clouds Without A Silver Lining*, 134 SCI. NEWS 249 (1988).

66. *Id.*

67. EXECUTIVE, *supra* note 51, at 19.

68. Begley, Hager & Wang, *A Gaping Hole in the Sky*, NEWSWEEK, July 11, 1988, at 21, 22 [hereinafter Begley].

III. The Consequences of Ozone Depletion

A. *Effects on Human Health*

Skin cancers are linked to exposure to ultraviolet radiation (UV).

> Skin cancer has reached epidemic proportions in the U.S. It is the most common of all cancers, affecting one out of seven Americans. One-third of all new cancers affect the skin; upwards of a half million new cases are treated each year. This is a thirty percent increase in just 10 years.[69]

A two percent increase in skin cancers results when UV-B radiation[70] increases by one percent.[71]

The two most common categories of skin cancer are melanoma and non-melanoma.[72] Malignant melanoma is the most dangerous type of skin cancer.[73] The EPA estimated that in 1987, there would be 25,800 malignant melanoma cases resulting in 5,800 fatalities in the United States.[74] The lifetime risk of contracting malignant melanoma in the United States is about one in one hundred fifty.[75] Non-melanoma skin cancers

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69. Mintzis, *Skin Cancer: The Price for a Depleted Ozone Layer*, 12 EPA J. 7 (Dec. 1986).

70. UV-B radiation is UV radiation which covers the range of radiation from approximately 290 to 320 nanometers. Rowland, *supra* note 7, at 4.

71. Mintzis, *supra* note 69.

> The sun gives off radiation across a broad spectrum. The light detectable by the human eye covers the range from approximately 400 to 700 nanometers in wavelength, or from violet to red in color. Much of the 'near' ultraviolet radiation (320-400 nanometers) also reaches the ground and can be tolerated by biological species at the surface. In contrast, the adjacent segment of the ultraviolet spectrum (UV-B, 290-320 nanometers) has been shown to be biologically damaging.

Rowland, *supra* note 7, at 4.

72. "[M]alignant melanoma . . . arises in the pigment-forming cells (melancytes). When a melanoma reaches a certain thickness, it spreads rapidly to the vital organs of the body . . . . Non-melanoma skin cancers - mainly basal cell and squamous cell carcinomas - affect the skin's surface." *Id.*

73. *Id.*

74. EPA, ASSESSING THE RISKS OF TRACE GASES THAT CAN MODIFY THE STRATOSPHERE, at ES-35 para. 25(b) (Dec. 1987) [hereinafter RISKS].

75. *Id.*

are less dangerous but still very harmful and often deadly.[76]

UV-B radiation also has been linked to the formation of cataracts and other adverse health effects.[77] The most recent studies have found evidence that the risk of cataracts is tripled by extensive exposure to sunlight.[78] The EPA has postulated that "[b]ased on epidemiological studies, if current trends in the use of ozone depleting gases continued, the number of cataract cases would increase by eighteen million (for the population alive today or born before 2075)."[79] UV-B radiation may cause other diseases.[80] Damage to the immune system caused by UV-B radiation may affect a person's overall health.[81] There is evidence that DNA is damaged by radiation.[82] Also, outbreaks of herpes virus infections and leishmaniasis may be a result of immune system damage.[83]

B. *The Earth's Ecosystem*

Research has shown that UV-B radiation can damage aquatic systems, specifically animals in the marine food

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76. "[Non-melanoma skin cancers] in their advanced forms . . . can result in great disfigurement - the loss of an eye, ear, lip, or nose. And close to 2,000 Americans will [have died in 1986] because of non-melanoma cancers that spread - or metastasize - throughout the body." Mintzis, *supra* note 69, at 7.

77. *Effects*, *supra* note 8, at 142. *Eye Protection Urged After New Study Links Cataracts to Sun Rays*, N.Y. Times, Dec. 1, 1988, at B23, col. 1 [hereinafter *Eye Protection*]. OZONE, *supra* note 41, at 2. "Cataracts cloud the lens of the eye, thus limiting vision." *Id.*

78. *Eye Protection*, *supra* note 77. "Cataracts are classified according to where they occur. The cataract linked to ultraviolet exposure is the cortical cataract and forms in the outer layer of the lens. . . ." *Id.* The article goes on to quote Dr. Hugh R. Taylor of Johns Hopkins University School of Medicine stating, "[The] data suggest that for every 10 percent increase in ultraviolet B radiation, there will be a 6 percent increase in cortical cataracts." *Id.* at col. 3-4. But researchers have not found an increase in ultraviolet B radiation. *Id.* at col. 4.

79. OZONE, *supra* note 41, at 2.

80. *Ozone Depletion: Other Health Effects*, 12 EPA J. 8 (Dec. 1986) [hereinafter *Health*]. RISKS, *supra* note 74, at ES-38-ES-39, paras. 32-33. Researchers discovered the danger to the immune system when they irradiated a mouse before transplanting a tumor. The tumor took hold and spread. *Id.*

81. *Health*, *supra* note 80; RISKS, *supra* note 74, at ES-38-ES-39, paras. 32-33.

82. *Effects*, *supra* note 8, at 133-34. DNA is the essential genetic material. *Id.* at 133.

83. *Health*, *supra* note 80. Leishmaniasis is a disfiguring disease, caused by parasites, which is widespread in the tropics. *Id.* RISKS, *supra* note 74, at ES-39, para. 35.

chain.[84] Experiments with marine phytoplankton showed that increasing radiation slowed the process of photosynthesis.[85] Also, phytoplankton died almost completely when UV radiation was increased by ten percent.[86] Researchers believe that damage to the food chain could ultimately cause a collapse of the ecosystem.[87] Yet, evidence suggests this may not happen. Preliminary research indicates that both ocean and land plant life are adjusting to the antarctic ozone hole with negligible effects.[88] Researchers will now try to track long-term effects.

Crops will also be greatly affected by ozone depletion.[89] Experiments on soybeans have shown that increases in radiation, resulting from a twenty-five percent loss of ozone, has caused a twenty to twenty-five percent reduction in crop yield.[90] Furthermore, the quality of the grain, its protein content, and the plant's protection from insects and weeds might be adversely affected.[91]

Some scientists believe that increased UV-B radiation will detrimentally affect two out of three plant species.[92] Climatologists also believe that ozone depletion will change global wind patterns, consequently changing the earth's cli-

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84. RISKS, *supra* note 74, at ES-42-ES-43, para. 46; *Effects*, *supra* note 8, at 175-88.

85. Shabecoff, *As Ozone is Depleted, Much of Life Could Go With It*, N.Y. Times, Apr. 17, 1988, at E28, col. 1.

> [The] marine phytoplankton [are] microscopic plants that flourish in the Antarctic Ocean. These tiny plants . . . are the food source of krill, a shrimp that abounds in the Antarctic waters. Krill, in turn, are the principal food of squid, fish, penguins, seals, whales and other animal life in the southern regions of the globe. The phytoplankton are also a major food source of zooplankton, microscopic marine animals that also form an important link in the food chain . . . . The smaller species of these plants, the kind forming the primary food source for the krill, were especially sensitive to the radiation . . . .

Id. *See Effects*, *supra* note 8, at 179-88.

86. Shabecoff, *supra* note 85.

87. *Id.*

88. *Antarctic Research Finds Few Effects of Hole in Ozone*, Wall St. J., Mar. 21, 1989, at B4, col. 6.

89. Shabecoff, *supra* note 85; RISKS, *supra* note 74, at ES-41-ES-42, paras. 41-45.

90. Shabecoff, *supra* note 85; RISKS, *supra* note 74, at ES-41-ES-42, paras. 41-45.

91. Shabecoff, *supra* note 85; RISKS, *supra* note 74, at ES-41-ES-42, paras. 41-45.

92. Shabecoff, *supra* note 85.

mate and destroying valuable agricultural land.[93]

IV. Efforts To Protect The Ozone Layer

A. *The First Target: Aerosols*

In 1977, the United States Congress amended the Clean Air Act[94] to protect the ozone.[95] The Environmental Protection Agency (EPA) and the Food and Drug Administration (FDA)[96] cut CFC-propelled aerosols by ninety percent in the United States by banning all non-essential uses.[97] Manufacturers of today's aerosol products use an ozone-safe hydrocarbon propellant system.[98]

The United States was not alone in its actions as other countries have also implemented bans. Canada and the Scandinavian countries also banned the use of CFCs in aerosol sprays.[99] Despite existing bans, CFC use in the 1980s returned to the levels of the mid-1970s.[100]

B. *International Cooperation: The Montreal Protocol*

After a period of inaction by the Reagan Administration, a renewed effort to curb CFCs began with Lee Thomas' appointment by President Reagan as the EPA Administrator. The appointment, combined with an increasing amount of hard scientific evidence[101] linking CFCs with ozone depletion,

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93. Begley, *supra* note 68, at 23.

94. 42 U.S.C. §§ 7450-59 (1982).

95. Doniger, *Politics of The Ozone Layer*, ISSUES SCI. & TECH., Spring 1988, at 86, 87.

96. 40 C.F.R. §§ 762.1-.70 (1989); 21 C.F.R. § 2.125 (1989).

97. 40 C.F.R. §§ 762.1-.70 (1989); 21 C.F.R. § 2.125 (1989); Doniger, *supra* note 95. "To deal with other uses of CFCs, EPA proposed a cap on total production." *Id.*

98. *The Saga of Spray Cans*, 12 EPA J. 11 (Dec. 1986) [hereinafter *Saga*]. Today, consumers can still buy quality aerosol products which are less expensive than their CFC-propelled counterparts. "In 1974, CFCs in aerosols accounted for over half of total consumption; by 1978, this use constituted less than 5 percent." *Id.*

99. Doniger, *supra* note 95, at 88.

100. S. ROAN, *supra* note 9, at 113. CFC use, aerosol and non-aerosol, increased in Western Europe and Japan while non-aerosol CFC use increased in countries which had imposed an aerosol ban. *See* Doniger, *supra* note 95, at 88; *see* S. ROAN, *supra* note 9, at 113.

