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Future Concentrations of Stratospheric Chlorine and Bromine

FUTURE CONCENTRATIONS OF STRATOSPHERIC CHLORINE AND BROMINE

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TABLE OF CONTENTS

PROLOGUE

The recently completed Summary of the Ozone Trends Panel Report provides new information about recent trends in global ozone levels. It suggests that ozone depletion in certain seasons and at certain latitudes may be larger than predicted by current atmospheric models and that "the observed changes may be due wholly, or in part, to the increased atmospheric abundance of trace gases, primarily chlorofluorocarbons (CFCs)."

Atmospheric scientists are attempting to understand and model the mechanisms that have produced ozone declines. Such improvements in understanding and models would allow for more accurate assessments of future risks of ozone depletion.

This report presents a method for evaluating risks that avoids the uncertainties currently involved in linking atmospheric chlorine and bromine levels and projected ozone depletion. Instead, it relates rates of emissions to stratospheric levels of chlorine and bromine. Because chlorine and bromine concentrations ultimately determine risk, this approach, although imperfect, aids in assessing the potential risk of additional ozone depletion. Using this approach, potential changes to the current levels of chlorine and bromine that could occur under various emission scenarios, including the Montreal Protocol, are projected along with the relative contribution of different chemicals (e.g., CFC-11; CFC-12; CFC-113; methyl chloroform; HCFC-22, etc.) to these changes. The report also examines the reductions in potential ozone depleters needed in order to stabilize the atmosphere at current levels of chlorine and bromine. Finally, the chlorine levels associated with various changes in the coverage, timing, and stringency of the Montreal Protocol are projected.

FINDINGS

1. Based on reductions required under the Montreal Protocol and assuming substantial global participation, chlorine and bromine levels will increase substantially from current levels.

    - By 2075, even with 100 percent global participation in the Protocol, chlorine abundance is projected to grow by a factor of three to over 8 ppbv from current levels of about 2.7 ppbv, assuming methyl chloroform emissions grow.

    - If methyl chloroform emissions do not grow, either due to global agreement on emission restrictions or due to a lack of demand, chlorine levels would still grow to over 6 ppbv by 2075, even with 100 percent participation in the Montreal Protocol.

    - Because of long atmospheric residence times and transport delays to the stratosphere, stratospheric chlorine levels will continue to grow for about 6-8 years even if emissions were totally eliminated.

2. An immediate 100 percent reduction in the use of all fully-halogenated compounds and a freeze in methyl chloroform would be needed to essentially stabilize chlorine and halon atmospheric abundances at current levels during the next 100 years.

3. Future chlorine growth has several sources.

   - In our "standard" evaluation[1] of the impact of the Protocol, chlorine-containing chemicals not covered by the Protocol account for about 40 percent of the projected growth in stratospheric chlorine levels by 2075 (assuming methyl chloroform use grows as projected by some analysts).

   - Emissions from non-participant nations are projected to account for about 15 percent of the chlorine growth in the standard protocol scenario.

   - About 45 percent of projected chlorine growth in the standard Protocol scenario stems from allowed use of controlled compounds under that agreement.

   - For the scenarios in which methyl chloroform grows, it accounts for over 80 percent of the growth in chlorine levels associated with substances not covered by the Protocol. If its emissions do not grow from current levels, methyl chloroform's contribution would be much lower.

4. The projected levels of chlorine under the Montreal Protocol are influenced by the extent to which the use of partially-halogenated compounds increases as they substitute for the foregone CFCs covered by the Protocol.

   - Under worst case assumptions -- HCFC-22 (or other compounds such as HCFC-141b, -142b, or 123)[2] substitute one-for-two for all the CFC-11 and CFC-12 foregone -- chlorine concentrations could increase by about an additional 1.0 ppbv by 2100 due to the increased use of these substitutes.

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[1] Our standard evaluation of the Protocol includes: 100 percent U.S. participation; 94 percent participation among other developed nations; 65 percent participation among developing nations; reduced growth in compound use among non-participants; no growth in compound use after 2050.

[2] "HCFC" stands for "hydrochlorofluorocarbon," i.e., chlorofuorocarbon with a hydrogen atom. The hydrogen atom reduces the amount of chlorine transported to the stratosphere by increasing the oxidation rate in the lower atmosphere.

- Under more realistic substitution assumptions of one-to-five for foregone CFC-11 and CFC-12, chlorine levels would be increased by about an additional 0.4 ppbv by 2100, an amount which is about 10 percent of the increase associated with the continued use of the fully-halogenated compounds covered under the Protocol.

5. Bromine levels will grow under the Montreal Protocol.

   - Current abundances are on the order of 1 pptv for Halon 1211 and Halon 1301.

   - By 2075 Halon 1211 is projected to grow to about 6 pptv, and Halon 1301 is projected to grow to nearly 13 pptv.

6. Additional reductions of the fully-halogenated compounds would reduce future chlorine and bromine levels substantially.

   - The reductions in chlorine levels will depend on the speed and magnitude of the emissions reductions. The difference between peak chlorine levels between a 100 percent phaseout by 1990 and a 95 percent phaseout by 1998 (with 100 percent participation and a freeze on methyl chloroform emissions) would be 0.8 ppbv. The slower and less stringent phasedown would result in chlorine levels in excess of the peak level from the faster, more stringent phasedown for over 50 years.

   - To stabilize chlorine abundances at current levels would require a 100 percent phaseout of the fully-halogenated compounds with 100 percent participation globally, at least a freeze on methyl chloroform use, and substitution of partially-halogenated compounds at relatively conservative rates. These relatively conservative rates of substitution would nonetheless allow HCFC-22-like compounds to grow at nearly 4.0 percent per year, to nearly 80 times current HCFC-22 use levels by 2100. There would be a trade off between the ability to use increasing amounts of partially-halogenated substitutes and methyl chloroform.

   - To stabilize bromine levels requires about a 100 percent phaseout of Halon 1301, and 90 to 100 percent phaseout of Halon 1211, with 100 percent participation.

1. INTRODUCTION

The recent Summary of the Ozone Trends Panel Report suggests that current atmospheric models may be underpredicting the amount of depletion for a given increase in atmospheric chlorine. The ability of models to project future depletion has been called into question. This analysis does not seek to address this problem -- that is, it does not focus on determining how the models should be modified to better depict the quantitative relationship among atmospheric levels of chlorine and bromine, and stratospheric ozone.

Instead, the goals of this report are to:

1. assess how atmospheric levels of chlorine and bromine will change over time under the Montreal Protocol;

2. assess the emissions reductions necessary to stabilize the abundances of chlorine and bromine;

3. assess the relative contribution of different compounds to future increases in atmospheric levels of chlorine and bromine;

4. assess the potential contribution of partially-halogenated compounds such as HCFC-22, in contributing to future increases in chlorine levels; and

5. assess how atmospheric levels of chlorine and bromine may change with different coverage and stringency requirements in the Montreal Protocol.

The merit of examining the potential for future ozone depletion by examining future levels of chlorine and bromine stems from the fact that chlorine and bromine abundances are currently thought to be the <u>primary determinants of the risk of ozone depletion</u>. Consequently, information about the abundances of chlorine and bromine can be of use to the decision making process without making final and certain conclusions about the quantitative relationship between their abundances and ozone depletion. Of course, to the extent that other chemicals, for example, NO_x from high speed airplanes, or climate-induced shifts in atmospheric dynamics threaten stratospheric ozone, chlorine and bromine are inadequate measures of the potential risk of ozone depletion.[3]

1.1 The Concept and Meaning of Stabilization

The concept of stabilizing current chlorine and bromine levels as a means of preventing additional ozone depletion, or the risk of depletion, has received widespread attention. In particular, public references are frequently made to an 85 percent reduction in CFC-12 which is required in order to stabilize the chlorine contribution from that compound.

While stabilizing chlorine and bromine from all chemical sources should stabilize the risk of further ozone depletions in the absence of other chemical or dynamical changes (i.e., assuming all other factors remain unchanged), emphasis must be placed on the inclusion of all industrial sources of these ozone-depleting chemicals. As is shown below, the potential chlorine contributions from non-regulated compounds (e.g., methyl chloroform, HCFC-22) must be considered in order to achieve the goal of stabilizing chlorine and bromine levels. The risk of additional ozone depletion is a function of increases in the levels of chlorine and bromine from regulated and non-regulated compounds alike. Thus, while an 85 percent reduction is sufficient to stabilize chlorine levels from one compound (i.e., CFC-12), it is not

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[3] One reviewer also noted that the chlorine and bromine values estimated using the algorithm used in this analysis cannot be a perfect measure of ozone depletion risk because the algorithm is based on results of 1-D models in which the downward and poleward transport of chlorine (and bromine) are ignored. To the extent that some compounds contribute relatively more chlorine (or bromine) to latitudes and altitudes of high ozone, simple chlorine (and bromine) estimates will not reflect precisely the relative or absolute ozone depletion potential of different compounds. Investigations are currently under way to evaluate the implications of the simplifying assumptions used in this analysis for estimates of the relative risks associated with the contributions of chlorine from each of the compounds.

sufficient for stabilizing total chlorine levels if the production and use of non-regulated chlorine-contributing compounds are considered.

One other caveat is needed with regard to stabilization. As suggested by the Summary of the Ozone Trends Panel Report, if the ozone layer has already begun to deplete at current atmospheric levels of chlorine and bromine, stabilizing the contribution of chlorine or bromine from various chemicals would not reverse past depletion. Furthermore, to the extent that global ozone depletion is occurring due to dilution from the Antarctic ozone hole, stabilizing chlorine at current levels would not completely prevent the occurrence of future depletion associated with continued dilution from the existing hole. At this time, only preliminary estimates have been made of the ultimate dilution that will be associated with the current hole. There may be some additional hemispheric or global depletion still to come from the current hole. Therefore, the global ozone layer may already be committed to a residual amount of depletion at current levels of chlorine and bromine which has not yet had time to occur.

1.2 Report Organization

Section 2 of this analysis discusses the methods used to estimate chlorine and bromine levels. Section 3 focuses on assessing the chlorine and bromine levels associated with the Montreal Protocol and their dependency on various assumptions about participation, substitution, and emissions after 2050. This section also addresses the question of the effect of widespread substitution of HCFC-22 or other partially-halogenated compounds. Section 4 focuses on determining the level of controls that would be necessary to stabilize the abundance of chlorine and bromine. Section 5 examines the effects on chlorine of different reduction stringencies and timings.

2. METHODS

Future chlorine (Clx) and bromine concentrations depend primarily on future CFC and halon emissions and their atmospheric fate.[4] Scenarios of emissions are analyzed based on estimates of current and projected future use of chlorine and bromine containing compounds under various assumptions. Compounds examined include CFCs (CFC-11, 12, 22, 113, 114, and 115), methyl chloroform (CH3CCl3), carbon tetrachloride (CCl4), and halons (Halon 1211 and Halon 1301).[5] A parameterized model (presented in Appendix A) is used to estimate chlorine and bromine concentrations for this wide range of emissions scenarios. While not considering all the factors that influence Clx and halon levels (e.g., the impact of ozone depletion on atmospheric lifetimes is omitted), the model provides a useful first order approximation (UNEP 1987). Exhibit 1 shows a conceptual diagram of the model (interested readers should consult the appendix for details).

2.1 Emissions Scenarios

In this analysis, the middle scenario of CFC and halon use and emissions reported in EPA (1988) is used as a baseline "No Controls" scenario. This scenario is based on updated 1986 and 1987 data. Appendix B shows the global emissions in this scenario and the other scenarios analyzed. The following factors are varied in the scenarios: rate of participation in the

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[4] It is assumed in this analysis that natural sources of chlorine and bromine remain unchanged. The contribution from natural sources is therefore ignored in computing changes in Clx and bromine from current levels

[5] Halon 1211 includes not only chlorine but bromine as well; Halon 1301 includes bromine (but no chlorine) Bromine is believed to pose risks to stratospheric ozone (WMO 1986). Halon 2402, which is included in the Protocol, is not assessed due to lack of data. The contribution of compounds like HCFC-141b are included later in the analyses by assuming that such partially-halogenated chlorine-containing compounds have the atmospheric characteristics of HCFC-22.

Montreal Protocol; growth in compound use among the non-participants; growth in methyl chloroform use; and extent to which partially-halogenated compounds are substituted for foregone CFCs. These factors are discussed more fully below.

In the baseline scenario the average annual growth rate in demand for products and services that would use CFCs, if they were available, is approximately 4.0 percent from 1986 to 2000, and 2.5 percent from 2000 to 2050, for an average rate of 2.8 percent from 1986 to 2050 (based on preliminary data, growth in the U.S. from 1985 to 1987 has averaged 11.3 percent per year, ITC 1988). It is assumed that production is constant following 2050.[6]

It should be noted that the conclusions of the analysis are not overly sensitive to the baseline emissions assumptions. The baseline scenario is merely a convenient case that is used as a basis for comparison with other cases. It is reasonable to consider <u>the range of scenarios examined here as "what if" scenarios</u>.

For purposes of evaluating compliance with the Montreal Protocol, global use is divided into six regions: U.S.; USSR and Other East Bloc; Other Developed Nations (i.e., Europe, Japan, Australia and New Zealand); China and India; Developing Nations I (i.e., developing nations with relatively higher levels of per capita CFC use); and Developing Nations II (i.e., developing nations with relatively lower levels of per capita CFC use) (see EPA 1988, Chapter 4). Each region is simulated to participate in the Protocol to various extents: the U.S. is assumed to participate; the USSR and the Other Developed Nations are assumed to achieve 94 percent participation; and

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[6] This assumption of constant production after 2050 is relaxed below in some scenarios to evaluate its implications for Clx and halon levels.

Developing Nations are assumed to achieve 65 percent participation (see EPA 1988 for a discussion of the participation assumptions).[7] Alternative participation assumptions are explored below.

2.2 The Effects of Chemical Lifetimes on Chlorine Contributions

The emissions of the compounds are translated into Clx and halon levels using atmospheric lifetimes and conversion factors for each compound (see Exhibit 2). The lifetimes indicate how long the chlorine associated with the compounds will remain in the atmosphere.[8] As shown in the exhibit, the lifetimes of the compounds vary from about 8 years (CH3CCl3) to 380 years (CFC-115). For the compounds other than the halons, the conversion factors convert emissions in millions of kilograms into ppbv of Clx and adjust for the relative efficiencies of the various compounds in supplying ozone-depleting chlorine to the stratosphere. The conversion factors for the halons convert millions of kilograms of emissions into atmospheric abundances in pptv for each compound. Also used is a mixing time of 3.5 years to simulate the time needed for the emissions to rise into the stratosphere.

Note that the chlorine contribution of Halon 1211 is not counted in the Clx levels reported below. Because halons are treated separately in the

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[7] The basis for these participation estimates includes participation in the Protocol process to date and judgments about the current receptiveness of nations to the Protocol. Alternative judgments are possible, and are tested below. Of note is that the non-participants are assumed to experience reduced use of the compounds in response to the development (by the participants) of technologies that do not rely on ozone depleters (see EPA 1988, Appendix C). For the years following 2000, the non-participants in the USSR, East Bloc, and other developed nations are assumed to experience 37.5 percent of their baseline growth rate, or about 0.94 percent growth per year. In developing nations it is assumed that non-participants experience 50 percent of their baseline growth rate, or about 1.25 percent per year.

[8] The lifetimes are "e-folding" lifetimes, meaning that after the period of one lifetime has elapsed, the remaining level in the atmosphere is 1/e or about 37 percent of the original value. See Appendix A for a description of the model used to compute atmospheric levels.

Protocol and contribute primarily bromine, halon abundances are reported separately.

To assess the extent to which emissions result in increases in Clx levels, the current Clx and halon levels associated with these compounds are required.[9] As shown in Exhibit 3, the anthropogenic-related Clx levels estimated with the model (totalling about 2.7 ppbv across the compounds included in the model) are similar to those estimated by Connell and Wuebbles (1986) and reported by WMO (1986).[10] Also shown are halon levels.

Based on the estimated values of the compound lifetimes and conversion factors, the level of emissions that would maintain the Clx and halon abundances at their 1985 simulated values can be computed. At these estimated levels of emissions, the decline in Clx and halon levels due to natural atmospheric removal processes would be exactly balanced by additional emissions. Exhibit 3 shows the levels of emissions that are consistent with stabilizing the chlorine contribution from each compound. These emissions are much smaller than the estimated 1985 levels of global emissions (also shown in Exhibit 3), indicating that reductions in emissions are required in order to stabilize the Clx and halon levels from individual compounds at their 1985 values. Total chlorine can also be stabilized by cutting back some compounds more and others less than is shown in Exhibit 3; in fact, it would make little sense to stabilize total chlorine by stabilizing each compound's individual contribution. The estimates of changes in Clx and halon levels reported below are computed using the 1985 values as base values.

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[9] The background level of Clx from other sources is assumed to remain constant, and is consequently not considered in this analysis. The abundance of halons comes solely from human sources, although there are other sources of bromine in the atmosphere (see WMO 1986).

[10] These estimates do not include the naturally occurring chlorine from CH_3Cl.

The difference in the compounds' atmospheric lifetimes have important implications for the relative contributions that the compounds make to chlorine levels over time. For example, it has been estimated that CFC-11 and CFC-12 have approximately the same ozone-depleting potential on a mass basis. This implies that at constant and equal levels of emissions, each of the compounds would contribute the same amount of chlorine to the stratosphere once steady-state conditions were achieved.

However, because the two compounds have different lifetimes, steady-state conditions are not achieved at the same rate for each. Additionally, because the lifetimes are very long for each compound and because atmospheric conditions are not near steady state given current levels of emissions, it will take many decades before steady state conditions are approached. Therefore, as shown in Exhibit 4, the contributions of chlorine from CFC-11 and CFC-12 would not be equal over the next 50 years from equal annual emissions of 300 million kilograms per year.

The differences in contributions of chlorine between these two compounds is emphasized in Exhibit 5 which shows the contribution over time from a single year of emissions of 300 million kilograms. Initially, CFC-11 contributes significantly more chlorine. Because CFC-12 has a longer lifetime, its contribution declines more slowly over time, and after about 100 years its contribution exceeds the contribution from CFC-11. Exhibit 6 shows the contribution of each of the compounds relative to the CFC-11 contribution on a year-by-year basis. As expected, the relative contributions of CH3CCl3 and HCFC-22 decline rapidly due to their short lifetimes. However, to the extent that one is concerned about near-term increases in Clx on the order of 1.0 2.0 ppbv, near-term increases in CH3CCl3 emissions must be considered carefully. Although the compounds with longer lifetimes show increasing chlorine contributions over time relative to CFC-11, CH3CC13 emissions present near-term risks from near-term emissions. (Other short-lived compounds should similarly by examined.) Therefore, in evaluating ozone-depletion risks based on Clx contribution, one must make judgments about relative concern to be placed on the potential for near-term depletion.

By changing the radiative properties of the atmosphere, CFC emissions also warm the Earth's surface. By limiting the use and emissions of the fully-halogenated CFCs, the Montreal Protocol is expected to reduce the contribution of these compounds to this "greenhouse effect" by about 80 percent by 2100. This estimate is based on the assumption that currently-anticipated control options are used to reduce CFC use and emissions.

However, if the mix of CFC use among compounds shifts significantly, the resulting greenhouse impact could be significantly different because the compounds have different impacts on global warming. As shown in Exhibit 7, the relative greenhouse impacts of the various compounds differ over time for equal amounts of emissions, and the relative impacts of the compounds with the longer lifetimes are quite high.

As allowed under the Montreal Protocol, the use of the various CFCs can be traded off at rates that are defined by estimates of their steady-state relative ozone-depleting potentials. For example, about 1.7 kilograms of CFC-115 can be traded off for 1.0 kilograms of CFC-11. If this theoretically permissible tradeoff were to occur between all the controlled CFCs and CFC-115 (a highly unlikely event), the expected CFC contribution to the greenhouse effect would almost double as compared to the standard Protocol scenario by 2100. Recognizing that the framers of the Protocol were "conscious of the potential climate effects of [CFC] emissions," this analysis indicates that the tradeoffs among compounds allowable under the Protocol could unintentionally worsen the greenhouse impacts of the CFCs.

3. EVALUATION OF THE MONTREAL PROTOCOL

3.1 Potential Future Clx Levels

By agreeing to and implementing the Montreal Protocol, the nations of the world are altering the future trajectory of Clx levels. Exhibit 8 presents a graph of changes in Clx for three scenarios of emissions: No Controls;[11] Protocol;[12] and a True Global Freeze. The No Controls scenario shows large increases in Clx by 2100. The Protocol (under standard participation and growth assumptions) and True Global Freeze scenarios show approximately the same Clx increases (about 6.7 to 7.6 ppbv by 2100).[13] The True Global Freeze scenario assumes that the use of all the chlorine containing compounds (including HCFC-22 and methyl chloroform) is frozen at 1986 levels starting in 1990, and that 100 percent participation is achieved worldwide. An alternative formulation of the Protocol, in which methyl chloroform is also assumed to be frozen at 1986 levels, shows less of an increase in Clx over the long term.[14]

Note that even by 2100 the Clx values in the Protocol and True Global Freeze scenario have not stabilized. Despite having constant emissions for

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[11] As described above, the No Controls scenario assumes average annual growth in use of 2.8 percent from 1985 to 2050 and no growth thereafter.

[12] The Montreal Protocol calls for a limit on the use of CFC-11, -12, 113, -114 and 115 at 1986 levels starting in 1989, a 20 percent reduction from 1986 levels in 1993, and a 50 percent reduction from 1986 levels in 1998. It also calls for a limit on halon use at 1986 levels starting in 1992.

[13] The chlorine values are increases in Clx relative to current levels of about 2.7 ppbv. Total Clx levels in 2100 are simulated to be about 9.4 to 10.3 ppbv for these two scenarios.

[14] Methyl chloroform may be frozen due to international agreement to limit emissions or due to a lack of demand. At least one reviewer associated with a chemical manufacturer considered methyl chloroform growth to be unlikely

about 100 years under the True Global Freeze scenario, the Clx levels continue to increase slowly. The compounds with the longest lifetimes (CFCs 11, 12, 113, 114, and 115; CCl4) have yet to achieve a steady-state level by this time, whereas the compounds with short lifetimes (HCFC-22, CH3CCl3) have achieved a steady-state level. Although an increase in Clx of about 6.7 ppbv is achieved for this scenario by 2100, the eventual steady-state increase (which will take hundreds of years to approach) is 9.9 ppbv, with CFC-11 and CFC-12 accounting for about 7.9 ppbv of the increase.[15]

Exhibits 9 to 12 show the simulated increases in Clx values over time, the percent of the increase in Clx associated with each compound, and the equilibrium increase in Clx over 1985 values associated with the final level of emissions simulated. As shown in Exhibit 9, CFCs 11, 12 and 113 account for most of the Clx increases over time in the No Controls scenario (over 70 percent). CH3CCl3 is initially significant (see the year 2000), but declines over time in relative importance while the importance of CCl4 increases. The other compounds (CFCs 114 and 115 and HCFC-22) have a negligible relative contribution.

Exhibit 10 shows the contribution by compound for the Protocol scenario. In this scenario the importance of the controlled compounds decreases over time, while the relative importance of CH3CCl3 increases significantly, and the importance of HCFC-22 increases only slightly.[16]

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[15] For readers familiar with ozone-depletion estimates from 1-D models, Appendix C shows several cases of projected depletion. These cases show various emission scenarios for ozone-depleting compounds as well as scenarios for methane, carbon dioxide, and nitrous oxide concentrations. These projections of ozone depletion based on a 1-D model now appear to be inconsistent with monitored changes in ozone, thereby calling into question the adequacy of these models for projecting future changes in ozone.

[16] Although CCl4 is not controlled directly, CCl4 emissions are assumed to decline as the use of CFC-11 and CFC-12 declines because the primary source of CCl4 emissions is during the production of these CFCs.

Although CH3CCl3 is relatively more important in the Protocol scenario as compared with the No Controls scenario, the actual Clx contribution from the compound is the same for the two cases; the increased relative importance of CH3CCl3 in the Protocol scenario is due to reductions in the contributions of the other compounds. As shown in the exhibit, under the Protocol assumptions, the contribution of CH3CCl3 to Clx levels (e.g., about 35 percent in 2075) could become more important than the contribution of CFC-11 or CFC-12 (about 25 percent each in 2075).

Exhibit 11 shows the relative contribution from each compound for the True Global Freeze scenario (in this scenario the use of all the compounds is frozen). As shown in the exhibit, CFCs 11, 12, and 113 grow in importance due to their relatively long lifetimes. CH3CCl3 and HCFC-22, with their short lifetimes, become relatively less important.[17] The other CFCs (CFC-114 and CFC-115) make relatively little contribution despite their long lifetimes because of their small levels of emissions.

Exhibit 12 shows the relative contribution across the compounds for the Protocol scenario with CH3CCl3 frozen at 1986 levels starting in 1989. As expected, the relative contribution of CH3CCl3 is reduced significantly.

It should be emphasized that neither HCFC-22 nor CH3CCl3 grow faster in the above analyses due to the Protocol restrictions on CFC-11, CFC-12, or CFC-113. This assumption is relaxed below.

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[17] Of note is that a key factor that will influence the future chlorine contributions of the partially-halogenated compounds is the future level of the OH radical in the troposphere. The OH radical is primarily responsible for the oxidation of the partially-halogenated compounds in the troposphere, thereby keeping their lifetimes short and their chlorine contributions low. The OH radical is itself influenced by many factors, including methane (CH4) and carbon monoxide (CO) levels. If CH4 and CO increase beyond levels now contemplated, or if their effects on the OH radical are greater than now believed, then the lifetimes of the partially-halogenated compounds (such as CH3CCl3) would increase and their contributions of chlorine to the stratosphere would also increase.

3.2 Impact of Participation Assumptions

The importance of the international participation assumptions in the Protocol Clx estimates is assessed by evaluating alternative sets of participation assumptions, listed in Exhibit 13. In addition to the standard assumption of 94 percent participation among non-U.S. developed nations and 65 percent participation among developing nations, both higher (up to 100 percent) and lower (down to 60 percent for developed nations and down to 40 percent for developing nations) participation scenarios are examined. The results are displayed in Exhibit 14.

As shown in Exhibit 14, even with 100 percent global participation (Participation Scenario D), the Protocol requirements do not maintain Clx levels at their 1985 values. Assuming that CH3CCl3 does not grow (Scenario D'), Clx increases by nearly 4 ppbv by 2100 (with 100 percent participation) which is approximately 2 ppbv less than Scenario D. Exhibit 15 shows that CH3CCl3 accounts for nearly 40 percent of the increase in Clx by 2100 under the Scenario D assumptions. The scenarios with lower participation rates show larger increases in Clx.

3.3 Impact of Substitution Assumptions

In the previous sections it is assumed that as the Protocol requirements are implemented and CFC and halon use is reduced, demand for other ozone-depleting compounds is not affected. In fact, other ozone-depleting compounds (HCFC-22 and CH3CCl3 for example) will be substituted for the controlled CFCs. These other compounds could, therefore, contribute to increasing levels of Clx over time.

To evaluate the potential contributions of Clx from these substitute compounds, five scenarios were analyzed in which a range of assumptions about the quantity of substitutions was examined. Furthermore, it was assumed that the substituted compounds have the same atmospheric characteristics as HCFC-22, or about 1/20 the depletion potential of CFC-11.[18]

The five substitution scenarios are as follows:

- 1:1 -- Add one kilogram of the chemical substitute for each kilogram of CFC-11 and CFC-12 reduced;
- 1:2 -- Add one kilogram of the chemical substitute for each two kilograms of CFC-11 and CFC-12 reduced;
- 1:5 -- Add one kilogram of the chemical substitute for each five kilograms of CFC-11 and CFC-12 reduced;
- 1:10 -- Add one kilogram of the chemical substitute for each 10 kilograms of CFC-11 and CFC-12 reduced; and
- 1:1* -- Add one kilogram of the chemical substitute for each kilogram of CFC-11, CFC-12, CFC-113, CFC-114 and CFC-115 reduced.

Exhibit 16 displays the results of these five scenarios, along with the standard assumption of no substitution (i.e., the Protocol scenario).

As shown in Exhibit 16, substitution results in increased Clx levels. The 1:1 and 1:1* substitutions, which must be considered as unrealistically high due to the numerous opportunities for reducing CFC use without using ozone-depleting compounds as substitutes,[19] results in an increase in Clx of about 3 ppbv over the standard assumption by 2100. The 1:2 substitution assumption, a more realistic worst case, results in an increase on the order

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[18] Other partially-halogenated chlorine containing compounds under consideration as substitutes include: HCFC-142b; HCFC-123; HCFC-141b; and HCFC-124. Each of these compounds has an ozone depletion potential of the same magnitude as HCFC-22. In addition, compounds containing no chlorine are being considered as substitutes, such as HFC-134a. To the extent that any of the widely-used partially-halogenated substitutes have significantly different characteristics than HCFC-22, additional analyses may be required to assess their implications for chlorine levels.

[19] EPA (1988) describes a series of control options for reducing CFC use. Major control options that do not include ozone-depleting chemicals include: product substitutes for many foam-blowing applications; non-chlorinated chemical substitutes in solvent applications; recycling of used CFCs in refrigeration and air conditioning applications; and HFC-134a as a chemical substitute in refrigeration and air conditioning applications.

of 1.0 ppbv by 2100. The more likely scenarios of 1:5 and 1:10 indicate less of an increase in Clx, with 1:5 producing an increase of an additional 0.4 ppbv by 2100.[20]

3.4 Impact of Post-2050 Growth Assumptions

The above analyses assumes that the use of all the analyzed compounds levels out in 2050. In fact, assuming that the world's population and economy continue to grow beyond 2050 may imply continued growth in the demand for products and services that would use these compounds if available. Exhibit 17 displays simulated Clx levels for the No Controls and Protocol cases under the standard assumption of no growth following 2050, and under an alternative assumption of continued 2.5 percent annual growth following 2050. In the Protocol Post-2050 Growth case, continued growth occurs among non-participants and for non-controlled compounds.

As shown in the exhibit, continued growth results in substantially higher Clx levels. In particular, one sees in the exhibit that the modest extent of leveling out of Clx that occurs in the long run in the Protocol case is in fact driven by the assumption of no growth in demand following 2050. When this assumption is relaxed, it appears as though the Protocol would allow higher long term Clx increases.

3.5 Potential Future Halon Levels

Exhibit 18 presents estimates of potential future halon levels for the No Controls and Protocol scenarios. Although Halon 1301 emissions are modeled to be less than the Halon 1211 emissions (see Appendix B), the Halon 1301

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[20] Analysis in EPA (1988) indicates that the potential for substitution of ozone-depleting compounds for CFC-11 and CFC-12 is relatively small, on the order of 1:5 or 1:10. Because HFC-134a (which may substitute for CFC-12) does not have any ozone-depleting chlorine, a 1:1 ratio of substitution with chlorine-bearing compounds is very unlikely even if there were no other control options and even if future use of substitutes were not moderated due to increased costs relative to currently-used CFCs.

concentrations are higher due to the compound's longer atmospheric lifetime. The potential role of halons in ozone depletion remains somewhat uncertain. Based on analyses by Connell (1986) with a 1-D model, the following general rules of thumb describe the ozone-depleting potential of the compounds:

- o based on atmospheric concentrations, 20 pptv of Halon 1211 is as effective at depleting stratospheric ozone as is 40 pptv of Halon-1301;[21] and
- o at moderate levels of Clx abundance (e.g., on the order of 10 ppbv), 20 pptv of Halon 1211 is about as effective as 1 ppbv of Clx at depleting stratospheric ozone.[22]

Based on these rough rules of thumb, the combined halon concentrations in 2100 in the No Controls scenario shown in Exhibit 18 may result in about the same level of ozone depletion as 3 ppbv of Clx. This assessment is very rough, but is provided to put the impact of halons on ozone into context.

