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STRATOSPHERIC OZONE: UNITED STATES REGULATION OF CHLOROFLUOROCARBONS

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I. INTRODUCTION

For thousands of years, stratospheric ozone has shielded life on earth from harmful ultraviolet light. In the last three decades, humanity has released enough chlorofluorocarbons (CFCs) into the atmosphere to cause the almost total destruction of ozone above Antarctica during its winter months (the so-called Antarctic ozone hole) and the loss of significant amounts of global ozone at the mid-latitudes. Moreover, the CFCs already in the atmosphere will remain there destroying ozone for the next one hundred years.

We are at a crisis point. We must act now to reduce the depletion of ozone in the future. Despite the urgency of the situation, however, nations, including the United States, have been slow to act.

This Article, after preliminarily outlining the scientific nature of the problem and the attempts at regulation prior to 1985, focuses on the provisions of the 1987 Montreal Protocol on Substances That Deplete the Ozone Layer (the Protocol) and the final United States Environmental Protection Agency (EPA) regulations issued to implement the Protocol. The operation and impact of the Protocol's scheme provide a necessary foundation for reviewing EPA's regulations. This Article then reviews the EPA regulations, not merely for compliance with the Protocol, but in light of the regulations' advantages and disadvantages, the available alternatives, and EPA's role under the Clean Air Act. Finally, this Article takes a hard look at the adequacy of both the Protocol and the EPA regulations, taking into account the most recent scientific evidence and the debate over unilateral United States action.

II. THE CFC PROBLEM

A. Chlorofluorocarbons

New technologies developed to serve one beneficial purpose ironically often have unintended, unanticipated, and unsuspected consequences with potentially disastrous results. Such technologies have yielded a multitude of adverse environmental consequences as we approach the twenty-first century. CFC and halon emissions provide a classic example of these problems.

CFCs are a subcategory of halocarbons, which are compounds of carbon and one or more halogens (fluorine, chlorine, bromine or iodine). Unlike other halocarbons, CFCs contain both chlorine and fluorine and may also contain hydrogen.[1] Halons are compounds containing bromine and are produced in much smaller quantities than CFCs.[2] Both are man-made and do not occur naturally.[3]

CFCs are chemically stable, non-corrosive, non-flammable, non-toxic chemicals.[4] Their superior thermodynamic properties have resulted in more efficient refrigeration and widespread use. Their use in aerosols began during World War II after researchers at the United States Department of Agriculture found that dispersal of insecticides as fine aerosols greatly increased effectiveness.[5] Subsequently, personal care products using aerosol applications developed into large markets.[6]

In the 1960s, two significant new uses that greatly expanded production of CFCs were created. CFC-11 was used to make plastic foams and CFC-12 was used for automobile air conditioning. Most recently, CFC-113 has been used as a solvent in the manufacture of electronic components and computer chips,[7] and halons have been used primarily in hand-held and total flooding fire extinguishers.[8]

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[1] THE ECONOMICS OF MANAGING CHLOROFLUOROCARBONS, STRATOSPHERIC OZONE AND CLIMATE ISSUES 3 (J. Cumberland, J. Hibbs, & I. Hoch eds. 1982) [hereinafter THE ECONOMICS]; *see* 42 U.S.C. § 7452(1) (1982). Chlorofluorocarbons (CFCs) are best known under DuPont's trade name, "freon." They have been widely used in aerosol spray cans, air conditioning and refrigeration, foams used for cushioning, insulation, and packaging, and as industrial solvents. They also are a blowing agent used to make such things as foam cups, trays, and egg cartons. WORLD CLIMATE CHANGE: THE ROLE OF INTERNATIONAL LAW AND INSTITUTIONS 153 (V. Nanda ed. 1983) [hereinafter WORLD CLIMATE CHANGE].

[2] Protection of Stratospheric Ozone, 52 Fed. Reg. 47,489, 47,491 (1987) (to be codified at 40 C.F.R. pt. 82) (proposed Dec. 14, 1987). Bromine is more ozone-destructive than chlorine. It reacts catalytically with ozone, and also can interact synergistically with chlorine to consume ozone. On a pound-for-pound basis, halons pose a two and one-half to twelve and one-half times greater threat to deplete ozone than do CFCs. EPA OFFICE OF AIR AND RADIATION, ASSESSING THE RISKS OF TRACE GASES THAT CAN MODIFY THE STRATOSPHERE 3-5 (1987) [hereinafter ASSESSING THE RISKS]; Turco, *Stratospheric Ozone Perturbations*, in OZONE IN THE FREE ATMOSPHERE 195, 203 (1985); *see also* L. DOTTO & H. SCHIFF, THE OZONE WAR 188 (1978) [hereinafter THE OZONE WAR]. For this reason, halons are included with the more abundant CFCs in the Montreal Protocol and EPA's proposed regulation.

[3] ASSESSING THE RISKS, *supra* note 2, at 3-3.

[4] Forziati, *The Fluorocarbon Problem*, in THE ECONOMICS, *supra* note 1, at 40–41.

[5] COUNCIL ON ENVIRONMENTAL QUALITY AND FEDERAL COUNCIL FOR SCIENCE AND TECHNOLOGY, FLUOROCARBONS AND THE ENVIRONMENT, REPORT OF FEDERAL TASK FORCE ON INADVERTENT MODIFICATION OF THE STRATOSPHERE 77 (1975) [hereinafter FLUOROCARBONS AND THE ENVIRONMENT].

[6] ASSESSING THE RISKS, *supra* note 2, at 3-7.

[7] *Id.*

[8] *Id.* at 3-5.

Production of these ozone-depleting substances is expected to increase in the future. CFC-11 and CFC-12, for example, constitute over eighty percent of current worldwide production.[9] Combined production of CFC-11 and CFC-12 grew at an average rate of 8.7 percent from 1960 to 1974,[10] peaking in 1974.[11] Although declines in aerosol use resulted in global reduction between 1976 and 1984, by 1986 total CFC-11 and CFC-12 production was nearly as much as that in 1974.[12] Studies project average rates of production growth for CFC-11 and CFC-12 over the next sixty-five years ranging from 0.2 percent to 4.7 percent,[13] with CFC-113 production growing at a faster rate.[14] Unlike CFCs, annual production of halons has remained relatively steady at 20,000 kilograms.[15]

B. Atmospheric Ozone

The earth's atmosphere consists of three layers. They are, in ascending order, the troposphere, stratosphere, and mesosphere.[16] The air temperature becomes cooler with increasing altitude to a minimum of about minus eighty degrees Fahrenheit, and then becomes warmer.[17] In the troposphere, cold air is above the warm air.[18] Because the cold air is denser, it tends to sink, while the warm air tends to rise. Thus, there is a good deal of vertical mixing in the troposphere.[19]

In contrast, the stratosphere is a stable, virtually cloudless region. Lying above the troposphere, the stratosphere has slow vertical circulation because the denser, cooler air is at lower altitudes and

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[9] *Id.* at 3-3.

[10] *Id.*

[11] *Id.* (total global CFC-11 and CFC-12 production peaked in 1974 at over 700 million kilograms).

[12] *Id.*

[13] *Id.* at 3-4.

[14] *Id.*

[15] *Id.* at 3-5.

[16] Forziati, *supra* note 4, at 42.

[17] NATIONAL ACADEMY OF SCIENCES, HALOCARBONS: EFFECTS ON STRATOSPHERIC OZONE 21 (1976) [hereinafter HALOCARBONS]. This temperature minimum is known as the tropopause. *Id.*

[18] THE OZONE WAR, *supra* note 2, at 34.

[19] *Id.* The stratosphere lies above the troposphere. In the stratosphere, the temperature rises from its minimum at the tropopause to a maximum of about 50 degrees Fahrenheit at the stratopause. HALOCARBONS, *supra* note 17, at 21; *see also* 42 U.S.C. § 7452(2) (1982). In the stratosphere, the temperature rises from its minimum at the tropopause to a maximum of about fifty degrees Farenheit at the stratopause.

does not readily rise.[20] Transfer of gases between the troposphere and stratosphere is limited.[21]

Although ozone constitutes one of the gases in the stratosphere, it exists in very small amounts, only a few parts per million.[22] In fact, if all stratospheric ozone existed in a single layer at sea-level pressure, it would be no more than 0.3 centimeters thick.[23] Yet this thin and scattered band of ozone molecules is absolutely essential to the existence of life on the earth's surface because of its capacity to absorb ultraviolet radiation.[24]

Ultraviolet radiation causes sunburn, skin cancer, and other biological effects, including alteration of deoxyribonucleic acid (DNA), the material that carries the genetic information of living cells.[25] Ultraviolet radiation reaches the atmosphere in a range of varying wavelengths. The shorter the wavelength, the greater the harm caused by the radiation.[26] Ozone in the stratosphere destroys almost all of the most destructive radiation and most of the less destructive radiation.[27] Consequently, relatively little harmful ultraviolet radiation has been reaching the earth's surface.[28]

C. CFCs in the Atmosphere

Because CFCs are gases at room temperature, production of CFCs eventually translates into emissions into the atmosphere.[29] Aerosol

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[20] HALOCARBONS, *supra* note 17, at 21.

[21] Forziati, *supra* note 4, at 43.

[22] HALOCARBONS, *supra* note 17, at 22.

[23] THE OZONE WAR, *supra* note 2, at 26.

[24] *Id.* Moreover, ozone is responsible for the heating of the atmosphere above the tropopause, and therefore is linked to the dynamic state of the atmosphere and finally to the terrestrial climate. *See* STRATOSPHERIC OZONE REDUCTION, SOLAR ULTRAVIOLET RADIATION AND PLANT LIFE 1 (R. Worrest & M. Caldwell eds. 1983).

[25] Forziati, *supra* note 4, at 43–44; *see also* NATIONAL RESEARCH COUNCIL, CAUSES AND EFFECTS OF CHANGES IN STRATOSPHERIC OZONE: UPDATE 1983 198–204 (1984) [hereinafter CAUSES AND EFFECTS]. Ultraviolet radiation wavelengths of 290 to 320 nanometers (1 nm = 10^{-9} m) known as UV-B is largely responsible for these effects. Forziati, *supra* note 4, at 44.

[26] Forziati, *supra* note 4, at 44. The DNA-altering effectiveness of ultraviolet radiation increases by a factor of about 5,000 from 320 nm to 290 nm. *Id.* Thus, even a small increase in 290 nm radiation may be more significant biologically than a large increase at 320 nm.

[27] *See id.* Damaging radiation in the 290 nm to 320 nm wavelengths is partially absorbed by the stratospheric ozone. Radiation of wavelengths from 240 nm to 290 nm is almost completely absorbed by the stratospheric ozone. Radiation between 190 nm and 240 nm wavelengths is absorbed by molecular oxygen before it reaches the high stratosphere. *Id.*

[28] *Id.*

[29] THE ECONOMICS, *supra* note 1, at 5. Recent measurements of atmospheric gases affecting ozone reveal annual growth in concentrations of CFC-11 (5%), CFC-12 (5%), CFC-13 (10%), and halon 1211 (23%). ASSESSING THE RISKS, *supra* note 2, at 2-9 to 2-10.

use of CFCs results in immediate release to the atmosphere. Use of CFCs for refrigerants or foam-blowing delays emissions; however, leakage occurs and eventually the disposal of the product will release the CFCs.[30]

Once in the atmosphere, CFCs remain there despite the troposphere's "sinks," natural removal processes which cleanse the air.[31] Precipitation is the most common sink. The troposphere can cleanse itself of pollutants in about one week.[32] There are no significant natural tropospheric sinks, however, for CFCs.[33] The Federal Task Force on Inadvertent Modification of the Stratosphere concluded in 1975 that the amount of CFCs in the oceans, soil, subsurface groundwater, and polar icecaps was insignificant.[34] The stability that made CFCs ideal for their original purposes permits them to remain inert in the troposphere.[35] Thus, CFCs, with lifetimes of up to 120 years, accumulate in the troposphere and eventually migrate to the stratosphere.[36]

The amount of ozone in the stratosphere is normally maintained in relative equilibrium as a result of a dynamic balance between formation and destruction processes.[37] Ozone is formed when ultraviolet radiation breaks molecular oxygen (O_2) into oxygen atoms (O), the latter then combining with molecular oxygen to form ozone.[38]

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[30] THE OZONE WAR, *supra* note 2, at 230; HALOCARBONS, *supra* note 17, at 57–59.

[31] *See* T. STOEL JR., A. MILLER, & B. MILROY, FLUOROCARBON REGULATION, AN INTERNATIONAL COMPARISON 10 (1980) [hereinafter FLUOROCARBON REGULATION]; Forziati, *supra* note 4, at 42.

[32] THE OZONE WAR, *supra* note 2, at 34.

[33] FLUOROCARBON REGULATION, *supra* note 31, at 10; FLUOROCARBONS AND THE ENVIRONMENT, *supra* note 5, at 7. In the early and mid-1970s, government and industry searched for such sinks but did not find any. Prior to recognition of the ozone problem, this absence of sinks was considered beneficial because CFCs could otherwise be classified as a pollutant. The ozone issue turned the tables but no sink was ever identified. *See* THE OZONE WAR, *supra* note 2, at 230–42.

[34] FLUOROCARBONS AND THE ENVIRONMENT, *supra* note 5, at 7.

[35] THE ECONOMICS, *supra* note 1, at 1. In addition, during the long period when the CFCs reside in the troposphere, they contribute to the "greenhouse effect" by absorbing emissions of infrared radiation from the surface of the earth. *Id.*

[36] EPA, CFCS AND STRATOSPHERIC OZONE, 1 (1987); Forziati, *supra* note 4, at 41; HALOCARBONS, *supra* note 17, at 27–28. As early as 1975, CFCs were detected in the stratosphere. FLUOROCARBONS AND THE ENVIRONMENT, *supra* note 5, at 7.

[37] HALOCARBONS, *supra* note 17, at 22.