101. *See supra* text accompanying notes 44-68.

led to international cooperation.[102] Negotiations were conducted through United Nations' sponsored meetings which had first begun in the late 1970s.[103]

However, negotiations did not run smoothly. At first, the world's largest CFC producers in Western Europe and Japan refused to agree to any substantial CFC cuts.[104] Progress was stalled further by lobbying pressures of the chemical industry and their sympathizers in governments around the world. Finally, in September 1987, the mounting scientific evidence motivated the parties to reach an agreement: the Montreal Protocol (Protocol).[105]

Under the Protocol, parties must freeze and later reduce their production and use of CFCs and halons.[106] A revision in reduction requirements is to occur if scientific and economic data warrant it.[107] Less developed countries[108] are encouraged to join the Protocol.[109] They will be assisted by the more advanced nations in developing CFC substitutes.[110] The agreement also encourages non-parties to sign the Protocol by restricting trade of ozone-depleting products with non-participants.[111] The parties will meet at least every four years, beginning in 1990, to reassess the provisions pursuant to any new scientific and economic data.[112]

The Protocol became effective January 1, 1989.[113] Yet,

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102. Doniger, *supra* note 95, at 87-90.

103. *Id.* at 144.

104. Doniger, *supra* note 95, at 88-90.

105. Protocol, *supra* note 3.

106. *Id.*, art. 2, *reprinted in* 26 I.L.M. at 1552-53. The Montreal Protocol calls for a freeze in CFC-11, -12, -113, -114, and -115 at 1986 consumption levels beginning in ninety days after entry into force. Reductions of twenty percent from 1986 levels of these same chemicals would be required by July 1, 1993, with reductions of fifty percent by July 1, 1988. Halon -1211, -1301, and -2402 would be frozen at 1986 consumption levels in 1992, or three years after entry into force. *Id.*

107. *Id.*, art. 6, *reprinted in* 26 I.L.M. at 1556.

108. China and India are two examples of less developed countries.

109. Protocol, *supra* note 3, art. 5, *reprinted in* 26 I.L.M. at 1555-56, art. 9, *reprinted in* 26 I.L.M. at 1556-57, art. 10, *reprinted in* 26 I.L.M. at 1557.

110. *Id.*

111. *Id.*, art. 4, *reprinted in* 26 I.L.M. at 1554-55.

112. *Id.*, art. 6, *reprinted in* 26 I.L.M. at 1556.

113. *Treaty*, *supra* note 4.

soon after it was signed, many government officials and scientific organizations proclaimed that the provisions were too weak to halt ozone depletion.[114] This opinion reflected a growing consensus within the scientific community that the problem was much more serious than previously thought. These government officials and scientific organizations called for an earlier reassessment of the Protocol's provisions.[115]

Nations which had already ratified the Protocol met in Finland during May, 1989, to discuss strengthening the Protocol's provisions.[116] On May 2, 1989, eighty nations signed the Helsinki Declaration (Declaration).[117] Four main points in the Declaration supported tougher measures to reduce ozone-depleting CFCs:

- A phase-out of five CFCs that have been blamed for depleting the stratospheric ozone layer, not later than 2000;
- A phase-out of three halons and other ozone-depleting substances as soon as possible;
- Identification of alternative chemicals, products, and technologies; and
- Helping developing countries gain access to information and technology so that they do not pay too high a price for phasing out the chemicals of concern, and development of funding mechanisms to facilitate this.[118]

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114. *EC, Member States Ratify Protocol for Protecting Stratospheric Ozone*, 19 Env't Rep. (BNA) 1756 (Dec. 23, 1988) [hereinafter *Ratify*]. Lee Thomas, EPA Administrator, a NASA scientist, and the National Resource Defense Council (NRDC) all proclaimed the provisions too weak. *NASA Scientist Says Deeper CFC Cutbacks Needed*, 12 Chem. Reg. Rep. (BNA) 1329 (Dec. 2, 1988) [hereinafter *NASA*]; *E.P.A. Chief Asks Total Ban on Ozone-Harming Chemicals*, N.Y. Times, Sept. 27, 1988, at A20, col. 1 [hereinafter *Chief*].

115. *Ratify*, *supra* note 114; *NASA*, *supra* note 114; *Chief*, *supra* note 114.

116. *80 Nations Favor Ban to Help Ozone*, N.Y. Times, May 3, 1989, at A13, col. 1 [hereinafter *Favor*]; *Nations Back Tougher CFC Measures but Decline to Set Up Climate Fund*, 20 Env't Rep. (BNA) 121 (May 12, 1989) [hereinafter *Fund*]; *Nations Back Tougher CFC Measures, But Decline to Set Up Climate Fund*, 13 Chem. Reg. Rep. (BNA) 183 (May 12, 1989) [hereinafter *Climate*].

117. *Favor*, *supra* note 116; *Fund*, *supra* note 116; *Climate*, *supra* note 116.

118. *Fund*, *supra* note 116; *Climate*, *supra* note 116.

Environmentalists find these provisions too lenient, especially since the Declaration is not binding on its signatories.[119] Developing countries criticized the Declaration for its failure to establish an international climate fund.[120] The Helsinki meeting preceded a planned June 1990 meeting where the participants will formally propose amendments to the Protocol.[121]

C. *Federal Regulatory Actions*

In March, 1988, the United States Senate unanimously ratified the Montreal Protocol.[122] President Reagan immediately signed the instrument of ratification on April 5, 1988.[123] The United States fulfilled its commitment under the agreement when the EPA announced, on August 1, 1988, new domestic regulations limiting the production and consumption of certain ozone-depleting CFCs and halons.[124] The Stratospheric Ozone Rule (Rule), enacted under the authority of the Clean Air Act,[125] allocates quotas to each of the firms which engaged in production and consumption of CFCs and halons in 1986. The regulations became effective when the Protocol entered into force on January 1, 1989.[126]

> [The final rule] requires a . . . freeze at 1986 levels of production and consumption (defined as production plus imports minus exports) of CFC-11, -12, -113, -114, and -115

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119. *Fund, supra* note 116; *Climate, supra* note 116. The Declaration does not have the binding effect of a treaty.

120. The fund would have helped developing nations phase-out use and production of the chemicals. *Fund, supra* note 116; *Climate, supra* note 116.

121. In November 1989, at a meeting in Geneva, the Protocol's working parties discussed amendments which would be formally proposed at the June meeting. *Interim Steps Before CFC Phase-Out Debated by Parties to Montreal Protocol*, 13 Chem. Reg. Rep. (BNA) 1187 (Dec. 1, 1989).

122. 100th Cong., 2d Sess., 134 CONG. REC. S2109 (daily ed. Mar. 14, 1988).

123. *Statement on Signing the Montreal Protocol on Ozone-Depleting Substances*, 24 WEEKLY COMP. PRES. DOC. 435 (Apr. 11, 1988).

124. *Rule Limiting Production, Importation of Chlorofluorocarbons, Halons Issued by EPA*, 19 Env't Rep. (BNA) 468 (Aug. 5, 1988).

125. 42 U.S.C. §§ 7401-642 (1982 & Supp. 1987).

126. EPA Protection of Stratospheric Ozone, 53 Fed. Reg. 30,566 (1988) (to be codified at 40 C.F.R. pt. 82); *see* 40 C.F.R. §§ 82.1-.20 (1989).

> based on their relative ozone depletion weights, followed by a phased reduction to 80 percent and 50 percent of 1986 levels beginning in mid-1993 and mid-1998, respectively. It also limits production and consumption of Halon 1211, 1301, and 2401 to 1986 levels beginning as early as 1992. Under specified circumstances, limited increases in production (but not consumption) above these levels will be permitted.[127]

In April 1989, the EPA made several technical revisions to the Rule regarding the timing of control periods.[128] The timing was contingent on when the Protocol went into effect:

> Since the Protocol entered into force on January 1, 1989, § 82.3(f)(1) of EPA's rule now provides that the first control period will begin on July 1, 1989, and run until June 30, 1990, and that subsequent control periods will run from July 1 to June 30 thereafter. Similarly, § 82.3(f)(2) provides that for Group II substances the first control period will run from January 1 to December 31, 1992, and that subsequent control periods will extend from January 1 to December 31 of each year thereafter.[129]

The EPA also proposed several amendments to the Rule in August, 1989.[130] These changes were needed to conform the Rule with recent agreements reached by the Protocol signatories regarding the implementation of the Protocol.[131] "The first proposed amendment implements the . . . interpretation of 'industrial rationalization' . . . . "[132] The second proposed

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127. *Id.*

128. EPA Protection of Stratospheric Ozone, 54 Fed. Reg. 13,502 (1989) (to be codified at 40 C.F.R. pt. 82). Control periods are those periods during which the prohibitions under § 82.4 apply. *Id.* at 13,503. *Chlorofluorocarbons: EPA Makes Technical Revisions To Stratospheric Ozone Protection Rule*, 13 Chem. Reg. Rep. (BNA) 16 (Apr. 7, 1989); *see* 40 C.F.R. § 82.3 (1989).

129. EPA Protection of Stratospheric Ozone, 54 Fed. Reg. 13,502 (1989) (to be codified at 40 C.F.R. pt. 82); *see* 40 C.F.R. § 82.3 (1989).

130. EPA Protection of Stratospheric Ozone, 54 Fed. Reg. 29,353 (1989) (to be codified at 40 C.F.R. pt. 82) (proposed July 12, 1989).

131. *Id.*

132. *Id.*

According to the . . . interpretation, a Party can only increase its production

amendment concerns the definition of exports. "[It] expands the definitions of exports to include used and recycled controlled substances."[133] The EPA also proposed to grant additional allowances or credits to persons who use controlled substances as a feedstock for other substances.[134] The last proposed amendment regards new record keeping requirements for producers of controlled substances.[135] "The . . . producers [would have] to maintain records of the date and estimated quantity of any spills or releases of controlled substances."[136]

The EPA has continued to look for additional ways to slow the growth of CFC use. The EPA sought public comment on a proposal to add a regulatory fee to its use of quotas.[137] This fee would seize the billion-dollar windfall profits which CFC and halon producers would receive as a result of the allocated quota system.[138] The agency believes such windfalls would create an economic incentive for the producers to delay the introduction of CFC substitutes.[139]

The Agency also sought comments on shifting to auctions or further strengthening its quota system with specific-use controls or bans.[140] The auction proposal is an alternative to

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of controlled substances by specified amounts if there is a documented, corresponding decrease in production by another Party, or if the increase in production is exported to Parties operating under Article 5 of the Protocol . . . . EPA's current rule, however, allows an increase up to the production limits for exports to *any* Party.

Id. The amendment regarding the interpretation of "industrial rationalization" has become final. EPA Protection of Stratospheric Ozone, 55 Fed. Reg. 5007 (1990) (to be codified at 40 C.F.R. pt. 82); *Amendment To CFC Rule Outlines Steps For Transferring Production Allotments*, 20 Env't Rep. (BNA) 1826, (Mar. 2, 1990).