Due to the long atmospheric lifetime of Halon 1301, the freeze in use required under the Protocol is not sufficient to stabilize its atmospheric concentration. The fact that Halon 1301 is simulated to be stored in fire extinguishing systems which will result in emissions for many years also contributes to the continued increase in atmospheric concentrations shown in Exhibit 18.

Exhibit 18 also shows estimates for Halon 1211. Because Halon 1211 has a relatively short atmospheric lifetime, and because Halon 1211 fire extinguishers are simulated to have shorter lives, the abundance of Halon 1211

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[21] Although on a concentration basis (i.e., in terms of ppbv) Halon 1211 is more potent than Halon 1301 at depleting ozone, on a mass basis (i.e., in terms of millions of kilograms of emissions) the reverse is true. The increased potency of Halon 1301 relative to Halon 1211 on a mass basis is due to the compound's longer lifetime which results in substantially higher concentrations for equivalent levels of emissions.

[22] The relationship between Clx and ozone depletion varies depending on the Clx abundance and the concentrations of other trace gases (CO_2, N_2O, and CH_4).

flattens out in response to the Protocol requirements. Despite these characteristics, the Protocol requirements do not reduce the abundance of Halon 1211 to its 1985 levels over the next 50 years.

4. REDUCTION SCENARIOS TO STABILIZE Clx AND HALON LEVELS

4.1 Identification of Necessary Reductions

Scenarios more stringent than the Protocol would be needed to stabilize Clx and halon abundances at 1985 levels. Several scenarios were examined to evaluate what controls would be needed. First, the Protocol reduction of 50 percent (a freeze for halons) was replaced with a reduction of 90 percent, and the timing of the reduction was moved from 1998 (1992 for halons) to 1990. As shown in Exhibit 19, under the standard Protocol participation assumptions, this scenario results in over a 4 ppbv increase in Clx by 2100. If the global participation in the reduction is increased to 100 percent, the Clx increment is held to about 2 ppbv by 2100, and is no longer increasing at that time. If the reduction was increased to 100 percent (i.e., full phase out of the fully-halogenated CFCs by 1990) with 100 percent participation, the increment in the Clx level would be limited to about 1.5 ppbv and would be declining by 2100. As shown in Exhibit 20, CH_3CCl_3 is the primary compound contributing to the increases in the Clx levels relative to the 1985 value in this 100 percent Reduction scenario.[23]

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[23] Also shown in Exhibit 20 are negative contributions to Clx increases from several compounds. The negative values indicate that although overall Clx levels increased relative to 1985 values, the Clx associated with those compounds decreased. For example, in Exhibit 20 the contribution from CCl_4 is shown as negative. This occurs because the simulated emissions are less than the level necessary to keep the CCl_4 contribution to Clx constant at its 1985 level, and the change in Clx associated with CCl_4 is consequently negative. This negative change for Clx (associated with CCl_4) divided by the positive overall change in Clx across all the compounds results in a negative contribution for CCl_4 being reported in the exhibit.

Because the investigations above indicate that CH3CCl3 may become an important relative contributor to Clx levels in the future (and because some industrial reviewers indicated that they beleived that the demand for CH3CCl3 may not grow), a scenario of freezing this compound at 1986 levels in 1990 was investigated. Exhibit 21 shows the simulated increases in Clx associated with the 100 percent reduction in the fully-halogenated CFCs along with the freeze in CH3CCl3. The increase in Clx is limited to under 1.5 ppbv assuming participation similar to the participation used to model the Protocol. If 100 percent participation is assumed, Clx levels are simulated to decrease by 2100 by about 0.6 ppbv. By that time, the contribution of chlorine from all compounds is less than the loss rate from stratosphere. In this scenario, the Clx associated with all the compounds except CH3CCl3 (which is frozen) and HCFC-22 (which is not controlled) is simulated to decline. Unlike the other scenarios examined, this scenario, which includes a freeze on CH3CCl3 (but does not include potential HCFC substitutes), stabilizes or reduces Clx abundances.

4.2 Impact of Substitution and Post-2050 Growth Assumptions on Stabilization

The long term outlook for Clx levels is influenced by the substitution of ozone-depleting compounds for controlled compounds and by the assumption that baseline compound use does not grow after 2050. Exhibit 22 shows the implications of assuming that the baseline demand for products and services that would use CFCs continues to grow at 2.5 percent per year from 2050 to 2100.[24] The top two lines show the case of a 100 percent reduction in fully-halogenated CFCs and a freeze on CH3CCl3, assuming the participation rates

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[24] Under these baseline assumptions, compound use grows by 2.5 percent per year after 2050. As described above, non-participants' use of controlled substances is reduced relative to these baseline assumptions when use limits are simulated.

used for the standard Protocol evaluation. In this case the assumption of continued growth after 2050 results in simulated increases in Clx levels of about 2.4 ppbv by 2100 instead of 1.5 ppbv.

The bottom two lines on the exhibit show the case of 100 percent reduction in the fully-halogenated CFCs, a freeze on CH3CCl3, with 100 percent global participation. In this case the assumption of continued growth in use after 2050 results in the Clx levels rebounding so that by 2100 the levels are increasing, although the levels remain below the 1985 simulated values.

Exhibit 23 displays simulated levels of Clx assuming that one kilogram of a substitute compound is used for each two or five kilograms of CFC-11 and CFC-12 that are foregone. As above, it is assumed that the substitute has the atmospheric characteristics of HCFC-22 (i.e., about 1/20 the depleting potential of CFC-11). The substitutions result in modest increases in the simulated Clx values. In the 100 percent global participation scenario, the 1:5 substitution results in an increase in simulated Clx levels of about 0.4 ppbv by 2100 relative to the no-substitute scenario.

Exhibit 24 displays the implications of having both continued growth after 2050 and the use of chlorine-bearing substitute compounds. As above, a substitute with the atmospheric characteristics of HCFC-22 is assumed for two levels of substitution. Also, growth after 2050 continues at 2.5 percent per year. As shown in the exhibit, the combined effect of substitution and continued growth could result in increased chlorine levels even under stringent restrictions. Exhibit 24 may present the restrictions most likely to be necessary to stabilize Clx at current levels: a phaseout of the fully-halogenated compounds; a freeze in CH3CCl3 use at current levels; and conservative use (e.g., about 1:5 substitution) of partially-halogenated replacement compounds.[25] Of note is that even this conservative rate of substitution (1:5) allows for significant increases in the use of HCFC-22-like compounds in the future. The 1:5 substitution assumption allows for nearly 4.0 percent annual growth of these compounds through 2100, or nearly and 80-fold increase over current levels.

4.3 Potential Future Halon Levels

Similarly large reductions in use are required to stabilize halon abundances. Exhibit 25 displays estimates of Halon 1301 for 90 percent and 100 percent reductions. Even with 100 percent reduction in use by 1990, levels are simulated to remain above current values through 2100. Of note, however, is that this analysis does not assume significant recovery of Halon 1301 in existing systems. If these amounts were substantially recovered (and not emitted) Halon 1301 levels could decline.

Exhibit 26 displays similar estimates for Halon 1211. Because Halon 1211 has a relatively short atmospheric lifetime, its atmospheric levels respond quickly to reduced emissions. As in the analysis of Halon 1301, increased recovery activity is not presumed.

5. IMPLICATIONS OF A VIRTUAL PHASEOUT OF CFCs FOR CHLORINE LEVELS

The previous sections have examined the potential future levels of stratospheric chlorine that may be associated with the Montreal Protocol and the emissions reductions required in 1990 in order to stabilize chlorine levels at current values. This section assesses the implications of virtual phaseouts of CFC compounds that could be achieved within the Protocol framework and time frame. Unlike the previous section which evaluated large reductions starting in 1990, this section builds upon the current Protocol

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[25] The conservative use of the substitutes could be achieved by: agreements to limit use; the use of efficacious containment technologies; and/or the use of non-chlorine-containing compounds and technologies as substitutes

schedule of reductions. The implications of requiring deeper reductions in 1998 is examined, followed by an evaluation of the effects of speeding up or delaying the required reductions.

5.1 Virtual Phaseouts in 1998

The following factors were varied in examining the implications of virtual phaseouts:

- <u>Stringency of the phaseout</u>: 90 percent; 95 percent; 97 percent; and 100 percent.
- <u>Participation</u>: standard participation assumptions[26] and 100 percent global participation.
- <u>Methyl chloroform growth</u>: methyl chloroform use and emissions grow in the future and methyl chloroform use is frozen at 1986 levels either due to international agreement or due to a lack of demand.
- <u>Substitution</u>: ozone-depleting substitutes for foregone CFCs were assumed to range from no substitutes to one kilogram for each two kilograms of CFC-11 and CFC-12 foregone.
- <u>Long Term Growth</u>. Compound use was assumed to have no growth following 2050 and was assumed to have continued growth at 2.5 percent per year following 2050.

While varying these factors, the basic structure of the phased Protocol reductions was maintained. The 50 percent reduction required in 1998 was replaced with the more stringent reductions of 90, 95, 97, and 100 percent. The special allowances for developing nations and nations with planned expansions of production were also maintained.

Exhibit 27 displays the estimated chlorine values for the four stringency levels assuming standard (i.e., less than 100 percent) participation and growth in CH3CCl3. As shown in the exhibit, even with these stringent phaseouts, chlorine levels may increase on the order of 4 ppbv to 5 ppbv by 2100. Exhibit 28 shows that 100 percent participation in such

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[26] Standard participation assumptions are: U.S participation; 94 percent participation among other developed nations including the USSR and East Bloc nations; and 65 percent participation among developing nations.

phaseouts would reduce the size of the increases in chlorine by about 2 ppbv by 2100. Even with 100 percent participation, however, the chlorine levels increase from current values.

Exhibit 29 displays the estimated chlorine levels for the case when CH3CCl3 is assumed to be frozen at 1986 levels starting in 1989. When compared to Exhibit 28, this exhibit shows that the continued growth in CH3CCl3 contributed to the continued increase in chlorine relative to current levels over the long term. By virtually phasing out the CFCs and freezing CH3CCl3 at 1986 levels, chlorine increases are kept below 1 ppbv by 2100.

These results, however, do not include two factors that may increase future chlorine levels. As discussed in the previous sections, ozone-depleting compounds may be substituted for foregone CFCs. Exhibit 30 shows that "one-for-two" substitution may increase the estimated chlorine levels somewhat.[27] Similarly, Exhibit 31 shows the implications of both substitution and continued growth in compound use following 2050.[28] Even with 100 percent global compliance, the assumptions of continued growth and "one-for-two" compound substitution combine to result in estimated chlorine <u>increases</u> by 2100 for the four stringency levels.

Of interest is that a tradeoff between stringency and substitution exists. For example, Exhibit 32 shows that the 90 percent reduction with one-to-five substitution yields approximately the same chlorine increases as a 100 percent reduction with a one-to-three or one-to-2.5 substitution. The

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[27] As discussed in previous sections, the substitute is assumed to have the atmospheric characteristics of HCFC-22. Also, "one-for-two" substitution is considered to be an upper bound for likely future substitution.

[28] Assuming 100 percent compliance, the continued growth after 2050 affects only the use of HCFC-22 (which is not controlled) and the level of substitutes used. Continued growth after 2050 results in larger amounts of substitutes being used after 2050.

implication of this tradeoff is that increasing the stringency of the phaseout from 90 percent to 100 percent would allow the use of HCFC-22-like substitutes to be approximately doubled. In other words, by giving up about 125 million kilograms of CFCs 11, 12 and 113 annually, an additional 235 million kilograms of substitutes could be used in the year 2000 without increasing Clx levels. By the year 2050 an additional 870 million kilograms of substitutes could be used annually without increasing Clx levels.

This analysis indicates that within the Protocol framework, increases in chlorine levels can be kept to relatively low levels if the following is achieved: almost 100 percent participation; no future growth in CH3CCl3 emissions; low rate of substitution of other ozone-depleting compounds (i.e., the HCFCs);[29] and movement out of all fully-halogenated ozone-depleting compounds over the long term in order to prevent long term growth in demand.

5.2 Speeding up or Delaying the Phaseout

The timing of the phaseout will influence the trajectory of chlorine levels over time. Delays will allow additional emissions to increase chlorine levels. The increased levels will persist over time, increasing the risk of ozone depletion.

To assess the implications of changing the timing of the phaseout a 100 percent phaseout with 100 percent participation and a CH3CCl3 freeze was examined starting in six different years: 1990; 1993; 1996; 1998; 2003; and 2008. The general Protocol framework was maintained. As shown in Exhibit 33, the estimated chlorine levels for the six cases vary significantly by 2015. The differences among the cases persist for decades. In fact, delaying a full

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[29] As discussed above, even the low rate of substitution allows for significant increases in the use of these substitutes.

phaseout from 1998 to 2008 increases the maximum chlorine level by about 0.7 ppbv and delays the decline back to 1985 levels by about 70 years.

Because the differences among the cases persist for many years, the differences in the cumulative amount of chlorine contributed over time is a useful measure for evaluating the implications of the alternative timings. Exhibit 34 shows the differences in the cumulative amount of chlorine increase estimated for 1985 to 2100, relative to a timing of 1998. As shown, moving the phaseout up to 1990 reduces the cumulative contribution by over 11.5 ppbv. Delaying the phaseout to 2008 increases the cumulative contribution by over about 12.5 ppbv. Over this range the chlorine response is approximately linear to changes in the timing of the phaseout.

Of note is that the general magnitude of the effect of timing on the cumulative chlorine contribution is not overly sensitive to assumptions about CH3CCl3 growth or participation. Increasing participation tends to increase the importance of the timing of the phaseout.

6. SUMMARY

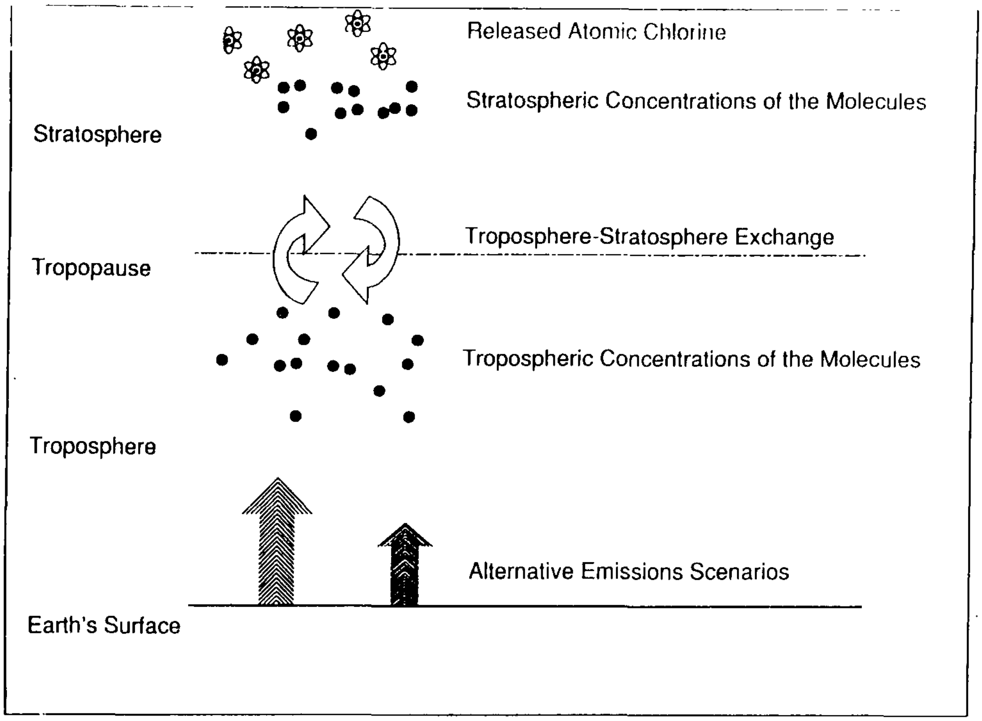
Very large increases in Clx and halon abundances would have been expected if the use and emissions of chlorine-containing compounds and halons had been allowed to increase without limit. The provisions of the Montreal Protocol will reduce the amount of the increase significantly, but will not keep the levels of Clx and halons in the stratosphere from increasing. Significant additional reductions in emissions are required to keep the levels from increasing, possibly including a complete phaseout of the fully-halogenated compounds and a freeze on methyl chloroform. The rate of substitution with partially-halogenated chlorine-containing compounds will also influence future chlorine levels. If substitution is limited to key uses, and if emissions are contained, the impact of these substitutes on future chlorine levels would be relatively small. The timing of a phaseout affects both the magnitude of the Clx increase and the time required for Clx levels to decline back to 1985 values.

EXHIBITS

EXHIBITS

EXHIBIT 1

CONCEPTUAL DIAGRAM OF THE CONCENTRATION MODEL



The concentrations model is based on results from a one-dimensional model of the atmosphere. As a one-dimensional analysis, the analysis reflects vertical transport only; latitudinal and longitudinal dependent effects are not considered.

The analysis begins with alternative emissions scenarios based on a variety of assumptions. The emissions are translated into tropospheric concentrations of the compounds. The tropospheric concentrations in any year are a function of <u>additions</u> (due to emissions) and <u>losses</u> (due to transport to the stratosphere). The transport to the stratosphere is modeled using an exponential time constant of 3.5 years. This implies that 3.5 years after an emission takes place, about 63 percent of it has reached the stratosphere.

In the stratosphere the molecules are broken down by solar radiation and release chlorine. The stratospheric concentrations of the molecules are adjusted for the relative amounts of ozone-depleting chlorine atoms supplied to the stratosphere.

EXHIBIT 2

COMPOUND LIFETIMES AND CONVERSION FACTORS

Compound	Lifetime[a]	Conversion Factor[b]
CFC-11	76.5 years	1.363×10^{-4}
CFC-12	138.8 years	0.761×10^{-4}
CFC-113	91.7 years	0.945×10^{-4}
CFC-114	185.0 years	0.372×10^{-4}
CFC-115	380.0 years	0.102×10^{-4}
HCFC-22	22.0 years	0.285×10^{-4}
CH3CCl3	8.3 years	1.466×10^{-4}
CCl4	67.1 years	1.709×10^{-4}
Halon 1211	12.9 years	3.31×10^{-2}
Halon 1301	100.9 years	3.68×10^{-2}

a The lifetimes indicate how long the chlorine associated with the compounds will remain in the atmosphere. The lifetimes are "e-folding" lifetimes, meaning that after the period of one lifetime has elapsed, the remaining level in the atmosphere is 1/e or about 37 percent of the original value.

b For the compounds other than the halons, the conversion factors convert millions of kilograms of emissions into ppbv of Clx, and adjust for the relative efficiencies of the various compounds in supplying ozone-depleting chlorine to the stratosphere. The conversion factors for halons convert millions of kilograms of emissions into atmospheric abundances in pptv for each compound.

Source: Connell (1986).

EXHIBIT 3

SIMULATED 1985 Clx AND HALON LEVELS

1985 Anthropogenic Clx Levels (ppbv)[a]

Compound	IAM[b]	Connell/ Wuebbles[c]	WMO[d]	Stabilizing Emissions (10^6 kg)[e]	Estimated 1985 Emissions (10^6 kg)
CFC-11	0.68	0.63	0.6	67.2 (76%)	278
CFC-12	0.63	0.76	0.64	61.1 (83%)	364
CFC-113	0.10	0.10	0.11	1.5 (99%)	150
CFC-114	0.01	NR	NR	1.0 (93%)	14
CFC-115	<0.01	NR	<0.01	<0.1 (98%)	5
HCFC-22	0.01	0.04	0.05	22.0 (69%)	74
CH3CC13	0.57	0.41	0.4	575.0 (29%)	813[f]
CC14	0.67	0.65	0.64	60.9 (30%)	87
TOTAL	2.68	2.59	NR	----	--

1985 HALON Levels (pptv)

Compound	IAM	Connell/ Wuebbles	WMO	Stabilizing Emissions (10^6 kg)[e]	Estimated 1985 Emissions (10^6 kg)
Halon 1211	0.20	0.0	1.2	0.5 (64%)	1.4
Halon 1301	0.40	0.0	1.0	0.1 (95%)	2.0

NR = Not reported

a Anthropogenic sources only. Does not include natural chlorine from CH3Cl.

b Current values of chlorine exceed the 1985 values.

c Computed by multiplying the surface mole fraction by the number of atoms per molecule.

d Values reported here computed by multiplying compound abundance values reported in WMO (1986) by the number of chlorine atoms in the compound molecule.

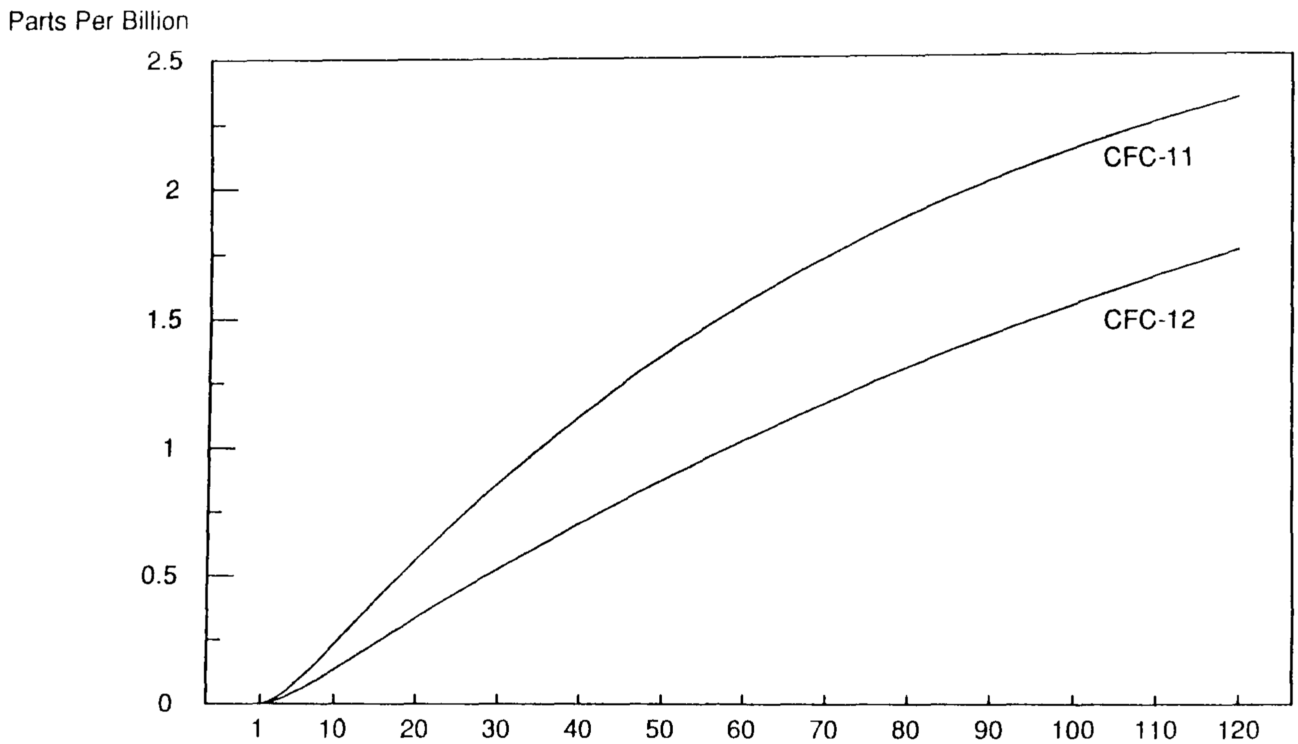
e "Stabilizing emissions" is the level of emissions that is estimated to result in constant Clx (or halon) levels at the IAM-simulated values. Estimates based on data developed in Connell (1986). Values in parentheses are percent reductions from 1985 emissions.

f Estimated 1985 production. Annual CH3CC13 production has varied significantly from year-to-year. Estimated 1986 production is approximately 600 million kilograms.

Sources: Connell and Wuebbles (1986), WMO (1986).

EXHIBIT 4

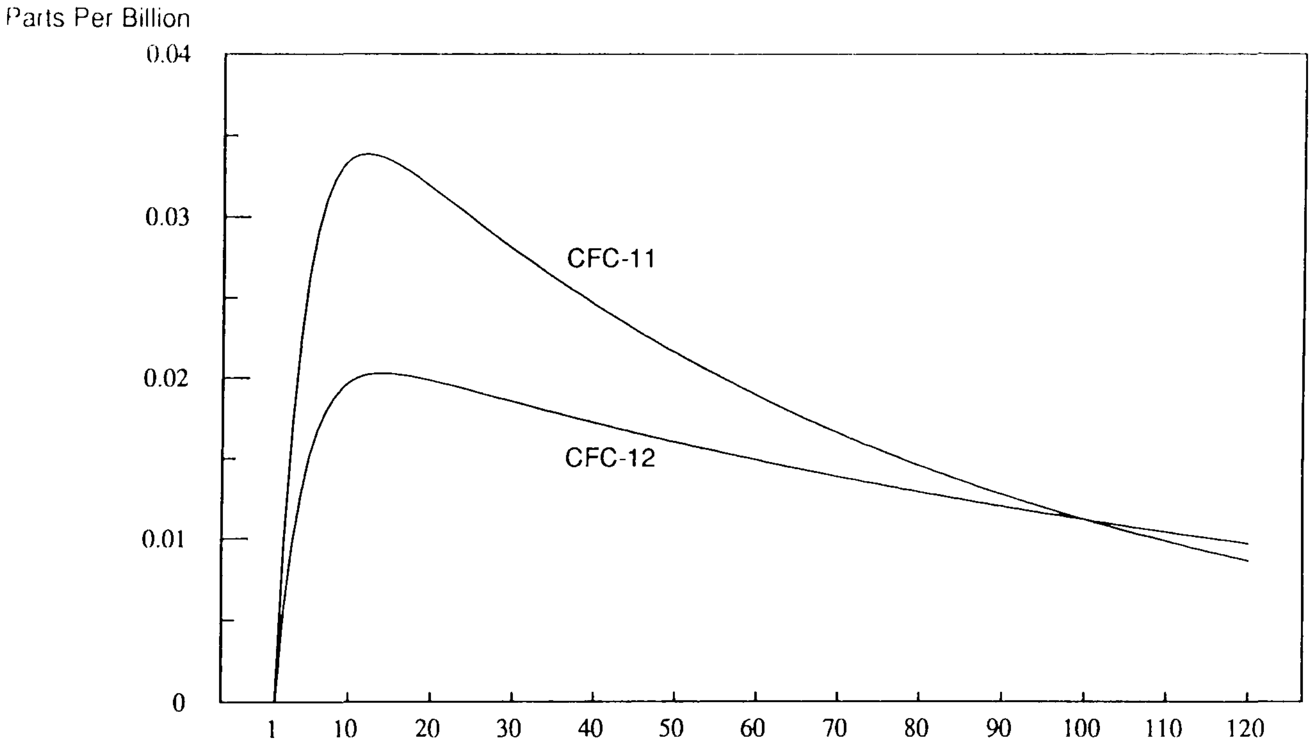
SIMULATED CHLORINE CONTRIBUTION FROM CFC-11 AND CFC-12
FROM HYPOTHETICAL CONSTANT EMISSIONS OF 300 MILLION KG PER YEAR



Chlorine contributions over time computed based on the lifetimes and conversion factors presented in Exhibit 2 and the model described in Appendix A.

EXHIBIT 5

SIMULATED CHLORINE CONTRIBUTIONS FROM CFC-11 AND CFC-12
FROM HYPOTHETICAL ONE-YEAR OF EMISSIONS OF 300 MILLION KILOGRAMS

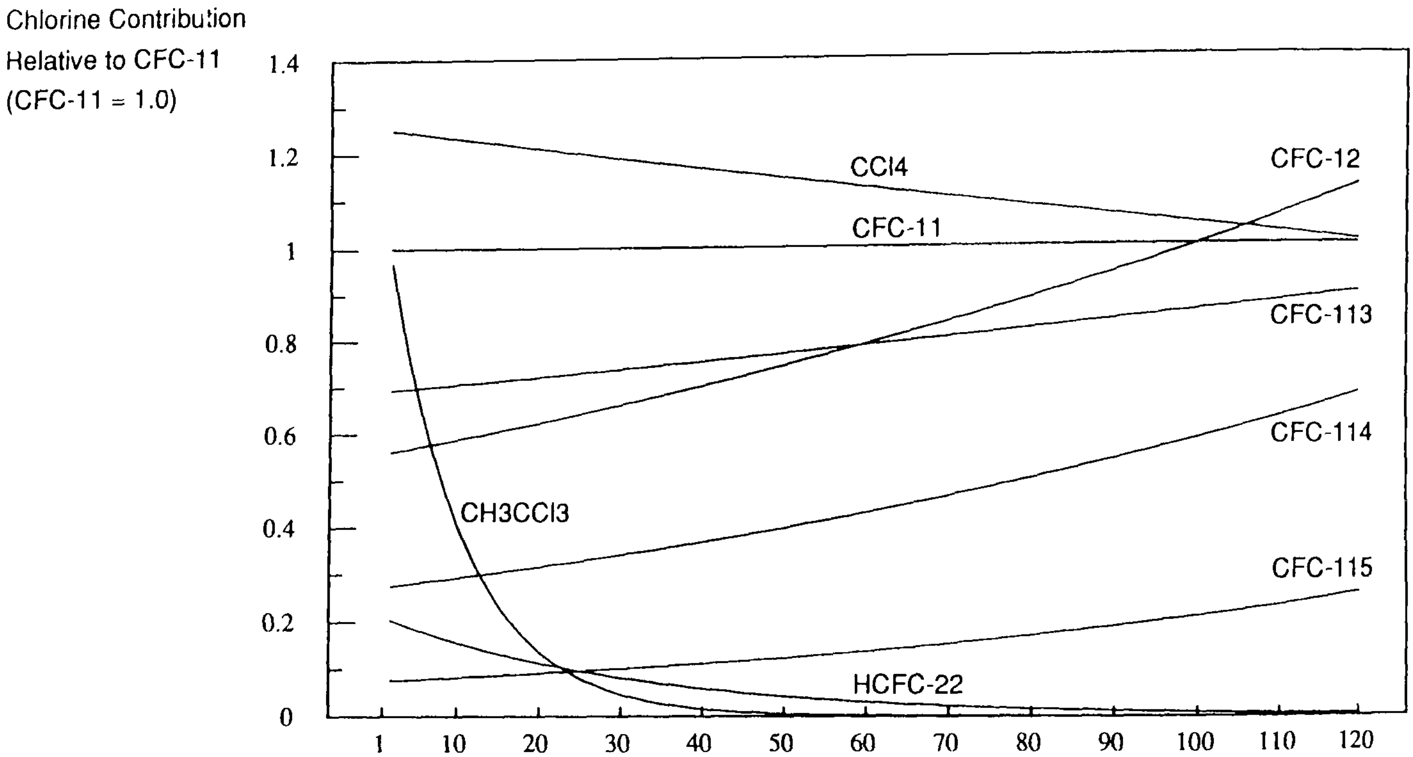


Chlorine contributions over time computed based on the lifetimes and conversion factors presented in Exhibit 2 and the model described in Appendix A.