[38] *Id.* at 22–23. Where hv is harmful ultraviolet radiation, this process may be represented as follows:

$$O_2 + hv \rightarrow O + O$$

$$O + O_2 + M \rightarrow O_3 + M \text{ (twice)}$$

$$\text{NET } 3O_2 \rightarrow 2O_3$$

Ozone is destroyed when it absorbs damaging ultraviolet radiation (DUV). DUV causes an oxygen atom to dissociate.[39] Dissociation of the oxygen atom is not a true destruction process because almost all freed oxygen atoms quickly recombine with molecular oxygen to again form ozone.[40]

Once CFCs reach the middle and upper stratosphere, the ozone layer no longer shields them from ultraviolet radiation. As a result, ultraviolet radiation breaks down the CFCs, thereby releasing chlorine atoms, or bromine atoms in the case of halons.[41] The chlorine and bromine released in the stratosphere catalyze the destruction process, repeatedly combining with and breaking apart ozone molecules, resulting in a net decrease in the stratospheric ozone content.[42]

D. Health and Environmental Impacts

Decreases in ozone would permit greater penetration of damaging ultraviolet radiation to the earth's surface.[43] EPA estimates that such penetration would adversely affect humans and the environment as follows:

(1) The cumulative increase in lifetime exposure to DUV that individuals would experience could increase the incidence of nonmelanoma cancers.[44] EPA estimates 153,587,100 additional cases of such cancers in the United States by the year 2075 if CFCs are not controlled.[45] The number of cases would shrink to 3,694,900 if halon production is frozen at current levels and CFC production is reduced by fifty percent.[46] In either case, EPA expects the increase in non-

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[39] *Id.* at 23. The process may be represented as:

$$O_3 + h\nu \rightarrow O_2 + O$$

[40] *Id.*

[41] *Id.* at 28, 61. Ultraviolet radiation at wavelengths of 200 nm causes such a breakdown of CFCs.

[42] FLUOROCARBONS AND THE ENVIRONMENT, *supra* note 5, at 8; FLUOROCARBON REGULATION, *supra* note 31, at 8; NATIONAL RESEARCH COUNCIL, STRATOSPHERIC OZONE DEPLETION BY HALOCARBONS: CHEMISTRY AND TRANSPORT 9 (1979); CFCS AND STRATOSPHERIC OZONE, *supra* note 36, at 1.

[43] ASSESSING THE RISKS, *supra* note 2, at 2-11.

[44] *Id.* at 7-1; *see also* CAUSES AND EFFECTS, *supra* note 25, at 164–67.

[45] ASSESSING THE RISKS, *supra* note 2, at 7-4. This figure assumes nonwhites would not be affected.

[46] *Id.* A one-percent decrease in stratospheric ozone has been estimated to cause a two-percent increase in DUV, which in turn translates into a four-percent increase in the rate of human skin cancer. THE ECONOMICS, *supra* note 1, at 5. Other estimates conclude that the ratio may be as high as an eight-percent increase in skin cancers for each one-percent decrease in ozone. FLUOROCARBON REGULATION, *supra* note 31, at 12.

melanoma skin cancers to increase mortality as well, with most of the additional deaths occurring in later generations.[47]

(2) Similarly, increased DUV could cause increased incidence of mortality from melanoma skin cancer, most cases occurring in later generations and most deaths from such melanomas occurring in people not yet born.[48]

(3) Epidemiological studies have identified a correlation between the prevalence of cataracts in humans and the flux of ultraviolet radiation reaching the earth's surface. EPA estimates that, for each one percent-increase in DUV, there will be a one-half of one percent increase in cataracts, the majority of cases occurring in people not yet born.[49]

(4) Increased DUV could have a detrimental effect on human and animal immune systems. DUV reduces the ability of the immune system to respond to antigens, thereby potentially reducing one's capacity to respond to infectious diseases or prevent the development of tumors.[50] All populations would be at risk, but those already immunosuppressed could be at greater risk.[51]

(5) DUV can penetrate more than five feet into unclear water and more than twenty feet into clear water. Such radiation causes decreases in fecundity, growth, survival, and other functions of a variety of marine organisms, including organisms essential to the aquatic food chain.[52]

(6) Increased DUV has the potential to affect agricultural crops and other terrestrial ecosystems.[53]

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[47] ASSESSING THE RISKS, *supra* note 2, at 7-2.

[48] *Id.* at 7-2, 7-11; *see also* CAUSES AND EFFECTS, *supra* note 25, at 168–90.

[49] ASSESSING THE RISKS, *supra* note 2, at 7-11; *see also* CAUSES AND EFFECTS, *supra* note 25, at 144–63.

[50] ASSESSING THE RISKS, *supra* note 2, at 7-11, 7-24.

[51] *Id.* at 7-24. There is evidence that immunosuppression could result from much lower doses of DUV than those required for carcinogenesis. Exposures to ultraviolet radiation insufficient to cause a sunburn may decrease the ability of the human immune system to defend against skin infection or neoplastic skin cells. *Id.*

[52] *Id.*; *see also* CAUSES AND EFFECTS, *supra* note 25, at 218–25. Currently, EPA has insufficient scientific evidence to estimate the amount of damage that would occur in the natural environment for a given increase in DUV. ASSESSING THE RISKS, *supra* note 2, at 7-25. Experiments have indicated that increased ultraviolet radiation may inhibit the photosynthesis of phytoplankton by as much as 50%. FLUOROCARBON REGULATION, *supra* note 31, at 13.

[53] ASSESSING THE RISKS, *supra* note 2, at 7-25. A number of studies on various crops have demonstrated that DUV adversely affects crop yield and quality. *Id.*; *see also* CAUSES AND EFFECTS, *supra* note 25, at 206–16. Field studies of soybeans have shown that ozone depletion of 25% could decrease the yield of soybeans by over 20%, with substantially greater reductions

(7) Increased ultraviolet radiation reaching the troposphere can cause increased amounts of tropospheric ozone.[54] Ozone in the troposphere adversely affects human health, agricultural crops, forests, and certain materials.[55]

(8) Ultraviolet radiation tends to degrade polymers by affecting their mechanical and optical properties.[56]

(9) Increased concentration of CFCs is a factor that will contribute to global warming and, consequently, to a rise in the level of the seas.[57] Increases in sea levels will flood coastal wetlands and lowlands, accelerate coastal erosion, and increase the salinity of estuaries and aquifers.[58]

These impacts relate to every aspect of our quality of life: our health, life expectancy, food supply, and climate. Their occurrence can only lower the standard of living for future generations, a villainous legacy.

III. UNITED STATES AND INTERNATIONAL RESPONSE

A. Aerosols

The destruction of stratospheric ozone by CFCs was first hypothesized in 1974.[59] That same year, congressional hearings addressed the possibility of United States governmental restriction of CFCs for the first time,[60] but Congress took no action on either of two bills addressing the problem.[61] It was the consumers who turned away from aerosol products and flooded Congress with letters of concern that provided the impetus to reduce use of CFCs in aerosols,[62] then the major use of CFCs.[63] As a result of consumer pressure, for

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in years when climatic stresses are also a factor. CFCs AND STRATOSPHERIC OZONE, *supra* note 36, at 2.

[54] ASSESSING THE RISKS, *supra* note 2, at 7-28. Ozone is a criteria pollutant regulated under sections 108, 109, and 110 of the Clean Air Act. 42 U.S.C. §§ 7408–7410 (1982).

[55] ASSESSING THE RISKS, *supra* note 2, at 7-30. Materials include elastomers, textile fibers and dyes, and certain paints. *Id.*

[56] *Id.* at 7-33.

[57] *Id.*

[58] *Id.*

[59] Molina & Rowland, *Stratospheric Sink for Chlorofluoromethanes: Chlorine Atom Catalyzed Destruction of Ozone*, 249 NATURE 810 (1974).

[60] EPA OFFICE OF AIR AND RADIATION, REGULATORY IMPACT ANALYSIS: PROTECTION OF STRATOSPHERIC OZONE 3-1 (1987) [hereinafter REGULATORY IMPACT ANALYSIS].

[61] Brodeur, *Annals of Chemistry: In the Face of Doubt*, NEW YORKER, June 9, 1986, at 70, 73.

[62] *Id.* at 70; *see also* REGULATORY IMPACT ANALYSIS, *supra* note 60, at 3-1.

[63] Brodeur, *supra* note 61, at 73.

example, Oregon banned the sale of spray cans containing CFCs, and New York passed legislation requiring such products to carry a warning label.[64]

In the winter of 1975–76, a draft of the National Academy of Sciences' task force report, "Fluorocarbons and the Environment," was circulated for review. The task force report affirmed the potential for stratospheric harm.[65] By 1976, EPA, the Food and Drug Administration (FDA), and the Consumer Product Safety Commission (CPSC) began considering regulations to restrict the use of CFCs in aerosols.[66] Three separate sets of regulations resulted.

On May 13, 1977, FDA proposed regulations pursuant to the Federal Food, Drug, and Cosmetic Act (FDCA).[67] These regulations generally prohibited use of CFCs as aerosol propellants in food, drug, medical device, or cosmetic products manufactured or packaged after December 15, 1978.[68] Finished products introduced into interstate commerce after April 15, 1979 also had to comply regardless of when they were manufactured or packaged.[69] In 1974, such products accounted for about eighty percent of CFCs used in aerosols.[70]

The remaining CFC propellants in aerosols are regulated by the Toxic Substances Control Act (TSCA).[71] With certain exceptions not pertinent to CFCs, TSCA grants EPA authority to regulate any chemical substance or mixture that presents an unreasonable risk of injury to health or to the environment.[72] Pursuant to this authority, on May 13, 1977 EPA proposed regulations to prohibit all manufacture, processing, and distribution in interstate commerce of CFCs for nonessential uses in aerosol propellants.[73] This rule became ef-

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[64] *Id.*

[65] *Id.*

[66] REGULATORY IMPACT ANALYSIS, *supra* note 60, at 3-1.

[67] 21 U.S.C. §§ 301–337 (1982 & Supp. IV 1986). This Act prohibits (1) the manufacture or sale of any "adulterated" food or cosmetic, or (2) the introduction into interstate commerce of any new drug that has not received "new drug" approval. 21 U.S.C. § 331 (1982 & Supp. IV 1986).

[68] 21 C.F.R. § 2.125 (1988). Certain specified uses were deemed essential and were therefore exempted from the prohibitions.

[69] *Id.*

[70] FLUOROCARBON REGULATION, *supra* note 31, at 55.

[71] 15 U.S.C. §§ 2601–2629 (1982 & Supp. IV 1986). Pesticides, tobacco, foods, food additives, drugs, cosmetics, medical devices, and certain nuclear material may not be regulated under TSCA. 15 U.S.C. § 2602 (1982).

[72] 15 U.S.C. § 2605 (1982).

[73] Toxic Substances Control Act, 42 Fed. Reg. 24,542 (1977) (codified at 40 C.F.R. pts. 702–799 (1987)).

fective on October 15, 1978.[74] The FDA and EPA each issued a set of regulations under separate statutes, coordinating their requirements so there would be no regulatory gap. If a CFC is not a TSCA chemical, it is an FDCA substance, and vice versa.[75]

Other sovereigns also responded. Belgium, Canada, Norway, and Sweden banned CFC use as aerosol propellants.[76] Australia reduced aerosol use of CFCs by sixty-six percent.[77] Member nations of the European Economic Community (EEC) reduced CFC use in aerosols by thirty percent from 1976 levels, and agreed not to increase their CFC production capacity. Portugal banned CFC production and established import quotas. Brazil implemented a production capacity cap.[78] Some states also enacted legislation to restrict the use of CFCs in aerosols.[79] Although these measures limiting CFCs in aerosols resulted in a decrease in CFC emissions, increasing use of CFCs for other purposes has offset these gains. The further reductions now needed must come from nonaerosol uses.

B. Clean Air Act

At the time of these aerosol regulations, EPA rejected the Clean Air Act as a basis for regulating CFCs,[80] even though the Act's purpose was to protect and enhance the quality of the nation's air. Because the Clean Air Act operates primarily through ambient air quality standards and state plans to achieve them, EPA could not readily apply the Act to CFCs.[81] The use of ambient standards to regulate CFCs would render attainment schedules, monitoring requirements, and other provisions of the Act meaningless, and pro-

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[74] 40 C.F.R. pt. 762 (1987).

[75] FLUOROCARBON REGULATION, *supra* note 31, at 54; *see also* 43 Fed. Reg. 11,320 (1978). The CPSC published a final rule on August 24, 1977, requiring that aerosol products subject to the Consumer Product Safety Act that contain CFC propellants carry a warning label as of February 20, 1978. 42 Fed. Reg. 22,017 (1977) (codified at 21 C.F.R. §§ 101.17, 369.21, 501.17, 505.10, 740.11, 801.425 (1988)). The Consumer Product Safety Act is codified at 15 U.S.C. §§ 2051–2083 (1982 & Supp. IV 1986).

[76] REGULATORY IMPACT ANALYSIS, *supra* note 60, at 3-4.

[77] *Id.*

[78] *Id.*

[79] FLUOROCARBON REGULATION, *supra* note 31, at 57. Further regulation of the use of CFCs at the state level is restricted by TSCA. TSCA allows state action only if such action is more stringent than federal regulation and if the effect does not unduly burden interstate commerce. *Id.*

[80] 42 U.S.C. §§ 7401–7508 (1982).

[81] FLUOROCARBON REGULATION, *supra* note 31, at 55; *see also* 42 U.S.C. §§ 7408–7410 (1982).

duce a strained extension of the Act's intended scope.[82] In addition, EPA rejected as impractical the use of the Clean Air Act's emergency powers to take action against any imminent and substantial endangerments to health.[83]

In contrast, the 1977 amendments to the Clean Air Act provided EPA with specific authority to regulate substances that adversely affect stratospheric ozone.[84] The amendments required EPA to study the cumulative effects of all substances, practices, processes, and activities on the stratosphere, particularly the ozone, and to report to Congress by August 7, 1979.[85] The amendments further provided that, upon submission of this report, the Administrator of EPA:

> shall propose regulations for the control of any substance, practice, process, or activity (or any combination thereof) which in his judgment may reasonably be anticipated to affect the stratosphere, especially ozone in the stratosphere, if such effect in the stratosphere may reasonably be anticipated to endanger public health or welfare. Such regulations shall take into account the feasibility and the costs of achieving such control.[86]

This provision granted EPA broad authority to regulate whenever, in the Administrator's judgment, a substance, practice, process, or activity could reasonably be anticipated to affect the ozone so as to endanger public health or welfare. The law does not require a finding that such harm has occurred, nor does it specify how the Administrator shall regulate.[87]

Pursuant to its new authority, on October 7, 1980 EPA issued an Advance Notice of Proposed Rulemaking, "Ozone-Depleting Chlorofluorocarbons: Proposed Production Restriction."[88] The proposed

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[82] FLUOROCARBON REGULATION, *supra* note 31, at 55.

[83] *Id.* EPA concluded:

> First, it would make the courts, rather than the agency, the initial triers of fact, and it was assumed that courts would be reluctant to ban a product unless presented with very strong evidence. Second, the provision applies only to health threats; environmental impacts of fluorocarbon use could not be considered.

Id.