133. EPA Protection of Stratospheric Ozone, 54 Fed. Reg. 29,353 (1989) (to be codified at 40 C.F.R. pt. 82) (proposed July 12, 1989).

134. Such allowances and credits will entitle a person to produce or import additional controlled substances. "The current rule only grants such allowances to the person who produces and then consumes the controlled substance as a feedstock." *Id.*

135. *Id.*

136. *Id.*

137. EPA Protection of Stratospheric Ozone, 53 Fed. Reg. 30,604 (1988) (to be codified at 40 C.F.R. pt. 82) (proposed Aug. 12, 1988).

138. *Id.*

139. *Id.*

140. *Id.*

the EPA's rule which allocates rights to past producers and importers.[141] The highest bidders would obtain the available CFCs and halons.[142] The auction system ensures that the limited supply of CFCs and halons are put to their most economical uses.[143] In addition, the system would shift windfall profits from producers to the United States Treasury.[144]

Some CFC and halon-producing industries may respond slowly to CFC-halon market-driven price increases and thus may delay their shift away from these chemicals.[145] EPA officials are also considering requiring certain user groups to increase recycling or to switch to alternative chemicals or processes to prevent unexpected price increases.[146]

In early 1989, the EPA introduced a transfer system as part of the regulatory plan to protect stratospheric ozone.[147] This system permits producers and importers of ozone-depleting chemicals to transfer their production and importation allowances to other companies.[148] However, the producers and importers must first submit transfer claims to the EPA and substantiate that they have allowances to transfer.[149] The EPA is also seeking comments on a coupon plan to be used as an alternative system for allowance transfers.[150] Regulations,

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141. *Id.*

142. *Id.*

143. *Id.*

144. *Id.*

145. The EPA is especially concerned with industries in which the CFCs and halons are a small part of the price of the final goods. Two examples of goods in which the CFCs and halons are a small part of the final price are refrigerators and computers. *Id.*

146. *Id.*

147. EPA Protection of Stratospheric Ozone, 54 Fed. Reg. 6376 (1989) (to be codified at 40 C.F.R. pt. 82). *EPA Rule On CFC Allowance Transfers Sets Requirements, Suggests Coupon System*, 12 Chem. Reg. Rep. (BNA) 1623 (Feb. 10, 1989) [hereinafter *Coupon*]; *see* 40 C.F.R. § 82.12 (1989).

148. *Coupon*, *supra* note 147; EPA Protection of Stratospheric Ozone, 54 Fed. Reg. 6376 (1989) (to be codified at 40 C.F.R. pt. 82); *see* 40 C.F.R. § 82.12 (1989).

149. *Coupon*, *supra* note 147; EPA Protection of Stratospheric Ozone, 54 Fed. Reg. 6376 (1989) (to be codified at 40 C.F.R. pt. 82); *see* 40 C.F.R. § 82.12 (1989).

150. *Coupon*, *supra* note 147; *see* 40 C.F.R. § 82.12 (1989); EPA Protection of Stratospheric Ozone, 54 Fed. Reg. 6376 (1989) (to be codified at 40 C.F.R. pt. 82). Under a coupon system, companies would not have to notify the EPA when they trade CFC allowances. The EPA would give coupons representing a company's full

codified in 1988, provided for the collection of data concerning CFCs.[151] This data has made it easier for the EPA to develop a regulatory scheme.

In an effort to encourage the recycling of CFCs, the EPA published a notice to clarify the applicability of Subtitle C of the Resource Conservation and Recovery Act (RCRA)[152] to CFC refrigerants.[153] Also, in an effort to assist generators, the EPA "announce[d] data which will greatly simplify the burden that the generator of any solid waste must undertake to determine whether the solid waste is hazardous by demonstrating that CFC refrigerants will not exhibit a characteristic of a hazardous waste under normal operating conditions."[154]

On March 21, 1990, the EPA sought comment on whether to add seven ozone-depleting chemicals to the list of substances covered by section 313 of the Emergency Planning and Community Right-to-Know Act (EPCRA).[155] This EPA action resulted from a request by the Natural Resources Defense Council (NRDC) and the governors of New York, New Jersey, and Vermont. On January 9, 1990, the NRDC and the governors petitioned the EPA to add the substances to the list.[156] They contended that the seven substances satisfied EPCRA requirements because the substances are known to cause

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allotment of allowances. The coupons would entitle the company to produce a certain amount of a controlled substance. After importing or producing the substance, the company would give the coupons to the EPA. If the company wants to trade its allowances, it just gives the coupons to its trading partner. *Id.* at 6378.

151. EPA Protection of Stratospheric Ozone, 40 C.F.R. § 82.20 (1989). Producers, exporters, and importers of CFCs in the United States must report the amount of CFCs which they produced, exported, or imported in 1986. *Id.*

152. 42 U.S.C. §§ 6921-39(b) (1982 & Supp. 1987).

153. 54 Fed. Reg. 31,335 (1989) (to be codified at 40 C.F.R. pt. 261); *EPA Issues 'Clarification' of Applicability of RCRA Rules for Regulating CFC Refrigerants*, 20 Env't Rep. (BNA) 632 (Aug. 4, 1989).

154. 54 Fed. Reg. 31,335 (1989) (to be codified at 40 C.F.R. pt. 261); *see* 40 C.F.R. §§ 261.31-.33 (1989).

155. 55 Fed. Reg. 10,473 (1990) (to be codified at 40 C.F.R. pt. 372); 42 U.S.C. §§ 11001-50 (Supp. 1987); *Comment Sought On whether to Add Ozone-Depleting Chemicals to EPCRA*, 20 Env't Rep. (BNA) 1916 (Mar. 30, 1990) [hereinafter *EPCRA*]. The seven substances are CFC-11, CFC-12, CFC-114, CFC-115, Halon-1211, Halon-1301, and Halon-2402. *Id.*

156. *EPCRA*, *supra* note 155.

cancer and other chronic health effects in humans.[157] If the EPA fails to take action within one hundred eighty days, the substances will automatically be added to the list.[158]

D. *State and Local Responses to the Ozone-Depletion Problem*

In the mid-1970s, state and local laws prohibiting the sale of CFC-aerosol products helped reduce CFC emissions.[159] Today, state and local laws prohibiting the sale and/or use of CFC-based products, aerosol and non-aerosol, are reducing emissions even further.

1. *State Action*

On April 26, 1988, Governor Rudy Perpich of Minnesota signed a bill[160] which "prohibit[s] state and local governments from using or purchasing CFC-processed products after July 1, 1989, and will ban the products statewide after January 1, 1990."[161] However, this legislation contains some loopholes. For example, the Minnesota Pollution Control Agency may grant an exemption to the ban if the company can prove a ban on its products would cause undue hardship.[162] This may be very difficult to prove with the advent of safe CFC alternatives. The legislation also provides for studies regarding elimination of all CFC-processed products.[163]

A Minnesota Pollution Control Agency report had urged

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157. *Id.* 42 U.S.C. § 11023(d)(2) (Supp. 1987).

158. July 15 is the deadline which the EPA has to meet. *EPCRA*, *supra* note 155. Since the petition was submitted by state governors, the statute requires automatic listing unless the EPA initiates a rulemaking or publishes a explanation of why the substances should not be listed. 55 Fed. Reg. 10,473 (1990) (to be codified at 40 C.F.R. pt. 372); 42 U.S.C. § 11023(e)(2) (Supp. 1987).

159. New York State's statute is a good example of CFC-aerosol prohibition. *See* N.Y. ENVTL. CONSERV. LAW §§ 38-0101-0111 (McKinney 1984).

160. MINN. STAT. ANN. §§ 116.70-.74 (West Supp. 1989).

161. *Perpich Signs CFC-Limiting Legislation, Will Ban State Purchases, All Uses By 1990*, 19 Env't Rep. (BNA) 83 (May 20, 1988) [hereinafter *Minnesota*]; MINN. STAT. ANN. § 116.71 (West Supp. 1989).

162. *Minnesota*, *supra* note 161; MINN. STAT. ANN. § 116.73 (West Supp. 1989).

163. *Minnesota*, *supra* note 161; MINN. STAT. ANN. § 116.74 (West Supp. 1989).

the state not to wait for federal action.[164] Minnesota, by passing restrictive legislation, could play an important role in ozone protection. "[The state] could cut its emissions of ozone-destroying gases by one-third in three years by banning certain chlorofluorocarbons, labeling others, and restricting use of some CFCs for which alternatives are not available . . . ."[165]

On August 3, 1989, Wisconsin Governor Tommy Thompson signed a state budget[166] which requires that three state agencies, responsible for granting state business development funds, give priority to companies which will use the funds to reduce or eliminate their use of ozone-depleting CFCs or halons.[167] Vermont enacted a bill[168] in May 1989 which prohibits the use of CFCs in automobile air conditioners and bans other ozone-depleting chemicals from a variety of other products.[169] On October 1, 1989, a new Connecticut law[170] was enacted which "prohibits the sale of new products packaged in or constructed of polystyrene foam containing certain chlorofluorocarbons."[171] The law also requires businesses to reduce CFC emissions by air-contaminant sources.[172] Also in 1989, Hawaii enacted a law[173] "restricting sales of chlorofluorocarbon-containing air conditioning refrigerants"[174]

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164. *Minnesota Report Urges State To Limit Emissions of Certain CFCs*, 12 Chem. Reg. Rep. (BNA) 1745 (Mar. 3, 1989).

165. *Id.*

166. 1989 Wis. Legis. Serv. 31 (West).

167. 1989 Wis. Legis. Serv. 31, § 560.605(4) (West); *Wisconsin Business Funds Linked To Reducing CFCs, Halons, In Budget*, 13 Chem. Reg. Rep. (BNA) 671 (Aug. 18, 1989).

168. 1989 Vt. Laws 59.

169. *Id.*; *Vermont Governor Signs CFC Control Bill*, 20 Env't Rep. (BNA) 210 (June 2, 1989); *Vermont to Ban Auto's Use of Ozone-Depleting Chemical*, N.Y. Times, May 10, 1989, at B6, col. 5.

170. 1989 Conn. Legis. Serv. 227 (West).

171. 1989 Conn. Legis. Serv. 227, § 2(a) (West); *Connecticut Law Bans CFC Containing Packaging*, 20 Env't Rep. (BNA) 1102 (Oct. 20, 1989) [hereinafter *Connecticut*].

172. 1989 Conn. Legis. Serv. 227, § 8 (West); *Connecticut*, *supra* note 171.

173. 1989 Haw. Sess. Laws 77.