EXHIBIT 6

RELATIVE CHLORINE CONTRIBUTION OVER TIME FROM EACH COMPOUND FOR HYPOTHETICAL ONE-YEAR EMISSIONS OF 300 MILLION KILOGRAMS

(Values are relative to CFC-11 which is set to 1.0)

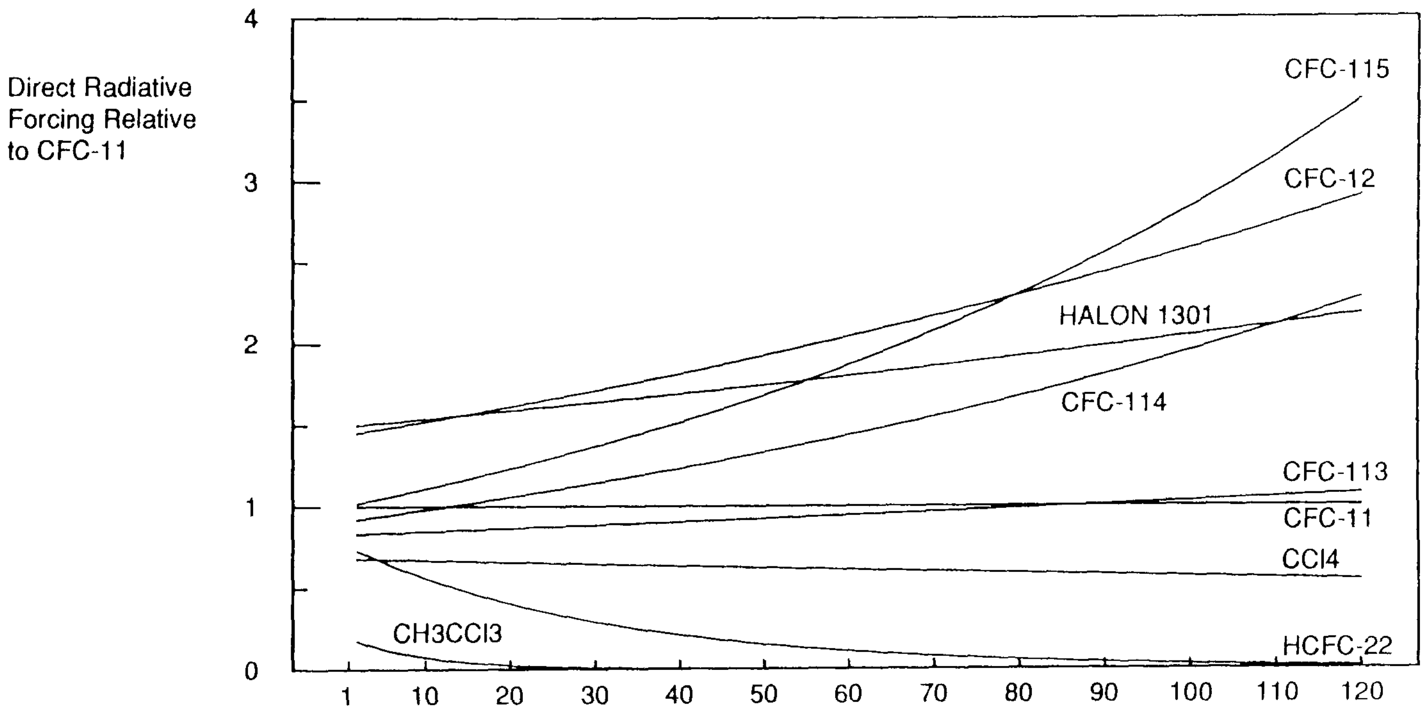


Chlorine contributions over time computed based on the lifetimes and conversion factors presented in Exhibit 2 and the model described in Appendix A.

EXHIBIT 7

RELATIVE GREENHOUSE IMPACTS OVER TIME FROM EACH COMPOUND FOR HYPOTHETICAL ONE-YEAR EMISSIONS OF 300 MILLION KILOGRAMS

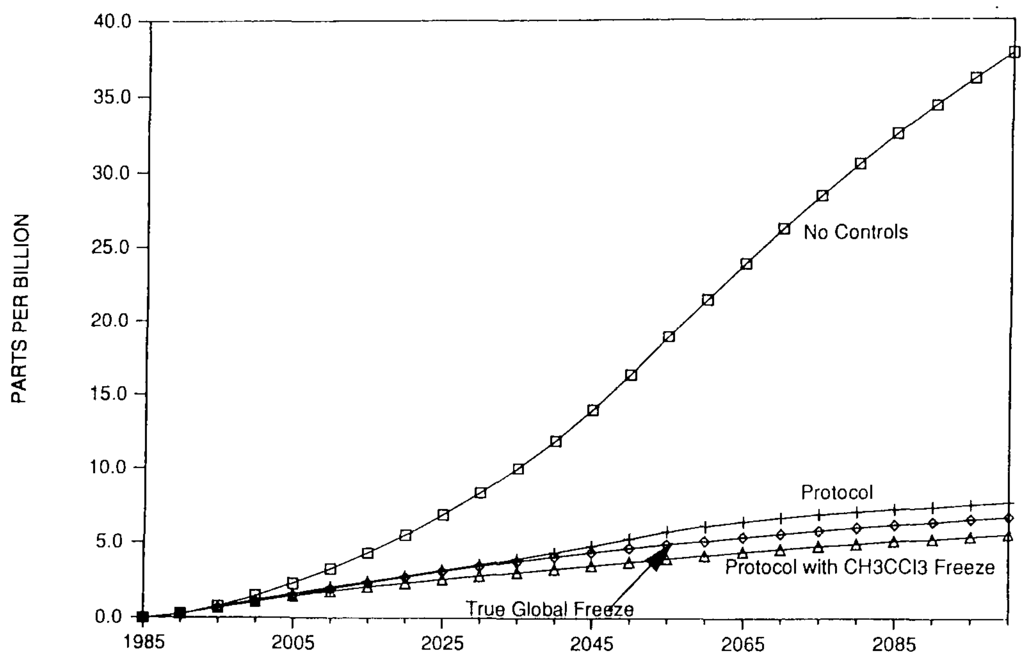
(Values are relative to CFC-11 which is set to 1.0)



Relative greenhouse impacts are computed based on the "direct radiative forcing" provided by the compounds. This value is a function of the extent to which the compounds absorb certain wavelengths of light and the atmospheric abundances of the compounds. The absorption characteristics are based on analysis in EPA (1987) for CFC-11, CFC-12, HCFC-22, CH3CCl3, CCl4 and Halon 1301. Estimates for CFCs 113, 114, and 115 are based on the assumption that the parameters are the average of the values for CFC-11 and CFC-12.

EXHIBIT 8

SIMULATED INCREASES IN Clx:
NO CONTROLS; PROTOCOL; AND TRUE GLOBAL FREEZE



Assumptions:

No Controls: Compound use grows at an average annual rate of 2.8 percent from 1985 to 2050, with no growth thereafter.

Protocol: U.S. participation; 94 percent participation in other developed nations; 65 percent participation in developing nations. Use of compounds not covered by the Protocol grows at the rates in the No Controls scenario. Growth rates among non-participants are reduced to 37.5 percent (developed nations) and 50 percent (developing nations) of their baseline values. Steady state increase in Clx is 10.2 ppbv.

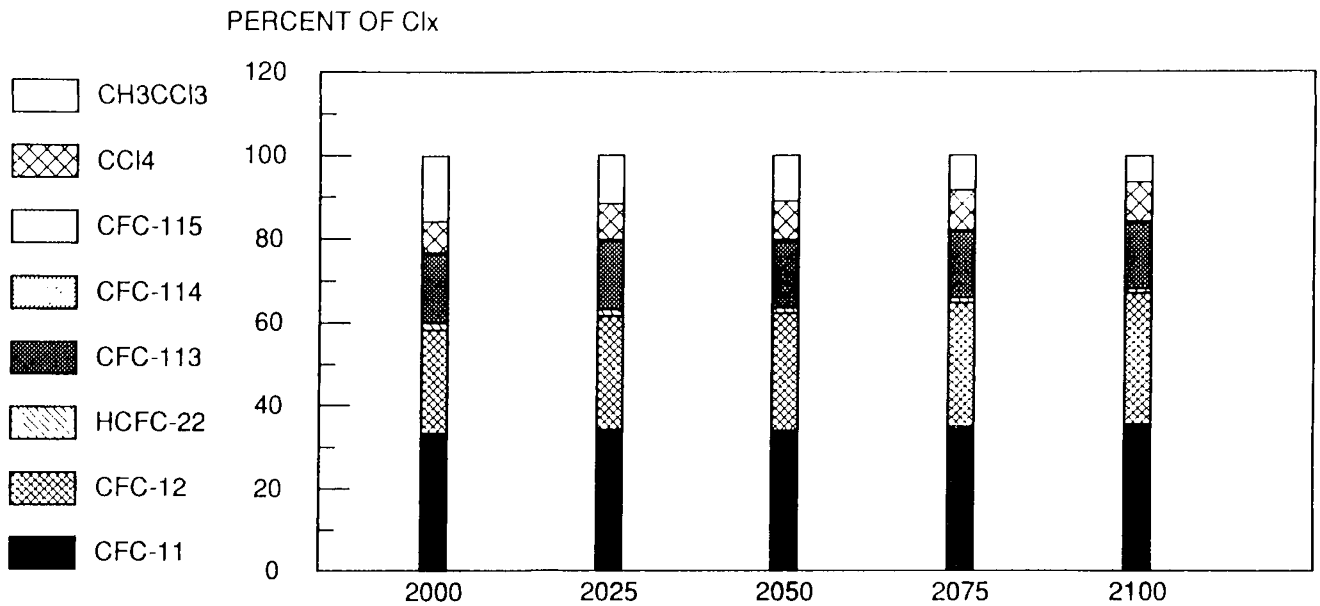
True Global Freeze: The use of all chlorine-containing compounds is frozen at 1986 levels starting in 1990, and 100 percent participation is achieved worldwide. Steady state increase in Clx is 9.9 ppbv.

Protocol with CH3CCl3 Freeze: Same as Protocol assumptions, plus a freeze on CH3CCl3 use starting in 1989. Steady state increase in Clx is 8.0 ppbv.

Baseline Compound use is assumed to be constant after 2050.

EXHIBIT 9

RELATIVE CONTRIBUTION OF THE COMPOUNDS TO INCREASES IN Clx: NO CONTROLS SCENARIO



Change in Clx (ppb):	1.5	6.8	16.3	28.5	37.8

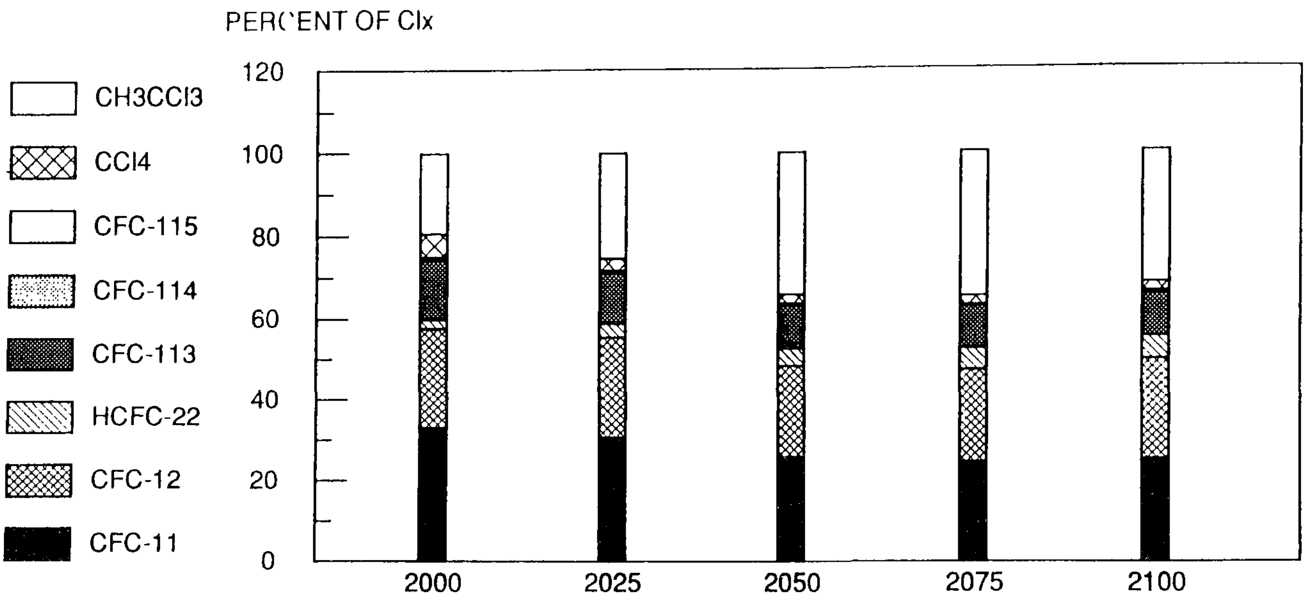
Steady State Increase in Clx (ppbv): 71.5

Assumptions:

No Controls: Compound use grows at an average annual rate of 2.8 percent from 1985 to 2050, with no growth thereafter.

EXHIBIT 10

RELATIVE CONTRIBUTION OF THE COMPOUNDS TO INCREASES IN Clx: PROTOCOL SCENARIO



Change in Clx (ppb):	1.2	3.2	5.2	6.8	7.6

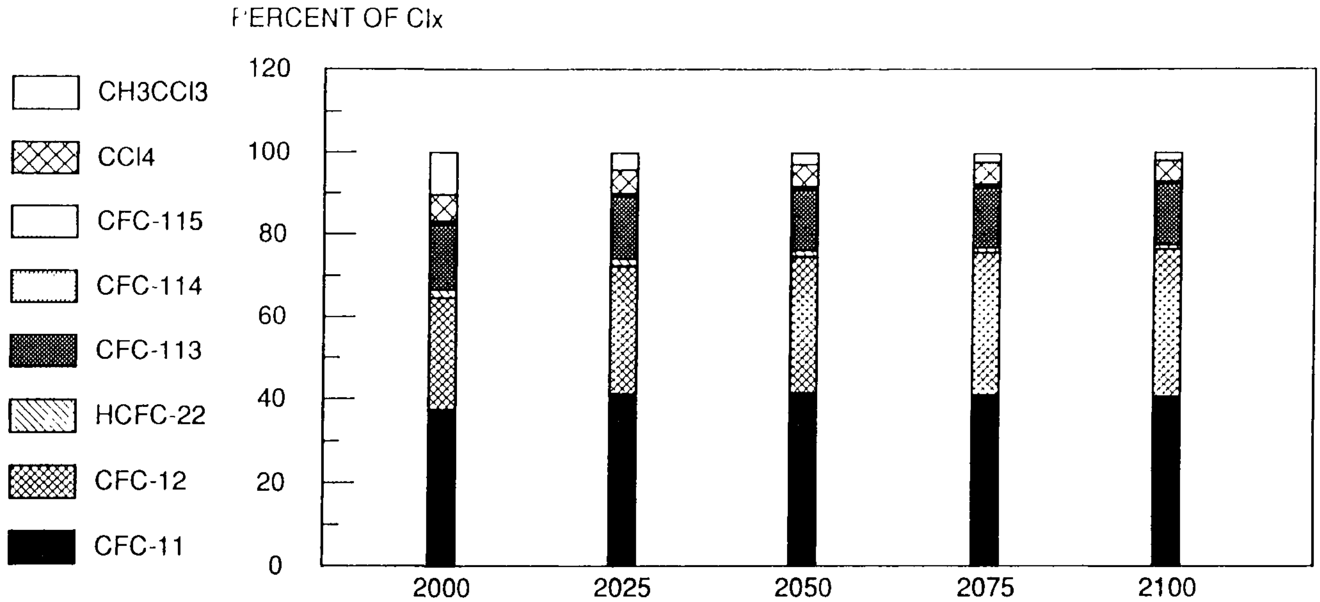
Steady State Increase in Clx (ppbv): 10.2

Assumptions:

Protocol: U.S. participation; 94 percent participation in other developed nations; 65 percent participation in developing nations. Use of compounds not covered by the Protocol grows at the rates in the No Controls scenario. Growth rates among non-participants are reduced. Baseline compound use is assumed to be constant after 2050.

EXHIBIT 11

RELATIVE CONTRIBUTION OF THE COMPOUNDS TO INCREASES IN Clx: TRUE GLOBAL FREEZE



Change in Clx (ppb):	1.0	3.1	4.6	5.8	6.7

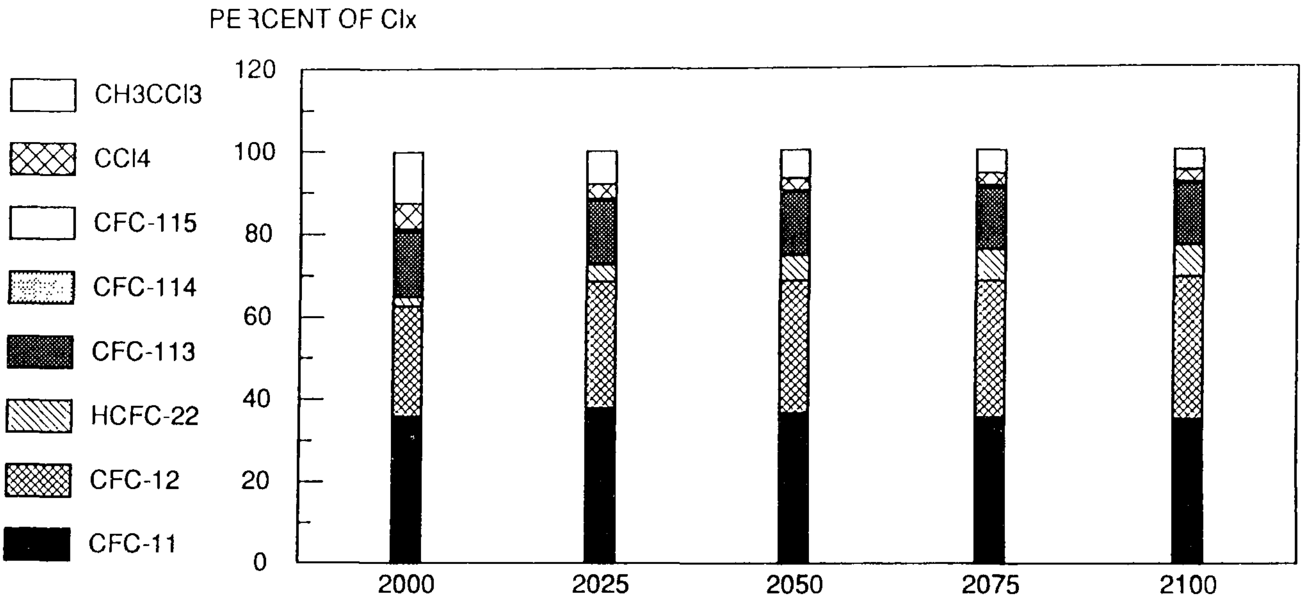
Steady State Increase in Clx (ppbv): 9.9

Assumptions:

True Global Freeze: The use of all chlorine-containing compounds is frozen at 1986 levels starting in 1990, and 100 percent participation is achieved worldwide.

EXHIBIT 12

RELATIVE CONTRIBUTION OF THE COMPOUNDS TO INCREASE IN Clx: PROTOCOL WITH CH3CCl3 FREEZE



Change in Clx (ppb):	1.1	2.6	3.7	4.7	5.5

Steady State Increase in Clx (ppbv): 8.0

<u>Assumptions:</u>

Protocol with CH3CCl3 Freeze: U.S. participation; 94 percent participation in other developed nations; 65 percent participation in developing nations. Use of compounds not covered by the Protocol grows at the rates in the No Controls scenario. Growth rates among non-participants are reduced. Baseline compound use is assumed to be constant after 2050.

EXHIBIT 13

RANGE OF PROTOCOL PARTICIPATION ASSUMPTIONS EXAMINED[a]

Participation Scenario	Developed Nations	Developing Nations	Comments
A	94%	65%	Standard Assumptions
B	100%	65%	Higher than standard assumptions
C	100%	85%	Higher than standard assumptions
D	100%	100%	Higher than standard assumptions
D'	100%	100%	Higher than standard assumptions[b]
E	94%	40%	Lower than standard assumptions
F	75%	65%	Lower than standard assumptions
G	60%	65%	Lower than standard assumptions
H	75%	40%	Lower than standard assumptions
I[c]	66%	66%	Lower than standard assumptions

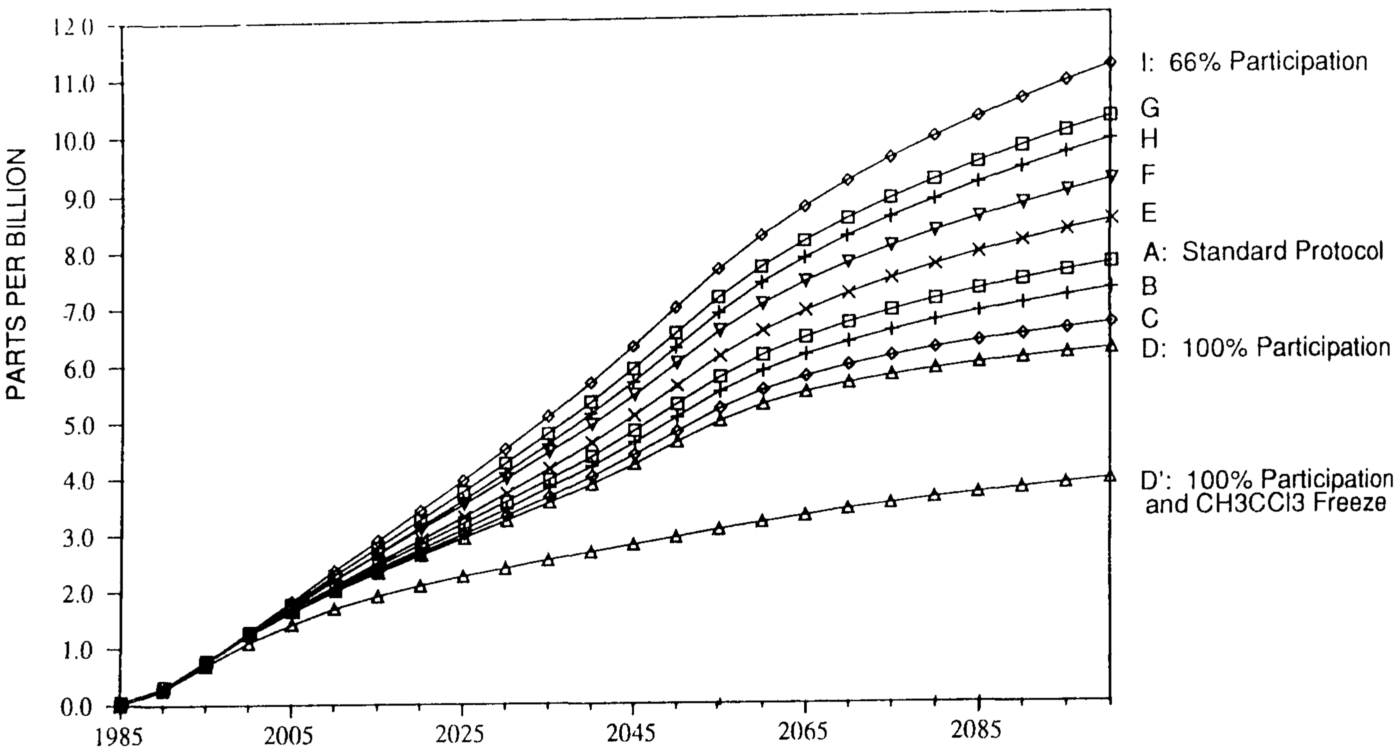
a Unless noted otherwise, 100% U.S. participation is assumed.

b Includes CH3CCl3 freeze along with Protocol requirements.

c Assumes 66% global participation, including the U.S.

EXHIBIT 14

SIMULATED INCREASES IN Clx FOR ALTERNATIVE PROTOCOL PARTICIPATION ASSUMPTIONS



Participation Scenario Definitions:

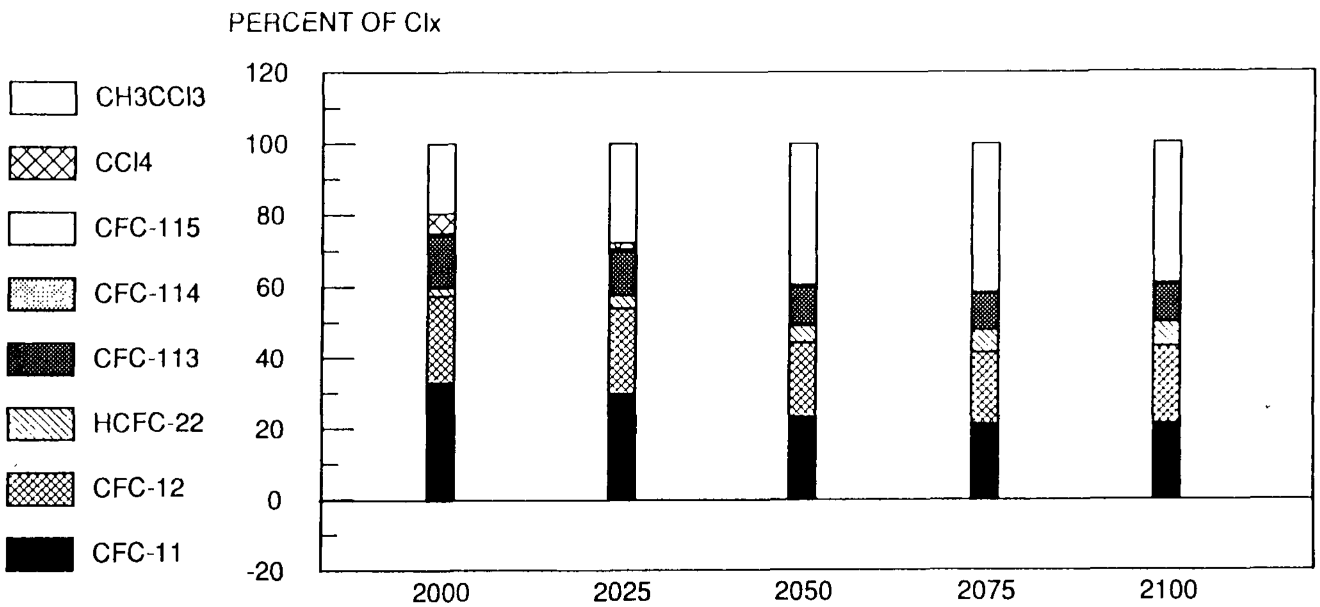
Scenario	Developed Nations	Developing Nations		Steady State Clx Increase[a]
A	94%	65%	Standard Assumption	10.2
B	100%	65%	Higher Assumption	9.4
C	100%	85% -	Higher Assumption	8.2
D and D'	100%	100%	Higher Assumption[b]	7.4 and 5.1
E	94%	40%	Lower Assumption	11.6
F	75%	65%	Lower Assumption	12.8
G	60%	65% -	Lower Assumption	14.8
H	75%	40% -	Lower Assumption	14.2
I	66%	66% -	Lower Assumption	16.4

a Increase over current level of about 2.7 ppbv.

b D' includes a freeze on CH3CCl3.

EXHIBIT 15

RELATIVE CONTRIBUTION OF THE COMPOUNDS TO INCREASES IN Clx: PROTOCOL WITH 100% GLOBAL PARTICIPATION



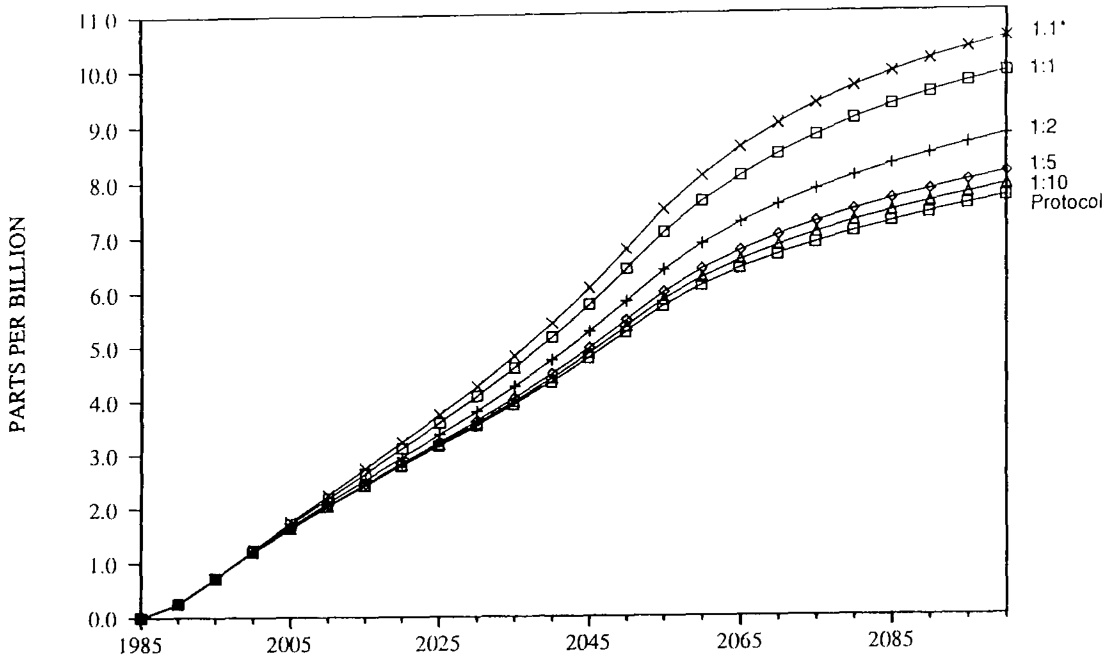
Change in Clx (ppb):	1.2	2.9	4.5	5.7	6.1

Steady State Increase in Clx (ppbv): 7.4

Baseline compound use is assumed to be constant after 2050.

EXHIBIT 16

SIMULATED INCREASES IN Clx: ALTERNATIVE SUBSTITUTION ASSUMPTIONS



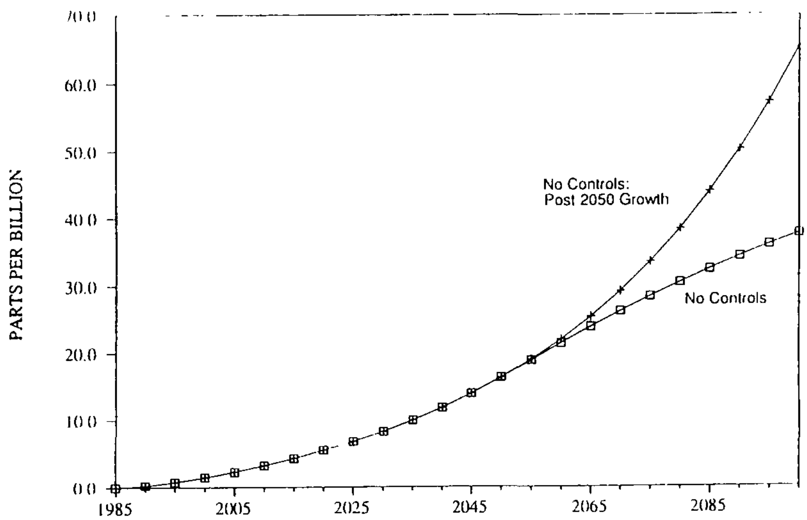
Scenario Definitions:

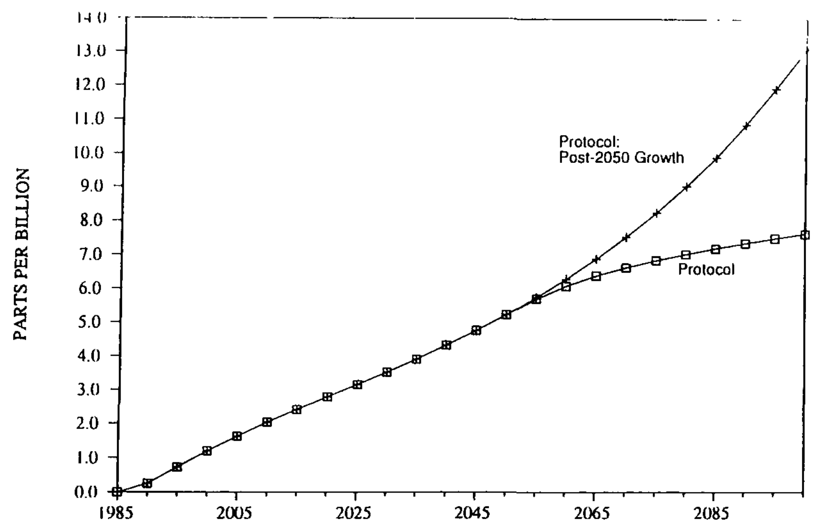
- 1:1 -- Add one kilogram of the substitute for each kilogram of CFC-11 and CFC-12 reduced;
- 1:2 -- Add one kilogram of the substitute for each two kilograms of CFC-11 and CFC-12 reduced;
- 1:5 -- Add one kilogram of the substitute for each five kilograms of CFC-11 and CFC-12 reduced;
- 1:10 -- Add one kilogram of the substitute for each 10 kilograms of CFC-11 and CFC-12 reduced; and
- 1:1* -- Add one kilogram of the substitute for each kilogram of CFC-11, CFC-12, CFC-113, CFC-114 and CFC-115 reduced.