[84] 42 U.S.C. §§ 7450–7459 (1982). The amendments specifically provided that the regulations proposed under TSCA prior to the enactment of amendments were not to be affected. 42 U.S.C. § 7458 (1982).

[85] *Id.* §§ 7453–7455.

[86] *Id.* § 7457(b).

[87] Compare this provision with TSCA provisions which authorize regulation of substances that pose an unreasonable risk to health and the environment. 15 U.S.C. § 2605 (1982). The TSCA unreasonable risk standard appears more onerous than a standard of reasonable anticipation of effects which may reasonably be anticipated to produce a risk.

[88] 45 Fed. Reg. 66,726 (1980).

rule would have applied to nonaerosol uses of CFCs, freezing the level of emissions of ozone-depleting compounds by mandated engineering controls and market-based controls.[89] The rule was never finalized. In 1983, EPA advised Congress that significant gaps existed in understanding the relationship between CFCs and ozone depletion and that EPA had no immediate plans to regulate CFCs further.[90]

This inaction prompted the Natural Resources Defense Council (NRDC) to file suit against EPA.[91] NRDC contended that the Advanced Notice of Proposed Rulemaking was a determination that CFC emissions endangered public health and the environment, thus triggering the Administrator's nondiscretionary duty under the Clean Air Act for the Administrator to issue regulations to control the emissions.[92] The parties settled, with EPA agreeing to publish proposed regulations or present a basis for deciding to take no action by May 1, 1987.[93] Faced with a court order to take some action, EPA announced its Stratospheric Ozone Protection Plan.[94] The Plan called for greater research, analysis, and emphasis on the United States' participation in international discussions of global strategies for protecting the ozone layer,[95] a policy that remains the cornerstone of EPA's approach.

C. United Nations Environmental Program

The protection of stratospheric ozone is a global concern. The tropospheric lifetimes of CFCs and halons result in wide dispersion of emissions. Thus, the release of CFCs in one nation will affect the stratosphere above another nation.[96] Because of the global nature of

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[89] *Id.*

[90] *Scientific Uncertainty Warrants Delay in CFC Regulation, EPA Tells Congress*, 7 Chem. Reg. Rep. (BNA) 456 (1983).

[91] *NRDC Sues to Require EPA to Issue Rules Limiting Emissions of Chlorofluorocarbons*, 15 Env't Rep. (BNA) 1384 (1984).

[92] *See id.*

[93] NRDC v. Thomas, No. 84-3587, slip op. (D.D.C. May 17, 1986). This deadline was later extended to December 1, 1987. The order, as extended, also required EPA to promulgate regulations by August 1, 1988. REGULATORY IMPACT ANALYSIS, *supra* note 60, at 3-10.

[94] 51 Fed. Reg. 1,257 (1986).

[95] *Id.* In March, 1986, EPA Administrator Lee Thomas, while addressing a workshop, seemed to indicate a new direction for EPA when he declared that EPA did not accept empirical verification that ozone depletion was occurring as a precondition for EPA's decision whether to regulate CFCs. He noted that action may be necessary "to avoid letting today's 'risk' become tomorrow's 'crisis.'" Brodeur, *supra* note 61, at 86.

[96] Protection of Stratospheric Ozone, 52 Fed. Reg. 47,489, 47,490 (1987).

stratospheric problems, the Clean Air Act calls upon the President to seek international agreements to protect the stratosphere,[97] and the United Nations (UN) eventually focused its environmental program on CFCs.

Although the participation by the UN in international environmental issues dates back to 1949, the UN has played a significant role only since 1972.[98] The UN Conference on Human Environment, held in Stockholm in 1972, drew international attention to the problems facing the global environment and led to the establishment of the United Nations Environment Programme (UNEP).[99] In 1976, UNEP identified the problem of ozone deterioration as one of five areas to receive priority treatment.[100] Subsequently, UNEP sponsored numerous meetings dealing specifically with the ozone problem.[101]

After years of negotiation, the international community struck a compromise by establishing the Vienna Convention for the Protection of the Ozone Layer in 1985.[102] Agreement on the Convention had failed because of lack of accord on whether to include a protocol imposing a worldwide ban on nonessential aerosol uses of CFCs.[103] The Convention requires parties to (1) cooperate in research and scientific assessments of the processes that may affect the ozone layer and effects from modification of the ozone layer;[104] and (2) exchange socioeconomic, commercial, and legal information.[105] Although the Convention failed to agree on any global control measures, it passed a resolution calling for an economic workshop and continued negotiations to culminate in a diplomatic conference.[106]

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[97] 42 U.S.C. § 4256 (1982).

[98] The first United Nations conference on environmental issues was the Scientific Conference and Utilization of Resources in 1949. Prior to 1972, the only other environmental conference called was the International Conference of Experts of the Scientific Basis for the Rational Use and Conservation of the Resources of the Biosphere in 1968. *See* Comment, *The Problem of Ozone Depletion—Is There an International Legal Solution?*, 12 N.C.J. INT'L L. & COM. REG. 433, 445 (1987).

[99] *Id.* at 448.

[100] *Id.*

[101] *Id.*

[102] Vienna Convention for the Protection of the Ozone Layer, May 2, 1985, printed as Treaty Doc. No. 9, 99th Cong., 1st Sess. 1985 (ratified by the United States in August 1986) [hereinafter Vienna Convention].

[103] UNEP Governing Council Reaches Compromise on Protocol for CFCs Under Ozone Convention, 8 Chem. Reg. Rep. (BNA) 305 (1984).

[104] Vienna Convention, *supra* note 102, at 24–25.

[105] *Id.* at 25–26.

[106] Brodeur, *supra* note 61, at 85.

Immediately after agreement was reached on the Vienna Convention, scientific evidence appeared indicating that the ozone problem was worse than previously believed. In June, 1984, scientific data presented at a Munich meeting, "Current Issues in Our Understanding of the Stratosphere and the Future of the Ozone Layer," indicated that CFC depletion of ozone was not directly related to CFC production.[107] Instead, doubling the amount of CFCs appeared to increase depletion by a factor of four to six.[108] In May 1985, British scientists published reports of large losses of ozone above Antarctica.[109] By August, satellites of the National Aeronautics and Space Administration (NASA) had confirmed the British observations and mapped an enormous hole in the ozone layer above Antarctica. The loss of ozone was nearly sixty percent by October.[110] A NASA report funded by UNEP reported that the ozone layer might have already decreased 4.9 to 9.4 percent from CFCs and that the destruction might be at a faster rate than production of CFCs.[111]

Faced with increasing evidence of environmental harm and a substantial economic interest in CFC production, an international consensus emerged that control measures were necessary, but there was not any consensus on what those measures should be.[112] To establish controls, several nations, including the United States, drafted proposed protocols.[113] The United States urged an immediate freeze at current emissions levels, scheduled reductions of up to ninety-five percent of emissions, and scheduled regular reassessments of controls based on changing stratospheric conditions.[114] Canada and the Nordic nations advocated similar actions. European

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[107] *Id.*

[108] *EPA To Reconsider Production Rules in Light of New Data on Ozone Depletion*, 8 Chem. Reg. Rep. (BNA) 349 (June 22, 1984).

[109] Mintzer & Miller, *The Ozone Layer: Its Protection Depends on International Cooperation*, 21 ENVTL. SCI. TECH. 1167 (1987) [hereinafter *International Cooperation*].

[110] Brodeur, *supra* note 61, at 84.

[111] *Up to 9.4 Percent Ozone Depletion Predicted in United Nations Report*, 9 Chem. Reg. Rep. (BNA) 1395 (Jan. 17, 1986).

[112] *See U.S. Participation in International Negotiations on Ozone Protocol: Hearings Before the House Subcomm. on Foreign Affairs*, 100th Cong., 1st Sess. 4–5 (1987) (statement of Richard Benedick, Deputy Assistant Secretary of State for Health, Environment, and Natural Resources) [hereinafter *U.S. Participation*].

[113] Comment, *Thinning Air, Better Beware: Chlorofluorocarbons and the Ozone Layer*, 6 DICK. J. INT'L L. 87, 110 (1987).

[114] Address by R. E. Benedick, Deputy Assistant Secretary of State for Environment, Health, and Natural Resources, before the 1987 Washington Conference on CFCs and Ozone Protection Programs (Mar. 25, 1987). The ninety-five percent reduction reflected Senate bills calling for a phase-out of ninety-five percent of CFCs. S. 570, 100th Cong., 1st Sess. (1987); S. 571, 100th Cong., 1st Sess. (1987).

nations, Japan, and the U.S.S.R., however, did not support long-term measures.[115] Nevertheless, despite initial differences, on September 16, 1987 twenty-four nations, including those producing two-thirds of all CFCs, responded to growing scientific evidence of ozone depletion by signing the Montreal Protocol on Substances that Deplete the Ozone Layer.[116]

IV. THE MONTREAL PROTOCOL

The Montreal Protocol[117] is an historic agreement because for the first time the international community reached agreement on control of a valuable economic commodity to prevent future environmental damage.[118] More than fifty nations participated in Montreal.[119] Twenty-four nations, including the United States, signed the Protocol upon its adoption.[120] Other delegations, including the U.S.S.R., expected their governments to sign after reviewing the agreement.[121] Both developed and developing nations played an active role in the process of reaching an agreement and signing the Protocol.[122]

A. Controlled Substances

The Protocol does not place limitations on all CFCs and halons, only on those listed as "controlled substances."[123] "Controlled substances" is defined as any substance listed in Annex A to the Protocol, whether existing alone or in a mixture.[124] The definition does

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[115] *U.S. Participation*, *supra* note 112, at 5–6.

[116] OZONE PROTOCOL, S. EXEC. REP. NO. 14, 100th Cong., 2d Sess. 55–56 (1988) [hereinafter OZONE PROTOCOL] (statement of Lee M. Thomas, EPA Administrator).

[117] MONTREAL PROTOCOL ON SUBSTANCES THAT DEPLETE THE OZONE LAYER, TREATY DOC. NO. 10, 100th Cong., 1st Sess. (1987), *reprinted in* 52 Fed. Reg. 47,515, 47,515–19 (1987) [hereinafter MONTREAL PROTOCOL] (ratified by the United States on March 14, 1988).

[118] *See* OZONE PROTOCOL, *supra* note 116, at 55 (statement of Lee M. Thomas, EPA Administrator).

[119] Statement of J.D. Negroponte, Assistant Secretary of State for Oceans and International Environmental and Scientific Affairs, before the House Comm. on Science, Space and Technology (October 29, 1987).

[120] *Id.*

[121] *Id.*

[122] *Id.* The signatories of the Protocol were: Belgium, Canada, Denmark, Egypt, Finland, France, Germany, Ghana, Italy, Japan, Kenya, Mexico, Netherlands, New Zealand, Norway Panama, Portugal, Senegal, Sweden, Switzerland, Togo, United Kingdom, United States, and Venezuela. REGULATORY IMPACT ANALYSIS, *supra* note 60, at K-11 (Appendix K).

[123] MONTREAL PROTOCOL, *supra* note 117, art. 1, para. 4, 52 Fed. Reg. at 47,515.

[124] *Id.* Annex A, 52 Fed. Reg. at 47,519.

not include any substance or mixture that is in a manufactured product other than a container used for the transportation or storage of the substance listed.[125]

Annex A lists two groups of substances. Group I consists of CFC-11, CFC-12, CFC-113, CFC-114, and CFC-115. Group II consists of halon-1211, halon-1301, and halon 2402.[126] The parties to the Protocol may add or remove any substance from the Annex by a two-thirds majority vote of those present and voting.[127] Parties are free to regulate substances not included in the Protocol or to take more stringent control measures than the Protocol requires.[128]

B. Control Measures

A basic feature of the Montreal Protocol is the obligation of the parties to limit production and consumption of controlled substances.[129] The Protocol does not, however, limit each controlled substance. It does limit the "calculated levels" of production and consumption for each Group (I and II) of controlled substances. A party to the Protocol may produce any combination of Group I controlled substances it chooses as long as the total calculated level does not exceed certain limits. All limits are based on the party's 1986 calculated level of production.[130]

In determining the 1986 calculated level of production, the starting point for each nation is its 1986 production.[131] Developed nations may add to their 1986 production the production from facilities under construction or contracted for prior to September 16, 1987 and from

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[125] *Id.*

[126] There are other CFCs currently being produced. The four major CFCs produced in commercial quantities are CFC-11, CFC-12, HCFC-22, and CFC-113. CFC-11 and CFC-12 account for approximately 80% of production in limited quantities. All halons are being produced in relatively small quantities but use is growing rapidly. ASSESSING THE RISKS, *supra* note 2, at 3-5. HCFC-22 is not covered because it has a short atmospheric lifetime and is substantially less harmful than the other chemicals. In addition, HCFC-22 is a potential substitute for more patent ozone-depleting chemicals. Protection of Stratospheric Ozone, 52 Fed. Reg. 47,489, 47,498 (1987) (to be codified at 40 C.F.R. pt. 82) (proposed Dec. 14, 1987).

[127] MONTREAL PROTOCOL, *supra* note 117, art. 2, para. 10, 58 Fed. Reg. at 47,516.

[128] *Id.* art. 2, para. 11, 52 Fed. Reg. at 47,516.

[129] *Id.* art. 2, para. 3, 52 Fed. Reg. at 47,515–16.

[130] The year 1986 was chosen as the baseline for controls so that nations did not have an incentive to increase their production and consumption during 1987 in order to establish higher baselines while the Protocol was being negotiated. Protection of Stratospheric Ozone, 52 Fed. Reg. 47,489, 47,496 (1987) (to be codified at 40 C.F.R. pt. 82) (proposed Dec. 14, 1987).

[131] MONTREAL PROTOCOL, *supra* note 117, art 2, para. 3, 52 Fed. Reg. at 47,515.

facilities provided for in national legislation prior to January 1, 1987.[132] Such facilities must, however, be completed by December 31, 1990, and production from them must not raise the party's annual calculated level of consumption of controlled substances above 0.5 kilograms per capita.[133]

Other than this adjustment for 1986, calculated levels of production are determined by the annual production of each individual controlled substance less the amount of that substance destroyed by technologies to be approved by the parties.[134] The resulting figure is then multiplied by the ozone depleting potential assigned to that controlled substance. A substance's ozone depleting potential is an arbitrary multiple contained in Annex A of the Protocol to give each controlled substance a weighted factor corresponding to its destructive effect on ozone.[135]

For example, CFC-11 has an ozone depleting potential of 1.0 while CFC-115 has a potential of 0.6. Thus, production of one kilogram of CFC-11 would count nearly twice as much against a party's calculated level of production as production of one kilogram of CFC-115. This multiplication process is repeated for each controlled substance in a Group. The sum of the products for each Group is the calculated level of production.[136] The calculated level of production for Group I controlled substances may be represented as equalling:
[(1.0) (kg CFC-11)] + [(1.0) (kg CFC-12)] + [(0.8) (kg CFC-113)] + [(1.0) (kg CFC-114)] + [(0.6) (kg CFC-115)].
Calculated levels of consumption are determined by adding calculated levels of imports and subtracting calculated levels of exports from the calculated level of production.[137]

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[132] *Id.* art. 2, para. 6, 52 Fed. Reg. at 47,516. This would, for example, allow the Soviet Union to include in its 1986 base year the expanded production foreseen in its 5 year plan. OZONE PROTOCOL, *supra* note 116, at 4. Under article 5, developing nations are granted an exemption from controls under certain conditions. *See infra* note 141 and accompanying text.