174. *Id.*; *Hawaii Enacts Measure To Restrict Sale Of CFC-Containing Air Conditioning Refrigerants*, 13 Chem. Reg. Rep. (BNA) 297 (May 26, 1989) [hereinafter *Hawaii*]; *Measure Signed By Governor To Restrict Sale Of CFC-Containing Air*

and requiring recycling of CFCs during air conditioner repair.[175]

In October 1989, New Jersey Governor Thomas Kean ordered state agencies to reduce pollution responsible for ozone depletion.[176] The Governor called on the state legislature to investigate CFC and halon alternatives and ordered the New Jersey Department of Environmental Protection to investigate the "feasibility of regulations or legislation to reduce CFC and halon releases." [177]

2. *Local Action*

On July 26, 1988, the Los Angeles City Council unanimously passed an ordinance which banned polystyrene packaging made with CFCs.[178] The ordinance, based on legislation recently approved at the state level by the Senate Natural Resources and Wildlife Committee, "makes it a misdemeanor to manufacture, sell, or distribute products in Los Angeles that are made with blowing agents composed of CFCs . . . ."[179] The ordinance became effective July 1, 1989.[180]

The City Council of Irvine, California passed one of the most restrictive measures on July 18, 1989.[181] The ordinance, effective July 1, 1990, bans the use of almost all CFCs and related compounds in any industrial process.[182] The measure also prohibits the sale and use of plastic foam food packaging manufactured with CFCs as well as the use of building insula-

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Conditioning Refrigerants, 20 Env't Rep. (BNA) 162 (May 19, 1989) [hereinafter *Governor*].

175. 1989 Haw. Sess. Laws 77; *Hawaii*, *supra* note 174; *Governor*, *supra* note 174.

176. *Kean Orders Action To Limit Global Warming*, 20 Env't Rep. (BNA) 1148 (Nov. 3, 1989).

177. *Id.*

178. *Los Angeles Bans Packaging Made With CFCs*, 12 Chem. Reg. Rep. (BNA) 709 (Aug. 5, 1988).

179. *Id.*

180. *Id.*

181. *Frustrated By Global Efforts, City Fights Ozone Own Way*, N.Y. Times, July 19, 1989, at A1, col. 5.

182. The ordinance exempts manufacture of drugs, medical devices, and military processes which require CFCs. *Id.*

tion containing ozone-depleting chemicals.[183] This action is very important because California is the largest source of ozone-depleting chemicals in the United States.[184]

3. *Local Enforcement*

Local laws are not enough to protect the ozone layer. Strict enforcement, by local authorities, is a necessary component of adequate ozone protection. The state of Massachusetts charged PI Inc., of Hyannis and three of its subsidiaries with emitting 1,300 tons of CFCs per year in violation of regulations promulgated by the Department of Environmental Quality Engineering under the state's Clean Air Act and Environmental Protection Act.[185] This was the first suit ever brought by a state to stop the release of CFCs.[186] The suit was successful. Under a consent decree, PI Inc., a foam production company, had to pay $700,000 in fines and phase out release of CFCs.[187]

E. *Private Sector Responses*

In early 1987, at the request of Senator Robert Stafford of Vermont, the McDonald's Corporation announced that it would curtail use of CFCs in its packaging material.[188] Senator Stafford, at the time the ranking Republican on the Senate Committee on Environment and Public Works, sent a well-publicized letter to McDonald's executives in March 1987 ask-

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183. The ordinance does not ban the use of CFCs in automobile air conditioning units and refrigerators, but does "require service and repair shops to capture and recycle the compounds . . . ." *Id.*

184. *Report Cites California As Largest Source Of Ozone-Depleting Chemicals, Seeks Phase-Out*, 13 Chem. Reg. Rep. (BNA) 86 (Apr. 28, 1989); *Report Cites California As Largest Source Of Ozone-Depleting Chemicals, Seeks Phase-Out*, 19 Env't Rep. (BNA) 2693 (Apr. 28, 1989).

185. *Settlement Agreement Calls for Fine, Phase-Out of Releases By Foam Producer*, 12 Chem. Reg. Rep. (BNA) 850 (Sept. 2, 1988).

186. *Id.*

187. *Id.*

188. Bazilchuk, *Industry's Dependence on CFCs Has No Quick Fix*, Burlington (Vt.) Free Press, Nov. 30, 1987, at 1A, col. 1. Senator Stafford is now retired from the Senate.

ing the company to stop using containers made with CFCs.[189] McDonald's responded four months later, by agreeing to phase out CFC packaging.[190] The phase-out is currently in progress. Although fast food packaging accounts for only one percent of CFC usage, the move is an encouraging sign of industry's willingness to respond to the problem and to political pressure.[191]

On April 12, 1988, representatives of fifteen manufacturers that use CFCs as the foaming agent for polystyrene cups, fast food packaging, meat trays, and egg cartons said they would switch to a substitute that is much less destructive to the ozone layer.[192] In February 1989, the Polystyrene Packaging Council and Foodservice and Packaging Institute announced that "[a]ll foam cups, sandwich cartons, food service trays, and carry-out containers manufactured in the United States in 1989 will be made using HCFC-22 . . . ."[193] HCFC-22, a substitute for CFC-12, has "five percent of the stratospheric ozone depletion potential" of CFC-12.[194] Both of these actions are encouraging even though the polystrene packing industry uses less than two percent of the CFCs annually produced in the United States.[195]

The automobile manufacturing industry voluntarily set "a purity standard for recycled automobile air conditioner refrigerant."[196] The refrigerant, CFC-12, is released when auto

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189. *Id.*

190. *Id.*

191. *Id.*

192. *Makers of Foam Containers Pledge To Stop Using CFCs*, Wash. Post, Apr. 13, 1988, at A10, col. 1 [hereinafter *Foam*].

193. *Safer CFC Now Used for Food Containers Made in the United States, Industry Says*, 12 Chem. Reg. Rep. (BNA) 1703 (Feb. 24, 1989). "The council is made up of manufacturers of polystyrene products, raw material suppliers, and trade associations. The institute is the national trade association for manufacturers of disposable products for food service and food packaging . . . . Egg cartons and meat trays . . . were not covered by the announcement[.]" *Id.*

194. "Companies switching to HCFC-22 are Dart Container Corp., Dolco Packaging Corp., Fort Howard Corp., Genpak Corp., Mobil Chemical Co., Prairie Packaging Co., and Solo Cup Co. Other food service packagers either never used CFCs or abandoned use of them in the late 1970s[.]" *Id.*

195. *Foam*, *supra* note 192.

196. *Standard Set By Auto Manufacturers For Purity Of Recycled Refrigerant*,

air conditioners are serviced.[197] This act is more significant than previous industry cutbacks because "this substance accounts for [nineteen] percent of the ozone-depleting potential of CFCs released by the United States."[198]

The General Electric Company has agreed to reduce its CFC use by 300,000 pounds.[199] It will also speed up "introduction of portable CFC recapture units" which will be used in routine refrigerator servicing.[200] AT&T announced on August 1, 1989 that it would eliminate all CFC emissions from its manufacturing processes by 1994.[201] General Motors Corporation will require its 10,000 dealers to purchase machines to recapture CFCs released when automobile air conditioners are serviced.[202] Also, Nissan Motor Corporation is developing automobile air conditioners that will use CFC-134, a likely substitute for CFC-12.[203] IG-LO Products, a manufacturer of CFC-12, will develop and market recycling equipment and spend one million dollars on an education program to encourage proper handling of ozone-depleting chemicals.[204]

Industry's voluntary cutbacks and initiatives are the result of a variety of factors. Industry has some concern for the environment, but it has also become economically efficient for companies to cut back on CFC use now rather than pay much

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19 Env't Rep. (BNA) 2066 (Feb. 3, 1989). "Automobile manufacturers set the standard for recycled refrigerant at 15 parts per million (ppm) by weight of moisture at 70 degrees Fahrenheit and 4,000 ppm by weight of mineral oil lubricant. The Motor Vehicle Manufacturers Association and SAAB-Scania of America Inc. approved the standard." *Id.*

197. *Id.*

198. "An estimated 120 million pounds of CFC-12 were used in vehicle air conditioners in the United States in 1985." *Id.*

199. *Senator Gore Announces Agreement by General Electric Co. to Reduce CFCs*, 13 Chem. Reg. Rep. (BNA) 632 (Aug. 4, 1989) [hereinafter *Electric*]; *Four Companies Will Cut CFC Emissions to Limit Stratospheric Ozone Depletion*, 20 Env't Rep. (BNA) 695 (Aug. 18, 1989) [hereinafter *Four*].

200. *Electric*, *supra* note 199; *Four*, *supra* note 199.

201. *Four*, *supra* note 199. AT&T also stated that it already rejects packing manufactured with CFCs. *Id.*

202. *Id.*

203. *Id.* Substitutes are now becoming available. *See infra* text accompanying notes 235-91.

204. *Freon Manufacturer Launches Recycling Initiative, Education Plan*, 13 Chem. Reg. Rep. (BNA) 819 (Sept. 29, 1989).

higher prices for CFCs once the Protocol and the EPA regulations take full effect. The availability of relatively inexpensive substitutes should spur more voluntary action.

F. *Non-Profit Environmental Organizations' Strategies*

The Natural Resources Defense Council (NRDC) sent a memo to its members in May 1988 which stated that its "principal objective over the next year [was] to keep up pressure for deeper and faster cuts in CFCs and halons than provided in the Montreal Agreement and the U.S. regulations issued by EPA."[205] NRDC's goal is to replace the compounds entirely with benign substitutes.[206]

On October 5, 1988, the NRDC filed suit in the United States Court of Appeals for the District of Columbia seeking a total phase-out of CFCs and other ozone-depleting chemicals.[207] This suit was a challenge to the regulations issued on August 1, 1988 by the EPA. The NRDC contended that the reductions were inadequate in light of the scientific consensus which calls for a complete elimination of the chemicals.[208] The EPA and the NRDC have reached a settlement agreement in which the EPA agreed to confront the total phase-out issue in late 1990.[209] This agreement will give the EPA an opportunity to evaluate new scientific data, new federal legislation, and any Montreal Protocol amendments. The EPA would have been forced to promulgate tougher regulations if the NRDC had obtained a favorable decision. If the NRDC had lost, the same regulations would have continued to apply. This type of judicial action had worked before. For example, the current EPA regulations regarding United States production and use of CFCs, which the NRDC was challenging, were originally promulgated under a court-ordered deadline obtained by the

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205. Memo from John H. Adams, Executive Director of the NRDC (May 1988).