It is assumed that the substitute has the atmospheric characteristics of HCFC-22, or about 1/20 the ozone-depleting potential of CFC-11. Baseline compound use is assumed to be constant after 2050.

EXHIBIT 17

SIMULATED INCREASES IN Clx: NO CONTROLS AND PROTOCOL
WITH ALTERNATIVE POST-2050 GROWTH ASSUMPTIONS



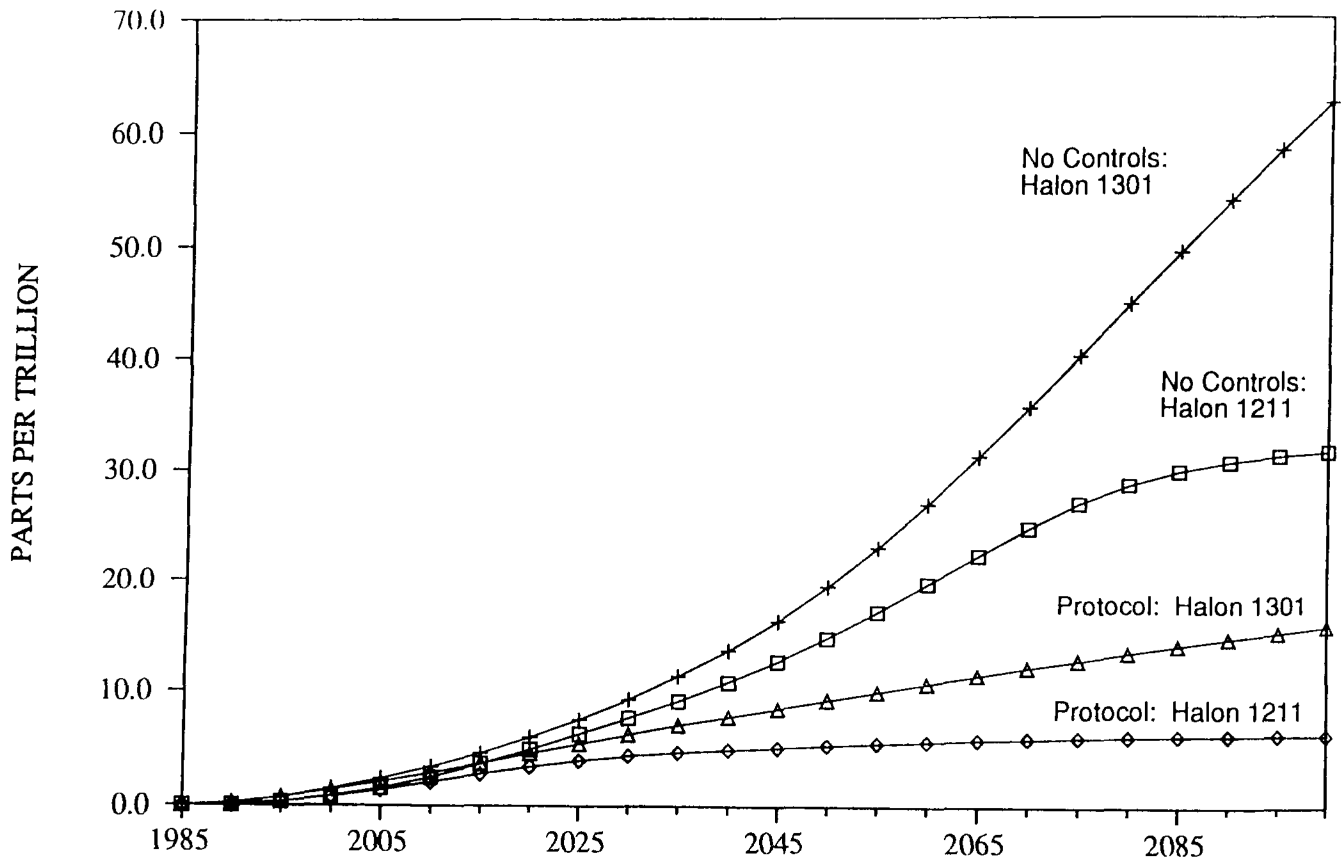


Assumptions:

- Protocol Participation: U.S. participation; 94% of other developed nations; 65% of developing nations.
- Baseline compound use grows by 2.5 percent per year after 2050

EXHIBIT 18

**SIMULATED INCREASE IN HALON LEVELS:
NO CONTROLS AND PROTOCOL SCENARIOS**

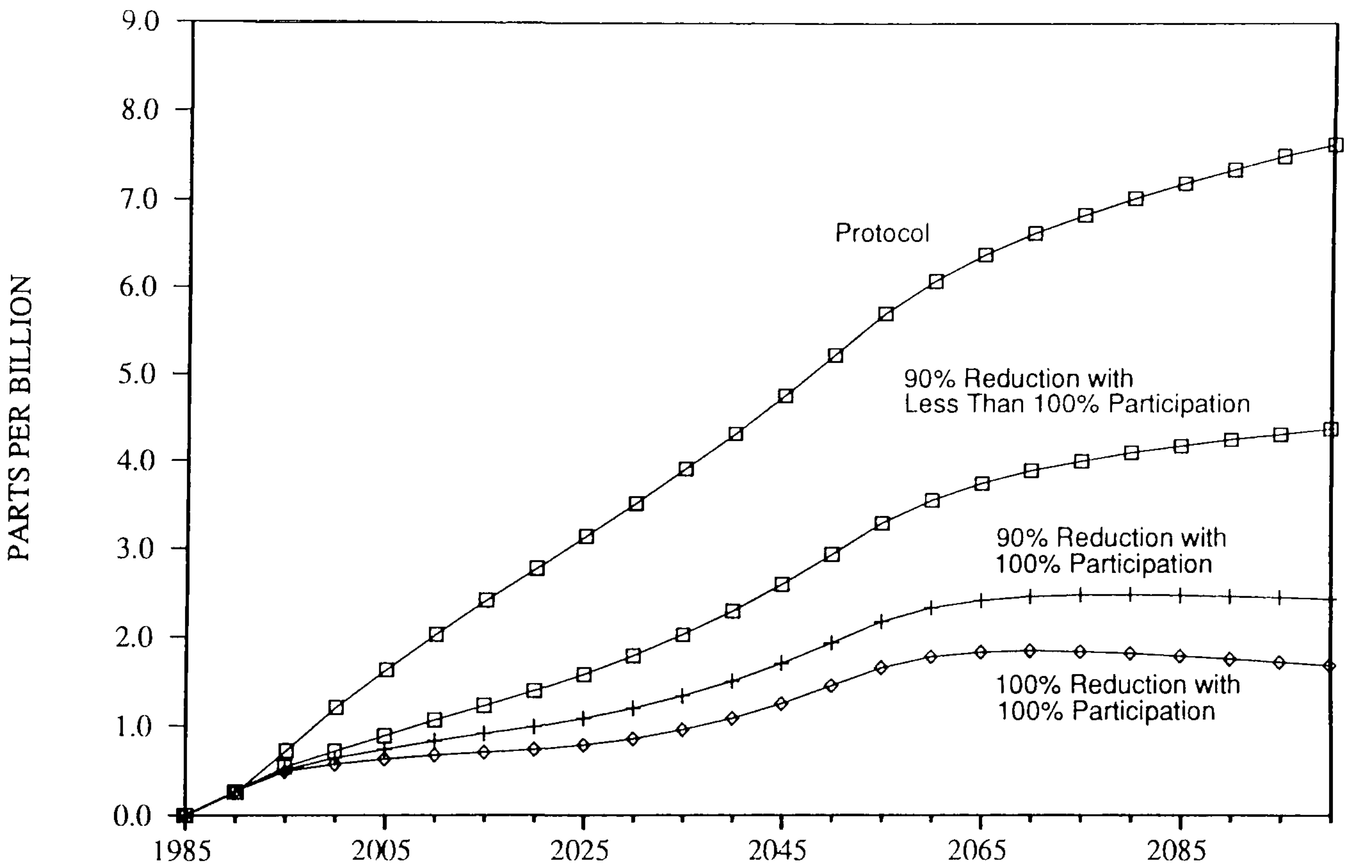


Assumptions:

- Protocol Participation: U.S. participation; 94% of other developed nations; 65% of developing nations.
- Baseline compound use is assumed to be constant after 2050.

EXHIBIT 19

SIMULATED INCREASES IN Clx:
PROTOCOL; 90% REDUCTION; 90% REDUCTION WITH 100% PARTICIPATION;
100% REDUCTION WITH 100% PARTICIPATION

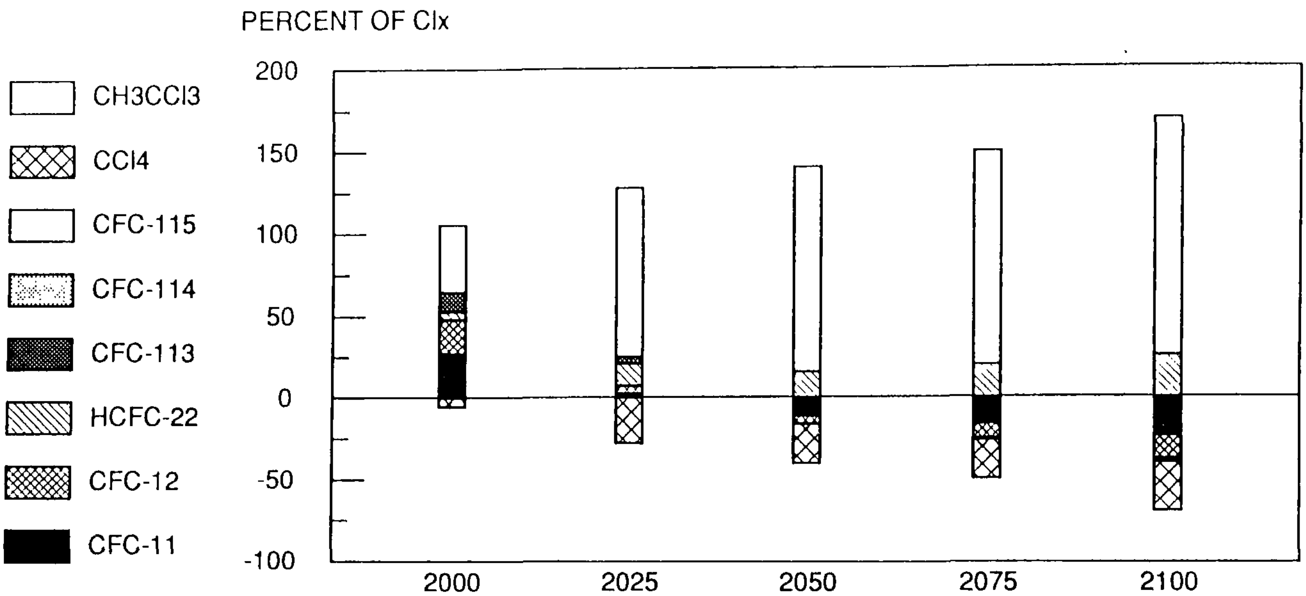


Assumptions:

- Participation in Protocol and 90 percent reduction scenarios: U.S. participation; 94 percent of developed nations; 65 percent of developing nations.
- 90 percent and 100 percent reductions are simulated in 1990.
- Baseline compound use is assumed to be constant after 2050.

EXHIBIT 20

RELATIVE CONTRIBUTION OF THE COMPOUNDS TO INCREASES IN Clx: 100% REDUCTION WITH 100% PARTICIPATION



Change in Clx (ppb):	0.6	0.8	1.4	1.8	1.7

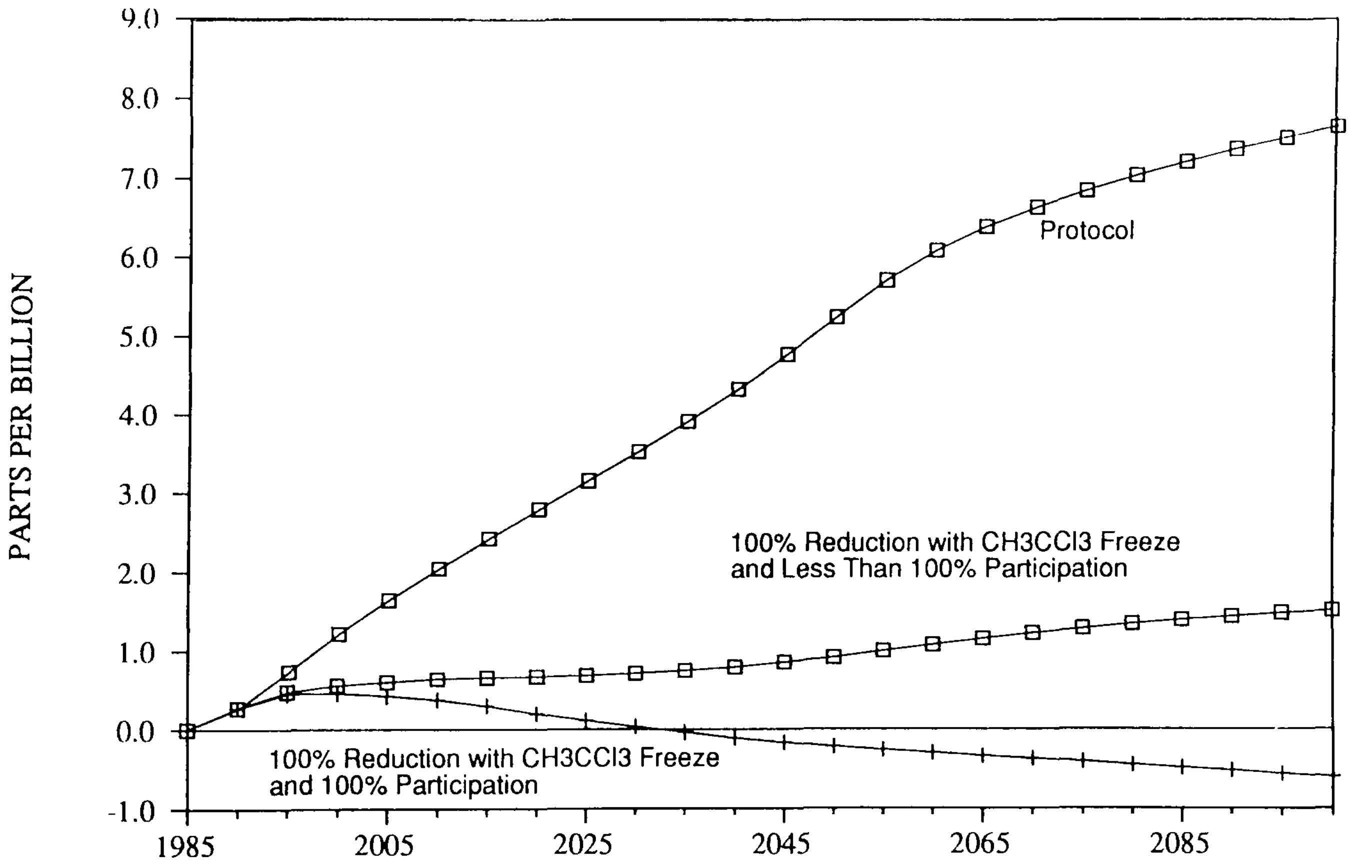
Steady State Increase in Clx (ppbv): 0.7

Assumptions:

- 100 percent reduction in the fully-halogenated CFCs is simulated in 1990, with 100 percent global participation.
- Negative contribution indicates reduced levels of Clx associated with those compounds.
- Baseline compound use is assumed to be constant after 2050.

EXHIBIT 21

SIMULATED INCREASES IN Clx:
PROTOCOL; 100% REDUCTION WITH CH3CCl3 FREEZE;
100% REDUCTION WITH CH3CCl3 FREEZE AND 100% PARTICIPATION

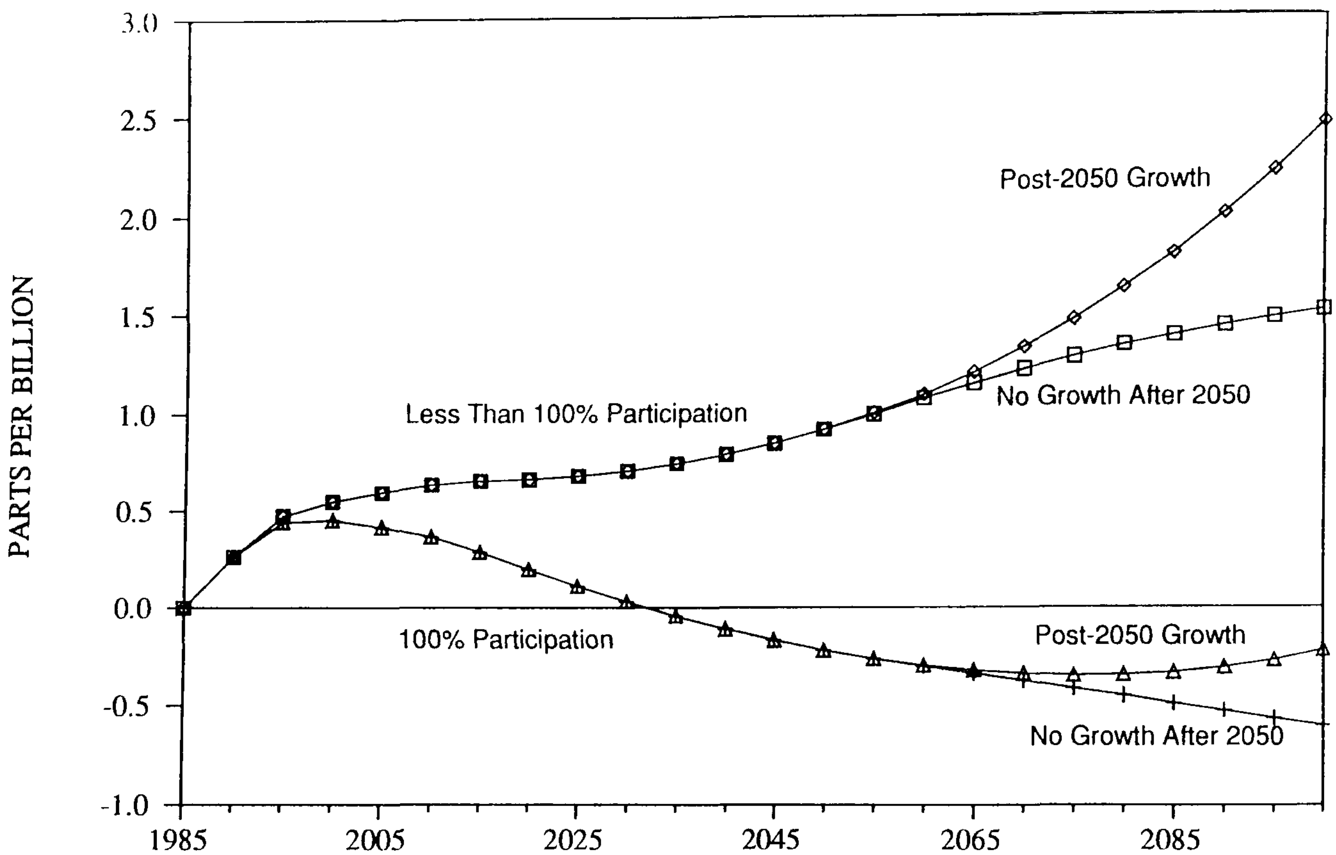


<u>Assumptions</u>:

- Protocol participation: U.S. participation; 94% of developed nations; 65% of developing nations.
- 100% reduction in the fully-halogenated CFCs and the CH3CCl3 freeze are simulated in 1990.
- Baseline compound use is assumed to be constant after 2050.

EXHIBIT 22

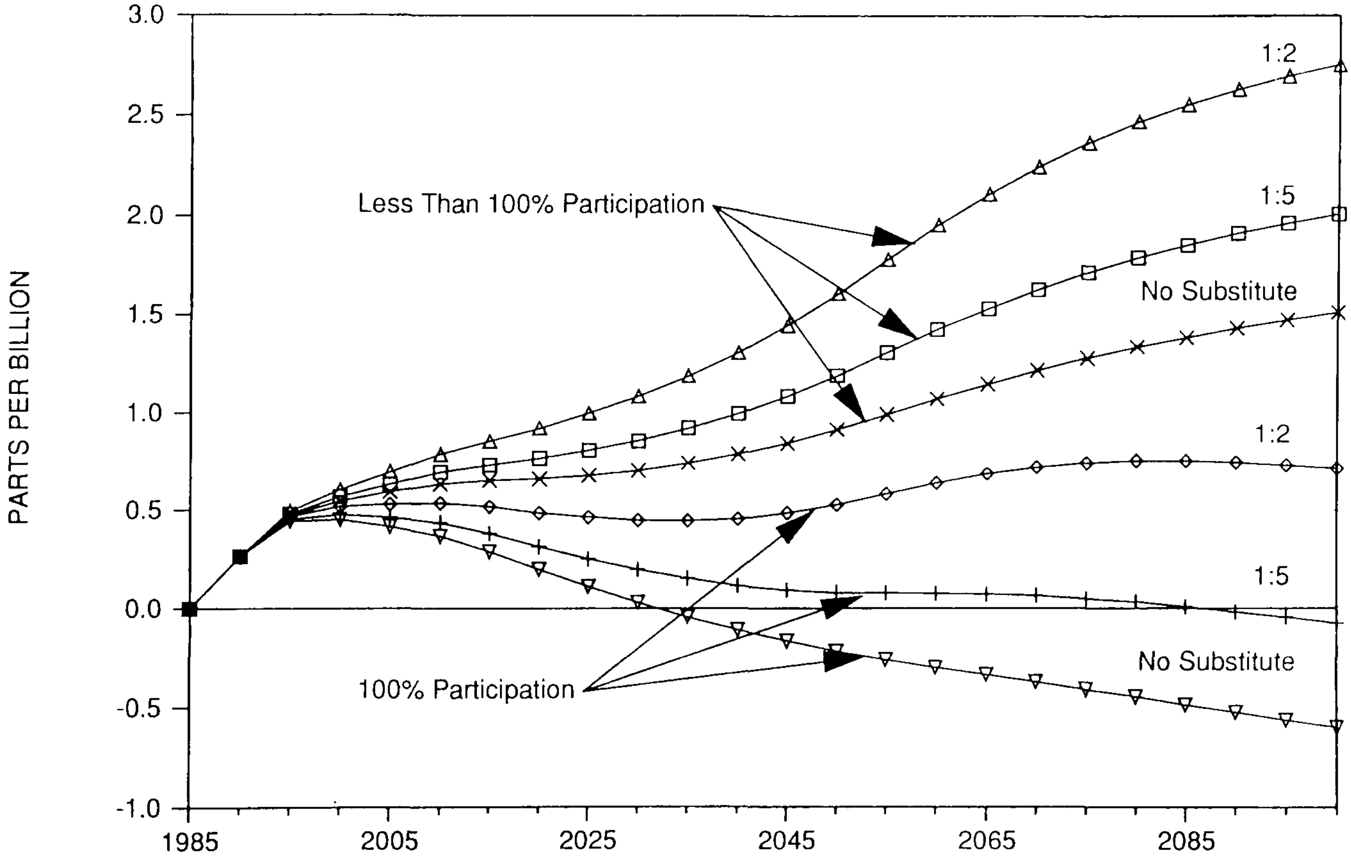
SIMULATED INCREASES IN Clx FOR ALTERNATIVE POST-2050 GROWTH ASSUMPTIONS: 100% REDUCTION WITH CH3CCl3 FREEZE; 100% REDUCTION WITH CH3CCl3 FREEZE AND 100% PARTICIPATION



Two lines are displayed for each of the two cases. One line for each is based on the assumption that baseline compound use stops growing in 2050. The second line assumes that baseline compound growth continues from 2050 to 2100 at a rate of 2.5 percent per year. As anticipated, higher levels of Clx are simulated by 2100 when compound use continues to grow beyond 2050.

EXHIBIT 23

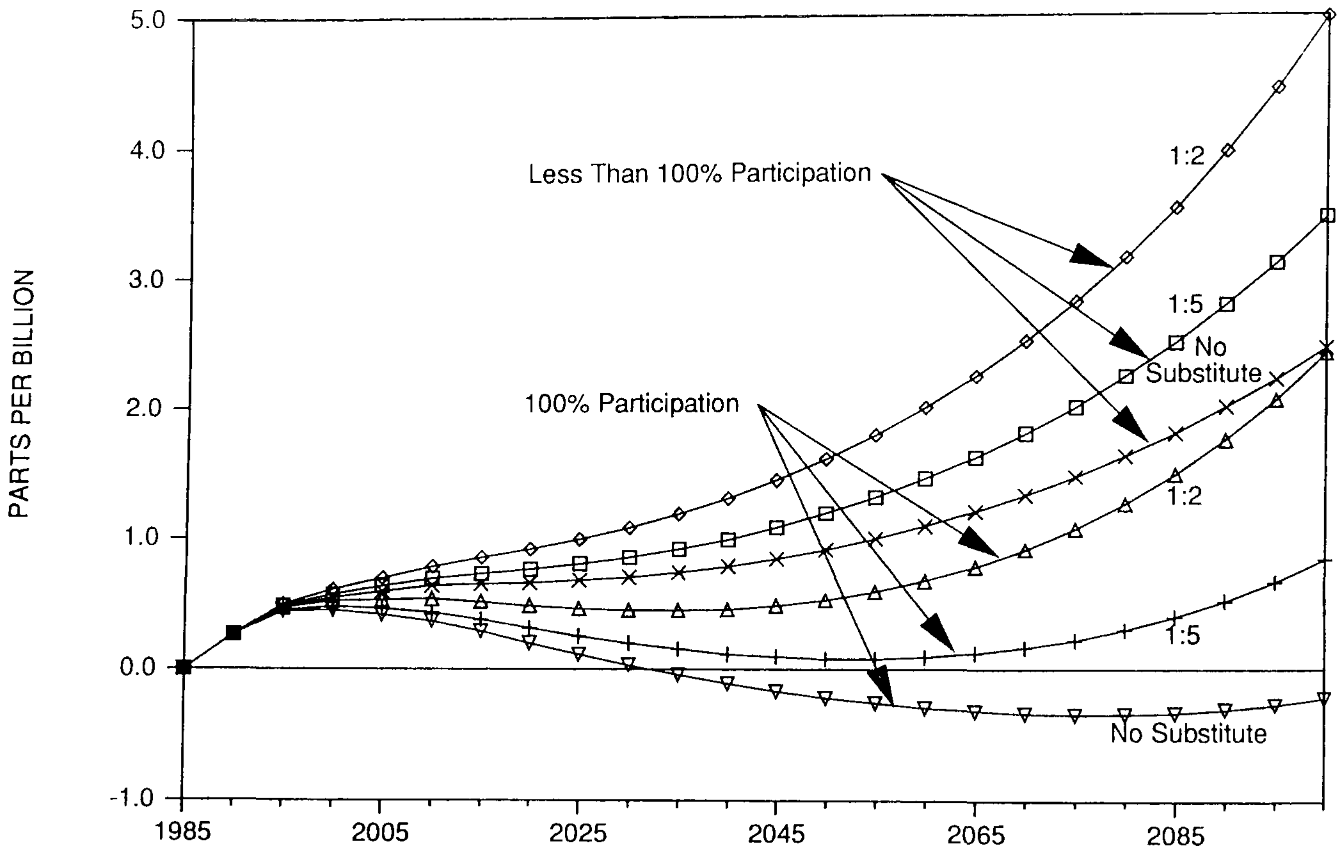
SIMULATED INCREASES IN Clx FOR ALTERNATIVE SUBSTITUTION ASSUMPTIONS:
100% REDUCTION WITH CH3CCL3 FREEZE;
100% REDUCTION WITH CH3CCl3 FREEZE AND 100% PARTICIPATION



Three lines are displayed for each of the two cases. One line is based on the assumption that no ozone-depleting compounds are substituted for the controlled compounds. The other two lines are for a range of substitution assumptions. The substitute is assumed to have the atmospheric characteristics of HCFC-22. Baseline compound use is assumed to be constant after 2050.