[133] MONTREAL PROTOCOL, *supra* note 117, art. 2, para. 6, 52 Fed. Reg. at 47,516. For purposes of comparison, 1985 United States per capita consumption of CFCs was 0.84 kilograms. REGULATORY IMPACT ANALYSIS, *supra* note 60, app. D, D-5.

[134] Production is defined in article 1 to exclude any amount destroyed. MONTREAL PROTOCOL, *supra* note 117, art. 1, para. 5, 52 Fed. Reg. at 47,515.

[135] *See* MONTREAL PROTOCOL, *supra* note 117, art. 3, 52 Fed. Reg. at 47,516.

[136] *Id.* art. 2, para. 4, 52 Fed. Reg. at 47,516.

[137] Calculated levels of imports and exports are determined by multiplying the annual tonnage by the appropriate ozone depletion potential. After January 1, 1993, any export of controlled substances to non-parties will not be subtracted in calculating the consumption level of the exporting party. *Id.* art. 3, 52 Fed. Reg. at 47,516.

Parties will implement control measures through a series of scheduled freezes and reductions in the production and consumption of CFCs and halons.[138] The freezes will proceed as follows:

On July 1, 1989, a freeze on Group I substances will be put in effect. For the twelve month period commencing July 1, 1989,[139] and every twelve month period thereafter, each party's annual calculated level of consumption of Group I controlled substances must not exceed its calculated level of consumption for 1986.[140] Similarly, a party's annual calculated level of production of Group I controlled substances must not exceed its calculated level of production for 1986 with three exceptions.

The first exception allows parties that are developing countries and whose annual calculated level of consumption of controlled substances is, and remains, less than 0.3 kilograms per capita to delay compliance with the Protocol by ten years from the date otherwise specified.[141] The other exceptions pertain to parties that are developed countries. These parties may exceed their 1986 calculated levels of production by as much as ten percent to satisfy the basic domestic needs of developing countries that are parties to the Protocol.[142] In addition, they may exceed that level for purposes of industrial rationalization between parties.[143] Industrial rationalization is the transfer of all or a portion of a party's calculated level of production to another party in order to achieve economic efficiency or to avoid shortfalls in supply caused by plant closures.[144] Article 2 of the Protocol permits any party whose calculated level of production of Group I controlled substances was less than twenty-five kilotons to

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[138] *Id.* art. 2, 52 Fed. Reg. at 47,516.

[139] If the Montreal Protocol did not enter into force on January 1, 1989, these controls will commence with the seventh month after the date the Protocol enters into force. *Id.* art. 2, para. 1, 52 Fed. Reg. 47,515.

[140] *Id.*

[141] The 1986 consumption of developing countries was low in comparison to developed countries. By allowing developing countries to increase their consumption to 0.3 kilograms per capita and allowing developed countries to increase production to supply the developing countries, the drafters of the Protocol hoped to encourage developing countries to join the Protocol. The drafters hoped that these actions would make it unnecessary for them to build or expand any capacity for producing controlled substances in order to supply for a limited period of time their growing domestic needs. Protection of Statospheric Ozone, 52 Fed. Reg. 47,489, 47,496–97 (1987) (to be codified at 40 C.F.R. pt. 82) (proposed Dec. 14, 1987).

[142] MONTREAL PROTOCOL, *supra* note 117, art. 2, para. 1, 52 Fed. Reg. at 47,515.

[143] *Id.*

[144] *Id.* art. 1, para. 8, 52 Fed. Reg. at 47,515.

transfer or receive production for purposes of industrial rationalization.[145]

A freeze on Group II substances will go into effect on January 1, 1992. For the twelve month period commencing January 1, 1992,[146] and every twelve month period thereafter, each party's annual calculated level of consumption of Group II controlled substances may not exceed its calculated level of consumption for 1986.[147] The annual calculated level of production of those substances may not exceed the nation's calculated level of production for 1986 except that such level may be exceeded: (1) to satisfy the basic domestic needs of parties that are developing countries (but not by more than ten percent of the 1986 figure); or (2) for purposes of industrial rationalization between parties.[148]

A twenty-percent reduction on Group I substances will go into effect on July 1, 1993. For the twelve month period commencing July 1, 1993,[149] and annually thereafter, each party's calculated level of consumption of Group I controlled substances may not exceed eighty percent of its calculated level of consumption for 1986.[150] Each party's calculated level of production of Group I substances for those periods may not exceed eighty percent of its calculated level of production for 1986 except: (1) to satisfy the basic domestic needs of developing countries, in which the case the limit may be exceeded by not more than ten percent of the 1986 calculated level of production; or (2) for industrial rationalization purposes.[151]

A fifty-percent reduction in Group I substances will become effective on July 1, 1998. For the twelve month period commencing July 1, 1998,[152] and annually thereafter, each party's calculated level of consumption of Group I controlled substances may not exceed fifty percent of its calculated level of production for 1986 except: (1) to

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[145] Industrial rationalization would allow, for example, United States producers to maintain production beyond allowed consumption levels in order to supply Canadian users if small Canadian plants were closed for inefficiency as a result of controls. OZONE PROTOCOL, *supra* note 116, at 4.

[146] If the Montreal Protocol did not enter into force on January 1, 1989, these controls will commence with the thirty-seventh month after the date the Protocol enters into force. MONTREAL PROTOCOL, *supra* note 117, art. 2, para. 2, 52 Fed. Reg. at 47,515.

[147] *Id.*

[148] *Id.*

[149] This reduction takes effect on July 1, 1993 regardless of when the Protocol enters into force, so long as the Protocol does enter into force by that date.

[150] MONTREAL PROTOCOL, *supra* note 117, art. 2, para. 3, 52 Fed. Reg. at 47,515–16.

[151] *Id.*

[152] This reduction takes effect on July 1, 1998 regardless of when the Protocol enters into force, so long as the Protocol enters into force by that date.

satisfy the basic domestic needs of developing countries, in which case the limit may be exceeded by not more than fifteen percent of the 1986 calculated level of production; or (2) for industrial rationalization purposes.[153]

C. Trade with Non-Parties

The trade provisions in Article 4 are the other key feature of the Protocol. These provisions seek to limit emissions of CFCs and halons by restricting trade with countries that are not parties. To accomplish this objective, the Protocol requires parties to impose the following specific restrictions on the trade of ozone-depleting products with non-parties:[154]

(1) Within one year of the Protocol entering into force, each party must ban the import of controlled substances from any state not a party to the Protocol.[155]

(2) Beginning January 1, 1993, no developing country under Article 5 of the Protocol may export a controlled substance to any state not a party to the Protocol.[156]

(3) Within three years of the Protocol entering into force, the parties must create an annex listing products containing controlled substances. Absent objection to the list, within one year of the annex becoming effective the parties must ban import of those products from any state not a party to the Protocol.[157]

(4) Within five years of the Protocol entering into force, the parties must determine the feasibility of banning or restricting imports of products produced with, but not containing, controlled substances. If feasible, an annex will be developed and parties not objecting to the list will effect such bans or restrictions within one year of the annex's effective date.[158]

Parties have an additional precatory trade obligation to discourage the export to non-parties of technology that would facilitate the

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[153] MONTREAL PROTOCOL, *supra* note 117, art. 3, 52 Fed. Reg. at 47,516.

[154] Nations that do not join the Protocol by complying fully with its terms are exempted from operation of the trade bans. *Id.* art. 4, para. 8, 52 Fed. Reg. at 47,516. Because Taiwan is no longer a member of the United Nations, it cannot become a party. It is likely, however, that Taiwan will abide by the Protocol's control measures and reporting provisions to avoid the trade controls. REGULATORY IMPACT ANALYSIS, *supra* note 60, at K-14 (Appendix K).

[155] MONTREAL PROTOCOL, *supra* note 117, art. 4, 52 Fed. Reg. at 47,516–17.

[156] *Id.* Beginning January 1, 1993, no party to the Protocol that takes advantage of the special provisions in article 5 permitting a ten-year delay in compliance may export controlled substances to non-parties.

[157] *Id.*

[158] *Id.*

production or utilization of controlled substances.[159] Finally, parties must refrain from providing financial assistance to non-parties for exports of products, equipment, plants, or technology that would facilitate the production of controlled substances.[160]

The purpose of the trade provisions is to induce countries to become parties to the Protocol and to reduce CFC and halon emissions by those who remain non-parties. CFCs and halons can be traded in three general forms: as bulk chemicals, as chemicals contained in end-user products, and as products made with, but not containing, CFCs. Products that contain CFCs include automobiles, refrigerators, and air conditioners. Electronic components and consumer goods are examples of products that are made with, but do not contain, CFCs.[161]

Industrialized countries are the largest producers and consumers of CFC and halon bulk chemicals and of CFC end-user products.[162] These countries are self-sufficient producers and net exporters of CFC and halon bulk chemicals.[163] Their participation in the Protocol is thus particularly important. Few such industrialized countries could afford not to join the Protocol because their CFC-related products would be banned by other industrialized countries that were parties to the Protocol.[164] These countries can afford the transition costs of developing and adopting alternative chemicals and industrial processes not using CFCs or halons. Companies in these countries are already working to develop substitutes and many have patents on potential substitute chemicals and technologies.[165]

Use of CFCs in non-industrialized, developing countries has contributed to the overall growth of global CFC use and increased use in those countries is expected.[166] Newly industrialized countries have economies in which the production of manufactured goods is significant and growing. These countries produce CFCs, but primarily for domestic use.[167] An import ban by industrialized countries on bulk

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[159] *Id.*

[160] *Id.*

[161] REGULATORY IMPACT ANALYSIS, *supra* note 60, at K-2 (Appendix K). The value of the CFCs contained in or used to manufacture these products is very small compared to the value of the products themselves. *Id.*

[162] *Id.* at K-13 (Appendix K).

[163] *Id.*

[164] *Id.* Twenty-two industrialized countries participated in the Montreal Protocol negotiations. Of those, nineteen either signed the Protocol or were members of the European Economic Community that signed.

[165] *Id.*

[166] *Id.* at D-1 (Appendix D).

[167] Newly industrialized countries producing CFCs include Brazil, Korea, Taiwan, Mexico, Venezuela, and Argentina. *Id.* at K-13 (Appendix K).

chemicals would have limited impact on them. Many of their exportable products, however, contain CFCs.[168] The possibility of restrictions on export of these products creates a strong incentive for them to join the Protocol in order to maintain exports and export earnings. Membership would allow continued access to the markets of other parties.[169]

Large, developing countries like China, India, and Indonesia are significant users of CFCs, but per capita use is much smaller than in industrialized countries.[170] Industrial use of CFCs in large, developing countries is similar to that in newly industrialized countries. Most CFC end-user products manufactured in these countries have been for domestic use. In recent years, however, these large developing countries have attempted to increase their manufactured exports, spur the technological growth and sophistication of these industries, achieve greater economies of scale and production efficiencies, and earn needed foreign exchange.[171] India, for example, has a domestic electronics industry and China has been trying to expand its electronics industry. The Protocol's trade provisions could impair the continued near-term growth of CFC end-user industries and perhaps the technological development of CFC end-user industries.[172] The attractiveness of joining the Protocol for large developing countries will depend on whether they continue to implement development strategies based on export-led growth of manufactured goods.[173]

The least developed countries are the smallest users of CFCs.[174] They generally have no domestic production capacity and do not produce CFC-related products.[175] For them, CFC use is limited to imports of CFCs contained in products or used to manufacture products. Consequently, the potential effects of the Protocol's trade provisions are less important to them than they are to other countries. Many least developed countries have little immediate economic incentive to participate because of the trade provisions.[176] A greater

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[168] Although production of these goods is partly for domestic markets, exports to industrialized countries has been increasing. *Id.* at K-14 (Appendix K).

[169] *Id.* at K-14 (Appendix K), D-29 (Appendix D).

[170] *Id.* at K-16 (Appendix K).

[171] *Id.* at D-32 (Appendix D).

[172] *Id.*

[173] *Id.* at K-16 (Appendix K). The ten year grace period permitting per capita consumption to rise to 0.3 kilogram could further their development strategy.

[174] *Id.*

[175] There are some exceptions. For example, Thailand exports air conditioners, and nations in the Caribbean basin are attempting to establish electronic assembly industries. *Id.* at D-30 (Appendix D).

[176] *Id.* at K-16 (Appendix K). The trade provisions would have some negative effect on those

incentive to join may result largely from environmental and political considerations. For example, membership could result in a more favorable international image and strengthened foreign relations.[177]

In summary, the Protocol's trade provisions could impair the export of manufactured goods by a non-party when it has successfully increased exports in recent years or is attempting to increase exports in the future. The cost of lost export earnings to these countries could be high. Retaining access to the markets of industrialized countries therefore provides a strong incentive for such countries to join.[178]

D. Reports

Within three months of becoming a party to the Montreal Protocol, countries must provide statistical data on production, imports, and exports of each controlled substance for the year 1986.[179] If actual data is not available, best possible estimates must be submitted.[180] Each party is also required to provide annual statistical data on production, destruction, imports, and exports of each controlled substance. The reports must be submitted within nine months of the end of the year in which the party becomes a member and annually thereafter.[181] Within two years of the Protocol entering into force and every two years thereafter, each party is required to submit a summary of activities it has conducted for the promotion of technologies to reduce CFC and halon emissions, the development of possible alternatives to controlled substances or products containing them, and the generation of public awareness of the environmental effects of emission of controlled substances.[182]

E. Assessments and Adjustments

The Protocol is not intended to be a static agreement. It sets out a schedule for controls based on scientific knowledge at the time it

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countries either currently attempting to, or considering, the development of domestic CFC end-user products. *Id.* at D-32 (Appendix D).