206. *Id.*

207. *NRDC Files Suit Over Ozone Depletion*, 19 Env't Rep. (BNA) 1191 (Oct. 14, 1988).

208. *Id.*

209. Telephone interview with NRDC personnel, Washington D.C. (Mar. 15, 1990).

NRDC.[210] More court action may result if the EPA's decision, regarding the total phase-out issue, does not adequately protect the ozone layer.

In 1989, NRDC specified ways in which individuals could act to protect the ozone layer.[211] Auto air conditioners, which leak CFCs, should be repaired by a professional repair shop equipped to capture, clean, and recycle the used CFCs.[212] The use of paper products, instead of CFC-produced foam plastics, and fiberglass and cellulose, instead of CFC foam building insulation, should be encouraged.[213] Halon fire extinguishers should not be bought for ordinary home use, and CFC aerosols which are not affected by earlier regulations should be avoided.[214]

The NRDC has asked that individuals write President Bush to remind him of his campaign promise to eliminate the use of ozone-depleting chemicals. President Bush must direct his Secretary of State to quickly negotiate a new international agreement to phase out the chemicals by 1995, and "[o]rder [the] EPA Administrator to issue new rules to eliminate U.S. emissions."[215] The NRDC also suggested writing to the EPA Administrator demanding that he implement the following five-part phase-out program:

- Issue new regulations to phase out U.S. production and use of CFCs and halons by 1995;
- Make early emission reductions by immediately ending unnecessary uses and wasteful practices;
- Require labels on products made with CFCs or halons to warn consumers of the danger to the ozone layer;

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210. NRDC, SAVING THE OZONE LAYER: A CITIZEN ACTION GUIDE 3 (1989) (obtainable from NRDC).

211. *Id.*

212. *Id.* at 2.

213. *Id.*

214. *Id.* Some CFC aerosol products still on the market include spray cans of string confetti, aerosol dust removers used by photographers, boat horns, and "cleaning sprays for sewing machines, VCRs, and electronic equipment." *Id.*

215. *Id.* at 3.

- Charge a fee on CFCs and halons to recoup the estimated $2.7 billion windfall profit that producers will reap from a phase-down;
- Ban imports of products made with CFCs and halons from countries that refuse to adopt equivalent phase-out rules.[216]

NRDC also suggested that the public write letters to local congressmen urging them to enact new laws which:

- Ban nearly all CFC and halon production and use by 1995;
- Place an immediate ban on unnecessary uses and wasteful practices;
- Label products made with ozone-depleting chemicals to warn consumers of danger to the ozone layer;
- Tax away the CFC and halon producers' multi-billion dollar windfall profits;
- Prohibit imports of products made with ozone-depleting chemicals from countries that refuse to end their use.[217]

Finally, NRDC urged consumers to pressure CFC manufacturers and industries which use CFCs to introduce safe substitutes and a CFC phase-out program.[218] A Texas coalition of environmental and consumer groups, including Texas Clean Water Action, Greenpeace, Texans United, and Texas Citizen Action, has begun a campaign to pressure businesses into halting production of ozone-depleting chemicals.[219]

G. *The European Community's Response*

In the United Kingdom, on August 5, 1988, the House of Lords Select Committee on the European Communities (Com-

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216. *Id.*
217. *Id.* at 5.
218. *Id.* at 6.
219. *Texas Coalition Of Activist Groups Unveils Campaign To Save Ozone Layer*, 20 Env't Rep. (BNA) 637 (Aug. 4, 1989).

mittee) said production of CFCs in the European Community should be cut by eighty-five percent.[220] The Committee found the present reduction schedule of the Montreal Protocol inadequate.[221] The Committee also called for strict control on exports and demanded increased funding for research.[222]

V. The Future

A. *International Political Action*

On March 2, 1989, the European Economic Community (EEC) took the lead in safeguarding the ozone shield when it agreed to ban, by the year 2000, production and use of chemicals which destroy the ozone layer.[223] The EEC also agreed to cut CFC production by eighty-five percent as soon as possible.[224] On July 7, 1989, the EEC announced import quotas for CFCs from July 1, 1989 to June 30, 1990.[225]

The United States quickly reacted to the EEC's total ban announcement. On March 3, 1989, President Bush stated that the United States would push for an international agreement to ban CFCs and halons by the year 2000, provided that safe

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220. *Production in European Community Should be Cut 85 Percent, UK Panel Says*, 12 Chem. Reg. Rep. (BNA) 869 (Sept. 9, 1988).

221. *Id.*

222. *Id.*

223. *12 Europe Nations To Ban Chemicals That Harm Ozone*, N.Y. Times, Mar. 3, 1989, at A1, col. 6 [hereinafter *Europe*]; Dickson & Marshall, *Europe Recognizes the Ozone Threat*, 243 SCI. 1279 (1989) [hereinafter Dickson]; *EC Council Agrees On Total CFC Ban By 2000, Bush, Reilly Say United States Has Same Goal*, 19 Env't Rep. (BNA) 2363 (Mar. 10, 1989) [hereinafter *EC*]. The EEC has recently proposed an elimination of CFC production and use by 1998; production and use of certain halons and carbon tetrachloride would be phased out by the year 2000, while production of methyl chloroform would be frozen at 1986 production levels. *Commission Proposes CFC Ban by End of 1997*, 20 Env't Rep. (BNA) 1808 (Feb. 23, 1990); *EC Commission Proposes To Ban CFCs by 1998; Will Phase Out Halons, Carbon Tetrachloride*, 13 Chem. Reg. Rep. (BNA) 1449 (Feb. 16, 1990).

224. *Europe*, *supra* note 223; Dickson, *supra* note 223; *EC*, *supra* note 223. "Although the European Community's agreement only relates to those CFCs covered by the Montreal Protocol, the ministers also announced they would be examining the elimination of the remaining CFCs, such as CFC-22, at a future date." *EC*, *supra* note 223.

225. *EC Commission Announces CFC Import Quotas*, 13 Chem. Reg. Rep. (BNA) 672 (Aug. 18, 1989).

substitutes are available.[226]

During a conference of one hundred twenty-four nations called by Prime Minister Margaret Thatcher in March 1989, an EEC official said that the European nations could eliminate production and use of the ozone-destroying chemicals as early as 1996 or 1997, three to four years ahead of schedule.[227] During the conference, an additional twenty countries agreed to join the Montreal Protocol.[228] These additional signatories will increase the effectiveness of the Protocol.

Nevertheless, the conference was not a complete success. Developing countries' concerns and the Soviet Union's reluctance to agree to any further action caused the conference to end without a consensus on whether to strengthen the Montreal Protocol.[229] The Soviet Union wanted more evidence that certain CFCs are destroying the ozone layer before banning them by the year 2000.[230] Key developing nations, such as China and India, wanted financial and technological aid from the world's wealthy nations in order to produce and use CFC alternatives before joining the Montreal Protocol.[231] The rapidly growing CFC-using industries in China and India could undermine cuts agreed to by the world's developed nations.[232]

The Soviet Union later changed its stance. In a surprising announcement on July 20, 1989, Soviet environmental officials acknowledged that a total phase-out of the use and produc-

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226. *Bush Backs Proposal to Eliminate Use of Ozone-Depleting Chemical*, N.Y. Times, Mar. 4, 1989, § 1, at 9, col. 1; Dickson, *supra* note 223; *EC*, *supra* note 223.

227. *London Talks Hear Call for 97 Ban on Anti-Ozone Chemicals*, N.Y. Times, Mar. 6, 1989, at B10, col. 1.

228. *20 Nations Agree to Join Ozone Pact*, N.Y. Times, Mar. 8, 1989, at A12, col. 1.

229. *Id. Developing Nations Link CFC Ban to Aid in Developing Alternatives*, 12 Chem. Reg. Rep. (BNA) 1794 (Mar. 10, 1989) [hereinafter *Developing Nations*].

230. *Soviets Delay Joining New Ozone Pact*, N.Y. Times, Mar. 7, 1989, at C13, col. 3.

231. *Developing Nations*, *supra* note 229. *China, India Balk at Signing Accord to Protect Ozone*, Wall St. J., Mar. 7, 1989, at B4, col. 5 [hereinafter *China*]. "China and India, [are] the two largest holdouts from an international accord to protect the ozone layer." *Id.* The developing nations will receive some aid under the provisions of the Helsinki Declaration. *See supra* notes 116-20.

232. *China*, *supra* note 231.

tion of ozone-depleting chemicals was needed to prevent further depletion of the ozone layer.[233] Thus, a total phase-out amendment to the Montreal Protocol is more likely.[234]

B. *The Search For Substitutes*

The key to total elimination of CFCs and halons is the development of safe substitutes. The search for new substances that will perform like CFCs, without harming the atmosphere, was begun in the early 1970s.[235] Industry de-escalated its search for substitutes in the early 1980s due to a declining market and a declining regulatory effort.[236] With the advent of new regulations and new scientific data, the search is now a priority.

New substances[237] developed so far are less harmful because they contain hydrogen which breaks down the chlorine atoms before it reaches the stratosphere.[238] HCFC-22, which is ninety-five percent less destructive to ozone than CFCs, is already available commercially.[239] HCFC-22 is gaining popularity as a coolant for commercial and residential air conditioning systems.[240] The FDA has approved HCFC-22 for containers used by the fast food industry.[241]

The poor insulating quality of HCFC-22, however, makes

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233. *Soviet Environmental Officials Advise Complete Chlorofluorocarbon Phase-Out*, 13 Chem. Reg. Rep. (BNA) 592 (July 28, 1989).

234. The United Nations Environment Program director believes the chances of phasing out all production of CFCs by the end of the century has greatly increased. He believes an agreement may be reached in June 1990, when the signatories to the Montreal Protocol meet in London. *UNEP Director General Predicts CFC Production To End By Year 2000*, 13 Chem. Reg. Rep. (BNA) 1609 (Mar. 23, 1990).

235. Bazilchuk, *supra* note 188, at 9A.

236. *Id.*

237. *See infra* text and accompany notes 239-91.

238. Gannes, *supra* note 13, at 141.

239. *Id.*

240. *Id.* Zurer, *Search Intensifies for Alternatives to Ozone-Depleting Halocarbons*, CHEM. & ENG'G NEWS, Feb. 8, 1988, at 17, 19; Browne, *In Protecting the Atmosphere, Choices Are Costly and Complex*, N.Y. Times, Mar. 7, 1989, at C1, col. 3; Naj, *Doubts Raised On Substitutes for CFCs*, Wall St. J., Mar. 6, 1989, at B4, col. 3.