EXHIBIT 24

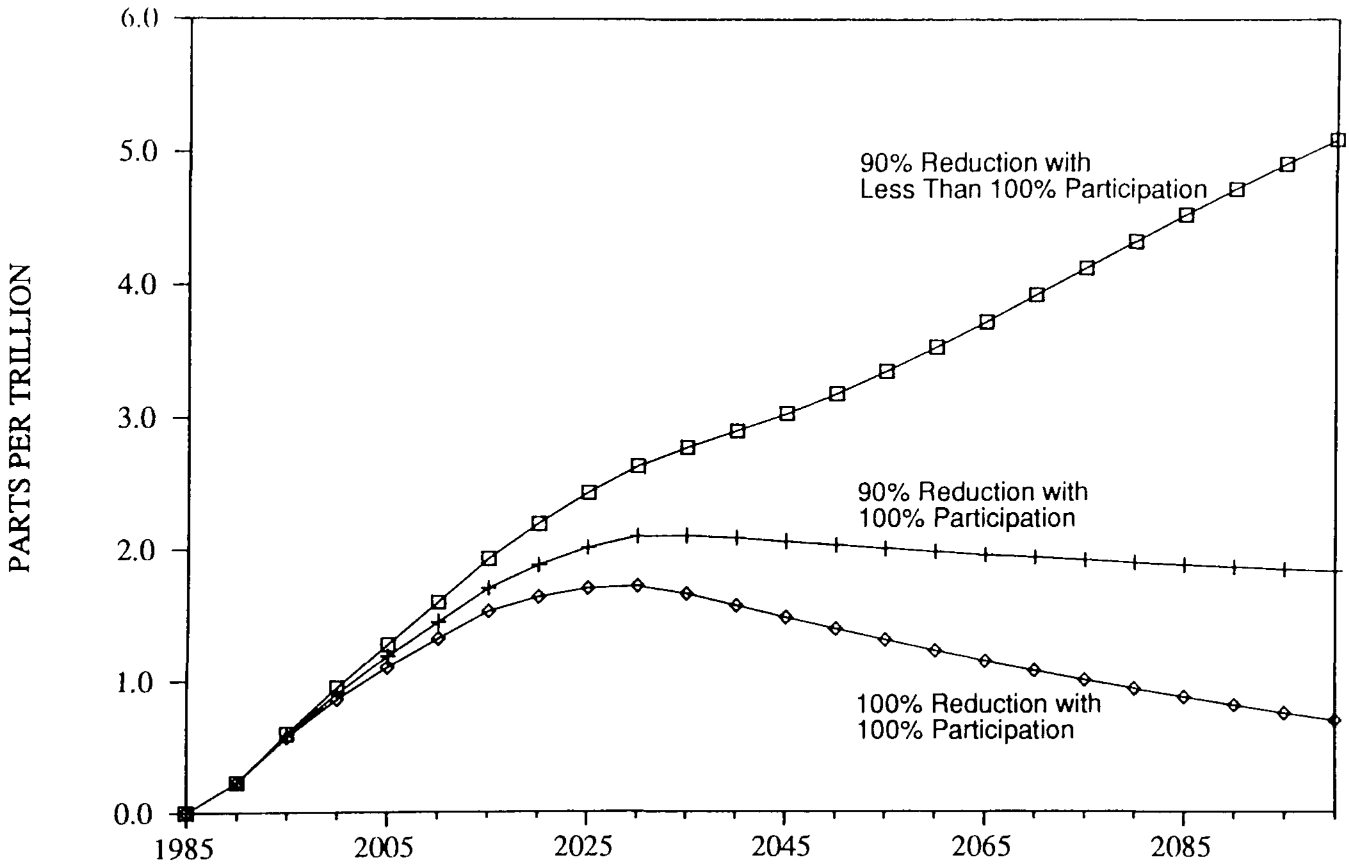
SIMULATED INCREASES IN Clx ASSUMING POST-2050 GROWTH
AND ALTERNATIVE SUBSTITUTION ASSUMPTIONS:
100% REDUCTION WITH CH3CC13 FREEZE;
100% REDUCTION WITH CH3CC13 FREEZE AND 100% PARTICIPATION



Three lines are displayed for each of the two cases. The rates of substitution are 1:2 -- one kilogram of a substitute for each two kilograms of CFC-11 and CFC-12 foregone; and 1:5 -- one kilogram of a substitute for each five kilograms of CFC-11 and CFC-12 foregone. The substitute is assumed to have the atmospheric characteristics of HCFC-22. Growth in use after 2050 is assumed to be 2.5 percent per year.

EXHIBIT 25

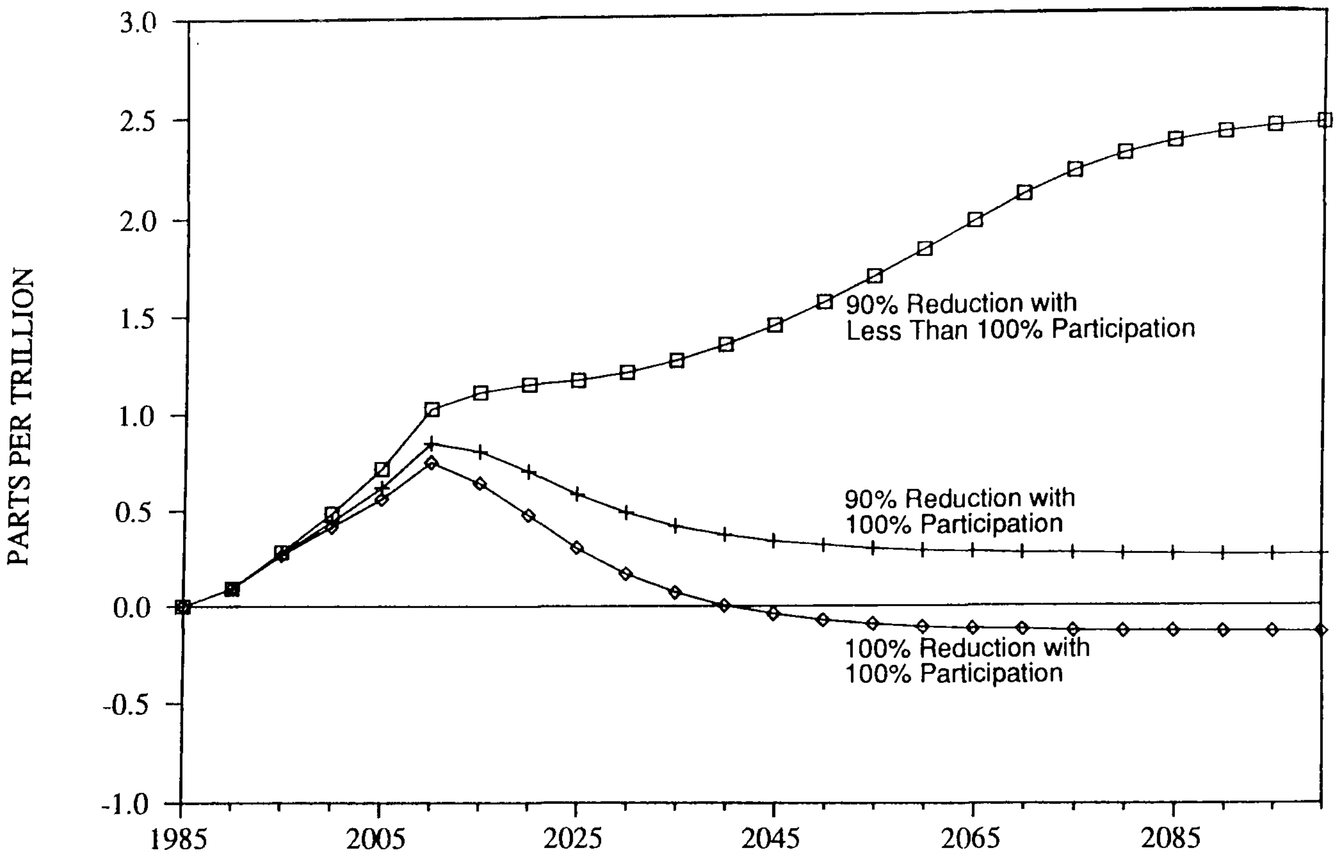
SIMULATED HALON 1301 ABUNDANCES:
90% REDUCTION; 90% REDUCTION AND 100% PARTICIPATION;
100% REDUCTION AND 100% PARTICIPATION



Halon 1301 is assumed to be released slowly over 40 years after it is placed in fire extinguishing systems. Most of the emissions occur within the first 25 years after charging. Baseline compound use is assumed to be constant after 2050.

EXHIBIT 26

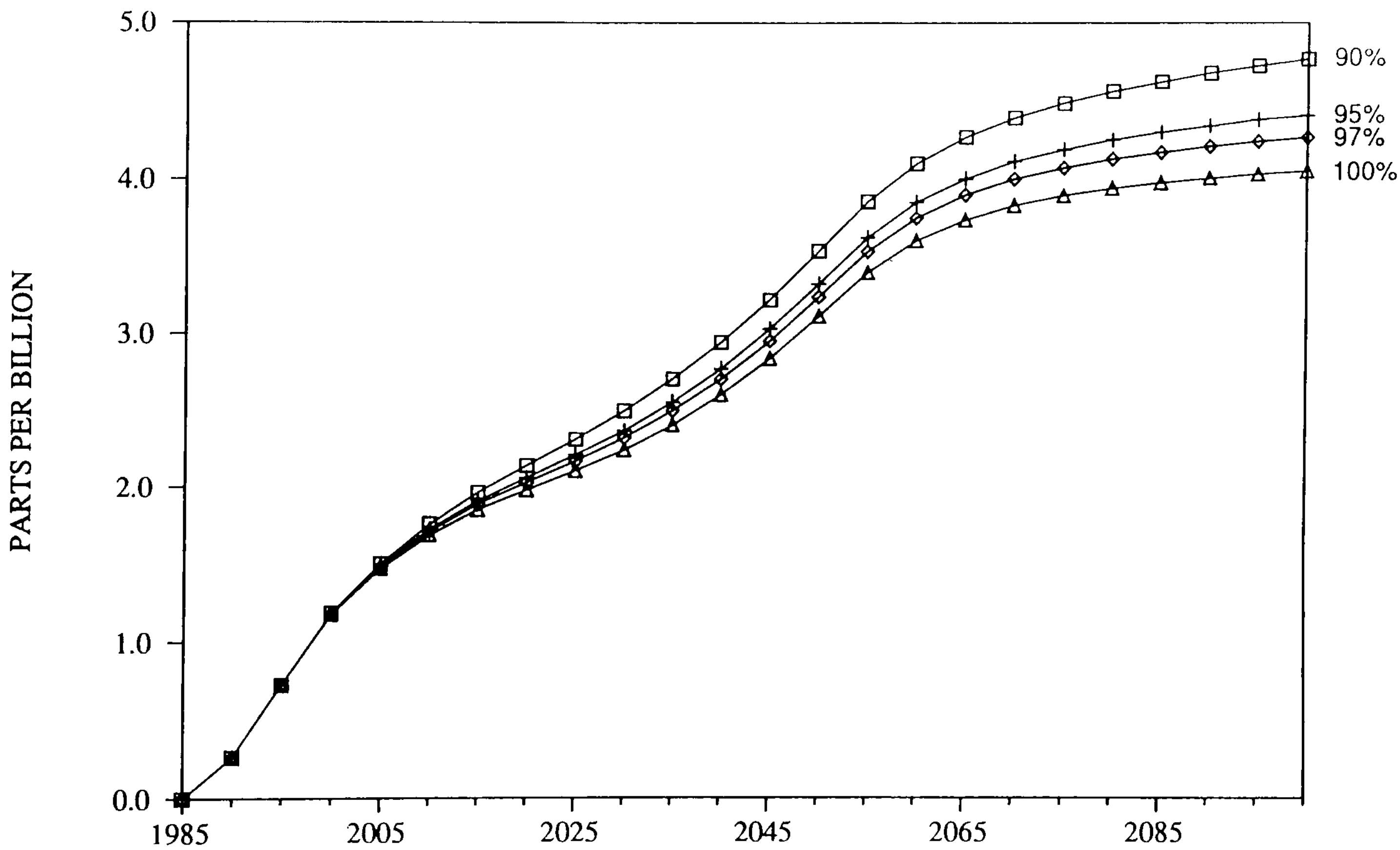
SIMULATED HALON 1211 ABUNDANCES:
90% REDUCTION; 90% REDUCTION AND 100% PARTICIPATION;
100% REDUCTION AND 100% PARTICIPATION



Halon 1211 is assumed to be released slowly over 30 years after it is placed in fire extinguishers. Most of the emissions occur within the first 20 years after charging. Baseline compound use is assumed to be constant after 2050.

EXHIBIT 27

SIMULATED INCREASES IN Clx FOR ALTERNATIVE STRINGENCY LEVELS:
90% REDUCTION; 95% REDUCTION; 97% REDUCTION; 100% REDUCTION

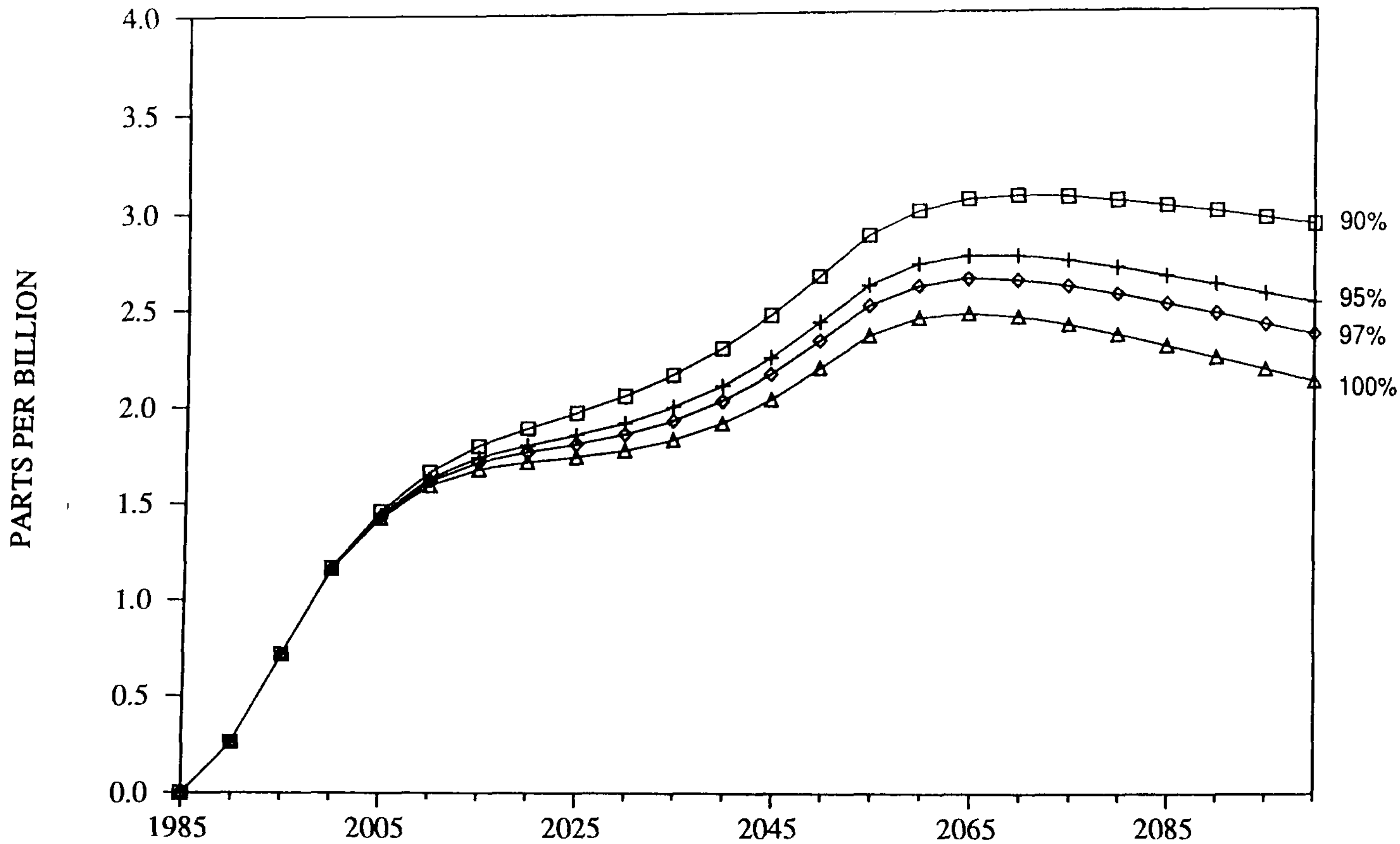


Assumption:

- Reductions simulated in place of the 50% Protocol Reduction.
- U.S. participation; 94% participation among other developed nations; 65% participation among developing nations.
- Baseline compound use is assumed to be constant after 2050.

EXHIBIT 28

SIMULATED INCREASES IN Clx FOR ALTERNATIVE STRINGENCY LEVELS
WITH 100% GLOBAL PARTICIPATION:
90% REDUCTION; 95% REDUCTION; 97% REDUCTION; 100% REDUCTION

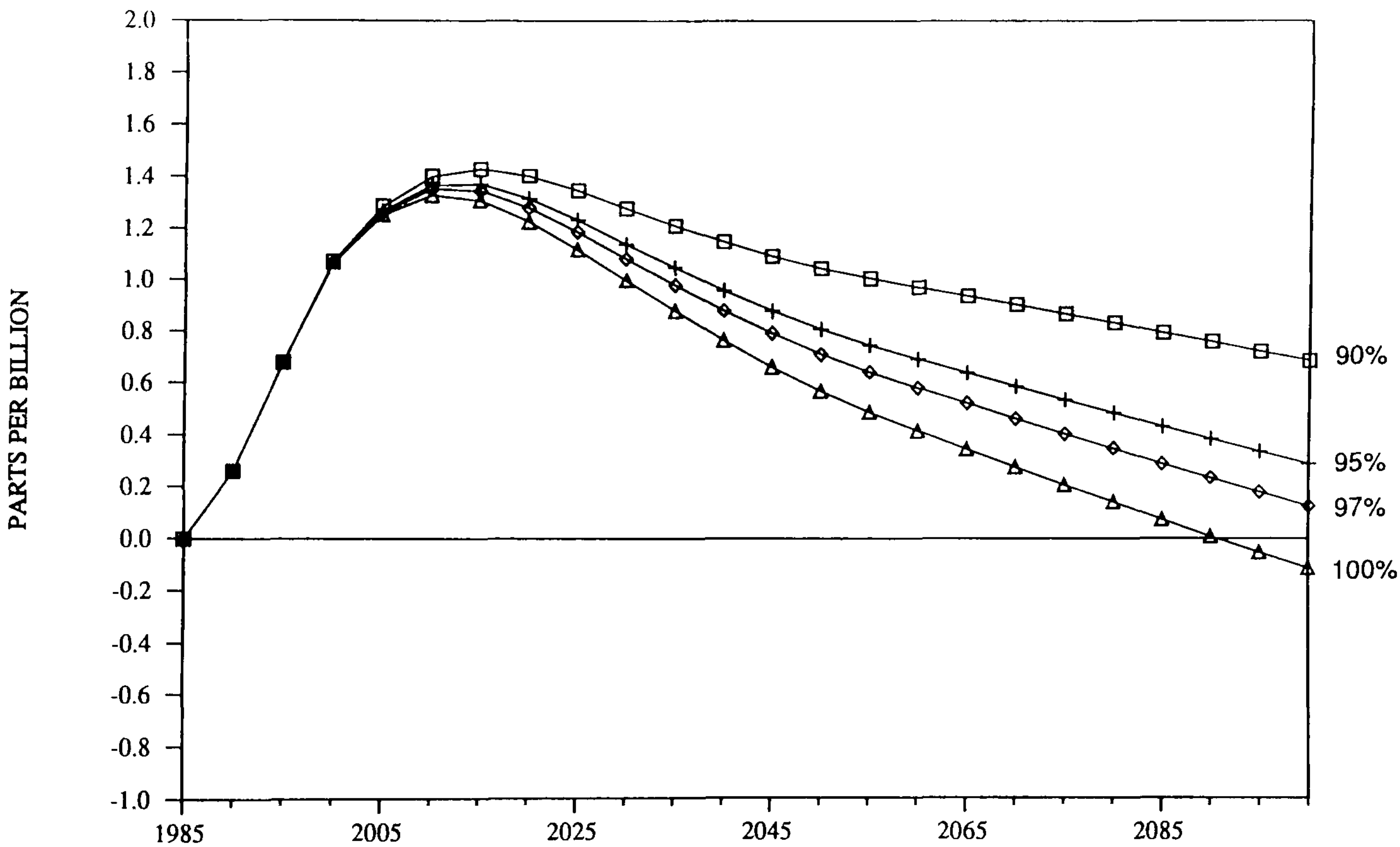


Assumptions:

- Reductions simulated in place of the 50% Protocol Reduction.
- 100% global participation.
- Baseline compound use is assumed to be constant after 2050.

EXHIBIT 29

SIMULATED INCREASES IN Clx FOR
ALTERNATIVE STRINGENCY LEVELS
WITH 100% PARTICIPATION AND A CH3CCl3 FREEZE:
90% REDUCTION; 95% REDUCTION; 97% REDUCTION; 100% REDUCTION

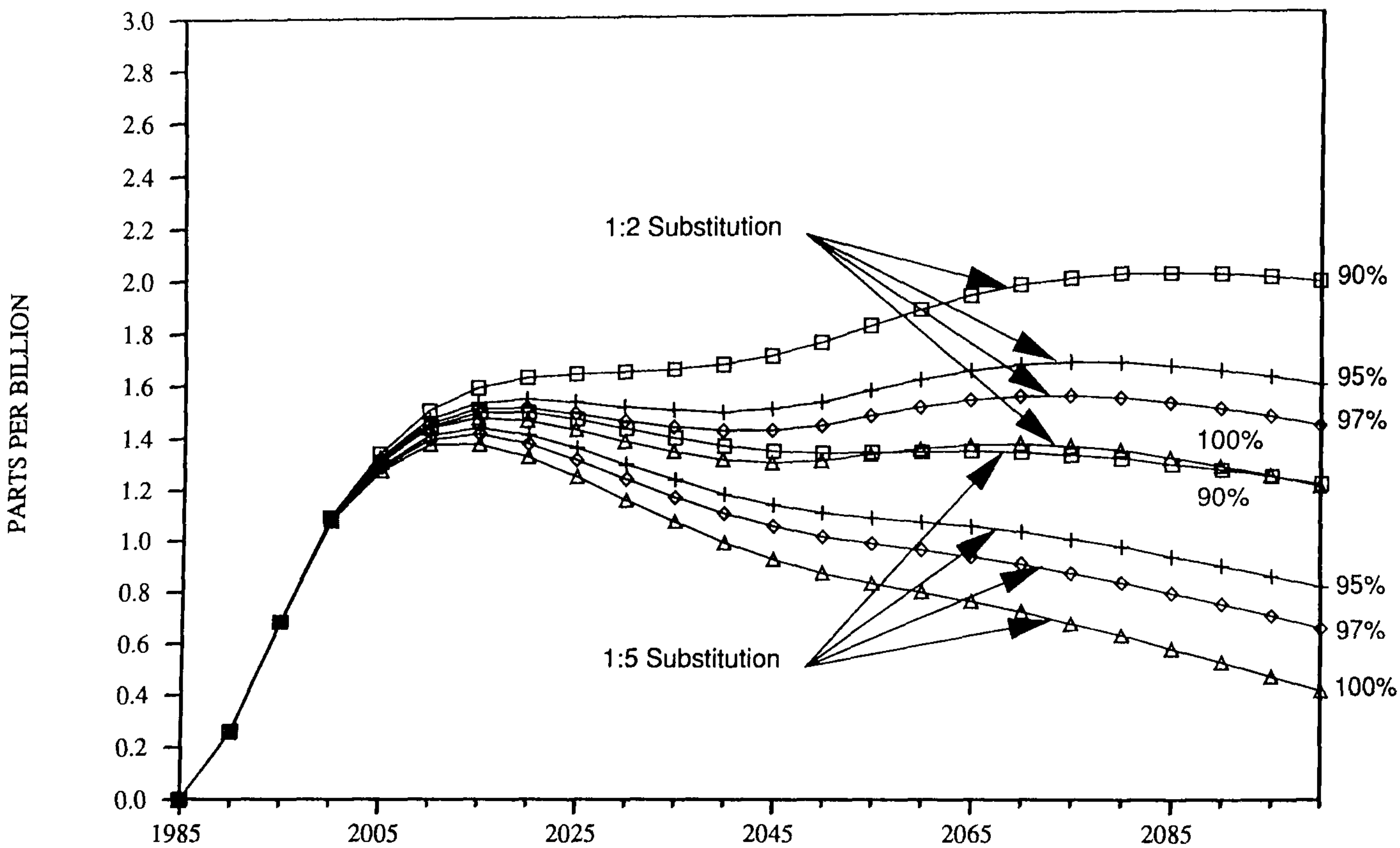


Assumptions:

- Reductions simulated in place of the 50% Protocol Reduction.
- 100% Global Participation.
- CH3CCl3 use frozen at 1986 levels in 1989.
- Baseline compound use is assumed to be constant after 2050.

EXHIBIT 30

SIMULATED INCREASES IN Clx FOR ALTERNATIVE STRINGENCY LEVELS AND SUBSTITUTION ASSUMPTIONS WITH 100% GLOBAL PARTICIPATION AND A CH3CCl3 FREEZE:
90% REDUCTION; 95% REDUCTION; 97% REDUCTION; 100% REDUCTION

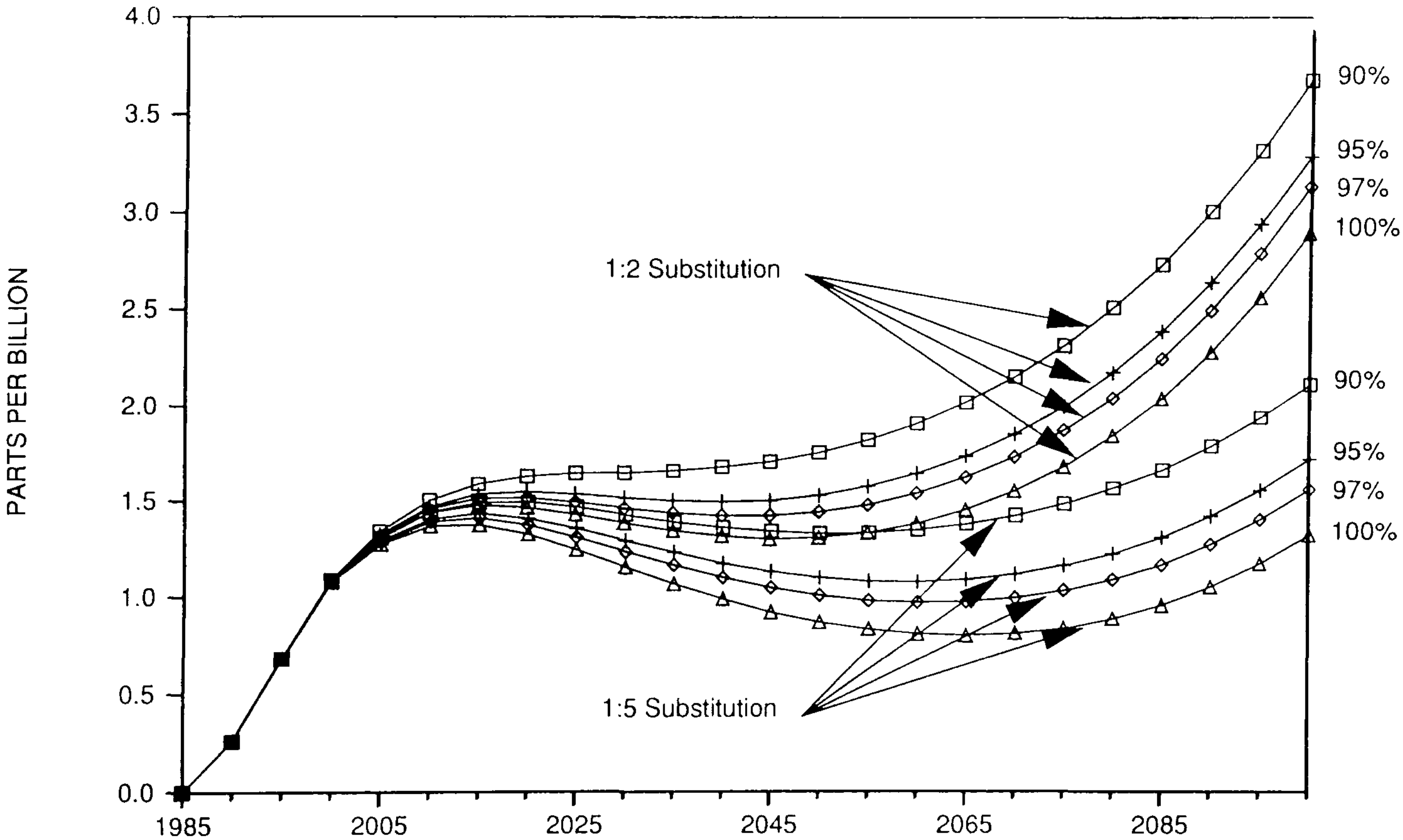


Assumptions:

- Reductions simulated in place of the 50% Protocol Reduction.
- 100% Global Participation.
- CH3CCl3 freeze at 1986 levels in 1989.
- Substitute assumed to have the atmospheric characteristics of HCFC-22.
- Baseline compound use is assumed to be constant after 2050.

EXHIBIT 31

SIMULATED INCREASES IN Clx FOR ALTERNATIVE STRINGENCY LEVELS AND SUBSTITUTION ASSUMPTIONS WITH 100% GLOBAL PARTICIPATION,
A CH3CCl3 FREEZE, AND POST-2050 GROWTH:
90% REDUCTION; 95% REDUCTION; 97% REDUCTION; 100% REDUCTION

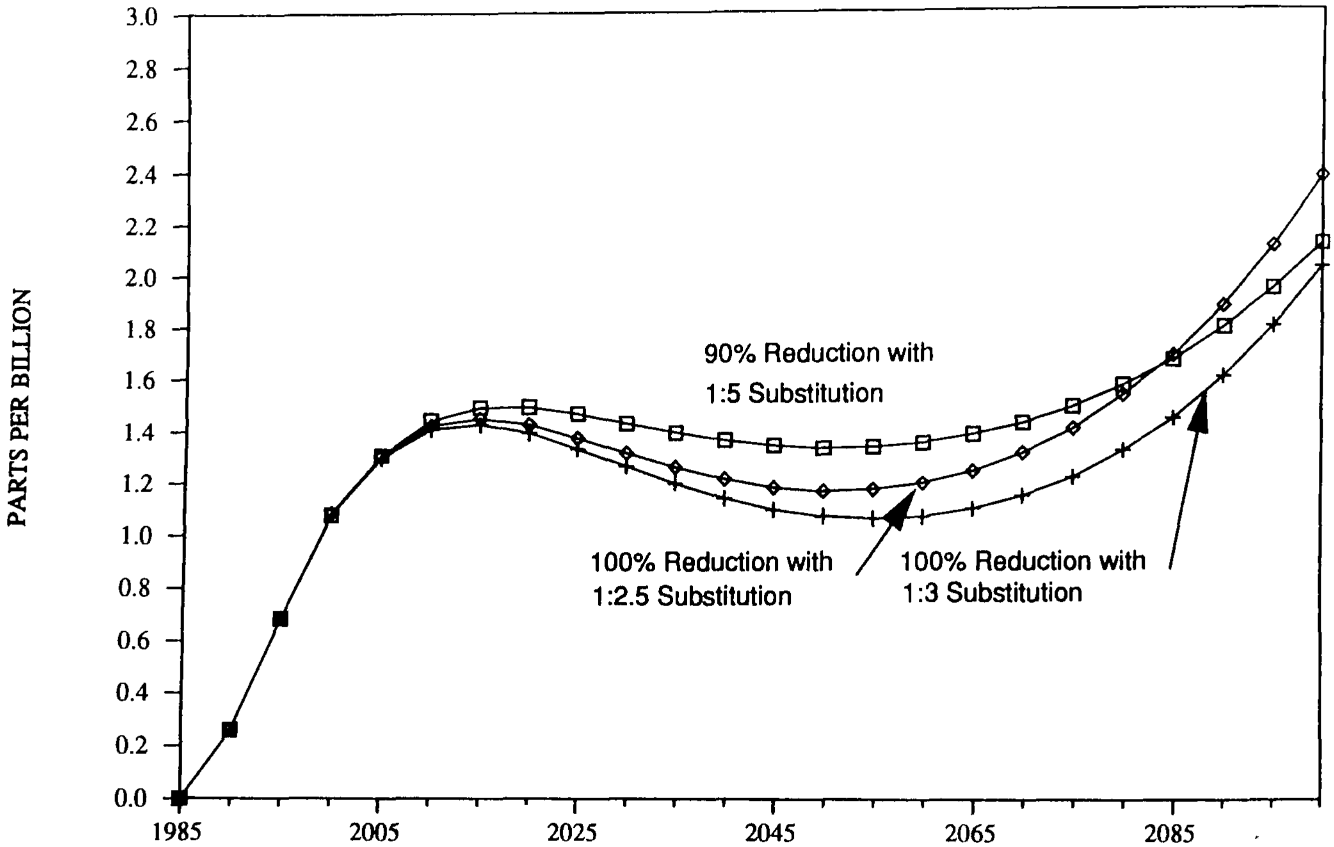


Assumptions:

- o Reductions simulated in place of the 50% Protocol Reduction.
- o 100% global participation.
- o CH3CCl3 freeze at 1986 levels in 1989.
- o Substitute assumed to have the atmospheric characteristics of HCFC-22.
- o Baseline compound use continues to grow at 2.5% per year after 2050.