[177] Nineteen of the least developed countries participated at Montreal. Six signed the final Protocol. The number could increase because some of the representatives were not authorized to sign at Montreal. *Id.* at K-16 (Appendix K).

[178] Developing countries not party to the Protocol have the option of trading amongst themselves. Historically, however, such trade has been a small part of their activity and has dealt largely with primary products. Even if these countries are not parties, they could assimilate technologies as they become available and target such technologies for parties.

[179] MONTREAL PROTOCOL, *supra* note 117, art. 7, para. 1, 52 Fed. Reg. at 47,517.

[180] *Id.*

[181] *Id.*, art. 7, para. 2, 52 Fed. Reg. at 47,517.

[182] *Id.* art. 9, 52 Fed. Reg. at 47,517.

was drafted. It also specifically provides for panels of experts to report on scientific, environmental, technical, and economic developments.[183] Beginning in 1990 and at least every four years thereafter, the parties to the Protocol will assess its control measures based on such reports.[184]

Based on these updated assessments of the control measures, parties may change the ozone depleting potentials listed in Annex A or may impose further reductions of production or consumption from 1986 calculated levels.[185] Although the Protocol states that such changes should be made by consensus, a decision may be adopted by a two-thirds majority of parties present and voting, provided it represents nations responsible for at least fifty percent of the total consumption of controlled substances of the parties.[186]

The parties may also decide to remove or add substances from an annex and to specify control measures applicable to those substances. Such changes must be adopted by a two-thirds majority of those present and voting without regard to their total consumption.[187]

In addition to these assessments and adjustments, Article 2 of the Protocol contains specific requirements in order to alter the Protocol's scheduled fifty-percent reduction of controlled substances.[188] Such a change must be agreed to by a two-thirds majority of the parties present and voting, provided it represents at least two-thirds of the total calculated level of consumption of those substances by all parties.[189]

F. Entry Into Force

The Protocol enters into force on January 1, 1989 if certain conditions are fulfilled: (1) the Protocol must be ratified by eleven or more states or regional economic integration organizations; (2) those ratifying the Protocol must represent at least two-thirds of the 1986 estimated global consumption of controlled substances; and (3) the Vienna Convention must first enter into force.[190] Should these con-

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[183] Statement of J.D. Negroponte, *supra* note 119. These reports are issued one year prior to the parties' assessment of control measures. MONTREAL PROTOCOL, *supra* note 117, art. 6, 52 Fed. Reg. at 47,517.

[184] *Id.*

[185] *Id.* art. 2, para. 9(a), 52 Fed. Reg. at 47,516.

[186] *Id.* art. 2, para. 9(c), 52 Fed. Reg. at 47,516.

[187] *Id.* art. 2, para. 10, 52 Fed. Reg. at 47,516.

[188] *Id.* art. 2, para. 4, 52 Fed. Reg. at 47,516.

[189] *Id.*

[190] *Id.* art. 16, para. 1, 52 Fed. Reg. at 47,518. The Vienna Convention has been ratified by the required number of nations and entered into force on September 22, 1988.

ditions not be fulfilled by January 1, 1989, the Protocol enters into force on the ninetieth day following the date on which all conditions are fulfilled. As of October 1, 1988, all major producers of CFCs had signed the Protocol, and nine nations had ratified it.[191]

V. EPA Regulations Implementing the Montreal Protocol

The Montreal Protocol does not specify how its production and consumption limitations are to be met. Each party to the Protocol has discretion to choose its own method. EPA has published two rules in order to implement the Protocol in the United States: one rule for collection of the United States 1986 production and consumption data[192] and a second rule that would implement the Protocol's substantive requirements.[193]

Congress did not enact any special enabling legislation for these regulations. Both rules are issued under statutory authority granted in the Clean Air Act.[194] EPA's authority to require information on 1986 production, consumption, imports, and exports of CFCs and halons is contained in section 114 of the Clean Air Act.[195] The Act empowers the Administrator to "require any person who owns or operates an emission source or is subject to any requirement of this chapter . . . to . . . provide such other information as he may reasonably require."[196] Likewise, authority to regulate CFCs and halons is contained in section 157(b) of the Clean Air Act.[197]

Based on its assessment of the scientific evidence, EPA "believes that the [Montreal] Protocol's requirements are an appropriate response to the potential ozone depletion problem at this time"[198] and "that implementation of the Protocol would best protect public health and welfare from the adverse effects of any ozone depletion."[199]

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[191] *More Controls Than Required by Protocol Needed to Protect Ozone Layer, Thomas Says*, 12 Chem. Reg. Rep. (BNA) 950 (Sept. 30, 1988) [hereinafter *More Controls Needed*].

[192] Protection of Stratospheric Ozone, 52 Fed. Reg. 47,486, 47,488 (1987) (to be codified at 40 C.F.R. § 82.20). EPA published the final rule without notice or opportunity for public comment. The statute authorizes this procedure when there is good cause to find that notice and public comment on the rule would be "impracticable, unnecessary, or contrary to the public interest." 5 U.S.C. § 553(b)(B) (1982).

[193] Protection of Stratospheric Ozone, 53 Fed. Reg. 30,566, 30,598–602 (1988) (to be codified at 40 C.F.R. §§ 82.1–82.14).

[194] 52 Fed Reg. 47,486; 53 Fed. Reg. 30,568.

[195] 42 U.S.C. § 7414 (1982).

[196] *Id.* § 7414(1)(E).

[197] *Id.* § 7457(b); *see supra* note 86 and accompanying text.

[198] Protection of Stratospheric Ozone, 52 Fed. Reg. 47,486, 47,498 (1987).

[199] *Id.*

Accordingly, the regulations replicate the requirements of the Montreal Protocol. They regulate the same controlled substances over specified control periods,[200] specify the same staged freezes and reductions,[201] and restrict trade to comply with the Protocol.[202] Moreover, the regulations become effective only after the Protocol enters into force.[203]

A. 1986 Calculated Levels

EPA has required producers, importers, and exporters of the controlled substances listed in Annex A of the Protocol to report the amount (in kilograms) of each controlled substance: (1) produced in the United States or its territories in 1986, (2) used and entirely consumed as a chemical intermediary in the production of other chemicals in 1986,[204] (3) imported into the United States or its territories in 1986 (including the date, port of entry, and country of origin), and (4) exported from the United States or its territories (including the date, port of exit, country of destination, and date of arrival at destination).[205] This information was required by January

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[200] Controlled substances are listed in Appendix A to Part 82. 52 Fed. Reg. at 47,523. They are identical to those in Annex A of the Protocol. 52 Fed. Reg. at 47,519. EPA has clarified the difference between a controlled substance in a container and a controlled substance in a manufactured product other than a container. A controlled substance includes any listed substance or mixture that is not part of a use system containing the substance. If the listed substance must be transferred from a bulk container to another container, vessel, or piece of equipment in order to realize its intended use, the first container is utilized only for storage and/or transport and the substance or mixture is considered to be in bulk form and not a product. 53 Fed. Reg. 30,598 (1988) (to be codified at 40 C.F.R. § 82.3(g)). EPA will designate control periods once the Protocol enters into force. Should there be a discontinuity between the timing of the Group I freeze and the twenty-percent reduction (that is, under the Protocol, the end of the last twelve-month freeze may not end precisely when the first twelve-month period of reduction begins), EPA will promulgate dates for the last control period of the freeze so that it overlaps with the twenty-percent reduction period. *Id.* at 30,580.

[201] The Protocol's twenty-percent and fifty-percent reductions are implemented by adjusting the amount of apportioned baseline production and consumption rights granted in specified control periods (for example, eighty percent for control periods between July 1, 1993 and June 30, 1998). 53 Fed. Reg. 30,599–600 (1988) (to be codified at 40 C.F.R. § 82.7).

[202] Importation of controlled substances from non-parties is prohibited beginning one year after the Protocol enters into force. *Id.* at 30,599 (to be codified at 40 C.F.R. § 82.4(d)). Exports to non-parties after January 1, 1993 are discouraged by denying additional consumption rights. *Id.* at 30,601 (to be codified at 40 C.F.R. § 82.10(b)). *See infra* note 249 and accompanying text.

[203] 53 Fed. Reg. 30,598 (1988) (to be codified at 40 C.F.R. § 82.2).

[204] This information is necessary to avoid counting CFC or halon production more than once.

[205] Protection of Stratospheric Ozone, 52 Fed. Reg. 47,488 (1987) (to be codified at 40 C.F.R. § 82.20).

13, 1988.[206] The information obtained provided the basis for determining the calculated levels of production and consumption in the United States for 1986,[207] an essential part of the regulatory scheme.

B. Regulatory Approach

Before settling on a regulatory approach, EPA considered three economic incentive approaches as well as several engineering controls and product bans.[208] The economic incentive approaches use higher CFC and halon prices to provide incentive for firms to reduce their use of those chemicals.[209] Higher prices should cause firms that can make relatively low-cost reductions to do so.

One of these economic incentive approaches provided for the auction of CFC permits to any interested party.[210] The permit would allow a firm to produce a specified amount of CFCs during a specified control period,[211] the number of permits auctioned determined by the permissible calculated levels for each group of controlled substances.[212] Revenues from the auctions would go to the United States Treasury.[213] It would not be permissible to hold permits for use in a later control period because such use could result in a violation of the Protocol in a future year.[214] The trading of permits, however, would be permissible.[215]

Another economic incentive approach involved setting production quotas based on regulatory goals.[216] The quotas would be allocated to the five domestic CFC producers and the approximately ten United States importers based on their share of the market in 1986.[217] Quotas could not be saved for use in a future year but could be traded among producers and importers for use in the same control year.[218]

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[206] *Id.*
[207] *Id.* at 47,487.
[208] REGULATORY IMPACT ANALYSIS, *supra* note 60, at 11-1.
[209] *Id.*
[210] *See id.* at 11-2 to 11-6.
[211] *Id.*
[212] *Id.* at 11-3.
[213] *Id.* at 11-2.
[214] *Id.* at 11-4.
[215] *Id.* at 11-5.
[216] *Id.* at 11-6.
[217] *Id.* at 11-7.
[218] *Id.* at 11-6 to 11-8.

The third economic incentive approach considered by EPA involved the use of regulatory fees.[219] EPA would assess fees against the regulated chemicals to encourage reduced usage,[220] basing the amount of those fees on the chemical's ozone depletion potential and the permitted calculated levels of CFCs.[221] A margin for error would be included to assure the target goal is met.[222] Revenues would go to the United States Treasury.[223]

EPA also considered developing specific engineering control measures requiring targeted CFC-user industries to reduce their consumption.[224] EPA could, for example, ban the use of CFC-blown packaging, require additional recovery and recycling from solvent users of CFCs, and require recycling of CFCs used in sterilization.[225] EPA could select control options based on pertinent societal considerations such as available technologies, cost of reductions, and quantity of reductions. A hybrid of these engineering controls/bans and of allocated quotas made up a fifth approach that EPA considered.[226]

EPA assessed each of these approaches against specific evaluation criteria: environmental protection, economic efficiency, equity, administrative feasibilty, legal certainty, incentives for innovation, and compliance and enforcement.[227] Regulatory fees lack certainty in accomplishing the degree of environmental protection required by the Protocol because users might decide to continue use at higher prices.[228] In addition, fees were considered to be of questionable legality because EPA would be raising revenues in excess of the costs of operating the program.[229] Auctioned permits, like fees, were considered legally questionable because of the revenues produced.[230] Like regulatory fees, engineering controls/bans may also fail to meet environmental protection goals because growth in unregulated uses could offset any gains in regulated industries.[231] Furthermore, con-

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[219] *See id.* at 11-9 to 11-10.
[220] *Id.* at 11-9.
[221] *Id.*
[222] *Id.* at 11-9 to 11-10.
[223] *Id.* at 11-9.
[224] *Id.* at 11-10.
[225] *Id.*
[226] *Id.* at 11-11 to 11-12.
[227] *Id.* at 11-1.
[228] *See id.* at 11-14.
[229] *Id.* at 11-22. The legal issue was whether EPA has authority under the Clean Air Act to collect revenues in excess of the costs of operating a program. *Id.*
[230] *Id.* at 11-22.
[231] *Id.* at 11-14.

trols and bans would provide incentives for innovation only to targeted industries.[232] The hybrid system was seen as sacrificing some economic efficiency[233] and raised potential administrative and enforcement burdens.[234]

Because concerns over environmental protection and legality could undermine the program and administrative costs of controls and bans could be high, EPA chose the allocated quota approach.[235] The sole identified drawback to the allocated quota approach was that CFC and halon producers and importers might realize substantial profits as a result of the scarcity created by regulation.[236] Moreover, the allocated quota approach provides economically efficient reductions, involves minimal administrative costs, does not raise potential legal issues, and is the most easily enforced option.[237]

C. Production and Consumption Levels

Consumption is defined in the regulations as it is in the Protocol: production plus imports minus exports.[238] Therefore, production and consumption allowances largely, but not entirely, overlap. Production allowances and consumption allowances would not be equal unless the 1986 calculated level of imports was equal to the 1986 calculated level of exports. Even if the two were equal, additional production and consumption are permitted under certain circumstances and could change the ratio. To the extent that exports exceed imports, production would exceed consumption, and, to the extent that imports exceed exports, consumption would exceed production. For example, if there were one hundred units of production, five units of imports, and ten units of exports, the level of consumption would be only ninety-five units.

Because the regulations must ensure compliance with the Protocol provisions limiting both production and consumption, they create separate production allowances and consumption allowances.[239] The regulations apportion calculated levels of baseline production allowances to any person who produced one or more controlled substances in the United States during 1986.[240] The apportionment is equal to

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[232] *Id.* at 11-17.
[233] *Id.* at 11-16.
[234] *Id.* at 11-21.
[235] *Id.* at 11-24.
[236] *See id.* at 11-17.
[237] *Id.*
[238] MONTREAL PROTOCOL, *supra* note 117, 52 Fed. Reg. at 47,515.
[239] 53 Fed. Reg. 30,599 (1988) (to be codified at 40 C.F.R. §§ 82.5–82.6).
[240] *Id.*

that person's calculated level of production of Group I and Group II controlled substances during 1986.[241] The regulations allocate baseline consumption allowances to persons who produced and/or imported one or more controlled substances into the United States in 1986.[242] The apportionment is equal to the calculated level of Group I and Group II controlled substances produced and/or imported in 1986 minus the amount of each controlled substance exported in 1986.[243]

Accordingly, the regulations prohibit the production of a calculated level of controlled substances in excess of the amount of unexpended production allowances held at that time for that period.[244] Similarly, the regulations prohibit the production of a calculated level of controlled substances in excess of the amount of unexpended consumption allowances held at that time for that period.[245] The consequence of these dual prohibitions is that, while consumption allowances alone are sufficient to allow importation of controlled substances, both production and consumption allowances are necessary in order to produce a quantity of controlled substances.[246]

Both additional consumption and additional production allowances are possible under the regulations. Additional consumption allowances may be granted upon proof of export of a controlled substance during the control period.[247] Such exports may be to any country prior to January 1, 1993. After that date, they must be exported to a party to the Protocol in order to qualify for additional allowances.[248] For purposes of apportioning consumption allowances, a shipment is considered an export upon its departure from the United States.[249]

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[241] *Id.* Because allowances are issued in terms of calculated levels of Group I or Group II controlled substances, holders of allowances could decide on any mix of controlled substances in a group. The Montreal Protocol left the ozone depletion potential of Halon 2402 for later determination. EPA has determined 6.0 to be scientifically justified and has included this figure in the regulation. *Id.* at 30,602 (to be codified at 40 C.F.R. pt. 82, app. A).