241. Gannes, *supra* note 13, at 136.

it an unattractive candidate for builders.[242] In addition, HCFC-22's low boiling point makes it impossible to use in car air conditioners.[243] General Motors stated that re-tooling for HCFC-22 would cost the company more than six hundred million dollars.[244] The high price of re-tooling has forced certain industries to search for more economical substitutes.

Rather than adapt for HCFC-22, the auto air conditioning industries are considering HFC-134a, a compound that is currently undergoing toxicology tests and is not expected to be commercially available for several years.[245] HFC-134a is more difficult to manufacture than CFC-12; it is three times as expensive to manufacture and it may not last as long.[246] Also, HFC-134a cannot be used in refrigeration units which previously used CFC-12 partially due to corrosion problems.[247] The auto industry is also testing a third substitute, a three-part blend of HCFC-22, HFC-134a, and HFC-142.[248] This substitute is not completely safe. "The 142-blend has the same characteristics as HCFC-22, [but] with the added problem that it is flammable."[249]

Industry has also discovered other substitutes for CFCs. HCFC-123 is a replacement for CFC-11, which is a blowing agent for foams.[250] HCFC-123 cannot be used in refrigerator insulation because it causes corrosion.[251] Pennwalt Corporation has been developing HCFC-141b, another foam blowing

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242. *Id.* Monastersky, *Decline of The CFC Empire*, 133 SCI. NEWS 235 (1988); Browne, *supra* note 240; Naj, *supra* note 240. "A big problem with HCFC-22 is that its molecules are small and can easily leak out of air-conditioning hoses and other parts." Naj, *supra* note 240, at B4, col. 4.

243. Gannes, *supra* note 13, at 136; Monastersky, *supra* note 242; Browne, *supra* note 240; Naj, *supra* note 240.

244. Gannes, *supra* note 13, at 141.

245. Monastersky, *supra* note 242, at 235. HCFC-22 and HFC-134a are replacements for CFC-12. *Id.*

246. Browne, *supra* note 240. The auto industry hopes to use HFC-134a in some autos by 1993 or 1994. The use of HFC-134a will mean changes in a car's grill area and engine. Naj, *supra* note 240.

247. Browne, *supra* note 240.

248. Naj, *supra* note 240.

249. *Id.* at col. 4.

250. Naj, *supra* note 240.

251. *Id.*

compound, which will be available by late 1990.[252] However, the problems with HCFC-141b include its explosive nature and its ability to dissolve the motor binding of commercial refrigeration systems.[253] Both HCFC-141b and HCFC-123 are poor insulators and are still being tested for toxicities.[254]

The problems associated with finding a safe, efficient, and inexpensive HCFC substitute to be used by the refrigeration industry will create problems for consumers. The Association of Home Appliance Manufacturers, a trade group, believes that re-designing the appliances and re-tooling production lines "will add $100 to $120 to the price of a typical refrigerator."[255]

The electronics industry is also attempting to reduce CFC use. "The use of CFC-113 . . . as a solvent for cleaning electronic assemblies has been growing in the past few years at a double-digit rate."[256] In early 1988, AT&T and Petroferm, Inc. announced the joint development of BIOACT EC-7, a safe substitute for CFC-113.[257]

In March 1989, DuPont, pursuant to its plan to eliminate CFC use, announced the development of two substitutes for CFC-113.[258] DuPont also announced that it would introduce a series of other substitutes beginning in 1990.[259] One product, KCD-9438, is a blend of organic solvents containing no CFCs.[260] This compound will be available for testing in 1989.[261] The second product contains small amounts of CFCs and will not be available commercially until the mid-1990's.[262] KCD-9438 and the second product will cost three times as

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252. Monastersky, *supra* note 242.

253. Naj, *supra* note 240.

254. *Id.*

255. Holusha, *The Next Refrigerator May Take a Step Back*, N.Y. Times, Mar. 4, 1989, § 1, at 37, col. 3.

256. Zurer, *supra* note 240, at 18.

257. *Id.* at 19. EC-7 is biodegradable. *Id.*

258. Browne, *supra* note 240; *Developing Nations*, *supra* note 229.

259. Browne, *supra* note 240; *Developing Nations*, *supra* note 229.

260. Browne, *supra* note 240.

261. *Id.*

262. *Id.*

much as CFC-113.[263] DuPont had previously announced it would phase out all production of CFCs completely.[264] The company currently has pilot plants to produce alternatives such as HFC-134a.[265] DuPont is also funding the construction of a twenty-four million dollar HCFC-123 plant in Ontario, Canada.[266] Also, in March 1989, Allied-Signal Inc. announced replacements for CFC solvents which will be available following toxological testing.[267] In early 1990, a panel of experts approved Allied-Signal's Genesolv TM 2010 as a replacement for CFC-113.[268]

Some corporations have discovered other ways of replacing CFCs. Northern Telecom Ltd. of Canada has designed a system which uses water instead of CFC solvents to clean electronic circuit boards.[269] AT&T has developed a system which eliminates the cleaning process in circuit-board manufacturing.[270] Union Carbide Corporation has developed a new process in which urethane foam can be produced without CFCs or methylene chloride.[271] This new process could cut use of ozone-depleting CFCs by ten percent.[272] Sufficient halon

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263. *Id.*

264. *DuPont Steps Up Commercialization of Substitutes for Chlorofluorocarbons*, 19 Env't Rep. (BNA) 1157 (Oct. 7, 1988).

265. *Id.*

266. *DuPont To Build HCFC-123 Plant In Ontario*, 13 Chem. Reg. Rep. (BNA) 575 (July 21, 1989). "DuPont is replacing CFC-11 use in industrial refrigeration equipment, insulation and cushioning foam with HCFC-123, which contains similar properties to CFC-11, but could reduce the substance's ozone depletion by 98 percent." *Id.*

267. *Thatcher Closes Ozone Conference With a Warning*, Wall St. J., Mar. 8, 1989, at B5, col. 1.

268. *Industry Panel Approves Use of CFC-Substitute To Clean Circuit Boards*, 13 Chem. Reg. Rep. (BNA) 1350 (Jan. 26, 1990).

269. Naj, *supra* note 240.

270. *Id.*

271. *New Method For Making Polyurethane Foam Could Cut CFC Use By 10 Percent, Firm Claims*, 13 Chem. Reg. Rep. (BNA) 782 (Sept. 22, 1989) [hereinafter *Method*]; Urethane foams are used for cushions, packaging, and padding. *Id.* This process is cheaper than if producers kept using CFCs because the cost of CFCs has doubled in the last year. *Id. See also New Polyurethane Foam Production Process Could Cut CFC Use By 10 Percent, Firm Claims*, 20 Env't Rep. (BNA) 957 (Sept. 29, 1989) [hereinafter *Foam*].

272. *Method*, *supra* note 271; *Foam*, *supra* note 271.

substitutes have not yet been developed.[273] Conservation is presently the only way to reduce halons' ozone-depleting potency.[274]

The safety of substitutes is very important. The General Accounting Office (GAO) recommended that the EPA use the Toxic Substance Control Act (TSCA)[275] to assess the safety of CFC substitutes.[276] The EPA can use section 8(d) of TSCA[277] to force chemical makers to provide copies of health and safety studies on CFC and halon substitutes.[278] The EPA can also issue significant new rules under TSCA section 5(a)(2)[279] "to require chemical manufacturers to notify the agency before producing these substances [which are already produced for other purposes] as substitutes for the ozone-depleting compounds."[280] In order to facilitate the production of safe CFC substitutes, the EPA has developed a new program in the Office of Toxic Substances.[281] This fast-track plan for voluntary testing will guide CFC substitutes through an expedited review and assessment.[282] The EPA has also told companies conducting voluntary testing on CFC substitutes to report their plans for toxicity testing before the end of 1989.[283] The agency may also force chemical manufacturers to conduct expensive toxicological tests on CFC substitutes.[284]

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273. U.S. GENERAL ACCOUNTING OFFICE, STRATOSPHERIC OZONE 56 (1989) [hereinafter GAO].

274. *Id.*

275. 15 U.S.C. §§ 2601-54 (1988).

276. *GAO Report Recommends EPA Use TSCA To Assess Safety of CFC Substitutes*, Chem. Reg. (BNA) (Mar. 17, 1989) [hereinafter *TSCA*]; GAO, *Stratospheric Ozone*, Feb. 1989; *GAO Report Recommends EPA Use TSCA To Assess Safety of CFC Substitutes*, 12 Chem. Reg. Rep. (BNA) 1841 (Mar. 17, 1989) [hereinafter *Safety*]; *Use of TSCA Authority Recommended To Assess Safety of CFC Substitutes*, 19 Env't Rep. (BNA) 2521 (Mar. 24, 1989) [hereinafter *Authority*].

277. 15 U.S.C. § 2607(d) (1988).

278. *TSCA*, *supra* note 276; *Safety*, *supra* note 276; *Authority*, *supra* note 276.

279. 15 U.S.C. § 2604(a)(2) (1988).

280. *TSCA*, *supra* note 276; *Safety*, *supra* note 276; *Authority*, *supra* note 276.

281. *EPA Announces Fast-Track Strategy For Voluntary Testing of CFC Substitutes*, 13 Chem. Reg. Rep. (BNA) 852 (Oct. 13, 1989).

282. *Id.*

283. *EPA Announces Deadline For Response On CFC Substitutes Voluntary Testing*, 13 Chem. Reg. Rep. (BNA) 875 (Oct. 20, 1989).

284. *Id.*

One problem has occurred with a possible substitute for CFCs in automobile air conditioners. The blend of substances decomposed into toxic materials during a simulation.[285] The blend, composed of ninety-three percent of refrigerant-12 and seven percent dimethyl ether, became contaminated with two highly toxic chlorinated ethers during a test in a simulated automobile air conditioner.[286] This blend poses a health risk if used in auto air conditioners especially for those who change the refrigerant.[287]

Some scientists believe that these chemicals, now considered as possible CFC substitutes, will have to be banned eventually in order to repair the hole in the ozone layer.[288] Robert Watson, a NASA scientist, believes that the substitute chemicals contain chlorine which causes ozone depletion.[289] Although the substitutes decompose faster in the atmosphere, an eventual ban is the only way to repair the ozone hole.[290] If the substitutes are not banned, the ozone hole will persist.[291]

C. *Federal Legislation*

One of the most promising ways to make substantial progress in the struggle to save the ozone layer is through federal legislation. On July 26, 1988, Senator Robert Stafford of Vermont introduced a bill into the Senate entitled the "Global

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285. *Blend Designed To Replace CFCs Formed Toxics In Simulated Air Conditioner, Firm Tells EPA*, 13 Chem. Reg. Rep. (BNA) 9999 (June 16, 1989).