EXHIBIT 32

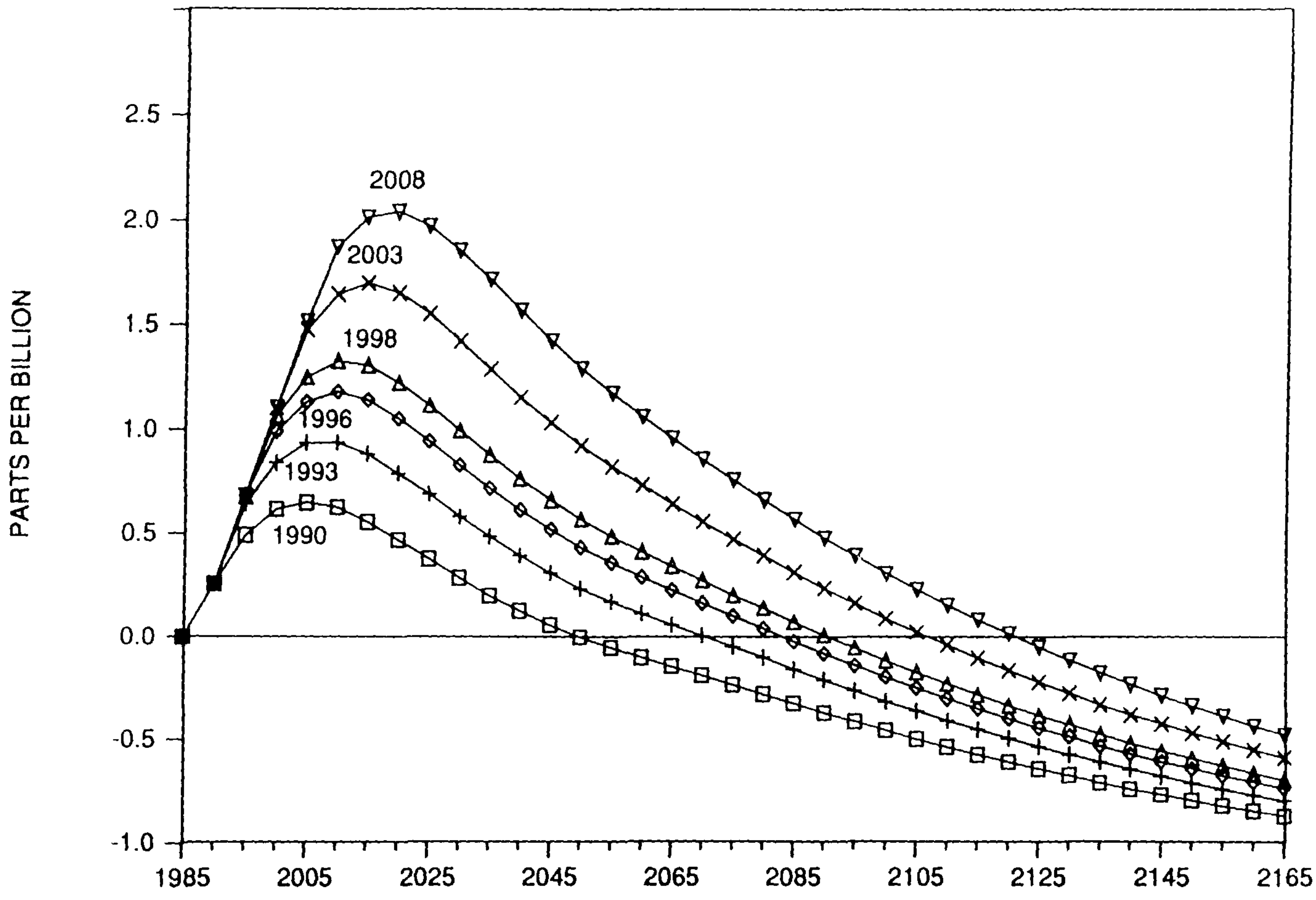
SIMULATED INCREASE IN Clx: THE TRADEOFF BETWEEN PHASEOUT STRINGENCY AND PARTIALLY-HALOGENATED COMPOUND SUBSTITUTION



A 90% reduction with 100% participation, CH_3CCl_3 freeze, Post-2050 growth, and 1:5 substitution yields approximately the same chlorine increases as a 100% reduction with 1:3 or 1:2.5 substitution.

EXHIBIT 33

SIMULATED INCREASES IN Clx FOR ALTERNATIVE PHASE-OUT TIMING ASSUMPTIONS: 1990; 1993; 1996; 1998; 2003; AND 2008



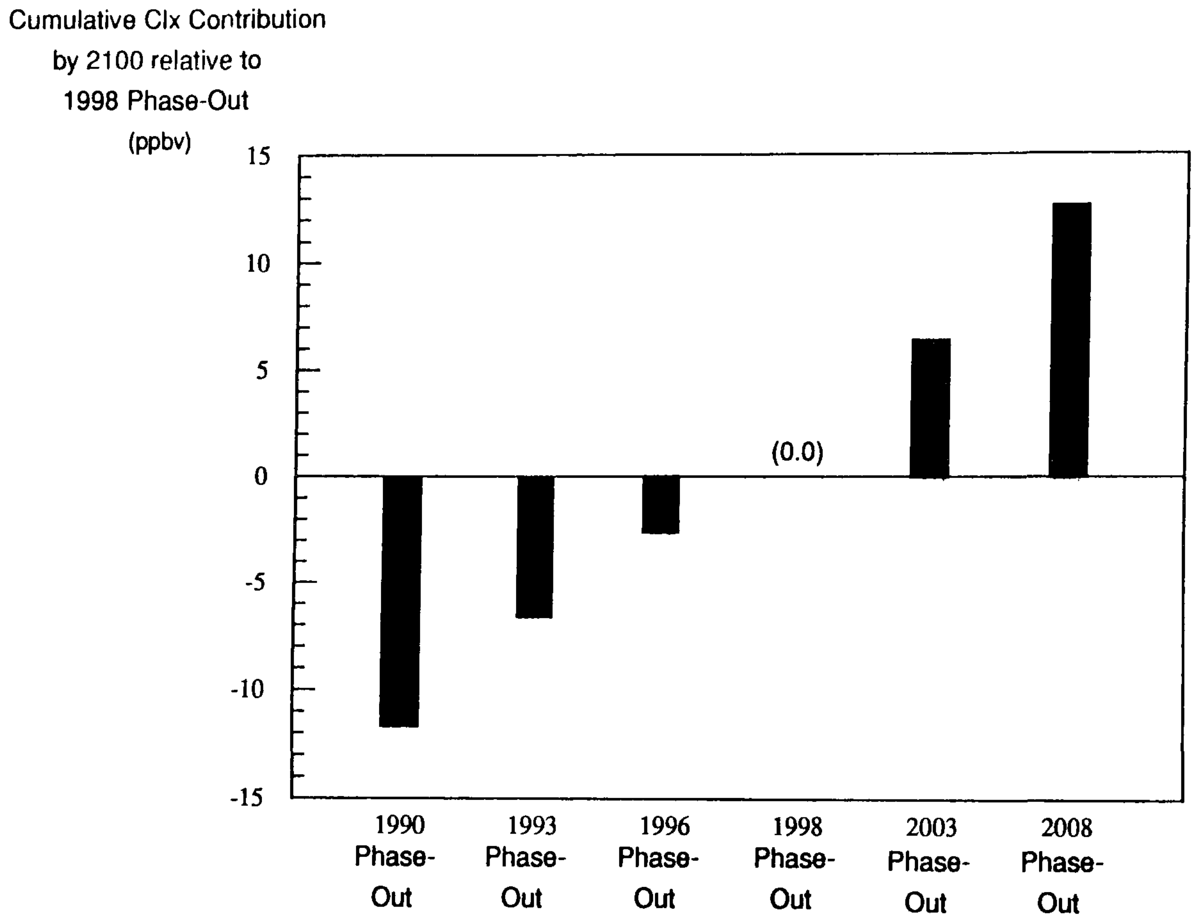
Assumptions:

- o 100% reduction in CFCs.
- o 100% global participation.
- o CH3CCl3 freeze in 1989 at 1986 levels.
- o Baseline compound use is assumed to be constant after 2050.

EXHIBIT 34

CUMULATIVE CHLORINE CONTRIBUTION BY 2100
FOR ALTERNATIVE PHASE-OUT TIMES

(Values are differences from the 1998 timing value which is set to 0.)



Assumptions:

- 100% reduction in CFCs.
- 100% global participation
- CH3CCl3 freeze in 1989 at 1986 levels.
- Baseline compound use is assumed to be constant after 2050.

REFERENCES

Connell (1986), "A Parameterized Numerical Fit to Total Column Ozone Changes Calculated by the LLNL 1-D Model of the Troposphere and Stratosphere," Lawrence Livermore National Laboratory, Livermore, California.

Connell and Wuebbles (1986), Ozone Puturbations in the LLNL One-Dimensional Model - Calculated Effects of Projected Trends in CFC's, CH4, CO2, N2O and Halons Over 90 Years, Lawrence Livermore National Laboratory, Livermore California.

EPA (1987), Assessing the Risks of Trace Gases That Can Modify the Stratosphere, Washington, D.C., EPA 400/1-87/001.

EPA (1988), Regulatory Impact Analysis: Protection of Stratospheric Ozone, Washington, D.C.

ITC (1988), "Synthetic Organic Chemicals," ITC, Washington, D.C.

UNEP (1987), "Ad Hoc Scientific Meeting to Compare Model-Generated Assessments of Ozone Layer Change for Various Strategies for CFC Control," April 1987.

WMO (1986), Atmospheric Ozone 1985, NASA, Washington, D.C.

APPENDIX A

APPENDIX A

CONCENTRATIONS MODEL

This appendix presents the concentrations model used to evaluate the potential increases in stratospheric inorganic chlorine levels, Clx. The method is taken from Connell (1986) and is based on a simplified representation of the exponential decay of abundances of each compound. The rate of decay is defined by an estimate of each compound's lifetime.

Of note is that the method recognizes that each of the compounds has slightly different "efficiencies" with which its chlorine can perturb stratospheric ozone. The greater a compound's efficiency, the larger the impact its chlorine will have on stratospheric ozone. For example, HCFC-22 dissociates (and consequently injects its chlorine) at a different altitude than does CFC-11. Therefore, its chlorine is less efficient at depleting stratospheric ozone. The estimates of chlorine abundances produced by this method adjust for these relative efficiencies so that the total change in chlorine abundances summed across the compounds is a consistent measure of the potential impact on stratospheric ozone.

The estimates of changes in Clx from 1985 levels are driven by the following data:

- <u>Emissions</u>: the emissions for each of the scenarios examined are presented in Appendix B.

- <u>Lifetimes</u>: the "e-folding" lifetimes of each of the compounds is presented in Exhibit 1 of the main text. These lifetimes (taken from Connell, 1986) were evaluated from a series of 1-D model runs with total column ozone depletions of around 10 percent (Connell 1986, p.5). Lower levels of depletion would result in higher estimates of the lifetimes, and consequently higher estimates of Clx. This downward bias in the estimates of Clx exists for the Protocol scenario examined in the main text, and the scenarios in which Clx is stabilized.

- <u>Conversion Factors</u>: the factors that convert emissions (in millions of kilograms) into abundances of Clx are presented in Exhibit 1 of the main text. These conversion factors reflect the number of chlorine atoms per molecule, the molecular weight of the molecule, the relative efficiency of the compound's chlorine at depleting ozone, and a factor combining the column number density of the atmosphere, the surface area of the earth, and Avogadro's number (see Connell 1986, p.5). The values used to compute the conversion factors are shown in Exhibit A-1. As shown in the exhibit, the relative efficiencies for the compounds vary from 0.288 for CFC-115 to 1.20 for CCl_4.

- <u>Mixing time</u>: the time constant for mixing a surface-released tracer completely in the atmosphere and stratosphere is estimated at 3.5 years.

- <u>Clx from Historical Emissions</u>: the algorithm estimates <u>changes</u> in Clx from levels in 1985. The contribution of historical emissions to these changes was estimated by Connell (1986) and is presented in Exhibit A-2. As shown in the exhibit, the contribution is initially positive, reflecting the mixing in of emissions prior to 1985. Over the long term the contribution becomes negative, reflecting the decay of the atmospheric abundance associated with emissions prior to 1985.

Given these values, the contribution of each compound to changes in Clx in year t relative to 1985 levels is computed as:

$$Clx(t,j) = CF(j) * \sum_{i=1}^{t} emissions(j) * e^{-(t-i)/L(j)} * (1-e^{(t-i)/MT})$$

where:

$Clx(t,j)$ = the change in Clx in year t (relative to 1985) associated with emissions of compound j;

$CF(j)$ = conversion factor for compound j;

$L(j)$ = atmospheric lifetime of compound j;

MT = mixing time.

To compute the total change in Clx in year t, the contributions from each of the compounds is summed, and added to the change in Clx associated with pre-1985 emissions.

This general method is also used for computing halon abundances. However, the halon abundances are of the entire molecules, and are not adjusted for the number of bromine and/or chlorine atoms, or their relative efficiencies at perturbing stratospheric ozone. Also, the contributions of historical halon emissions to future changes in abundances from 1985 are assumed to be zero.

EXHIBIT A-1

CONVERSION FACTOR COMPUTATION DATA

Compound	#Cl/Molecule[a]	Molecular Weight	Relative Efficiency	Conversion Factor[b]
CFC-11	3	137.4	1.14	1.363×10^{-4}
CFC-12	2	120.9	0.84	0.761×10^{-4}
CFC-22	1	86.5	0.45	0.285×10^{-4}
CFC-113	3	187.4	1.078	0.945×10^{-4}
CFC-114	2	170.9	0.58	0.372×10^{-4}
CFC-115	1	154.5	0.288	0.102×10^{-4}
CFCl4	4	153.8	1.20	1.709×10^{-4}
CH3CCl3	3	133.4	1.19	1.466×10^{-4}

a/ #Cl/Molecule = number of chlorine atoms per molecule.

b/ For each compound, the conversion factor is computed as: 5.477×10^{-3} * (#Cl/Molecule) / Molecular Weight * Relative Efficiency.

Source: Connell (1986)

EXHIBIT A-2

CONTRIBUTION OF PRE-1985 EMISSIONS TO POST-1985 CHANGES IN Clx

Year	Change in Clx (ppbv)
1985	0.000
1990	0.045
1995	-0.079
2000	-0.206
2005	-0.316
2015	-0.495
2020	-0.571
2025	-0.641
2030	-0.706
2035	-0.767
2040	-0.823
2045	-0.876
2050	-0.926
2055	-0.973
2060	-1.017
2065	-1.059
2070	-1.098
2075	-1.135

Source: Connell (1986).

APPENDIX B

APPENDIX B

EMISSIONS SCENARIOS

This appendix presents the global emissions of potential ozone depleting substances for the scenarios examined in the main text. All global emissions are presented in millions of kilograms. Exhibit B-1 shows the list of exhibits in this Appendix. The scenarios that consider the effects of a chemical substitute show an extra column to reflect these emissions. The chemical substitute is modeled using the atmospheric characteristics of HCFC-22. The scenarios discussed in Section 5 maintain the Protocol structure which is indicated in the exhibit titles. All exhibits reference the relevant sections in the main text. These emissions scenarios are similar to the scenarios analyzed in EPA (1988). Note that the scenarios examined in Section 5 (Exhibits B-37 to B-72) do not reflect controls on the halon compounds.

EXHIBIT B-1

LIST OF EXHIBITS IN APPENDIX B

EXHIBIT B-1 (Continued)

LIST OF EXHIBITS IN APPENDIX B

EXHIBIT B-1 (Continued)

LIST OF EXHIBITS IN APPENDIX B

EXHIBIT B-1 (Continued)

LIST OF EXHIBITS IN APPENDIX B

EXHIBIT B-1 (Continued)

LIST OF EXHIBITS IN APPENDIX B

EXHIBIT B-2

No Controls

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCl4	CH3CCl3	H-1211	H-1301
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1
1990	401.1	481.7	122.2	241.9	17.5	7.9	118.7	738.1	3.3	3.8
1995	491.6	603.7	165.4	304.5	21.3	9.3	140.3	866.4	6.2	5.0
2000	586.7	742.5	206.1	371.9	24.4	11.5	162.0	992.9	9.9	5.8
2005	689.0	879.6	245.4	420.7	27.7	13.5	183.3	1123.4	14.8	6.9
2010	787.6	1004.0	280.3	476.0	31.3	15.4	207.4	1271.0	19.7	8.4
2015	893.0	1139.7	317.8	538.6	35.4	17.5	234.6	1438.1	24.2	9.9
2020	1011.0	1290.6	359.7	609.3	40.1	19.8	265.5	1627.0	29.0	11.3
2025	1143.8	1460.2	407.0	689.4	45.4	22.4	300.3	1840.9	33.6	13.1
2030	1294.1	1652.0	460.4	780.0	51.3	25.3	339.8	2082.8	38.9	15.1
2035	1464.2	1869.1	520.9	882.5	58.1	28.6	384.5	2356.5	45.0	17.3
2040	1656.6	2114.7	589.4	998.4	65.7	32.4	435.0	2666.1	52.0	20.1
2045	1874.3	2392.6	666.9	1129.6	74.3	36.7	492.1	3016.5	60.2	23.4
2050	2120.6	2707.0	754.5	1278.1	84.1	41.5	556.8	3412.9	69.6	27.4
2055	2193.7	2810.5	815.1	1278.1	85.2	44.8	556.8	3412.9	78.7	30.5
2060	2252.3	2862.0	852.2	1278.1	85.2	46.9	556.8	3412.9	86.7	33.1
2065	2300.8	2905.3	875.5	1278.1	85.2	48.2	556.8	3412.9	93.9	35.3
2070	2332.4	2919.9	879.1	1278.1	85.2	48.3	556.8	3412.9	99.4	37.3
2075	2332.4	2919.9	879.1	1278.1	85.2	48.3	556.8	3412.9	100.2	38.8
2080	2332.4	2919.9	879.1	1278.1	85.2	48.3	556.8	3412.9	100.8	39.6
2085	2332.4	2919.9	879.1	1278.1	85.2	48.3	556.8	3412.9	100.8	40.3
2090	2332.4	2919.9	879.1	1278.1	85.2	48.3	556.8	3412.9	100.8	40.5
2095	2332.4	2919.9	879.1	1278.1	85.2	48.3	556.8	3412.9	100.8	40.5
2100	2332.4	2919.9	879.1	1278.1	85.2	48.3	556.8	3412.9	100.8	40.5

EXHIBIT B-3

Protocol

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCl4	CH3CCl3	H-1211	H-1301
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1
1990	364.3	440.8	122.2	202.5	15.7	6.9	104.6	738.1	3.3	3.8
1995	359.5	429.5	165.4	184.6	13.9	7.3	94.0	866.4	5.6	4.4
2000	321.5	392.8	206.1	140.6	10.6	7.0	73.1	992.9	8.3	4.8
2005	330.3	390.4	245.4	138.2	9.8	6.4	70.6	1123.4	11.7	5.3
2010	309.9	367.9	280.3	134.0	9.4	5.7	66.5	1271.0	14.7	6.0
2015	298.5	356.8	317.8	135.5	9.4	5.2	67.6	1438.1	15.2	6.4
2020	287.4	355.8	359.7	137.1	9.5	5.1	68.8	1627.0	16.4	6.4
2025	290.0	358.3	407.0	138.8	9.7	5.1	70.1	1840.9	16.5	6.6
2030	293.1	364.1	460.4	140.6	9.8	5.2	71.4	2082.8	16.9	6.6
2035	298.9	371.2	520.9	142.5	10.0	5.3	72.8	2356.5	17.2	6.5
2040	305.0	378.7	589.4	144.4	10.2	5.3	74.3	2666.1	17.6	6.6
2045	311.5	386.7	666.9	146.5	10.4	5.4	75.9	3016.5	18.0	6.8
2050	318.3	395.2	754.5	148.8	10.6	5.5	77.6	3412.9	18.5	7.0
2055	320.1	397.8	815.1	148.8	10.6	5.5	77.6	3412.9	18.9	7.2
2060	321.4	399.5	852.2	148.8	10.6	5.6	77.6	3412.9	19.3	7.3
2065	322.5	400.8	875.5	148.8	10.6	5.6	77.6	3412.9	19.6	7.4
2070	323.2	401.2	879.1	148.8	10.6	5.6	77.6	3412.9	19.9	7.5
2075	323.2	401.2	879.1	148.8	10.6	5.6	77.6	3412.9	19.9	7.6
2080	323.2	401.2	879.1	148.8	10.6	5.6	77.6	3412.9	19.9	7.6
2085	323.2	401.2	879.1	148.8	10.6	5.6	77.6	3412.9	19.9	7.6
2090	323.2	401.2	879.1	148.8	10.6	5.6	77.6	3412.9	19.9	7.6
2095	323.2	401.2	879.1	148.8	10.6	5.6	77.6	3412.9	19.9	7.6
2100	323.2	401.2	879.1	148.8	10.6	5.6	77.6	3412.9	19.9	7.6

EXHIBIT B-4

True Global Freeze

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCl4	CH3CCl3	H-1211	H-1301
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1
1990	348.7	415.3	116.2	180.3	15.2	7.1	96.6	606.6	3.1	3.5
1995	373.7	424.3	137.6	180.3	14.4	8.1	96.6	606.6	4.6	4.5
2000	399.7	460.4	152.6	180.3	14.4	9.0	96.6	606.6	6.4	5.4
2005	426.5	495.7	163.0	180.3	14.4	9.5	96.6	606.6	8.9	6.3
2010	424.9	488.4	159.1	180.3	14.4	9.9	96.6	606.6	9.1	7.2
2015	424.7	488.7	159.1	180.3	14.4	9.9	96.6	606.6	9.3	7.6
2020	424.6	488.7	159.1	180.3	14.4	9.9	96.6	606.6	9.3	8.0
2025	424.6	488.7	159.1	180.3	14.4	9.9	96.6	606.6	9.3	8.4
2030	424.6	488.7	159.1	180.3	14.4	9.9	96.6	606.6	9.3	8.3
2035	424.6	488.7	159.1	180.3	14.4	9.9	96.6	606.6	9.3	8.3
2040	424.6	488.7	159.1	180.3	14.4	9.9	96.6	606.6	9.3	8.3
2045	424.6	488.7	159.1	180.3	14.4	9.9	96.6	606.6	9.3	8.3
2050	424.6	488.7	159.1	180.3	14.4	9.9	96.6	606.6	9.3	8.3
2055	424.6	488.7	159.1	180.3	14.4	9.9	96.6	606.6	9.3	8.3
2060	424.6	488.7	159.1	180.3	14.4	9.9	96.6	606.6	9.3	8.3
2065	424.6	488.7	159.1	180.3	14.4	9.9	96.6	606.6	9.3	8.3
2070	424.6	488.7	159.1	180.3	14.4	9.9	96.6	606.6	9.3	8.3
2075	424.6	488.7	159.1	180.3	14.4	9.9	96.6	606.6	9.3	8.3
2080	424.6	488.7	159.1	180.3	14.4	9.9	96.6	606.6	9.3	8.3
2085	424.6	488.7	159.1	180.3	14.4	9.9	96.6	606.6	9.3	8.3
2090	424.6	488.7	159.1	180.3	14.4	9.9	96.6	606.6	9.3	8.3
2095	424.6	488.7	159.1	180.3	14.4	9.9	96.6	606.6	9.3	8.3
2100	424.6	488.7	159.1	180.3	14.4	9.9	96.6	606.6	9.3	8.3

EXHIBIT B-5

Protocol with CH3CCl3 Freeze

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCl4	CH3CCl3	H-1211	H-1301
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1
1990	364.4	440.9	122.2	202.6	15.7	6.9	103.9	643.3	3.3	3.8
1995	359.6	429.9	165.4	184.8	13.9	7.3	93.1	667.8	5.6	4.4
2000	321.6	393.1	206.1	140.8	10.6	7.0	72.3	681.7	8.3	4.8
2005	330.4	390.8	245.4	138.4	9.8	6.4	69.9	688.1	11.7	5.3
2010	310.1	368.2	280.3	134.2	9.4	5.7	65.7	695.2	14.7	6.0
2015	298.7	357.1	317.8	135.7	9.4	5.2	66.9	702.8	15.2	6.4
2020	287.6	356.1	359.7	137.3	9.6	5.1	68.0	711.2	16.4	6.4
2025	290.2	358.6	407.0	139.0	9.7	5.1	69.3	720.3	16.5	6.6
2030	293.3	364.5	460.4	140.8	9.9	5.2	70.6	730.2	16.9	6.6
2035	299.1	371.5	520.9	142.7	10.0	5.3	72.1	741.1	17.2	6.5
2040	305.2	379.1	589.4	144.6	10.2	5.3	73.6	752.9	17.6	6.6
2045	311.7	387.0	666.9	146.7	10.4	5.4	75.2	765.8	18.0	6.8
2050	318.5	395.5	754.5	149.0	10.6	5.5	76.9	779.9	18.5	7.0
2055	320.3	398.2	815.1	149.0	10.6	5.6	76.9	779.9	18.9	7.2
2060	321.6	399.8	852.2	149.0	10.6	5.6	76.9	779.9	19.3	7.3
2065	322.7	401.1	875.5	149.0	10.6	5.6	76.9	779.9	19.6	7.4
2070	323.4	401.5	879.1	149.0	10.6	5.6	76.9	779.9	19.9	7.5
2075	323.4	401.5	879.1	149.0	10.6	5.6	76.9	779.9	19.9	7.6
2080	323.4	401.5	879.1	149.0	10.6	5.6	76.9	779.9	19.9	7.6
2085	323.4	401.5	879.1	149.0	10.6	5.6	76.9	779.9	19.9	7.6
2090	323.4	401.5	879.1	149.0	10.6	5.6	76.9	779.9	19.9	7.6
2095	323.4	401.5	879.1	149.0	10.6	5.6	76.9	779.9	19.9	7.6
2100	323.4	401.5	879.1	149.0	10.6	5.6	76.9	779.9	19.9	7.6

EXHIBIT B-6

Protocol: Participation Scenario B

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCl4	CH3CCl3	H-1211	H-1301
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1
1990	362.6	439.4	122.2	201.4	15.7	6.9	104.1	738.1	3.3	3.8
1995	353.1	423.3	165.4	180.7	13.7	7.2	92.1	866.4	5.6	4.3
2000	309.5	380.5	206.1	133.2	10.3	6.9	69.7	992.9	8.2	4.7
2005	316.6	375.8	245.4	130.2	9.4	6.3	67.0	1123.4	11.6	5.3
2010	294.4	350.9	280.3	125.5	8.9	5.5	62.6	1271.0	14.5	5.9
2015	281.0	337.6	317.8	126.4	8.9	5.0	63.5	1438.1	14.8	6.3
2020	268.1	335.1	359.7	127.4	9.0	4.9	64.4	1627.0	16.0	6.3
2025	269.3	336.2	407.0	128.4	9.2	4.9	65.4	1840.9	16.0	6.5
2030	271.1	340.6	460.4	129.6	9.3	4.9	66.4	2082.8	16.3	6.4
2035	275.5	346.2	520.9	130.7	9.4	5.0	67.5	2356.5	16.6	6.3
2040	280.1	352.1	589.4	132.0	9.5	5.1	68.7	2666.1	16.9	6.4
2045	285.0	358.4	666.9	133.3	9.7	5.1	69.9	3016.5	17.2	6.6
2050	290.3	365.1	754.5	134.8	9.8	5.2	71.2	3412.9	17.6	6.8
2055	291.6	367.2	815.1	134.8	9.8	5.2	71.2	3412.9	18.0	6.9
2060	292.6	368.5	852.2	134.8	9.8	5.2	71.2	3412.9	18.3	7.0
2065	293.4	369.5	875.5	134.8	9.8	5.3	71.2	3412.9	18.5	7.1
2070	293.9	369.9	879.1	134.8	9.8	5.3	71.2	3412.9	18.7	7.2
2075	293.9	369.9	879.1	134.8	9.8	5.3	71.2	3412.9	18.7	7.2
2080	293.9	369.9	879.1	134.8	9.8	5.3	71.2	3412.9	18.8	7.3
2085	293.9	369.9	879.1	134.8	9.8	5.3	71.2	3412.9	18.8	7.3
2090	293.9	369.9	879.1	134.8	9.8	5.3	71.2	3412.9	18.8	7.3
2095	293.9	369.9	879.1	134.8	9.8	5.3	71.2	3412.9	18.8	7.3
2100	293.9	369.9	879.1	134.8	9.8	5.3	71.2	3412.9	18.8	7.3

EXHIBIT B-7

Protocol: Participation Scenario C

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCl4	CH3CCl3	H-1211	H-1301
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1
1990	362.6	439.4	122.2	201.4	15.7	6.9	104.1	738.1	3.3	3.8
1995	352.3	422.3	165.4	180.4	13.7	7.2	91.8	866.4	5.6	4.3
2000	305.3	375.3	206.1	131.6	10.1	6.9	68.3	992.9	8.2	4.7
2005	307.5	364.4	245.4	127.1	9.1	6.2	64.1	1123.4	11.5	5.2
2010	278.3	330.9	280.3	120.1	8.4	5.4	57.7	1271.0	14.4	5.8
2015	262.2	313.0	317.8	120.5	8.3	4.7	58.0	1438.1	14.6	6.2
2020	246.4	306.7	359.7	121.0	8.4	4.7	58.4	1627.0	15.7	6.2
2025	244.7	303.8	407.0	121.4	8.4	4.6	58.8	1840.9	15.5	6.4
2030	243.4	304.9	460.4	121.9	8.5	4.6	59.3	2082.8	15.6	6.2
2035	245.2	307.3	520.9	122.4	8.5	4.6	59.7	2356.5	15.7	6.1
2040	247.2	309.9	589.4	122.9	8.6	4.7	60.2	2666.1	15.8	6.1
2045	249.3	312.6	666.9	123.5	8.6	4.7	60.8	3016.5	15.9	6.2
2050	251.6	315.4	754.5	124.1	8.7	4.7	61.3	3412.9	16.1	6.3
2055	252.2	316.3	815.1	124.1	8.7	4.7	61.3	3412.9	16.2	6.4
2060	252.6	316.9	852.2	124.1	8.7	4.7	61.3	3412.9	16.3	6.5
2065	253.0	317.3	875.5	124.1	8.7	4.8	61.3	3412.9	16.4	6.5
2070	253.2	317.5	879.1	124.1	8.7	4.8	61.3	3412.9	16.5	6.6
2075	253.2	317.5	879.1	124.1	8.7	4.8	61.3	3412.9	16.5	6.6
2080	253.2	317.5	879.1	124.1	8.7	4.8	61.3	3412.9	16.5	6.6
2085	253.2	317.5	879.1	124.1	8.7	4.8	61.3	3412.9	16.5	6.6
2090	253.2	317.5	879.1	124.1	8.7	4.8	61.3	3412.9	16.5	6.6
2095	253.2	317.5	879.1	124.1	8.7	4.8	61.3	3412.9	16.5	6.6
2100	253.2	317.5	879.1	124.1	8.7	4.8	61.3	3412.9	16.5	6.6