[242] *Id.* at 30,599 (to be codified at 40 C.F.R. § 82.6).

[243] The apportionment for controlled substances produced in the United States, as opposed to imported, must be multiplied by a correction factor. The correction factor reduces each share in proportion to the United States' 1986 exports of controlled substances that cannot be accurately or verifiably attributed to specific producers. Stratospheric Ozone Protection: Apportionment of Baseline Consumption and Production Rights, 53 Fed. Reg. 18,801 (1988) (to be codified at 40 C.F.R. pt. 82) (proposed May 24, 1988).

[244] 53 Fed. Reg. 30,599 (1988) (to be codified at 40 C.F.R. § 82.4(a)).

[245] *Id.* (to be codified at 40 C.F.R. § 82.4(b)).

[246] *Id.* (to be codified at 40 C.F.R. § 82.4(c)).

[247] *Id.* at 30,600 (to be codified at 40 C.F.R. § 82.10).

[248] *Id.*

[249] Stratospheric Ozone Protection: Apportionment of Baseline Consumption and Production Rights, 53 Fed. Reg. 18,804 (1988) (to be codified at 40 C.F.R. pt. 82) (proposed May 24, 1988); *see also* 53 Fed. Reg. 30,600 (1988) (to be codified at 40 C.F.R. § 82.10). As originally

Additional production allowances may be obtained in two ways. The first method is by "converting" allocated "potential production allowances."[250] All producers who are apportioned baseline production allowances are granted a calculated level of potential production allowances equal to ten percent of their baseline apportionment (fifteen percent for Group I controlled substances beginning July 1, 1998).[251] Producers may convert these potential allowances to production allowances by exporting controlled substances to parties to the Protocol.[252]

The second way of obtaining additional production allowances is to accept the transfer of a calculated level of production from a party to the Protocol producing less than twenty-five kilotons of controlled substances (a twenty-five-kiloton party).[253] The United States producer must obtain from the party's principal diplomatic representative in the United States a document stating that the twenty-five-kiloton party will decrease its production by the amount it is transferring to the recipient.[254] Upon receipt of a copy of the document and of complete information concerning the transfer, EPA will notify the Protocol Secretariat and issue a notice granting production allowances equivalent to the calculated level of production transferred.[255]

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proposed, EPA required the export to arrive at its destination before additional consumption allowances could be granted. Protection of Stratospheric Ozone, 52 Fed. Reg. 47,521 (1987) (to be codified at 40 C.F.R. pt. 82) (proposed Dec. 14, 1987). EPA reasoned that deducting exports from consumption before their ultimate arrival could result in mass exports by parties at the end of control periods in order to stay within Protocol consumption limits. Because these exports would not arrive until the next control period, they would avoid being counted against any party and contribute to greater consumption of controlled substances than the Protocol allows. Requiring exports to arrive at their destination as a condition precedent to additional consumption rights may impose some burdensome time restraints on the industry to fully utilize its rights within a control period. In addition, even if no party had to account for the end-of-the-control period exports in that control period, parties would have to count them against consumption limits in the next control period. *Id.*

[250] 53 Fed. Reg. 30,600 (1988) (to be codified at 40 C.F.R. § 82.9).

[251] *Id.* (to be codified at 40 C.F.R. § 82.9(a), (b)).

[252] *Id.* at 30,601 (to be codified at 40 C.F.R. § 82.11). Exporters must submit a request for authority to convert potential production allowances to production allowances. If approved, EPA will issue a notice authorizing conversion of a specific quantity of potential production allowances. The authorization will be valid only during the control period in which the controlled substances arrived at the party importing them. Any controlled substance exported also provides a basis for obtaining additional consumption allowances. *See supra* note 236 and accompanying text. Therefore, consumption rights in the same amount and for the same control period are granted whenever EPA issues a notice authorizing conversion of potential production rights. *Id.*

[253] *See* Protection of Stratospheric Ozone, 53 Fed. Reg. 30,600 (1988) (to be codified at 40 C.F.R. § 82.9).

[254] *See id.*

[255] *Id.* Note that consumption allowances are not transferred and remain with the twenty-

D. Transfers

As originally proposed, any person could transfer to any other person consumption allowances, production allowances, potential production allowances, or authorization to convert potential production allowances by submitting a request for the transfer to EPA.[256] If EPA's records indicated that the transferor possessed unexpended allowances or authorization in the amount to be transferred, a notice of transfer would be issued to the transferor and transferee.[257]

Such a provision makes the system more economically efficient. If the owner of an allowance cannot produce as much value by using the allowance as another person, he or she would have incentive to sell it. Transferable allowances should come into the possession of those persons able to produce the most value with them. In its final rule, however, EPA omitted the transfer provisions and reserved the matter for later decision and implementation.[258]

E. Record Keeping and Reporting

The regulations impose a variety of record keeping and reporting requirements upon producers, importers, and exporters. These documents provide a paper trail that permits EPA to monitor all aspects of compliance. For example, all producers must apprise EPA of how production will be measured on a daily basis and how this data will be used to determine quarterly production.[259] Producers must also maintain dated records of the quantity of each controlled substance produced at each facility, the quantity of controlled substances used as a feedstock, the quantity of HCFC-22 and CFC-116 produced within each facility, the quantity of certain raw materials and feedstock chemicals used, the shipment of controlled substances produced at each plant, and the quantity of controlled substances recovered at each plant.[260] In addition, a producer must submit quarterly reports to EPA on production of each controlled substance for each facility it owns, on the total calculated levels of production of Group I and Group II controlled substances for each facility for

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five kiloton party. It is also possible for a United States producer to transfer allowances to a twenty-five kiloton party. *See id.*

[256] Protection of Stratospheric Ozone, 52 Fed. Reg. 47,522 (1987) (to be codified at 40 C.F.R. § 82.12).

[257] *Id.* EPA's involvement would assure that mistaken or fraudulent transfers do not cause the United States to violate the Protocol.

[258] *See* Protection of Stratospheric Ozone, 53 Fed. Reg. 30,601 (1988) (to be codified at 40 C.F.R. § 82.12).

[259] *See id.* (to be codified at 40 C.F.R. § 82.13(f)(1)).

[260] *See id.* (to be codified at 40 C.F.R. § 82.13(f)(2)).

the quarter and the control period, and on shipments of each controlled substance from each facility in that quarter.[261]

Importers of controlled substances must maintain records showing the quantity of each controlled substance imported, the date imported, the port of exit and entry, the country from which each substance was imported, the commodity code, the importer number for the shipment, a copy of the bill of lading, an invoice, and the United States Customs Service Entry Summary Form.[262] On a quarterly basis, importers must provide EPA with a report summarizing the information in their daily records, including the total quantity (kilograms) of each controlled substance imported during the previous quarter, the calculated level of Group I and Group II controlled substances imported during the quarter and since the beginning of the control period, and the importer's total expended and unexpended consumption allowances at the end of the month.[263]

Requests for additional consumption allowances or for conversion of potential production allowances must be accompanied by all necessary information concerning exports.[264] For exports not resulting in such a request, the exporter must report to EPA within forty-five days of the end of the control period in which the exports left the United States. In that report, the exporter must identify the parties, the exporter's employee identification number, the type and quantity of the controlled substance exported, including what percentage was recycled or used, the date and port from which the substances were exported, the country to which they were exported, and the commodity code of the controlled substance shipped.[265]

F. Users

It is important to note that no consumption allowances are required to *use* CFCs or halons. In fact, users of controlled substances are not involved with production allowances, consumption allowances, record keeping, or reporting.[266] Consumers will continue to rely on their supply channels, but are likely to encounter price

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[261] *See id.* (to be codified at 40 C.F.R. § 82.13(f)(3)). The complete monthly report has additional requirements. *See id.*

[262] *Id.* at 30,602 (to be codified at 40 C.F.R. § 82.13(g)).

[263] *Id.*

[264] *See id.* at 30,600–01 (to be codified at 40 C.F.R. §§ 82.10–82.11).

[265] *Id.* at 30,602 (to be codified at 40 C.F.R. § 82.13(h)).

[266] *See* Protection of Stratospheric Ozone, 52 Fed. Reg. 47,485, 47,501 (1988) (to be codified at 40 C.F.R. pt. 82).

increases because of the limited production.[267] These higher costs should provide incentive to find ways to avoid the use of controlled substances or to recover and recycle them.[268] Higher prices encourage timely development of low-cost reductions, thereby substantially improving the overall costs and efficiency of complying with the Protocol.[269]

G. Enforcement

EPA will monitor compliance by reviewing the submitted reports and by inspecting sites.[270] The Clean Air Act authorizes EPA to pursue injunctive relief, criminal prosecutions, or civil penalties of up to $25,000 per day for each violation.[271] The regulations provide added bite to civil penalties by narrowly defining what constitutes a violation.[272] Each kilogram of a controlled substance produced in excess of production allowances or in excess of consumption allowances constitutes a separate violation.[273] Likewise, each kilogram imported from a non-party also constitutes a separate violation.[274] Furthermore, the regulations provide that any producer who fails to maintain the required records and reports may be assumed to have been producing at full capacity during the period for which records or reports were not kept.[275] The result of this approach is to allow EPA to impose substantially greater civil penalties, thus discouraging violations.

H. Fees

The regulations do not provide for fees. EPA is, however, considering imposition of a fee on producers and importers to offset the cost of administering the regulatory system.[276] The Independent

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[267] *See* REGULATORY IMPACT ANALYSIS, *supra* note 60, at 11-17.

[268] *See id.*

[269] *See id.*

[270] 42 U.S.C. § 7414(a) (1982). This provision empowers the Administrator or his authorized representative to enter production, import, or export facilities; to inspect such facilities; and to have access to any records maintained. *See id.*

[271] *See* 42 U.S.C. § 7413(b) (1982).

[272] Protection of Stratospheric Ozone, 53 Fed. Reg. 30,599 (1988) (to be codified at 40 C.F.R. § 82.4).

[273] *See id.*

[274] *Id.* (to be codified at 40 C.F.R. § 82.4(d)).

[275] *Id.* at 30,602 (to be codified at 40 C.F.R. § 82.13(f)(4)).

[276] Protection of Stratospheric Ozone, 52 Fed. Reg. 47,505 (1987) (to be codified at 40 C.F.R. pt. 82) (proposed Dec. 14, 1987).

Offices Appropriation Act[277] permits federal agencies to recover the fair costs of services or things of value provided to a recipient. An agency may recover costs as long as it has identified the specific activities for which the fee is being assessed, the service provided produces a private benefit, the value of the benefit is reasonably related to the fee, the benefit accrues at least in part to an identifiable private beneficiary and not to an entire industry, and the service produces no independent public benefit.[278]

Accordingly, EPA considered a fee to recover the full costs of: (1) determining the amount of baseline production and baseline consumption allowances apportioned to specific producers and importers; (2) processing applications for additional production allowances and associated actions; (3) processing applications for additional consumption allowances; (4) processing applications for transfers of allowances; and (5) processing and maintaining reports submitted to EPA.[279] In its final regulations, however, EPA concluded that substantial agency resources would not be required to operate the allocated quota program, and omitted provision for payment of any administrative fees.[280]

VI. Looking Ahead

A. New Scientific Evidence

Since the discovery of the ozone hole over Antarctica in 1985, two national ozone expeditions have studied the phenomenon. In addition, NASA formed an Ozone Trends Panel in collaboration with the National Oceanic and Atmospheric Administration, the Federal Aviation Agency, the World Meteorological Organization, and the UNEP. The Panel involved more than one hundred scientists who critically analyzed all ground-based and satellite data concerning stratospheric ozone.[281] The results of these studies indicate that the

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[277] 31 U.S.C. § 9701 (1982). A public agency normally may exact a fee for a grant which bestows a benefit on an applicant not shared by other members of society. National Cable Television Ass'n v. United States, 415 U.S. 336, 340–41 (1974).

[278] Central & S. Motor Freight Tariff Ass'n v. United States, 777 F.2d 722, 730 (D.C. Cir. 1985).

[279] Protection of Stratospheric Ozone, 52 Fed. Reg. at 47,506.

[280] Protection of Stratospheric Ozone, 53 Fed. Reg. 30,592 (1988). EPA found that the costs of operating the fee program would be a substantial share of the total costs of the program.

[281] NASA, Executive Summary of the Ozone Trends Panel 1 (1988) [hereinafter Executive Summary].

amount of ozone depletion in the atmosphere was underestimated prior to 1988.[282]

The Antarctic ozone hole was a surprise. Computer models had not predicted its existence. In 1987, National Ozone Expedition II determined that the Antarctic ozone hole results from both unique meteorological conditions and high concentrations of chlorine in the atmosphere.[283] This expedition positively established the link between chlorine in the atmosphere and the destruction of ozone, a fact essential to support more stringent regulation.[284]

The polar vortex that begins forming over Antarctica in August creates conditions that are conducive to such an interaction between ozone and chlorine. For example, between August 15th and October 13th of 1987, ozone concentration at fifteen kilometers above Antarctica decreased by more than ninety-five percent.[285] In the region four to six kilometers in altitude, the ozone was ninety to ninety-eight percent less than normal. The ozone level cannot get any lower in that altitude. It already has been virtually destroyed,[286] and the ozone hole is now evident over the tip of South America.[287] In 1987, this region of low-column ozone over Antarctica lasted until late November or early December, the longest since the region was first detected.[288]

The hole disappears as the polar vortex breaks down and stratospheric ozone from elsewhere in the southern hemisphere replaces the ozone that has been destroyed.[289] The amount of ozone thus destroyed each year by the Antarctic phenomenon is potentially of

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[282] *See, e.g.*, Protection of Stratospheric Ozone, 52 Fed. Reg. 47,493. EPA projected that even in the absence of CFC regulation and with a high CFC growth rate, total column ozone depletion would not exceed 1.02 percent by the year 2000. *Id.* CFC models assuming a freeze of CFC emissions at 1987 rates had predicted global ozone depletion of a few percent in a 70-year time frame. Weisburd, *Ozone Reports Stir Debate*, 133 SCI. NEWS 20 (1988).