286. *Id.* "The decomposition products were bis (chloromethyl) ether, which is a known human carcinogen, and chloromethyl methyl ether, considered to be a suspected human carcinogen by the International Agency for Research on Cancer." *Id.*

287. *Id.* "Allied Signal sent the report (8EHA-0589-799) on the blend to EPA as required by Section 8(e) of the Toxic Substances Control Act." *Id.*

288. *NASA Scientist Says Repair Of Ozone Hole Will Require Eventual Ban On CFC Substitutes*, 20 Env't Rep. (BNA) 1094 (Oct. 20, 1989) [hereinafter *Repair*]; *CFC Substitutes Must Eventually Be Banned To Maintain Ozone Layer, NASA Scientist Says*, 13 Chem. Reg. Rep. (BNA) 855 (Oct. 13, 1989) [hereinafter *Maintain*].

289. *Repair*, *supra* note 288; *Maintain*, *supra* note 288.

290. *Repair*, *supra*, note 288; *Maintain*, *supra* note 288.

291. To calculate when an HCFC should be banned, the atmospheric lifetime of the substitute should be doubled and tripled and then both results should be subtracted from the year 2075. "For example, an HCFC that takes 10 years to break down in the atmosphere should be banned between the years 2045 and 2055." *Repair*, *supra* note 288; *Maintain*, *supra* note 288.

Environmental Protection Act of 1988 (Act)."[292] Although this bill died in committee, it was an example of the type of legislation which is needed to save the ozone layer. The objectives of the Act were to restore and maintain the chemical and physical integrity of the atmosphere and to protect human health and the global environment from dangers due to ozone depletion caused by chemicals such as CFCs.[293]

One of the Act's objectives was to eliminate atmospheric emissions of ozone-depleting substances.[294] The Act also promoted the rapid development and deployment of alternatives to ozone-depleting chemicals and scientific research.[295]

The Act contained a listing provision. Pursuant to the Act, the EPA would publish a priority list of substances which were known to cause ozone depletion.[296] The initial list would include CFC-11, CFC-113, halon-1211, and halon-1301.[297] The EPA would also publish another list of potentially dangerous chemicals at the agency's discretion.[298] These chemicals would include, but would not be limited to, CFC-22, CFC-114, CFC-115, carbon tetrachloride, methyl chloroform, and methylene chloride.[299] The EPA would update the list annually.[300] Along with the publication of the lists or additions, and at least annually, the EPA would assign a numerical value representing the ozone depletion factor to each listed substance.[301]

In addition to the listing, there would be reporting requirements. Within ninety days after enactment of the Act, each producer of a listed substance would file a report with the EPA setting forth the amount that was produced during

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292. S. 2663, 100th Cong., 2d Sess., 134 CONG. REC. S10,112-29 (daily ed. July 27, 1988).

293. *Id.* § 103, at S10,114.

294. *Id.*

295. *Id.*

296. *Id.* § 105(A), at S10,115.

297. *Id.*

298. *Id.* § 105(b).

299. *Id.*

300. *Id.*

301. *Id.* § 105(c). The Ozone depletion factor is a numerical value representing the ozone depletion potential of that substance. *Id.*

1986.[302] At least annually, each producer would be required to file a report for each successive twelve-month period.[303]

The Act contained a production phase-out provision. Effective January 1, 1989, the listed substances were to be frozen at 1986 production levels.[304] CFC production would drop to seventy-five percent of the producers' 1986 levels by January 1, 1990.[305] On January 1, 1991, the producer could not produce more than fifty percent of 1986 levels.[306] In 1993, it would drop to five percent; in 1995 all production and use would stop except for medical purposes.[307]

There was a similar schedule for limitations on the use of the listed chemicals. On January 1, 1994, it would be illegal to introduce into interstate commerce or to use a priority listed chemical, except for the Food and Drug Administration (FDA) approved medical uses, and to maintain and service household appliances.[308] It would also be unlawful to introduce or use a secondary listed chemical after January 1, 1999.[309] Further production restrictions were based on the substances' ozone-depletion factor (numerical value).[310] There was one significant loophole. The President would have veto power regarding production and use of halon-1211 and halon-1301 because both have national security implications.[311] This loophole would be necessary to permit the continued use of these halons by the military.

The Act also contained provisions for importation, labeling, and disposal. Twelve months after a substance would be placed on the priority list, it would be illegal to import the substance, any product containing the substance, or any product manufactured with a process which uses the substance.[312]

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302. *Id.* § 106(a),(b).
303. *Id.*
304. *Id.* § 107(a).
305. *Id.* § 107(b).
306. *Id.* § 107(c).
307. *Id.* § 107(d).
308. *Id.* § 108(a).
309. *Id.* § 108(b).
310. *Id.* § 109(a)-(e).
311. *Id.* § 110(a) at S10,115-6.
312. *Id.* § 111(a) at S10,116.

The Administrator would relax the ban if the importing nation had a regulatory program at least as stringent as the Act.[313] Effective ninety days after a substance was placed on either the priority or secondary list, every listed chemical container and product containing the chemical or manufactured with it would bear an appropriate label.[314] The disposal requirements called for incineration or other means of disposal which would assure destruction of the substance.[315] This bill was the first major advance in legislation pertaining to CFCs and ozone protection. It was referred to the Committee on Government Affairs,[316] yet no further action was taken.

Other significant legislation was introduced in 1989. Representative Fortney Stark of California introduced a labeling bill (H.R. 503) which required labels on products which contain, or are produced with, CFCs.[317] This would assist consumers in avoiding CFC products. No further action on this bill was taken.

Senator Albert Gore of Tennessee has been very active in introducing bills concerning ozone depletion. On January 25, 1989, he introduced S. 201[318] which provided for a freeze "on the production of ozone-depleting chemicals at 1986 production levels [beginning January 1, 1990]."[319] There would be a gradual phase-out until "all production is banned in the year 2000 with exceptions for medical and national security reasons."[320] Bill S. 870,[321] also introduced by Senator Gore, would prohibit the sale of certain consumer products containing ozone-depleting chemicals[322] and require the labeling and reg-

313. *Id.*

314. *Id.* § 112(a).

315. *Id.*

316. *Id.* at S10,112.

317. H.R. 503, 101st Cong., 1st Sess., 135 CONG. REC. H61 (daily ed. Jan. 4, 1989).

318. S. 201, 101st Cong., 1st Sess., 135 CONG. REC. S172, S575-78, Title II at S577 (daily ed. Jan. 25, 1989).

319. *Id.*

320. *Id.*

321. S. 870, 101st Cong., 1st Sess., 135 CONG. REC. S4542, S4543-45 (daily ed. May 1, 1989).

322. *Id.* §§ 5-7 at S4543.

ulation of other consumer products.[323] The proposed legislation would also require the Secretary of Commerce to develop a plan to encourage the recapture and recycling of CFCs and halons.[324]

The Senate Commerce, Science, and Transportation Subcommittee on the Consumer has reviewed bill S. 870.[325]The Chairman of the Subcommittee, Senator Richard Bryan of Nevada, has rejected arguments that certain emissions of CFCs and halons play a minor role in ozone depletion.[326]

Senator Gore has also introduced bill S. 871[327] which would create a manufacturer's excise tax[328] on some ozone-depleting chemicals[329] and an Ozone Layer Conservation Trust Fund.[330] Half of the revenues from the tax would be placed in this fund for research and development.[331] Another bill,[332] introduced by Senator Gore, provided for a five-year phase-out of CFC-11, CFC-12, CFC-113, halon-1211, halon-1301, and carbon tetrachloride.[333] There is also a ten-year phase-out for less potent chemicals.[334]

Senator Ernest Hollings[335] introduced bill S. 169[336] which would strengthen the government's research effort regarding

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323. *Id.* § 8 at S4543-44.

324. *Id.* § 9 at S4544.

325. *Senate Panel Chairman, Bill Sponsor Say Even Minor CFC Emissions Harmful*, 20 Env't Rep. (BNA) 1126 (Oct. 27, 1989) [hereinafter *Senate*]; *Head of Senate Panel Rejects Arguments that CFC Emissions by Some Industries Minor*, 13 Chem. Reg. Rep. (BNA) 878 (Oct. 20, 1989) [hereinafter *Minor*].

326. *Senate*, *supra* note 325; *Minor*, *supra* note 325.

327. S. 871, 101st Cong., 1st Sess., 135 CONG. REC. S4542, S4545-47 (daily ed. May 1, 1989).

328. The tax would be imposed on "any ozone-depleting chemical sold or used by the manufacturer, producer, or importer thereof, and . . . any imported taxable product sold or used by the importer thereof." *Id.* § 3(a) at S4545.

329. *Id.* § 3 at S4545-46.

330. *Id.* § 4 at S4546-47.

331. *Id.* at S4547.

332. S. 872, 101st Cong., 1st Sess., 135 CONG. REC. S4542, S4547-50 (daily ed. May 1, 1989).

333. *Id.* §§ 5, 7-9 at S4547-48.

334. *Id.*

335. Senator Hollings represents South Carolina.

336. S. 169, 101st Cong., 1st Sess., 135 CONG. REC. S171, S522-24 (daily ed. Jan. 25, 1989).

ozone layer depletion.[337] On April 18, 1989, the Senate Commerce Committee approved the bill.[338] The Committee also adopted an amendment proposed by Senator John McCain of Arizona which would establish a Federal Coordinating Council for Science, Engineering, and Technology working group to coordinate federal research of CFC and halon alternatives.[339] Senator McCain introduced a bill[340] earlier which would have improved coordination of national scientific research efforts to develop CFC substitutes.[341] The Hollings' bill passed the Senate by a unanimous vote[342] and referred to the House of Representatives.[343]

Senator John Chafee[344] introduced legislation to eliminate all production of CFCs by the year 2000.[345] The bill contains provisions requiring annual reports, production phaseout, national security exemptions, limitations on use and disposal, and labeling.[346] This legislation is very similar to the Stafford bill introduced in 1988.[347] Senator Max Baucus of Montana introduced legislation similar to previous bills except that his proposal contained a section imposing production and importation charges.[348] Another bill introduced by Senator Baucus, S. 676,[349] contained provisions which would prohibit CFC use by the year 2000 and establish standards for consumer and industrial sources.[350]

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337. *Id.*

338. *Global Change Research Voted by Panel*, 47 CONG. Q. 895 (Apr. 22, 1989).