EXHIBIT B-8

Protocol: Participation Scenario D

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCl4	CH3CCl3	H-1211	H-1301
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1
1990	362.6	439.4	122.2	201.4	15.7	6.9	104.1	738.1	3.3	3.8
1995	351.7	421.5	165.4	180.2	13.7	7.2	91.6	866.4	5.6	4.3
2000	302.1	371.4	206.1	130.5	10.0	6.9	67.2	992.9	8.1	4.7
2005	300.6	355.8	245.4	124.7	8.9	6.2	61.9	1123.4	11.5	5.2
2010	266.3	315.8	280.3	116.1	8.0	5.3	53.9	1271.0	14.3	5.8
2015	248.1	294.6	317.8	116.1	7.9	4.6	53.9	1438.1	14.4	6.2
2020	230.1	285.4	359.7	116.1	7.9	4.5	53.9	1627.0	15.4	6.1
2025	226.2	279.4	407.0	116.1	7.9	4.4	53.9	1840.9	15.1	6.3
2030	222.6	278.2	460.4	116.1	7.9	4.4	53.9	2082.8	15.1	6.1
2035	222.6	278.2	520.9	116.1	7.9	4.4	53.9	2356.5	15.1	5.9
2040	222.6	278.2	589.4	116.1	7.9	4.4	53.9	2666.1	15.0	5.9
2045	222.6	278.2	666.9	116.1	7.9	4.4	53.9	3016.5	15.0	5.9
2050	222.6	278.2	754.5	116.1	7.9	4.4	53.9	3412.9	14.9	6.0
2055	222.6	278.2	815.1	116.1	7.9	4.4	53.9	3412.9	14.9	6.0
2060	222.6	278.2	852.2	116.1	7.9	4.4	53.9	3412.9	14.8	6.1
2065	222.6	278.2	875.5	116.1	7.9	4.4	53.9	3412.9	14.8	6.1
2070	222.6	278.2	879.1	116.1	7.9	4.4	53.9	3412.9	14.8	6.1
2075	222.6	278.2	879.1	116.1	7.9	4.4	53.9	3412.9	14.8	6.1
2080	222.6	278.2	879.1	116.1	7.9	4.4	53.9	3412.9	14.7	6.1
2085	222.6	278.2	879.1	116.1	7.9	4.4	53.9	3412.9	14.7	6.1
2090	222.6	278.2	879.1	116.1	7.9	4.4	53.9	3412.9	14.7	6.1
2095	222.6	278.2	879.1	116.1	7.9	4.4	53.9	3412.9	14.7	6.1
2100	222.6	278.2	879.1	116.1	7.9	4.4	53.9	3412.9	14.7	6.1

EXHIBIT B-9

Protocol: Participation Scenario D'

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCl4	CH3CCl3	H-1211	H-1301
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1
1990	362.7	439.5	122.2	201.6	15.7	6.9	103.4	641.3	3.3	3.8
1995	351.8	421.8	165.4	180.5	13.7	7.2	90.7	660.9	5.6	4.3
2000	302.2	371.7	206.1	130.7	10.0	6.9	66.4	664.0	8.1	4.7
2005	300.8	356.2	245.4	124.9	8.9	6.2	61.1	664.0	11.5	5.2
2010	266.5	316.2	280.3	116.3	8.0	5.3	53.1	664.0	14.3	5.8
2015	248.3	294.9	317.8	116.3	7.9	4.6	53.1	664.0	14.4	6.2
2020	230.3	285.7	359.7	116.3	7.9	4.5	53.1	664.0	15.4	6.1
2025	226.3	279.8	407.0	116.3	7.9	4.4	53.1	664.0	15.1	6.3
2030	222.8	278.5	460.4	116.3	7.9	4.4	53.1	664.0	15.1	6.1
2035	222.8	278.5	520.9	116.3	7.9	4.4	53.1	664.0	15.1	5.9
2040	222.8	278.5	589.4	116.3	7.9	4.4	53.1	664.0	15.0	5.9
2045	222.8	278.5	666.9	116.3	7.9	4.4	53.1	664.0	15.0	5.9
2050	222.8	278.5	754.5	116.3	7.9	4.4	53.2	664.0	14.9	6.0
2055	222.8	278.5	815.1	116.3	7.9	4.4	53.2	664.0	14.9	6.0
2060	222.8	278.5	852.2	116.3	7.9	4.4	53.2	664.0	14.8	6.1
2065	222.8	278.5	875.5	116.3	7.9	4.4	53.2	664.0	14.8	6.1
2070	222.8	278.5	879.1	116.3	7.9	4.4	53.2	664.0	14.8	6.1
2075	222.8	278.5	879.1	116.3	7.9	4.4	53.2	664.0	14.8	6.1
2080	222.8	278.5	879.1	116.3	7.9	4.4	53.2	664.0	14.7	6.1
2085	222.8	278.5	879.1	116.3	7.9	4.4	53.2	664.0	14.7	6.1
2090	222.8	278.5	879.1	116.3	7.9	4.4	53.2	664.0	14.7	6.1
2095	222.8	278.5	879.1	116.3	7.9	4.4	53.2	664.0	14.7	6.1
2100	222.8	278.5	879.1	116.3	7.9	4.4	53.2	664.0	14.7	6.1

EXHIBIT B-10

Protocol: Participation Scenario E

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCl4	CH3CCl3	H-1211	H-1301
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1
1990	364.3	440.8	122.2	202.5	15.7	6.9	104.6	738.1	3.3	3.8
1995	360.5	430.8	165.4	184.9	14.0	7.3	94.4	866.4	5.6	4.4
2000	326.7	399.3	206.1	142.5	10.8	7.0	74.9	992.9	8.3	4.8
2005	341.7	404.7	245.4	142.1	10.2	6.5	74.3	1123.4	11.8	5.3
2010	330.0	393.0	280.3	140.7	10.0	5.9	72.7	1271.0	14.9	6.0
2015	322.0	387.5	317.8	142.9	10.2	5.4	74.5	1438.1	15.4	6.5
2020	314.6	391.3	359.7	145.2	10.4	5.4	76.3	1627.0	16.8	6.5
2025	320.9	398.8	407.0	147.6	10.6	5.5	78.3	1840.9	17.2	6.8
2030	327.8	408.7	460.4	150.2	10.9	5.6	80.3	2082.8	17.8	6.8
2035	336.7	419.8	520.9	152.9	11.1	5.7	82.5	2356.5	18.3	6.8
2040	346.1	431.5	589.4	155.8	11.4	5.8	84.9	2666.1	18.9	7.0
2045	356.1	444.0	666.9	158.8	11.7	5.9	87.4	3016.5	19.6	7.2
2050	366.7	457.2	754.5	162.1	12.0	6.1	90.0	3412.9	20.4	7.5
2055	369.4	461.4	815.1	162.1	12.0	6.1	90.0	3412.9	21.1	7.8
2060	371.5	464.0	852.2	162.1	12.0	6.2	90.0	3412.9	21.8	8.0
2065	373.1	466.0	875.5	162.1	12.0	6.2	90.0	3412.9	22.3	8.1
2070	374.1	466.7	879.1	162.1	12.0	6.2	90.0	3412.9	22.7	8.3
2075	374.1	466.7	879.1	162.1	12.0	6.2	90.0	3412.9	22.7	8.4
2080	374.1	466.7	879.1	162.1	12.0	6.2	90.0	3412.9	22.8	8.4
2085	374.1	466.7	879.1	162.1	12.0	6.2	90.0	3412.9	22.8	8.5
2090	374.1	466.7	879.1	162.1	12.0	6.2	90.0	3412.9	22.8	8.5
2095	374.1	466.7	879.1	162.1	12.0	6.2	90.0	3412.9	22.8	8.5
2100	374.1	466.7	879.1	162.1	12.0	6.2	90.0	3412.9	22.8	8.5

EXHIBIT B-11

Protocol: Participation Scenario F

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCl4	CH3CCl3	H-1211	H-1301
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1
1990	369.6	445.2	122.2	205.8	15.9	6.9	106.1	738.1	3.3	3.8
1995	379.5	449.2	165.4	196.8	14.5	7.4	99.8	866.4	5.7	4.4
2000	359.5	431.8	206.1	164.2	11.8	7.3	83.8	992.9	8.5	4.9
2005	373.5	437.0	245.4	163.5	11.1	6.8	82.1	1123.4	12.1	5.4
2010	359.2	421.6	280.3	161.0	10.8	6.2	78.8	1271.0	15.3	6.2
2015	354.1	417.6	317.8	164.4	10.9	5.8	80.8	1438.1	16.2	6.6
2020	348.8	421.4	359.7	167.9	11.2	5.8	82.8	1627.0	17.7	6.7
2025	355.4	428.2	407.0	171.6	11.4	5.8	85.0	1840.9	18.0	7.0
2030	362.8	438.7	460.4	175.5	11.7	6.0	87.3	2082.8	18.6	7.0
2035	373.0	450.6	520.9	179.5	11.9	6.1	89.7	2356.5	19.2	7.0
2040	383.8	463.1	589.4	183.9	12.2	6.2	92.3	2666.1	19.8	7.2
2045	395.2	476.4	666.9	188.4	12.5	6.3	95.0	3016.5	20.5	7.5
2050	407.2	490.4	754.5	193.1	12.9	6.5	97.9	3412.9	21.3	7.8
2055	410.3	494.8	815.1	193.1	12.9	6.6	97.9	3412.9	22.0	8.0
2060	412.7	497.5	852.2	193.1	12.9	6.6	97.9	3412.9	22.6	8.2
2065	414.5	499.7	875.5	193.1	12.9	6.7	97.9	3412.9	23.1	8.4
2070	415.7	500.4	879.1	193.1	12.9	6.7	97.9	3412.9	23.5	8.5
2075	415.7	500.4	879.1	193.1	12.9	6.7	97.9	3412.9	23.5	8.6
2080	415.7	500.4	879.1	193.1	12.9	6.7	97.9	3412.9	23.6	8.6
2085	415.7	500.4	879.1	193.1	12.9	6.7	97.9	3412.9	23.6	8.7
2090	415.7	500.4	879.1	193.1	12.9	6.7	97.9	3412.9	23.6	8.7
2095	415.7	500.4	879.1	193.1	12.9	6.7	97.9	3412.9	23.6	8.7
2100	415.7	500.4	879.1	193.1	12.9	6.7	97.9	3412.9	23.6	8.7

EXHIBIT B-12

Protocol: Participation Scenario G

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCl4	CH3CCl3	H-1211	H-1301
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1
1990	373.8	448.6	122.2	208.4	16.0	6.9	107.4	738.1	3.3	3.8
1995	395.3	464.8	165.4	206.5	15.0	7.5	104.4	866.4	5.7	4.5
2000	389.5	462.5	206.1	182.8	12.7	7.5	92.3	992.9	8.7	5.0
2005	407.7	473.7	245.4	183.4	12.2	7.2	91.2	1123.4	12.4	5.6
2010	398.1	464.0	280.3	182.4	11.9	6.6	88.5	1271.0	15.8	6.3
2015	397.9	465.6	317.8	187.2	12.1	6.3	91.1	1438.1	17.0	6.8
2020	397.2	473.2	359.7	192.2	12.4	6.3	93.9	1627.0	18.7	7.0
2025	407.1	483.4	407.0	197.5	12.8	6.4	96.8	1840.9	19.2	7.3
2030	417.8	497.5	460.4	203.0	13.1	6.6	99.9	2082.8	20.0	7.4
2035	431.6	513.2	520.9	208.8	13.5	6.7	103.1	2356.5	20.7	7.4
2040	446.1	529.8	589.4	215.0	13.9	6.9	106.5	2666.1	21.5	7.7
2045	461.3	547.2	666.9	221.4	14.3	7.1	110.1	3016.5	22.5	8.0
2050	477.4	565.6	754.5	228.2	14.7	7.2	113.8	3412.9	23.5	8.4
2055	481.5	571.4	815.1	228.2	14.8	7.4	113.8	3412.9	24.4	8.7
2060	484.7	575.0	852.2	228.2	14.8	7.4	113.8	3412.9	25.2	8.9
2065	487.2	577.8	875.5	228.2	14.8	7.5	113.8	3412.9	25.9	9.1
2070	488.7	578.7	879.1	228.2	14.8	7.5	113.8	3412.9	26.4	9.3
2075	488.7	578.7	879.1	228.2	14.8	7.5	113.8	3412.9	26.4	9.4
2080	488.7	578.7	879.1	228.2	14.8	7.5	113.8	3412.9	26.5	9.5
2085	488.7	578.7	879.1	228.2	14.8	7.5	113.8	3412.9	26.5	9.5
2090	488.7	578.7	879.1	228.2	14.8	7.5	113.8	3412.9	26.5	9.5
2095	488.7	578.7	879.1	228.2	14.8	7.5	113.8	3412.9	26.5	9.5
2100	488.7	578.7	879.1	228.2	14.8	7.5	113.8	3412.9	26.5	9.5

EXHIBIT B-13

Protocol: Participation Scenario H

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCl4	CH3CCl3	H-1211	H-1301
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1
1990	369.6	445.2	122.2	205.8	15.9	6.9	106.1	738.1	3.3	3.8
1995	380.5	450.5	165.4	197.2	14.6	7.4	100.2	866.4	5.7	4.4
2000	364.7	438.3	206.1	166.1	12.0	7.3	85.6	992.9	8.5	4.9
2005	385.0	451.2	245.4	167.4	11.5	6.9	85.8	1123.4	12.2	5.5
2010	379.3	446.7	280.3	167.7	11.5	6.4	85.0	1271.0	15.5	6.2
2015	377.5	448.3	317.8	171.7	11.7	6.0	87.6	1438.1	16.5	6.7
2020	375.9	456.9	359.7	175.9	12.0	6.1	90.3	1627.0	18.1	6.8
2025	386.3	468.7	407.0	180.4	12.3	6.2	93.2	1840.9	18.7	7.2
2030	397.5	483.2	460.4	185.1	12.7	6.4	96.2	2082.8	19.5	7.3
2035	410.8	499.1	520.9	190.0	13.0	6.5	99.4	2356.5	20.3	7.3
2040	424.9	515.9	589.4	195.2	13.4	6.7	102.8	2666.1	21.1	7.6
2045	439.8	533.7	666.9	200.7	13.8	6.9	106.4	3016.5	22.1	7.9
2050	455.5	552.5	754.5	206.5	14.3	7.0	110.2	3412.9	23.2	8.3
2055	459.6	558.4	815.1	206.5	14.3	7.2	110.2	3412.9	24.2	8.6
2060	462.7	562.0	852.2	206.5	14.3	7.2	110.2	3412.9	25.1	8.9
2065	465.1	565.0	875.5	206.5	14.3	7.3	110.2	3412.9	25.8	9.1
2070	466.6	565.8	879.1	206.5	14.3	7.3	110.2	3412.9	26.3	9.3
2075	466.6	565.8	879.1	206.5	14.3	7.3	110.2	3412.9	26.4	9.4
2080	466.6	565.8	879.1	206.5	14.3	7.3	110.2	3412.9	26.4	9.5
2085	466.6	565.8	879.1	206.5	14.3	7.3	110.2	3412.9	26.4	9.5
2090	466.6	565.8	879.1	206.5	14.3	7.3	110.2	3412.9	26.4	9.5
2095	466.6	565.8	879.1	206.5	14.3	7.3	110.2	3412.9	26.4	9.5
2100	466.6	565.8	879.1	206.5	14.3	7.3	110.2	3412.9	26.4	9.5

EXHIBIT B-14

Protocol: Participation Scenario I

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCl4	CH3CCl3	H-1211	H-1301
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1
1990	375.7	453.7	122.2	214.8	16.4	7.1	109.1	738.1	3.3	3.8
1995	399.3	483.4	165.4	222.5	16.3	7.9	108.2	866.4	5.8	4.5
2000	396.2	494.7	206.1	210.3	14.8	8.4	98.5	992.9	8.7	5.1
2005	417.1	514.3	245.4	212.7	14.5	8.5	97.7	1123.4	12.5	5.7
2010	411.5	507.8	280.3	213.4	14.4	8.3	95.4	1271.0	15.9	6.5
2015	414.9	512.7	317.8	220.2	14.7	8.1	98.5	1438.1	17.2	7.1
2020	417.3	523.6	359.7	227.3	15.2	8.3	101.7	1627.0	18.9	7.4
2025	428.4	536.9	407.0	234.7	15.7	8.5	105.1	1840.9	19.5	7.8
2030	440.4	554.2	460.4	242.6	16.2	8.8	108.7	2082.8	20.4	8.0
2035	455.4	573.3	520.9	250.8	16.8	9.1	112.4	2356.5	21.2	8.2
2040	471.3	593.4	589.4	259.4	17.4	9.4	116.4	2666.1	22.1	8.5
2045	488.0	614.5	666.9	268.5	18.0	9.7	120.5	3016.5	23.1	9.0
2050	505.6	636.8	754.5	278.0	18.7	10.1	124.9	3412.9	24.2	9.5
2055	511.1	644.2	815.1	278.0	18.7	10.3	124.9	3412.9	25.3	9.9
2060	515.3	648.0	852.2	278.0	18.7	10.4	124.9	3412.9	26.1	10.2
2065	518.7	651.0	875.5	278.0	18.7	10.5	124.9	3412.9	26.9	10.5
2070	520.7	652.0	879.1	278.0	18.7	10.5	124.9	3412.9	27.4	10.7
2075	520.7	652.0	879.1	278.0	18.7	10.5	124.9	3412.9	27.5	10.9
2080	520.7	652.0	879.1	278.0	18.7	10.5	124.9	3412.9	27.6	11.0
2085	520.7	652.0	879.1	278.0	18.7	10.5	124.9	3412.9	27.6	11.1
2090	520.7	652.0	879.1	278.0	18.7	10.5	124.9	3412.9	27.6	11.1
2095	520.7	652.0	879.1	278.0	18.7	10.5	124.9	3412.9	27.6	11.1
2100	520.7	652.0	879.1	278.0	18.7	10.5	124.9	3412.9	27.6	11.1

EXHIBIT B-15

Protocol: 1:1 Substitution Scenario

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCL4	CH3CCL3	H-1211	H-1301	SUBST *
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1	0.0
1990	364.3	440.8	122.2	202.5	15.7	6.9	104.6	738.1	3.3	3.8	77.7
1995	359.5	429.5	165.4	184.6	13.9	7.3	94.0	866.4	5.6	4.4	306.3
2000	321.5	392.8	206.1	140.6	10.6	7.0	73.1	992.9	8.3	4.8	614.9
2005	330.3	390.4	245.4	138.2	9.8	6.4	70.6	1123.4	11.7	5.3	847.9
2010	309.9	367.9	280.3	134.0	9.4	5.7	66.5	1271.0	14.7	6.0	1113.8
2015	298.5	356.8	317.8	135.5	9.4	5.2	67.6	1438.1	15.2	6.4	1377.4
2020	287.4	355.8	359.7	137.1	9.5	5.1	68.8	1627.0	16.4	6.4	1658.4
2025	290.0	358.3	407.0	138.8	9.7	5.1	70.1	1840.9	16.5	6.6	1955.7
2030	293.1	364.1	460.4	140.6	9.8	5.2	71.4	2082.8	16.9	6.6	2288.9
2035	298.9	371.2	520.9	142.5	10.0	5.3	72.8	2356.5	17.2	6.5	2663.2
2040	305.0	378.7	589.4	144.4	10.2	5.3	74.3	2666.1	17.6	6.6	3087.6
2045	311.5	386.7	666.9	146.5	10.4	5.4	75.9	3016.5	18.0	6.8	3568.7
2050	318.3	395.2	754.5	148.8	10.6	5.5	77.6	3412.9	18.5	7.0	4114.1
2055	320.1	397.8	815.1	148.8	10.6	5.5	77.6	3412.9	18.9	7.2	4286.3
2060	321.4	399.5	852.2	148.8	10.6	5.6	77.6	3412.9	19.3	7.3	4393.4
2065	322.5	400.8	875.5	148.8	10.6	5.6	77.6	3412.9	19.6	7.4	4482.8
2070	323.2	401.2	879.1	148.8	10.6	5.6	77.6	3412.9	19.9	7.5	4527.9
2075	323.2	401.2	879.1	148.8	10.6	5.6	77.6	3412.9	19.9	7.6	4527.9
2080	323.2	401.2	879.1	148.8	10.6	5.6	77.6	3412.9	19.9	7.6	4527.9
2085	323.2	401.2	879.1	148.8	10.6	5.6	77.6	3412.9	19.9	7.6	4527.9
2090	323.2	401.2	879.1	148.8	10.6	5.6	77.6	3412.9	19.9	7.6	4527.9
2095	323.2	401.2	879.1	148.8	10.6	5.6	77.6	3412.9	19.9	7.6	4527.9
2100	323.2	401.2	879.1	148.8	10.6	5.6	77.6	3412.9	19.9	7.6	4527.9

* Partially-halogenated chlorine-containing chemical substitutes (such as HCFCs 22, 123, 141b, 142b) modeled using the atmospheric characteristics of HCFC-22.

EXHIBIT B-16

Protocol: 1:2 Substitution Scenario

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCL4	CH3CCL3	H-1211	H-1301	SUBST *
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1	0.0
1990	364.3	440.8	122.2	202.5	15.7	6.9	104.6	738.1	3.3	3.8	38.8
1995	359.5	429.5	165.4	184.6	13.9	7.3	94.0	866.4	5.6	4.4	153.2
2000	321.5	392.8	206.1	140.6	10.6	7.0	73.1	992.9	8.3	4.8	307.5
2005	330.3	390.4	245.4	138.2	9.8	6.4	70.6	1123.4	11.7	5.3	424.0
2010	309.9	367.9	280.3	134.0	9.4	5.7	66.5	1271.0	14.7	6.0	556.9
2015	298.5	356.8	317.8	135.5	9.4	5.2	67.6	1438.1	15.2	6.4	688.7
2020	287.4	355.8	359.7	137.1	9.5	5.1	68.8	1627.0	16.4	6.4	829.2
2025	290.0	358.3	407.0	138.8	9.7	5.1	70.1	1840.9	16.5	6.6	977.9
2030	293.1	364.1	460.4	140.6	9.8	5.2	71.4	2082.8	16.9	6.6	1144.5
2035	298.9	371.2	520.9	142.5	10.0	5.3	72.8	2356.5	17.2	6.5	1331.6
2040	305.0	378.7	589.4	144.4	10.2	5.3	74.3	2666.1	17.6	6.6	1543.8
2045	311.5	386.7	666.9	146.5	10.4	5.4	75.9	3016.5	18.0	6.8	1784.4
2050	318.3	395.2	754.5	148.8	10.6	5.5	77.6	3412.9	18.5	7.0	2057.1
2055	320.1	397.8	815.1	148.8	10.6	5.5	77.6	3412.9	18.9	7.2	2143.2
2060	321.4	399.5	852.2	148.8	10.6	5.6	77.6	3412.9	19.3	7.3	2196.7
2065	322.5	400.8	875.5	148.8	10.6	5.6	77.6	3412.9	19.6	7.4	2241.4
2070	323.2	401.2	879.1	148.8	10.6	5.6	77.6	3412.9	19.9	7.5	2264.0
2075	323.2	401.2	879.1	148.8	10.6	5.6	77.6	3412.9	19.9	7.6	2264.0
2080	323.2	401.2	879.1	148.8	10.6	5.6	77.6	3412.9	19.9	7.6	2264.0
2085	323.2	401.2	879.1	148.8	10.6	5.6	77.6	3412.9	19.9	7.6	2264.0
2090	323.2	401.2	879.1	148.8	10.6	5.6	77.6	3412.9	19.9	7.6	2264.0
2095	323.2	401.2	879.1	148.8	10.6	5.6	77.6	3412.9	19.9	7.6	2264.0
2100	323.2	401.2	879.1	148.8	10.6	5.6	77.6	3412.9	19.9	7.6	2264.0

* Partially-halogenated chlorine-containing chemical substitutes (such as HCFCs 22, 123, 141b, 142b) modeled using the atmospheric characteristics of HCFC-22.

EXHIBIT B-17

Protocol: 1:5 Substitution Scenario

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCL4	CH3CCL3	H-1211	H-1301	SUBST *
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1	0.0
1990	364.3	440.8	122.2	202.5	15.7	6.9	104.6	738.1	3.3	3.8	15.5
1995	359.5	429.5	165.4	184.6	13.9	7.3	94.0	866.4	5.6	4.4	61.3
2000	321.5	392.8	206.1	140.6	10.6	7.0	73.1	992.9	8.3	4.8	123.0
2005	330.3	390.4	245.4	138.2	9.8	6.4	70.6	1123.4	11.7	5.3	169.6
2010	309.9	367.9	280.3	134.0	9.4	5.7	66.5	1271.0	14.7	6.0	222.8
2015	298.5	356.8	317.8	135.5	9.4	5.2	67.6	1438.1	15.2	6.4	275.5
2020	287.4	355.8	359.7	137.1	9.5	5.1	68.8	1627.0	16.4	6.4	331.7
2025	290.0	358.3	407.0	138.8	9.7	5.1	70.1	1840.9	16.5	6.6	391.1
2030	293.1	364.1	460.4	140.6	9.8	5.2	71.4	2082.8	16.9	6.6	457.8
2035	298.9	371.2	520.9	142.5	10.0	5.3	72.8	2356.5	17.2	6.5	532.6
2040	305.0	378.7	589.4	144.4	10.2	5.3	74.3	2666.1	17.6	6.6	617.5
2045	311.5	386.7	666.9	146.5	10.4	5.4	75.9	3016.5	18.0	6.8	713.7
2050	318.3	395.2	754.5	148.8	10.6	5.5	77.6	3412.9	18.5	7.0	822.8
2055	320.1	397.8	815.1	148.8	10.6	5.5	77.6	3412.9	18.9	7.2	857.3
2060	321.4	399.5	852.2	148.8	10.6	5.6	77.6	3412.9	19.3	7.3	878.7
2065	322.5	400.8	875.5	148.8	10.6	5.6	77.6	3412.9	19.6	7.4	896.6
2070	323.2	401.2	879.1	148.8	10.6	5.6	77.6	3412.9	19.9	7.5	905.6
2075	323.2	401.2	879.1	148.8	10.6	5.6	77.6	3412.9	19.9	7.6	905.6
2080	323.2	401.2	879.1	148.8	10.6	5.6	77.6	3412.9	19.9	7.6	905.6
2085	323.2	401.2	879.1	148.8	10.6	5.6	77.6	3412.9	19.9	7.6	905.6
2090	323.2	401.2	879.1	148.8	10.6	5.6	77.6	3412.9	19.9	7.6	905.6
2095	323.2	401.2	879.1	148.8	10.6	5.6	77.6	3412.9	19.9	7.6	905.6
2100	323.2	401.2	879.1	148.8	10.6	5.6	77.6	3412.9	19.9	7.6	905.6

* Partially-halogenated chlorine-containing chemical substitutes (such as HCFCs 22, 123, 141b, 142b) modeled using the atmospheric characteristics of HCFC-22.

EXHIBIT B-18

Protocol: 1:10 Substitution Scenario

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCL4	CH3CCL3	H-1211	H-1301	SUBST *
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1	0.0
1990	364.3	440.8	122.2	202.5	15.7	6.9	104.6	738.1	3.3	3.8	7.8
1995	359.5	429.5	165.4	184.6	13.9	7.3	94.0	866.4	5.6	4.4	30.6
2000	321.5	392.8	206.1	140.6	10.6	7.0	73.1	992.9	8.3	4.8	61.5
2005	330.3	390.4	245.4	138.2	9.8	6.4	70.6	1123.4	11.7	5.3	84.8
2010	309.9	367.9	280.3	134.0	9.4	5.7	66.5	1271.0	14.7	6.0	111.4
2015	298.5	356.8	317.8	135.5	9.4	5.2	67.6	1438.1	15.2	6.4	137.7
2020	287.4	355.8	359.7	137.1	9.5	5.1	68.8	1627.0	16.4	6.4	165.8
2025	290.0	358.3	407.0	138.8	9.7	5.1	70.1	1840.9	16.5	6.6	195.6
2030	293.1	364.1	460.4	140.6	9.8	5.2	71.4	2082.8	16.9	6.6	228.9
2035	298.9	371.2	520.9	142.5	10.0	5.3	72.8	2356.5	17.2	6.5	266.3
2040	305.0	378.7	589.4	144.4	10.2	5.3	74.3	2666.1	17.6	6.6	308.8
2045	311.5	386.7	666.9	146.5	10.4	5.4	75.9	3016.5	18.0	6.8	356.9
2050	318.3	395.2	754.5	148.8	10.6	5.5	77.6	3412.9	18.5	7.0	411.4
2055	320.1	397.8	815.1	148.8	10.6	5.5	77.6	3412.9	18.9	7.2	428.6
2060	321.4	399.5	852.2	148.8	10.6	5.6	77.6	3412.9	19.3	7.3	439.3
2065	322.5	400.8	875.5	148.8	10.6	5.6	77.6	3412.9	19.6	7.4	448.3
2070	323.2	401.2	879.1	148.8	10.6	5.6	77.6	3412.9	19.9	7.5	452.8
2075	323.2	401.2	879.1	148.8	10.6	5.6	77.6	3412.9	19.9	7.6	452.8
2080	323.2	401.2	879.1	148.8	10.6	5.6	77.6	3412.9	19.9	7.6	452.8
2085	323.2	401.2	879.1	148.8	10.6	5.6	77.6	3412.9	19.9	7.6	452.8
2090	323.2	401.2	879.1	148.8	10.6	5.6	77.6	3412.9	19.9	7.6	452.8
2095	323.2	401.2	879.1	148.8	10.6	5.6	77.6	3412.9	19.9	7.6	452.8
2100	323.2	401.2	879.1	148.8	10.6	5.6	77.6	3412.9	19.9	7.6	452.8

* Partially-halogenated chlorine-containing chemical substitutes (such as HCFCs 22, 123, 141b, 142b) modeled using the atmospheric characteristics of HCFC-22.

EXHIBIT B-19

Protocol 1:1* Substitiution Scenario

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCL4	CH3CCL3	H-1211	H-1301	SUBST *
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1	0.0
1990	364.3	440.8	122.2	202.5	15.7	6.9	104.6	738.1	3.3	3.8	118.9
1995	359.5	429.5	165.4	184.6	13.9	7.3	94.0	866.4	5.6	4.4	435.6
2000	321.5	392.8	206.1	140.6	10.6	7.0	73.1	992.9	8.3	4.8	864.5
2005	330.3	390.4	245.4	138.2	9.8	6.4	70.6	1123.4	11.7	5.3	1155.4
2010	309.9	367.9	280.3	134.0	9.4	5.7	66.5	1271.0	14.7	6.0	1487.4
2015	298.5	356.8	317.8	135.5	9.4	5.2	67.6	1438.1	15.2	6.4	1818.8
2020	287.4	355.8	359.7	137.1	9.5	5.1	68.8	1627.0	16.4	6.4	2175.9
2025	290.0	358.3	407.0	138.8	9.7	5.1	70.1	1840.9	16.5	6.6	2559.3
2030	293.1	364.1	460.4	140.6	9.8	5.2	71.4	2082.8	16.9	6.6	2989.9
2035	298.9	371.2	520.9	142.5	10.0	5.3	72.8	2356.5	17.2	6.5	3474.6
2040	305.0	378.7	589.4	144.4	10.2	5.3	74.3	2666.1	17.6	6.6	4024.2
2045	311.5	386.7	666.9	146.5	10.4	5.4	75.9	3016.5	18.0	6.8	4647.0
2050	318.3	395.2	754.5	148.8	10.6	5.5	77.6	3412.9	18.5	7.0	5352.9
2055	320.1	397.8	815.1	148.8	10.6	5.5	77.6	3412.9	18.9	7.2	5529.5
2060	321.4	399.5	852.2	148.8	10.6	5.6	77.6	3412.9	19.3	7.3	5638.6
2065	322.5	400.8	875.5	148.8	10.6	5.6	77.6	3412.9	19.6	7.4	5729.3
2070	323.2	401.2	879.1	148.8	10.6	5.6	77.6	3412.9	19.9	7.5	5774.5
2075	323.2	401.2	879.1	148.8	10.6	5.6	77.6	3412.9	19.9	7.6	5774.5
2080	323.2	401.2	879.1	148.8	10.6	5.6	77.6	3412.9	19.9	7.6	5774.5
2085	323.2	401.2	879.1	148.8	10.6	5.6	77.6	3412.9	19.9	7.6	5774.5
2090	323.2	401.2	879.1	148.8	10.6	5.6	77.6	3412.9	19.9	7.6	5774.5
2095	323.2	401.2	879.1	148.8	10.6	5.6	77.6	3412.9	19.9	7.6	5774.5
2100	323.2	401.2	879.1	148.8	10.6	5.6	77.6	3412.9	19.9	7.6	5774.5

* Partially-halogenated chlorine-containing chemical substitutes (such as HCFCs 22, 123, 141b, 142b) modeled using the atmospheric characteristics of HCFC-22.