[283] *Implications of the Findings of the Expedition to Investigate the Ozone Hole Over the Antarctic: Joint Hearing on S. 385 Before the Subcomm. on Environmental Protection and the Subcomm. on Hazardous Wastes and Toxic Substances of the Senate Comm. on Environment and Public Works*, 100th Cong., 1st Sess. 11 (1987) [hereinafter *Implications*] (statement of Dr. Robert Watson, NASA).

[284] *Id.* at 14 (statement of Dr. James Anderson, Harvard University).

[285] *Id.* at 10 (statement of Dr. Robert Watson, NASA).

[286] *Id.* at 11 (statement of Dr. Robert Watson, NASA).

[287] *Id.* at 47 (statement of Dr. Peter Wilkniss, Director, Division of Polar Programs, National Science Foundation).

[288] *Stratospheric Ozone Decreases Measurably in Northern Hemisphere, Ozone Report Says*, 11 Chem. Reg. Rep. (BNA) 1,933 (1988) [hereinafter *Ozone Report*].

[289] *Implications*, *supra* note 283, at 46 (statement of Dr. Peter Wilkniss, Director, Division of Polar Programs, National Science Foundation).

considerable global significance.[290] In fact, ozone appears to have decreased since 1979 by five percent or more at all latitudes south of sixty degrees south throughout the year.[291]

In addition to the losses above Antarctica, analysis of satellite measurements began yielding reports of significant global ozone losses elsewhere.[292] On March 15, 1988, the Ozone Trends Panel reported that stratospheric ozone over the northern hemisphere (between 53 degrees south and 53 north latitudes) decreased 2.5 percent between October 1978 and October 1985.[293] Consequently, in light of new scientific data about Antarctica and mid-latitude ozone depletion, protection of the environment and public health in the United States and other countries will require a much more rapid phase-out of CFCs than previously believed.

B. Compliance with the Clean Air Act

EPA maintains that the proposed regulations fulfill its responsibility under section 157(b) of the Clean Air Act to protect stratospheric ozone as needed to protect public health and welfare. EPA also maintains that the regulations meet the requirements of an agreement settling a lawsuit brought by the Natural Resources Defense Council seeking to compel EPA to promulgate regulations under section 157(b).[294] Both legal conclusions are subject to debate because of a condition precedent to the effectiveness of the regulations and because EPA failed to consider available scientific evidence in its risk assessment.[295]

By its own assessment, EPA has found that CFCs and halons deplete ozone and that such depletion will result in increased cancers, cataracts, damage to plants and aquatic organisms, and increased ground-level ozone.[296] It has also found that a fifty-percent reduction

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[290] *Id.* at 14 (statement of Dr. James Anderson, Harvard University).

[291] *Ozone Report*, *supra* note 288, at 1,933.

[292] *See, e.g.*, Bowman, *Global Trends in Total Ozone*, 239 SCIENCE 48, 49 (1988).

[293] EXECUTIVE SUMMARY, *supra* note 281, at 3 (1988); *Ozone Report*, *supra* note 288, at 1,933.

[294] Protection of Stratospheric Ozone, 52 Fed. Reg. 47,490 (1987).

[295] 42 U.S.C. § 7607(d)(9)(A)–(D) (1982).

[296] *See generally* ASSESSING THE RISKS, *supra* note 2; Protection of Stratospheric Ozone, 52 Fed. Reg. at 47,491–95; *see supra* notes 44–55 and accompanying text. Even discounting the Antarctic ozone hole, the United States position in the negotiations leading to the Protocol, a position in which EPA participated and supported, was that available data on depletion of stratospheric ozone supported a 95 percent phase-out. *Ozone Layer Depletion: Hearing Before the Subcomm. on Health and the Environment of the House Comm. on Energy and Commerce*, 100th Cong., 1st Sess. 113 (1987) (statement of Lee Thomas, Administrator, EPA) [hereinafter *Ozone Layer Depletion*].

by the United States alone would reduce ozone depletion by one half by the year 2075.[297] Having made such a determination, an issue arises as to whether the Administrator of EPA then has discretion to regulate the substances causing ozone depletion. Section 157(b) provides that the Administrator "shall" propose regulations for the control of any substance which in his or her judgment may reasonably be anticipated to affect the stratosphere so as to endanger human health.[298] The statutory language must normally be regarded as conclusive.[299]

This language gives the Administrator broad latitude in determining whether harm to the stratosphere or to human health is reasonably anticipated. The statute clearly permits regulation before harm occurs. It does not follow, however, that the Administrator has complete discretion in deciding to regulate. The plain meaning of the word "shall" connotes a nondiscretionary duty. Thus, while Administrators could avoid making a determination that would trigger the duty to regulate, when they do assess the risks and determine that harm is likely, they must regulate to reduce these risks.

As required, the Administrator has now promulgated regulations. The Administrator has made them effective, however, only upon the occurrence of a particular event, an event that is beyond the control of the United States and unrelated to the degree of human endangerment posed. The regulations become effective only when the Montreal Protocol becomes effective.[300] Furthermore, in promulgating the regulations, EPA did not consider the scientific evidence concerning the Antarctic ozone hole or global ozone depletion.[301]

Congress conditioned domestic regulation on EPA's determination that a substance could reasonably be anticipated to affect stratospheric ozone so as to endanger public health. Clearly, it cannot be

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[297] Protection of Stratospheric Ozone, 52 Fed. Reg. 47,499 (1987) (Table 4).

[298] 42 U.S.C. § 7457(b) (1982).

[299] Consumer Product Safety Comm'n v. GTE Sylvania, Inc., 447 U.S. 102, 108 (1980). The legislative history of section 157(b) does not explain the use of "shall." The conference report does state that "EPA may promulgate regulations to protect the stratospheric ozone layer if the Administrator finds that public health or welfare may reasonably be anticipated to be endangered." H.R. CONF. REP. NO. 564, 95th Cong., 1st Sess. 147, *reprinted in* 1977 U.S. CODE CONG. & ADMIN. NEWS 1077, 1528. This language implies a purely discretionary function, but whether such discretion flows from the Administrator exercising his or her judgment and how it relates to the obligatory "shall propose" is not explained. This one isolated comment cannot be construed as a clear legislative intent contrary to the statutory language.

[300] 53 Fed. Reg. 30,598 (1988) (to be codified at 40 C.F.R. § 82.2).

[301] EPA made a de facto assumption that the Antarctic ozone hole was not related to CFCs and halons. Protection of Stratospheric Ozone, 52 Fed. Reg. 47,492 (1987).

the case that this condition is met if the Protocol goes into force but will not be met if the Protocol does not. Except for establishing a required minimum level of regulation, the Protocol does not change EPA's duty.[302] To regulate only if required by treaty is not consistent with EPA's role and the congressional mandate to protect human health and may well be subject to challenge as not being in accordance with the law.[303] The condition reflects EPA's decision to seek an international solution to ozone depletion and to avoid unilateral action.[304]

In promulgating its regulations, EPA did not consider data concerning the Antarctic ozone hole or evidence of global ozone depletion.[305] If this information were taken into account, it would reveal substantially accelerated ozone depletion. Consequently, there would be substantially increased health and environmental damage at all times, and substantially increased total damages. The net benefits from each level of control, including monetary benefits, would increase dramatically because total health and environmental damage over the period would be higher and much more damage would occur earlier. The value of controls would also be less affected by discounting.

Even though this evidence was available before final regulations were promulgated, EPA chose not to include it in their risk analysis. At the proposal stage, they cited uncertainty as the basis for this decision, but there are at least two other reasons why they did not supplement their risk assessment with the significant new information. First, it takes a significant amount of time to develop a risk assessment and to proceed through the rulemaking steps. There may have been insufficient time to accomplish these actions so as to still ensure United States compliance with the Protocol. Second, EPA is

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[302] Ratification of the Protocol by the United States and its entry into force make it a binding treaty obligation that supersedes any earlier federal law inconsistent with it. To that extent, the Protocol becomes a lower limit, a floor, for United States regulation of listed CFCs and halons.

[303] Conditioning regulation upon the entry into force of the Protocol cannot be justified by 42 U.S.C. § 7456 (1982) as part of an undertaking for international agreement. That provision envisions the domestic regulations as driving the international agreements and not vice versa. On the other hand, while this provision may not be in accordance with the law, at this point there appears to be no harm occassioned by it. The Vienna Convention has entered into force, all major CFC-producing nations have signed the Protocol, nine nations have ratified the Protocol, and there is every expectation that it will enter into force on January 1, 1989. *More Controls Needed, supra* note 191, at 950.

[304] *See Ozone Layer Depletion, supra* note 296, at 97 (statement of Lee Thomas, Administrator, EPA).

[305] Protection of Stratospheric Ozone, 52 Fed. Reg. 47,493 (1987).

committed to an international solution to the ozone problem. Should a revised risk assessment result in more stringent United States regulations without an international agreement, it might weaken prospects for further international negotiations.

EPA's decision not to jeopardize implementation of the Montreal Protocol by delay for reassessment of risk is both reasonable and prudent from the perspective of the Protocol. It makes less sense, however, from the perspective of EPA's responsibilities under the Clean Air Act.

Pursuant to the Clean Air Act, EPA is required to report annually to Congress on the actions taken to regulate halocarbon emissions, the results of regulations, and the need for additional action, if any.[306] At this time, EPA should be conducting a meaningful reassessment, not one that is stacked against unilateral United States action. In its 1987 regulatory impact analysis, for example, the only scenario analyzed for United States action beyond the Protocol's required levels was an eighty-percent reduction by the year 2003. In addition, the analysis assumed no other country would join the United States action.[307] Because studies show that the environmental and health damage will be greater and occur sooner than previously anticipated, a new analysis should show greater benefits from immediate United States action beyond the Protocol's levels. More realistic scenarios with a phased ninety-five percent reduction by the United States and other concerned countries, beginning immediately and completed over a shortened time period, are needed for EPA and Congress to address their duties to protect public health and welfare responsibly.

C. Allocated Quotas

EPA's allocated quota approach ensures United States compliance with the Montreal Protocol. Because there are only five producers of CFCs in the United States, and ten or so importers, quotas are also the simplest and least expensive approach to regulate CFCs. As implemented, however, such quotas have noteworthy shortcomings.

One shortcoming results from the fact that CFCs and halons are useful chemicals. Without regulation, demand for such chemicals

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[306] 42 U.S.C. § 7455 (1982).

[307] REGULATORY IMPACT ANALYSIS, *supra* note 60, at 10-9.

would continue to increase.[308] Any program designed to limit supply without limiting demand will created a scarcity, thus causing prices to rise. Indeed, EPA is counting on price increases to be the means by which the market will efficiently determine how the available controlled substances are used. Because EPA will distribute production and consumption rights on a gratis basis, the revenues from higher prices will accrue to the holders of those rights. EPA estimates the total revenue to producers could range from $2 billion to $5.7 billion for the eleven years from 1989 to 2000.[309] Everyone, with the possible exception of CFC producers, recognizes the inequity of giving valuable market rights to the very persons who profited while creating the ozone problem and who opposed and delayed earlier regulatory action. More appropriately, the revenues generated should go to those who will suffer from the damage wrought to the ozone layer, the world's present and future population.[310]

An even more important concern than equity is the very real possibility that allocated quotas may reduce producers' economic incentive for innovation. While higher prices to users will give them incentive to conserve or find substitutes for CFCs, the EPA's grant of a monopoly to CFC and halon producers creates a CFC-cartel and increases the profitability of controlled substances. As a result, although the best solution to the problem of ozone depletion is finding substitutes for ozone-depleting chemicals, producers have no incentive to find such substitutes because the large profits from CFC and halon production will disappear when substitutes become available. Producers handed windfall profits would thus be discouraged from maximizing efforts on research, development, and introduction of substitutes. Such a loss of incentive will result if the same producers owned the substitute technology, if they were in a position to control the availability of substitutes by slowing the pace of testing, or if they could deter new producers of substitutes from entering the market.

EPA considered two approaches that would have transferred the windfall profits from CFC and halon producers to the United States Treasury. Both also would have assured that producers had the same

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[308] Statistics from the International Trade Commission reflect United States production of CFC-12 increased by 14 percent in 1986 and production of CFC-11 increased by 24 percent in 1986. *Ozone Layer Depletion, supra* note 296, at 114.

[309] Protection of Stratospheric Ozone, 52 Fed. Reg. 47,506.

[310] Such revenues could be used to fund research on ozone depletion, to find chemical substitutes, or to find ways to reduce the biological harm that will result from depletion.

incentive as users for innovation. Both approaches were, however, found to be legally questionable.[311]

Another shortcoming is that allocated quotas without engineering controls[312] could result in some industries not taking available, low-cost options in a timely manner. Such a result is particularly likely when the cost of CFCs is only a relatively small portion of the total cost of the product, such as a car or computer. To ensure cost-efficient control of CFCs and halons, then, some engineering controls may be necessary.

D. Auctions and Fees

Auctions and fees transfer the profit from price increases from industry to the government. By doing so, they create a market incentive to develop substitutes by placing the risks and rewards of developing such CFC and halon substitutes on industry.

Three statutory authorities may enable EPA to auction CFC production and halon rights or to impose regulatory fees on such rights. Section 157 of the Clean Air Act grants EPA broad regulatory authority to protect the public health.[313] The legislative history of this provision reveals that Congress intended EPA to consider economic effects and social impacts of the methods employed to regulate and that Congress did not want to "tie the Administrator's hands or confer an authority which is cumbersome or unduly difficult to use, administer, or enforce."[314]

TSCA[315] grants similar power to EPA. While TSCA is normally a residual statutory authority, it would permit regulation of CFCs and halons if the Administrator determines that it is in the public interest to protect against the risks that those substances pose.[316] TSCA also grants broad authority to prohibit or limit production of substances and leaves the methods of implementation to EPA's discretion. Moreover, its legislative history reflects congressional concern about excess profits occurring under limited production:

> [I]f the Administrator chooses to impose a production limitation on any chemical substance, such limitation, if not carefully

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[311] *See supra* notes 229, 230 and accompanying text.