339. *Id.*

340. S. 644, 101st Cong., 1st Sess., 135 CONG. REC. S3036, S3037-38 (daily ed. Mar. 17, 1989).

341. *Id.*

342. S. 169, 101st Cong., 2d Sess., 136 CONG. REC. S838, S838-40 (daily ed. Feb. 6, 1990).

343. S. 169, 101st Cong., 2d Sess., 136 CONG. REC. H426, (daily ed. Feb. 22, 1990).

344. Senator Chafee represents Rhode Island.

345. S. 491, 101st Cong., 1st Sess., 135 CONG. REC. S1998, S1999-2005 (daily ed. Mar. 2, 1989).

346. *Id.*

347. *See supra* notes 292-316 and accompanying text.

348. S. 503, 101st Cong., 1st Sess., 135 CONG. REC. S1999, S2018-21, § 6(a), (b) at S2019-20 (daily ed. Mar. 2, 1989).

349. S. 676, 101st Cong., 1st Sess., 135 CONG. REC. S3137, S3138-45 (daily ed. Mar. 17, 1989).

350. *Id.* Part A at S3138-40.

Senator James Jeffords[351] introduced a bill[352] which would ban the sale or export of domestically-produced automobiles with air conditioners using CFCs after 1993.[353] Senator John Kerry of Massachusetts introduced a similar bill, S. 1052,[354] which would phase in a ban on the sale or export of such automobiles.[355] The bill also required certification of equipment used to install, maintain, and repair those air conditioners.[356] Senator Frank Lautenberg[357] introduced a bill, S. 1089,[358] which would require the Council of Environmental Quality[359] to issue regulations to ensure that Environmental Impact Statements address global environmental problems, including ozone depletion.[360]

Although only one of the Senate bills, S. 169, has been passed,[361] the enactment of the Clean Air Act[362] by the Senate contained stratospheric ozone protection provisions. A provision sponsored by Senator John Chafee virtually eliminates the use of CFCs, carbon tetrachloride, and halons by the year

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351. Senator Jeffords represents Vermont.

352. S. 1035, 101st Cong., 1st Sess., 135 CONG. REC. S5610, S5615-16 (daily ed. May 18, 1989).

353. *Id.* § 2 at S5616.

354. S. 1052, 101st Cong., 1st Sess., 135 CONG. REC. S5611, S5664-66 (daily ed. May 18, 1989).

355. *Id.* § 3 at S5665.

356. *Id.*

357. Senator Lautenberg represents New Jersey.

358. S. 1089, 101st Cong., 1st Sess., 135 CONG. REC. S5989, S5990-92 (daily ed. June 1, 1989).

359. The Council of Environmental Quality (Council) is a three member panel which is part of the Executive Office of the President. The members are appointed by the President with advice and consent of the Senate. The Council formulates and recommends national policies to promote the improvement of the quality of the environment. 42 U.S.C. § 4342 (1982).

360. S. 1089, 101st Cong., 1st Sess., 135 CONG. REC. S5989, S5990-92 (daily ed. June 1, 1989).

361. *See supra* text accompanying notes 342-43.

362. S. 1630, 101st Cong., 2d Sess., 136 CONG. REC. S3833 (daily ed. Apr. 3, 1990); *Senators Approve Clean Air Measure By A Vote of 89-11*, N.Y. Times, Apr. 4, 1990, at A1, col. 4; *Senate Passes Clean Air Legislation; President Calls Bill Carefully Balanced*, 14 Chem. Reg. Rep. (BNA) 3 (Apr. 6, 1990) [hereinafter *Clean*]; *Senate Passes Clean Air Legislation; President Calls Bill Carefully Balanced*, 29 Env't Rep. (BNA) 1931 (Apr. 6, 1990) [hereinafter *Air*].

2000.[363] An amendment by Senator Gore and Senator Patrick Leahy[364] would ban, by the year 2030, CFC substitutes which contribute to ozone depletion.[365] Three other provisions were also approved. One provides for consultation with other federal agencies regarding a safe alternatives policy;[366] another supports global participation in the Montreal Protocol and provides assistance to developing nations that are parties to the Protocol;[367] and the third provision grants power to the EPA Administrator to authorize limited production of halons after the year 2000 for aviation safety purposes if necessary.[368]

The House of Representatives also continues to take action. Congressman Jim Bates of California has introduced H.R. 2699[369] which would expedite the timetable for phase-out of production and consumption of ozone-depleting chemicals.[370] "[T]he proposal would immediately freeze production of five ozone-depleting chlorofluorocarbons and three halons at the 1986 production levels and call for a [fifty] percent cut in their production by July 1, 1993."[371] Congressman Peter Smith[372] introduced H.R. 3257[373] which would restrict certain uses of CFCs.[374] Although these two bills have not been

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363. S. 1630, 101st Cong., 2d Sess., 136 CONG. REC. S630, S592-624 (daily ed. Jan. 31, 1990) (Amendment 1219); *Clean*, *supra* note 362; *Air*, *supra* note 362.

364. Senator Leahy represents Vermont.

365. S. 1630, 101st Cong., 2d Sess., 136 CONG. REC. S2416-31 (daily ed. Mar. 8, 1990) (Amendment 1334 to Amendment 1293); *Clean*, *supra* note 362; *Air*, *supra* note 362.

366. S. 1630, 101st Cong., 2d Sess., 136 CONG. REC. S2233-35 (daily ed. Mar. 7, 1990) (Amendment 1306 to Amendment 1293).

367. S. 1630, 101st Cong., 2d Sess., 136 CONG. REC. S3350-51, S3353-54 (daily ed. Mar. 28, 1990) (Amendment 1410 to Amendment 1293).

368. S. 1630, 101st Cong., 2d Sess., 136 CONG. REC. S3717, S3801 (daily ed. Apr. 3, 1990) (Amendment 1307 to Amendment 1293).

369. H.R. 2699, 101st Cong., 1st Sess., 135 CONG. REC. H2991 (daily ed. June 21, 1989).

370. *Bates Bill Would Speed CFC Phase-Out*, 20 Env't Rep. (BNA) 501 (June 30, 1989) [hereinafter *Bates*]; *Bill Calls for Accelerating CFC Production and Use Phase-Out*, 13 Chem. Reg. Rep. (BNA) 406 (June 23, 1989).

371. *Bates*, *supra* note 370. "The Montreal Protocol calls for reaching the [fifty] percent cut by 1998." *Id.*

372. Congressman Smith represents Vermont.

373. H.R. 3257, 101st Cong., 1st Sess., 135 CONG. REC. H5595 (daily ed. Sept. 12, 1989).

374. *Id.*

passed, the 1989 Omnibus Budget Reconciliation Act[375] contains a provision which places a new per pound tax on CFCs and other chemicals which deplete the ozone.[376]

Another legislative initiative may have a positive effect on environmental problems. Senator John Glenn of Ohio and Representative John Conyers of Michigan have introduced bills to elevate the EPA to cabinet status.[377] On March 28, 1990, the House of Representatives overwhelmingly passed the Conyers' bill.[378] President Bush had announced his support for a cabinet level EPA position,[379] yet has threatened to veto this bill because it gives too much power to the EPA.[380] The Bush Administration hopes that a different bill emerges from the conference between the House of Representatives and the Senate.[381] With the President's support, the EPA could achieve cabinet status within the next year.

VI. Conclusion

The urgency of combatting ozone depletion has resulted in an unprecedented international effort to halt and reverse

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375. H.R. 3299, 101st Cong., 1st Sess., 135 CONG. REC. H9597, H9624, S16635, S16662 (daily ed. Nov. 21, 1989).

376. *Id.* at S16639. The Internal Revenue Code Sections 4681 and 4682, which were added by the Reconciliation Act, impose an excise tax on the sale or use by a producer, manufacturer, or importer of certain ozone depleting chemicals. The tax is effective January 1, 1990. The base tax amount is $1.37 per pound of chemical, and it rises in 1992 to $1.67, $2.65 in 1993 and 1994 and will increase 45 cents per pound every year thereafter. *IRS Issues Guidance Implementing Excise Tax On Ozone-Depleting Chemicals*, 20 Env't Rep. (BNA) 1510 (Jan. 5, 1990).

377. *President Bush Announces Support for Making EPA Cabinet-Level Department*, 20 Env't Rep. (BNA) 1652 (Jan. 26, 1990) [hereinafter *Cabinet*]; S. 2006, 101st Cong., 2d Sess., 136 CONG. REC. S98, S121-28 (daily ed. Jan. 23, 1990); H.R. 3847, 101st Cong., 2d Sess., 136 CONG. REC. H36 (daily ed. Jan. 23, 1990).

378. The vote was 371 to 55. *House Votes Bill To Elevate E.P.A. To Cabinet Level*, N.Y. Times, Mar. 29, 1990, at A1, col. 1 [hereinafter *House*]; H.R. 3847, 101st Cong., 2d Sess., 136 CONG. REC. H1170-1215 (daily ed. Mar. 28, 1990).

379. *Cabinet*, *supra* note 377.

380. The President opposes the legislation because it requires a major reorganization and expansion of the EPA The bill would also create an independent statistics-gathering agency within the EPA The Bush Administration believes this independent agency "[c]hallenges the President's constitutional right to manage the executive branch." *House*, *supra* note 378.

381. *Id.*

the problem. World leaders have acknowledged that international cooperation is imperative to protect the Earth's environment. The Montreal Protocol is just one result of this international cooperation. In the summer of 1990, as a result of further cooperation, the Protocol will be strengthened to accelerate the phase-out schedule of CFCs and halons. It is also very likely that the amended Protocol will call for regulation of carbon tetrachloride and methyl chloroform.

In addition to the Protocol, other efforts also contribute significantly to the protection of the ozone layer. In the United States, Clean Air legislation containing stratospheric ozone protection provisions will be enacted in 1990. The European Economic Community has assumed a leadership role in ozone layer protection, calling for quicker phase-outs of CFCs, halons, carbon tetrachloride, and methyl chloroform.

Additionally, local governments, environmental organizations, and individuals are effectively safeguarding the ozone layer for future generations. Local governments have enacted and enforced ozone protection statutes, while environmental organizations have brought lawsuits to protect the ozone layer. These organizations have also educated society regarding ways in which everyone can combat ozone depletion. Individuals have boycotted ozone depleting products and pressured their elected officials.

This global effort to protect and repair the earth's stratospheric ozone layer is a forerunner to future action concerning global environmental change. Environmental deterioration does not respect national and international boundaries. Thus, international cooperation is essential to effectively confront these problems.

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