[312] *See supra* notes 224–26 and accompanying text.

[313] 42 U.S.C. § 7457 (1982); *see supra* notes 84–87 and accompanying text.

[314] H.R. REP. NO. 294, 95th Cong., 1st Sess. at 101, *reprinted in* 1977 U.S. CODE CONG. & ADMIN. NEWS 1077, 1180.

[315] *See supra* notes 71–72 and accompanying text.

[316] 15 U.S.C. § 2608 (1982).

> drawn, could produce monopoly profits. The conferees believe that the Administrator should consult with the Attorney General and Federal Trade Commission in order to avoid any anticompetitive consequences.[317]

Finally, the Independent Offices Appropriation Act[318] allows agencies to promulgate regulations that establish charges for a "service or thing of value" provided by the agency.[319] The charges must be fair and based on the costs to the government, the value of the service or thing to the recipient, the public interest served, and other relevant factors.[320] Concerns over the legality of auctions and fees arise from cases interpreting this Act, however. Specifically, the Supreme Court has cautioned that unlimited discretion by agencies in setting fees would be an unconstitutional delegation of Congress's power to tax.[321]

In the leading case, *National Cable Television Association v. United States*,[322] the Court struck down a thirty cent-per-subscriber charge, distinguishing fees from taxes. Fees connote some benefit and are incident to voluntary acts, such as a request for a permit.[323] Taxes have no necessary relationship to benefits received, may be based on ability to pay, and may be designed to serve public policy.[324] The Court held that the proper measure of a fee is the value of the service to the recipient.[325] Consistent with that holding, and on the same day, the Court in *Federal Power Commission v. New England Power Company*[326] struck down charges on utilities to finance the Federal Power Commission's regulatory activities because there was no nexus between the charges and the benefits received by specific companies.[327] The Court emphasized the lack of identifiable recipients of the benefits.

Subsequent to the *National Cable Television* decision, a number of lower courts have suggested that any charge in excess of the government's expense in providing the benefit is invalid. For in-

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[317] H.R. CONF. REP. NO. 1679, 94th Cong., 2d Sess. 75, *reprinted* in 1976 U.S. CODE CONG. & ADMIN. NEWS 4491, 4560.

[318] 31 U.S.C. § 9701 (1982).

[319] *See supra* notes 277–80 and accompanying text.

[320] 31 U.S.C. § 9701 (1982).

[321] National Cable Television Ass'n v. United States, 415 U.S. 336, 340 (1974).

[322] *Id.*

[323] *Id.* at 340–41.

[324] *Id.*

[325] *Id.* at 342–43.

[326] 415 U.S. 345 (1974).

[327] *Id.* at 351.

stance, the D.C. Circuit established three constraints in setting fees: the fee may not exceed agency costs of providing the service; the fee must be reasonably related to, and may not exceed, the value of the service to the recipient, regardless of the agency's costs; and, when the agency activity produces an independent public benefit, the agency must reduce the fee by that portion of the costs attributable to that public benefit.[328] In addition, where the agency in question served the public interest, the D.C. Circuit held that fees based in part on public policy would be considered a tax rather than a fee.[329]

Similarly, the Tenth Circuit found that an agency may recover full costs of services provided an identified beneficiary but may not charge general management costs and other expenses not incurred in the agency action.[330] Like the D.C. Circuit, the Court of Claims held that a fee must not unreasonably exceed the value to the recipient. Rather, the fee should be a reasonable approximation of the attributable costs incurred by the agency.[331]

It appears that none of the lower court decisions turned on the central issue identified by the Supreme Court of whether the charges can reflect the value of the benefit received. Acting cautiously, EPA chose to avoid the possibility of a successful legal challenge based on the distribution of CFC and halon production rights. This choice is understandable because a successful challenge would result in overturning the distribution mechanism and could lead to United States violations of its treaty obligations under the Protocol.

E. Labeling

The regulations make no provision for labeling, even though labeling products containing or manufactured with CFCs and halons is inexpensive and is the least burdensome form of regulation. A label similar to the labels presently required for aerosols containing CFCs[332] would be consistent with the market-oriented approach of the CFC and halon regulations. The public has a right to know that a product contains ozone-depleting substances and a right to express

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[328] Central & S. Motor Freight Tariff Ass'n v. United States, 777 F.2d 722, 729 (D.C. Cir. 1985). It is important to note that any challenge to nationally applicable regulations promulgated under the Clean Air Act may only be filed in the United States Court of Appeals for the District of Columbia. 42 U.S.C. § 7607(b)(1) (1982).

[329] National Ass'n of Broadcasters v. FCC, 554 F.2d 1118, 1128 (D.C. Cir. 1976).

[330] Nevada Power Co. v. Watt, 711 F.2d 913, 933 (10th Cir. 1983).

[331] Yosemite Park and Curry Co. v. United States, 686 F.2d 925, 932 (Ct. Cl. 1982).

[332] *See* 21 C.F.R. § 101.17 (1987).

a choice for or against such substances. Given the information, consumers might prefer substitute products not containing CFCs and halons. Using CFCs could be viewed as a marketing disadvantage, such a disadvantage operating as an effective incentive toward substitution and moving the market in the desired direction.

F. Revising the Protocol

The delegates at Montreal were instructed not to consider the Antarctic phenomenon in their deliberations.[333] The Protocol, however, makes specific provisions for revision should circumstances warrant it.[334] Because the environmental and health damage will be greater and will occur sooner than previously anticipated, the Protocol's reduction schedule can no longer be considered a proportionate, adequate response.

The Executive Director of UNEP, Dr. Mostaba Tolba, pledged to call an emergency session to reopen the Protocol if scientists discovered that the Antarctic hole is caused by CFCs.[335] This session must occur as soon as the Protocol is ratified. The amount of chlorine in the atmosphere has already more than doubled during the time that decisionmakers were waiting for further investigation of ozone depletion by CFCs.[336] That chlorine will stay in the atmosphere for approximately one hundred years. The Antarctic hole, for example, will persist for one hundred years even if nations immediately ban the release of CFCs.[337] The present Protocol will not even reduce the amount of chlorine entering the atmosphere until 1993.[338] Even with an eighty-five percent reduction in 1994, as opposed to the Protocol's twenty-percent reduction, the amount of chlorine in the atmosphere will continue to increase into the twenty-first century.[339]

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[333] OZONE PROTOCOL, *supra* note 116, at 11 (statement of Sen. Baucus); *Implications*, *supra* note 283, at 18 (statement of Dr. Michael McElroy, Harvard University).

[334] *See supra* notes 183–89 and accompanying text.

[335] *Implications*, *supra* note 283, at 4 (statement of Sen. Chafee).

[336] *See id.* at 21 (statement of Dr. Sherwood Rowland, University of California). Current global capacity for producing CFC-11 and CFC-12 is about 1,245 million kilograms each year. *International Cooperation*, *supra* note 109, at 1,168.

[337] *Implications*, *supra* note 283, at 18 (statement of Dr. Michael McElroy, Harvard University).

[338] *Id.* at 20; *see also* MONTREAL PROTOCOL, *supra* note 117, art. 2, 52 Fed. Reg. at 47,515–16.

[339] *See Implications*, *supra* note 283, at 21 (statement of Dr. Sherwood Rowland, University of California).

In addition to providing inadequate reductions of chlorine, the Montreal Protocol does not specify controls on some commercially available CFCs such as CFC-13 and CFC-112.[340] Reportedly, companies in the United States and Japan are pushing CFC-112 as a substitute for the CFCs on the list of controlled substances. No progress in preventing ozone-depletion will be made if producers can simply substitute one ozone-depleting substance for another, switching to a substitute not on the list.[341] The Protocol must thus be expanded to include these ozone-depleting substitutes.

G. Unilateral Action

There has been, and continues to be, a debate in this country over whether the United States should take unilateral action to reduce CFCs. On one hand, EPA has steadfastly disfavored unilateral action and has even delayed compliance with the Clean Air Act in order to accommodate that view. No country dominates the emissions or the utilization of CFCs to such a degree that its actions alone can solve the ozone problem.[342] The United States accounts for only about twenty-five percent of worldwide CFC production and consumption.[343] Accordingly, EPA maintains that only a global agreement can truly safeguard the ozone layer. Unilateral action by the United States could also cause some United States firms to move to non-regulating countries, resulting in a loss of United States jobs.[344] Moreover, unilateral action could lessen the urgency of the situation.[345] Other nations, seeing the United States reducing emissions, would lose incentive to take action. That lack of incentive, according to EPA's Administrator, is what happened in 1980 with aerosol regulations.[346]

On the other hand, the United States and other concerned countries *can* make a difference. The United States is the largest producer and consumer of CFCs. While a twenty-five percent reduction

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[340] *See* MONTREAL PROTOCOL, *supra* note 117, Annex A, 52 Fed. Reg. at 47,519.

[341] *Implications*, *supra* note 283, at 20 (statement of Dr. Sherwood Rowland, University of California).

[342] *See Ozone Layer Depletion*, *supra* note 296, at 97 (statement of Lee Thomas, Administrator, EPA).

[343] OZONE PROTOCOL, *supra* note 116, at 19.

[344] *Ozone Layer Depletion*, *supra* note 296, at 97 (statement of Lee Thomas, Administrator, EPA).

[345] *Id.* at 115.

[346] OZONE PROTOCOL, *supra* note 116, at 19.

may not be enough to solve the ozone problem, such a reduction demonstrates good faith and leadership.[347] In fact, because the situation is worse than originally believed, unilateral action by the United States would have a greater impact than EPA projected.[348]

In addition to providing the impact of unilateral action, the United States can also use its position as the world's largest economic market to leverage other countries. The trade implications brought to bear by the United States would be far greater than those raised by the aerosol bans.[349] Inaction by the United States, the world's largest producer, would discourage other countries from regulating beyond the Protocol and might signal diminished urgency.

VII. CONCLUSION

For the past several years, EPA has been parrying attempts by environmental groups and legislators to force regulations of CFCs under the Clean Air Act's provisions for protection of public health. EPA successfully delayed domestic action until international measures were achieved and, undoubtedly, will attempt to continue putting off further domestic regulation to pursue a more stringent international agreement. Only revising the Protocol, congressional action, or a court order will move EPA to action.

Certainly, a global response is preferable to unilateral action by fewer nations. As soon as the Montreal Protocol is ratified by the requisite number of nations, the United States must seek reassessment and a revised reduction schedule with deeper and faster reductions of nearly all ozone-depleting substances. At the same time, however, the United States must prepare an alternative strategy in the event the Protocol is not ratified or no agreement to toughen the Protocol is reached.

Furthermore, the United States should allow the parties to the Protocol only a reasonable time to agree on more stringent controls before taking unilateral action. Considering the likely damage from continued degradation of the ozone and the high cost of delaying regulatory action, the United States should pursue more stringent domestic controls with concurrent trade restrictions if the parties

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[347] *Id.* (statement of Sen. Kerry). EPA estimates that the United States now contributes 30 percent of worldwide CFC emissions. As developing countries increase consumption, the United States percentage might well decrease. *See* 53 Fed. Reg. 30,566 (1988).

[348] *See supra* note 305 and accompanying text.

[349] *Stratospheric Ozone Depletion and Chlorofluorocarbons: Joint Hearings on S. 201 Before the Subcomm. on Environmental Protection and the Subcomm. on Hazardous Wastes and Toxic Substances of the Senate Comm. on Environment and Public Works*, 100th Cong., 1st Sess. 280 (1987) (statement of Senator John H. Chafee).

have not reached agreement by the end of 1989.[350] Such trade restrictions will protect industry and encourage other nations to join the United States. Such action may also provide impetus for the Protocol amendments. Considering what is at stake and the reluctance of some nations to regulate, it would be irresponsible for EPA to be unprepared for a possible failure to agree on amendments to the Protocol.

Industry spokespersons have said that they think substitutes could be brought on line within five years.[351] That period would be a reasonable time-frame for the ninety-five percent phase-out consistently urged by the United States. Such deep reductions in CFC use in the United States are possible without disrupting the economy and curtailing the use of valuable products only if industry develops safe chemical and product substitutes that can be put on the market at reasonable prices as soon as possible.

There is currently little incentive to develop such substitutes. Under the present Protocol, there are no mandatory reductions until 1993 and prices may not rise sufficiently to encourage reductions or alternatives. In fact, producers stand to profit from CFC shortages so long as there are no substitutes on the market. Accordingly, without waiting for further Protocol negotiations, the market must be given incentive. The price of CFCs must be high to reflect the value of production and consumption allowances. The price must be high not just to users of CFCs, but to producers and importers as well. High prices will promote efficient use of CFCs, stimulate introduction of alternative, safer CFC formulations, and encourage the development of technologies employing non-CFC substitutes. Congress should specifically authorize the auction of consumption and production allowances, the imposition of regulatory fees for the commercial value of consumption and production allowances, or the creation of a windfall profits tax to capture excess profits from the granting of consumption and production allowances without charge.

As the EPA Administrator has pointed out, "[i]f we wait for ozone depletion to occur before reducing CFC emissions, any depletion would continue to worsen for several decades."[352] Depletion has occurred. The United States no longer has the luxury of waiting for greater scientific certainty or ensuring protection of the domestic

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[350] An immediate phase-out spreads economic transition over a period of time. If the United States delays further, it risks finding out that the situation is so serious that the chemicals must be phased out at once causing far greater economic disruption.

[351] *U.S. Participation*, *supra* note 112, at 18–89. Patents are already out on substitute products in the United States, United Kingdom, Japan, Germany, and France. *Id.*

[352] *Ozone Layer*, *supra* note 296, at 95.

CFC industry. It is time to take a stand, whether alone or together.[353]

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[353] On July 30, 1988, EPA issued an Advance Notice of Proposed Rulemaking seeking to develop possible regulations to remedy potential windfall profit consequences of the final rule. EPA is also considering engineering controls to assure that available low cost reductions occur. *See* Protection of Stratospheric Ozone, 53 Fed. Reg. 30,604 (1988). On September 20, 1988, EPA issued a report stating that even with a 50 percent reduction in CFCs, there would be a quadrupling of 1987 chlorine levels in the atmosphere. *EPA Study Recommends Phaseout of CFCs, Other Chlorine Compounds By End of Century*, 19 Env't Rep. (BNA) 1,082, 1,083 (1988). EPA has recommended the complete phase-out of CFCs by the year 2000. *Id.* at 1,082. Among other recommendations, EPA recommended complete fulfillment and extension of the Montreal Protocol. *Id.* at 1,083. It remains to be seen whether international negotiation constitutes an initial strategy to gain cooperation or EPA's complete agenda.