EXHIBIT B-20

No Controls: 2.5 percent Growth After 2050

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCl4	CH3CCl3	H-1211	H-1301
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1
1990	401.1	481.7	122.2	240.9	18.0	7.4	118.7	738.1	3.3	3.8
1995	491.6	603.7	165.4	304.5	21.3	9.3	140.3	866.4	6.2	5.0
2000	586.7	742.5	206.1	371.9	24.4	11.5	162.0	992.9	9.9	5.8
2005	689.0	879.6	245.4	420.7	27.7	13.5	183.3	1123.4	14.8	6.9
2010	787.6	1004.0	280.3	476.0	31.3	15.4	207.4	1271.0	19.7	8.4
2015	893.0	1139.7	317.8	538.6	35.4	17.5	234.6	1438.1	24.2	9.9
2020	1011.0	1290.6	359.7	609.3	40.1	19.8	265.5	1627.0	29.0	11.3
2025	1143.8	1460.2	407.0	689.4	45.4	22.4	300.3	1840.9	33.6	13.1
2030	1294.1	1652.0	460.4	780.0	51.3	25.3	339.8	2082.8	38.9	15.1
2035	1464.2	1869.1	520.9	882.5	58.1	28.6	384.5	2356.5	45.0	17.3
2040	1656.6	2114.7	589.4	998.4	65.7	32.4	435.0	2666.1	52.0	20.1
2045	1874.3	2392.6	666.9	1129.6	74.3	36.7	492.1	3016.5	60.2	23.4
2050	2120.6	2707.0	754.5	1278.1	84.1	41.5	556.8	3412.9	69.6	27.4
2055	2399.2	3062.7	853.6	1446.0	95.2	46.9	630.0	3861.3	80.2	31.7
2060	2714.5	3465.2	965.8	1636.0	107.7	53.1	712.8	4368.7	92.0	36.4
2065	3071.2	3920.6	1092.7	1851.0	121.8	60.1	806.4	4942.8	105.2	41.7
2070	3474.8	4435.8	1236.3	2094.3	137.8	68.0	912.4	5592.3	119.9	47.6
2075	3931.4	5018.7	1398.8	2369.5	155.9	76.9	1032.3	6327.1	135.7	54.1
2080	4448.0	5678.1	1582.6	2680.9	176.4	87.0	1167.9	7158.6	153.6	61.4
2085	5032.6	6424.3	1790.5	3033.1	199.6	98.5	1321.4	8099.3	173.8	69.7
2090	5693.9	7268.5	2025.8	3431.7	225.8	111.4	1495.1	9163.5	196.7	78.9
2095	6442.1	8223.6	2292.0	3882.7	255.5	126.1	1691.5	10367.7	222.5	89.2
2100	7288.6	9304.3	2593.2	4392.8	289.1	142.6	1913.8	11730.3	251.8	101.0

EXHIBIT B-21

Protocol: 2.5 Percent Growth After 2050

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCl4	CH3CCl3	H-1211	H-1301
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1
1990	364.3	440.8	122.2	202.5	15.7	6.9	104.6	738.1	3.3	3.8
1995	359.5	429.5	165.4	184.6	13.9	7.3	94.0	866.4	5.6	4.4
2000	321.5	392.8	206.1	140.6	10.6	7.0	73.1	992.9	8.3	4.8
2005	330.3	390.4	245.4	138.2	9.8	6.4	70.6	1123.4	11.7	5.3
2010	309.9	367.9	280.3	134.0	9.4	5.7	66.5	1271.0	14.7	6.0
2015	298.5	356.8	317.8	135.5	9.4	5.2	67.6	1438.1	15.2	6.4
2020	287.4	355.8	359.7	137.1	9.5	5.1	68.8	1627.0	16.4	6.4
2025	290.0	358.3	407.0	138.8	9.7	5.1	70.1	1840.9	16.5	6.6
2030	293.1	364.1	460.4	140.6	9.8	5.2	71.4	2082.8	16.9	6.6
2035	298.9	371.2	520.9	142.5	10.0	5.3	72.8	2356.5	17.2	6.5
2040	305.0	378.7	589.4	144.4	10.2	5.3	74.3	2666.1	17.6	6.6
2045	311.5	386.7	666.9	146.5	10.4	5.4	75.9	3016.5	18.0	6.8
2050	318.3	395.2	754.5	148.8	10.6	5.5	77.6	3412.9	18.5	7.0
2055	325.6	404.1	853.6	151.1	10.8	5.6	79.4	3861.3	19.0	7.2
2060	333.3	413.6	965.8	153.6	11.0	5.7	81.3	4368.7	19.6	7.4
2065	341.5	423.7	1092.7	156.3	11.2	5.8	83.3	4942.8	20.2	7.6
2070	350.2	434.4	1236.3	159.1	11.4	5.9	85.5	5592.3	20.8	7.8
2075	359.4	445.8	1398.8	162.0	11.7	6.0	87.7	6327.1	21.5	8.1
2080	369.1	457.8	1582.6	165.1	12.0	6.1	90.2	7158.6	22.3	8.3
2085	379.5	470.6	1790.5	168.5	12.3	6.2	92.7	8099.3	23.2	8.6
2090	390.5	484.2	2025.8	172.0	12.6	6.3	95.4	9163.5	24.1	8.8
2095	402.1	498.6	2292.0	175.7	12.9	6.5	98.3	10367.7	25.1	9.1
2100	414.4	513.9	2593.2	179.6	13.2	6.6	101.3	11730.3	26.2	9.4

EXHIBIT B-22

90 Percent Reduction Scenario (1990)

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCl4	CH3CCl3	H-1211	H-1301
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1
1990	140.0	209.9	122.2	31.9	5.3	5.6	20.1	738.1	2.8	2.5
1995	141.2	117.6	165.4	37.9	2.9	4.0	22.8	866.4	3.2	2.3
2000	151.2	149.5	206.1	44.2	3.2	3.4	25.4	992.9	4.2	2.2
2005	165.5	179.8	245.4	45.6	3.3	3.0	26.4	1123.4	6.1	2.3
2010	111.7	135.5	280.3	47.0	3.5	1.6	27.4	1271.0	3.5	2.6
2015	117.0	142.9	317.8	48.5	3.6	1.7	28.5	1438.1	4.1	1.9
2020	122.2	149.1	359.7	50.1	3.7	1.8	29.7	1627.0	4.0	2.0
2025	127.3	155.4	407.0	51.8	3.9	1.8	31.0	1840.9	4.4	2.2
2030	132.7	162.1	460.4	53.5	4.0	1.9	32.3	2082.8	4.7	1.5
2035	138.5	169.2	520.9	55.4	4.2	2.0	33.7	2356.5	5.1	1.6
2040	144.6	176.7	589.4	57.4	4.4	2.0	35.2	2666.1	5.5	1.7
2045	151.1	184.7	666.9	59.5	4.5	2.1	36.8	3016.5	6.0	1.9
2050	158.0	193.1	754.5	61.7	4.7	2.2	38.5	3412.9	6.5	2.0
2055	159.7	195.8	815.1	61.7	4.8	2.3	38.5	3412.9	7.0	2.1
2060	161.1	197.5	852.2	61.7	4.8	2.3	38.5	3412.9	7.4	2.2
2065	162.1	198.8	875.5	61.7	4.8	2.3	38.5	3412.9	7.8	2.3
2070	162.8	199.2	879.1	61.7	4.8	2.3	38.5	3412.9	8.0	2.4
2075	162.8	199.2	879.1	61.7	4.8	2.3	38.5	3412.9	8.0	2.5
2080	162.8	199.2	879.1	61.7	4.8	2.3	38.5	3412.9	8.1	2.5
2085	162.8	199.2	879.1	61.7	4.8	2.3	38.5	3412.9	8.1	2.5
2090	162.8	199.2	879.1	61.7	4.8	2.3	38.5	3412.9	8.1	2.5
2095	162.8	199.2	879.1	61.7	4.8	2.3	38.5	3412.9	8.1	2.5
2100	162.8	199.2	879.1	61.7	4.8	2.3	38.5	3412.9	8.1	2.5

EXHIBIT B-23

90 Percent Reduction with 100 Percent Participation (1990)

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCl4	CH3CCl3	H-1211	H-1301
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1
1990	106.4	179.5	122.2	19.5	4.3	5.5	9.6	738.1	2.8	2.4
1995	96.3	66.9	165.4	20.7	1.4	3.6	9.5	866.4	2.9	2.1
2000	96.1	83.5	206.1	21.8	1.4	2.9	9.4	992.9	3.5	1.9
2005	104.4	105.9	245.4	21.8	1.4	2.4	9.4	1123.4	5.1	1.9
2010	39.5	48.1	280.3	21.8	1.4	.8	9.4	1271.0	1.6	2.1
2015	39.3	48.1	317.8	21.8	1.4	.8	9.4	1438.1	1.8	1.3
2020	39.2	48.0	359.7	21.8	1.4	.8	9.4	1627.0	1.2	1.3
2025	39.2	48.0	407.0	21.8	1.4	.8	9.4	1840.9	1.3	1.4
2030	39.2	48.0	460.4	21.8	1.4	.8	9.4	2082.8	1.3	.5
2035	39.2	48.0	520.9	21.8	1.4	.8	9.4	2356.5	1.3	.5
2040	39.2	48.0	589.4	21.8	1.4	.8	9.4	2666.1	1.2	.5
2045	39.2	48.0	666.9	21.8	1.4	.8	9.4	3016.5	1.2	.5
2050	39.2	48.0	754.5	21.8	1.4	.8	9.4	3412.9	1.2	.5
2055	39.2	48.0	815.1	21.8	1.4	.8	9.4	3412.9	1.2	.5
2060	39.2	48.0	852.2	21.8	1.4	.8	9.4	3412.9	1.2	.5
2065	39.2	48.0	875.5	21.8	1.4	.8	9.4	3412.9	1.2	.5
2070	39.2	48.0	879.1	21.8	1.4	.8	9.4	3412.9	1.2	.5
2075	39.2	48.0	879.1	21.8	1.4	.8	9.4	3412.9	1.2	.5
2080	39.2	48.0	879.1	21.8	1.4	.8	9.4	3412.9	1.2	.5
2085	39.2	48.0	879.1	21.8	1.4	.8	9.4	3412.9	1.2	.5
2090	39.2	48.0	879.1	21.8	1.4	.8	9.4	3412.9	1.2	.5
2095	39.2	48.0	879.1	21.8	1.4	.8	9.4	3412.9	1.2	.5
2100	39.2	48.0	879.1	21.8	1.4	.8	9.4	3412.9	1.2	.5

EXHIBIT B-24

100 Percent Reduction with 100 Percent Participation (1990)

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCl4	CH3CCl3	H-1211	H-1301
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1
1990	80.2	153.4	122.2	.0	3.1	5.4	.0	738.1	2.7	2.3
1995	67.2	27.8	165.4	.0	.0	3.2	.0	866.4	2.7	1.9
2000	65.1	42.4	206.1	.0	.0	2.3	.0	992.9	3.1	1.7
2005	71.5	63.4	245.4	.0	.0	1.7	.0	1123.4	4.5	1.6
2010	.0	.0	280.3	.0	.0	.0	.0	1271.0	.5	1.8
2015	.0	.0	317.8	.0	.0	.0	.0	1438.1	.6	.8
2020	.0	.0	359.7	.0	.0	.0	.0	1627.0	.0	.8
2025	.0	.0	407.0	.0	.0	.0	.0	1840.9	.0	.9
2030	.0	.0	460.4	.0	.0	.0	.0	2082.8	.0	.0
2035	.0	.0	520.9	.0	.0	.0	.0	2356.5	.0	.0
2040	.0	.0	589.4	.0	.0	.0	.0	2666.1	.0	.0
2045	.0	.0	666.9	.0	.0	.0	.0	3016.5	.0	.0
2050	.0	.0	754.5	.0	.0	.0	.0	3412.9	.0	.0
2055	.0	.0	815.1	.0	.0	.0	.0	3412.9	.0	.0
2060	.0	.0	852.2	.0	.0	.0	.0	3412.9	.0	.0
2065	.0	.0	875.5	.0	.0	.0	.0	3412.9	.0	.0
2070	.0	.0	879.1	.0	.0	.0	.0	3412.9	.0	.0
2075	.0	.0	879.1	.0	.0	.0	.0	3412.9	.0	.0
2080	.0	.0	879.1	.0	.0	.0	.0	3412.9	.0	.0
2085	.0	.0	879.1	.0	.0	.0	.0	3412.9	.0	.0
2090	.0	.0	879.1	.0	.0	.0	.0	3412.9	.0	.0
2095	.0	.0	879.1	.0	.0	.0	.0	3412.9	.0	.0
2100	.0	.0	879.1	.0	.0	.0	.0	3412.9	.0	.0

EXHIBIT B-25

100 Percent Reduction with CH3CCl3 Freeze (1990)

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCl4	CH3CCl3	H-1211	H-1301
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1
1990	116.9	186.4	122.2	13.6	4.2	5.5	11.4	615.7	2.8	2.4
1995	115.3	82.0	165.4	18.5	1.6	3.6	14.2	627.5	3.0	2.1
2000	123.4	112.2	206.1	23.8	1.9	2.8	16.9	639.4	3.8	2.0
2005	136.1	141.3	245.4	25.1	2.0	2.4	17.9	645.8	5.6	2.0
2010	76.1	92.1	280.3	26.5	2.2	.9	18.9	652.8	2.5	2.3
2015	81.6	99.4	317.8	28.0	2.3	1.0	20.0	660.5	3.0	1.5
2020	86.9	105.7	359.7	29.6	2.4	1.0	21.2	668.9	2.7	1.5
2025	92.0	112.0	407.0	31.3	2.6	1.1	22.5	678.0	3.0	1.6
2030	97.4	118.7	460.4	33.1	2.7	1.1	23.8	687.9	3.2	.9
2035	103.2	125.8	520.9	34.9	2.9	1.2	25.2	698.8	3.4	.9
2040	109.3	133.3	589.4	36.9	3.0	1.3	26.7	710.6	3.6	1.0
2045	115.8	141.3	666.9	39.0	3.2	1.4	28.3	723.5	3.9	1.1
2050	122.7	149.7	754.5	41.3	3.4	1.4	30.0	737.6	4.2	1.2
2055	124.4	152.4	815.1	41.3	3.4	1.5	30.0	737.6	4.4	1.2
2060	125.8	154.0	852.2	41.3	3.4	1.5	30.0	737.6	4.6	1.3
2065	126.8	155.4	875.5	41.3	3.4	1.6	30.0	737.6	4.8	1.3
2070	127.5	155.7	879.1	41.3	3.4	1.6	30.0	737.6	4.9	1.4
2075	127.5	155.7	879.1	41.3	3.4	1.6	30.0	737.6	5.0	1.4
2080	127.5	155.7	879.1	41.3	3.4	1.6	30.0	737.6	5.0	1.4
2085	127.5	155.7	879.1	41.3	3.4	1.6	30.0	737.6	5.0	1.4
2090	127.5	155.7	879.1	41.3	3.4	1.6	30.0	737.6	5.0	1.4
2095	127.5	155.7	879.1	41.3	3.4	1.6	30.0	737.6	5.0	1.4
2100	127.5	155.7	879.1	41.3	3.4	1.6	30.0	737.6	5.0	1.4

EXHIBIT B-26

100 Percent Reduction with CH3CCl3 Freeze and 100 Percent Participation (1990)

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCl4	CH3CCl3	H-1211	H-1301
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1
1990	80.2	153.4	122.2	.0	3.1	5.4	.0	606.6	2.7	2.3
1995	67.2	27.8	165.4	.0	.0	3.2	.0	606.6	2.7	1.9
2000	65.1	42.4	206.1	.0	.0	2.3	.0	606.6	3.1	1.7
2005	71.5	63.4	245.4	.0	.0	1.7	.0	606.6	4.5	1.6
2010	.0	.0	280.3	.0	.0	.0	.0	606.6	.5	1.8
2015	.0	.0	317.8	.0	.0	.0	.0	606.6	.6	.8
2020	.0	.0	359.7	.0	.0	.0	.0	606.6	.0	.8
2025	.0	.0	407.0	.0	.0	.0	.0	606.6	.0	.9
2030	.0	.0	460.4	.0	.0	.0	.0	606.6	.0	.0
2035	.0	.0	520.9	.0	.0	.0	.0	606.6	.0	.0
2040	.0	.0	589.4	.0	.0	.0	.0	606.6	.0	.0
2045	.0	.0	666.9	.0	.0	.0	.0	606.6	.0	.0
2050	.0	.0	754.5	.0	.0	.0	.0	606.6	.0	.0
2055	.0	.0	815.1	.0	.0	.0	.0	606.6	.0	.0
2060	.0	.0	852.2	.0	.0	.0	.0	606.6	.0	.0
2065	.0	.0	875.5	.0	.0	.0	.0	606.6	.0	.0
2070	.0	.0	879.1	.0	.0	.0	.0	606.6	.0	.0
2075	.0	.0	879.1	.0	.0	.0	.0	606.6	.0	.0
2080	.0	.0	879.1	.0	.0	.0	.0	606.6	.0	.0
2085	.0	.0	879.1	.0	.0	.0	.0	606.6	.0	.0
2090	.0	.0	879.1	.0	.0	.0	.0	606.6	.0	.0
2095	.0	.0	879.1	.0	.0	.0	.0	606.6	.0	.0
2100	.0	.0	879.1	.0	.0	.0	.0	606.6	.0	.0

EXHIBIT B-27

100 Percent Reduction with CH3CCl3 Freeze and Post-2050 Growth (1990)

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCl4	CH3CCl3	H-1211	H-1301
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1
1990	116.9	186.4	122.2	13.6	4.2	5.5	11.4	615.7	2.8	2.4
1995	115.3	82.0	165.4	18.5	1.6	3.6	14.2	627.5	3.0	2.1
2000	123.4	112.2	206.1	23.8	1.9	2.8	16.9	639.4	3.8	2.0
2005	136.1	141.3	245.4	25.1	2.0	2.4	17.9	645.8	5.6	2.0
2010	76.1	92.1	280.3	26.5	2.2	.9	18.9	652.8	2.5	2.3
2015	81.6	99.4	317.8	28.0	2.3	1.0	20.0	660.5	3.0	1.5
2020	86.9	105.7	359.7	29.6	2.4	1.0	21.2	668.9	2.7	1.5
2025	92.0	112.0	407.0	31.3	2.6	1.1	22.5	678.0	3.0	1.6
2030	97.4	118.7	460.4	33.1	2.7	1.1	23.8	687.9	3.2	.9
2035	103.2	125.8	520.9	34.9	2.9	1.2	25.2	698.8	3.4	.9
2040	109.3	133.3	589.4	36.9	3.0	1.3	26.7	710.6	3.6	1.0
2045	115.8	141.3	666.9	39.0	3.2	1.4	28.3	723.5	3.9	1.1
2050	122.7	149.7	754.5	41.3	3.4	1.4	30.0	737.6	4.2	1.2
2055	129.9	158.7	853.6	43.6	3.6	1.5	31.8	752.9	4.5	1.3
2060	137.7	168.2	965.8	46.1	3.8	1.6	33.7	769.7	4.8	1.3
2065	145.8	178.3	1092.7	48.8	4.1	1.7	35.7	788.0	5.1	1.4
2070	154.5	189.0	1236.3	51.5	4.3	1.8	37.9	808.0	5.4	1.5
2075	163.7	200.4	1398.8	54.5	4.6	1.9	40.1	829.9	5.7	1.6
2080	173.5	212.4	1582.6	57.6	4.8	2.0	42.6	853.7	6.1	1.7
2085	183.8	225.2	1790.5	60.9	5.1	2.2	45.1	879.8	6.4	1.8
2090	194.8	238.8	2025.8	64.5	5.4	2.3	47.8	908.3	6.8	2.0
2095	206.4	253.2	2292.0	68.2	5.8	2.4	50.7	939.4	7.2	2.1
2100	218.8	268.4	2593.2	72.1	6.1	2.6	53.7	973.4	7.6	2.2

EXHIBIT B-28

100 Percent Reduction with CH3CCl3 and 100 Percent Partipation and Post-2050 Growth (1990)

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCl4	CH3CCl3	H-1211	H-1301
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1
1990	80.2	153.4	122.2	.0	3.1	5.4	.0	606.6	2.7	2.3
1995	67.2	27.8	165.4	.0	.0	3.2	.0	606.6	2.7	1.9
2000	65.1	42.4	206.1	.0	.0	2.3	.0	606.6	3.1	1.7
2005	71.5	63.4	245.4	.0	.0	1.7	.0	606.6	4.5	1.6
2010	.0	.0	280.3	.0	.0	.0	.0	606.6	.5	1.8
2015	.0	.0	317.8	.0	.0	.0	.0	606.6	.6	.8
2020	.0	.0	359.7	.0	.0	.0	.0	606.6	.0	.8
2025	.0	.0	407.0	.0	.0	.0	.0	606.6	.0	.9
2030	.0	.0	460.4	.0	.0	.0	.0	606.6	.0	.0
2035	.0	.0	520.9	.0	.0	.0	.0	606.6	.0	.0
2040	.0	.0	589.4	.0	.0	.0	.0	606.6	.0	.0
2045	.0	.0	666.9	.0	.0	.0	.0	606.6	.0	.0
2050	.0	.0	754.5	.0	.0	.0	.0	606.6	.0	.0
2055	.0	.0	853.6	.0	.0	.0	.0	606.6	.0	.0
2060	.0	.0	965.8	.0	.0	.0	.0	606.6	.0	.0
2065	.0	.0	1092.7	.0	.0	.0	.0	606.6	.0	.0
2070	.0	.0	1236.3	.0	.0	.0	.0	606.6	.0	.0
2075	.0	.0	1398.8	.0	.0	.0	.0	606.6	.0	.0
2080	.0	.0	1582.6	.0	.0	.0	.0	606.6	.0	.0
2085	.0	.0	1790.5	.0	.0	.0	.0	606.6	.0	.0
2090	.0	.0	2025.8	.0	.0	.0	.0	606.6	.0	.0
2095	.0	.0	2292.0	.0	.0	.0	.0	606.6	.0	.0
2100	.0	.0	2593.2	.0	.0	.0	.0	606.6	.0	.0

EXHIBIT B-29

100 Percent Reduction with CH3CCl3 Freeze and 1:5 Substitution (1990)

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCL4	CH3CCL3	H-1211	H-1301	SUBST *
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1	0.0
1990	116.9	186.4	122.2	13.6	4.2	5.5	11.4	615.7	2.8	2.4	115.9
1995	115.3	82.0	165.4	18.5	1.6	3.6	14.2	627.5	3.0	2.1	179.6
2000	123.4	112.2	206.1	23.8	1.9	2.8	16.9	639.4	3.8	2.0	218.7
2005	136.1	141.3	245.4	25.1	2.0	2.4	17.9	645.8	5.6	2.0	258.2
2010	76.1	92.1	280.3	26.5	2.2	0.9	18.9	652.8	2.5	2.3	324.7
2015	81.6	99.4	317.8	28.0	2.3	1.0	20.0	660.5	3.0	1.5	370.3
2020	86.9	105.7	359.7	29.6	2.4	1.0	21.2	668.9	2.7	1.5	421.8
2025	92.0	112.0	407.0	31.3	2.6	1.1	22.5	678.0	3.0	1.6	480.0
2030	97.4	118.7	460.4	33.1	2.7	1.1	23.8	687.9	3.2	0.9	546.0
2035	103.2	125.8	520.9	34.9	2.9	1.2	25.2	698.8	3.4	0.9	620.9
2040	109.3	133.3	589.4	36.9	3.0	1.3	26.7	710.6	3.6	1.0	705.7
2045	115.8	141.3	666.9	39.0	3.2	1.4	28.3	723.5	3.9	1.1	802.0
2050	122.7	149.7	754.5	41.3	3.4	1.4	30.0	737.6	4.2	1.2	911.0
2055	124.4	152.4	815.1	41.3	3.4	1.5	30.0	737.6	4.4	1.2	945.5
2060	125.8	154.0	852.2	41.3	3.4	1.5	30.0	737.6	4.6	1.3	966.9
2065	126.8	155.4	875.5	41.3	3.4	1.6	30.0	737.6	4.8	1.3	984.8
2070	127.5	155.7	879.1	41.3	3.4	1.6	30.0	737.6	4.9	1.4	993.8
2075	127.5	155.7	879.1	41.3	3.4	1.6	30.0	737.6	5.0	1.4	993.8
2080	127.5	155.7	879.1	41.3	3.4	1.6	30.0	737.6	5.0	1.4	993.8
2085	127.5	155.7	879.1	41.3	3.4	1.6	30.0	737.6	5.0	1.4	993.8
2090	127.5	155.7	879.1	41.3	3.4	1.6	30.0	737.6	5.0	1.4	993.8
2095	127.5	155.7	879.1	41.3	3.4	1.6	30.0	737.6	5.0	1.4	993.8
2100	127.5	155.7	879.1	41.3	3.4	1.6	30.0	737.6	5.0	1.4	993.8

* Partially-halogenated chlorine-containing chemical substitutes (such as HCFCs 22, 123, 141b, 142b) modeled using the atmospheric characteristics of HCFC-22.

EXHIBIT B-30

100 Percent Reduction with CH3CCl3 Freeze and 100 Percent Participation and 1:5 Substitution (1990)

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCL4	CH3CCL3	H-1211	H-1301	SUBST *
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1	0.0
1990	80.2	153.4	122.2	0.0	3.1	5.4	0.0	606.6	2.7	2.3	129.8
1995	67.2	27.8	165.4	0.0	0.0	3.2	0.0	606.6	2.7	1.9	200.1
2000	65.1	42.4	206.1	0.0	0.0	2.3	0.0	606.6	3.1	1.7	244.3
2005	71.5	63.4	245.4	0.0	0.0	1.7	0.0	606.6	4.5	1.6	286.7
2010	0.0	0.0	280.3	0.0	0.0	0.0	0.0	606.6	0.5	1.8	358.3
2015	0.0	0.0	317.8	0.0	0.0	0.0	0.0	606.6	0.6	0.8	406.5
2020	0.0	0.0	359.7	0.0	0.0	0.0	0.0	606.6	0.0	0.8	460.3
2025	0.0	0.0	407.0	0.0	0.0	0.0	0.0	606.6	0.0	0.9	520.8
2030	0.0	0.0	460.4	0.0	0.0	0.0	0.0	606.6	0.0	0.0	589.2
2035	0.0	0.0	520.9	0.0	0.0	0.0	0.0	606.6	0.0	0.0	666.7
2040	0.0	0.0	589.4	0.0	0.0	0.0	0.0	606.6	0.0	0.0	754.3
2045	0.0	0.0	666.9	0.0	0.0	0.0	0.0	606.6	0.0	0.0	853.4
2050	0.0	0.0	754.5	0.0	0.0	0.0	0.0	606.6	0.0	0.0	965.5
2055	0.0	0.0	815.1	0.0	0.0	0.0	0.0	606.6	0.0	0.0	1000.8
2060	0.0	0.0	852.2	0.0	0.0	0.0	0.0	606.6	0.0	0.0	1022.9
2065	0.0	0.0	875.5	0.0	0.0	0.0	0.0	606.6	0.0	0.0	1041.2
2070	0.0	0.0	879.1	0.0	0.0	0.0	0.0	606.6	0.0	0.0	1050.5
2075	0.0	0.0	879.1	0.0	0.0	0.0	0.0	606.6	0.0	0.0	1050.5
2080	0.0	0.0	879.1	0.0	0.0	0.0	0.0	606.6	0.0	0.0	1050.5
2085	0.0	0.0	879.1	0.0	0.0	0.0	0.0	606.6	0.0	0.0	1050.5
2090	0.0	0.0	879.1	0.0	0.0	0.0	0.0	606.6	0.0	0.0	1050.5
2095	0.0	0.0	879.1	0.0	0.0	0.0	0.0	606.6	0.0	0.0	1050.5
2100	0.0	0.0	879.1	0.0	0.0	0.0	0.0	606.6	0.0	0.0	1050.5

* Partially-halogenated chlorine-containing chemical substitutes (such as HCFCs 22, 123, 141b, 142b) modeled using the atmospheric characteristics of HCFC-22.

EXHIBIT B-31

100 Percent Reduction with CH3CCl3 Freeze and 1:2 Substitution (1990)

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCL4	CH3CCL3	H-1211	H-1301	SUBST *
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1	0.0
1990	116.9	186.4	122.2	13.6	4.2	5.5	11.4	615.7	2.8	2.4	289.8
1995	115.3	82.0	165.4	18.5	1.6	3.6	14.2	627.5	3.0	2.1	449.0
2000	123.4	112.2	206.1	23.8	1.9	2.8	16.9	639.4	3.8	2.0	546.8
2005	136.1	141.3	245.4	25.1	2.0	2.4	17.9	645.8	5.6	2.0	645.6
2010	76.1	92.1	280.3	26.5	2.2	0.9	18.9	652.8	2.5	2.3	811.7
2015	81.6	99.4	317.8	28.0	2.3	1.0	20.0	660.5	3.0	1.5	925.9
2020	86.9	105.7	359.7	29.6	2.4	1.0	21.2	668.9	2.7	1.5	1054.5
2025	92.0	112.0	407.0	31.3	2.6	1.1	22.5	678.0	3.0	1.6	1200.0
2030	97.4	118.7	460.4	33.1	2.7	1.1	23.8	687.9	3.2	0.9	1365.0
2035	103.2	125.8	520.9	34.9	2.9	1.2	25.2	698.8	3.4	0.9	1552.2
2040	109.3	133.3	589.4	36.9	3.0	1.3	26.7	710.6	3.6	1.0	1764.4
2045	115.8	141.3	666.9	39.0	3.2	1.4	28.3	723.5	3.9	1.1	2004.9
2050	122.7	149.7	754.5	41.3	3.4	1.4	30.0	737.6	4.2	1.2	2277.6
2055	124.4	152.4	815.1	41.3	3.4	1.5	30.0	737.6	4.4	1.2	2363.7
2060	125.8	154.0	852.2	41.3	3.4	1.5	30.0	737.6	4.6	1.3	2417.3
2065	126.8	155.4	875.5	41.3	3.4	1.6	30.0	737.6	4.8	1.3	2462.0
2070	127.5	155.7	879.1	41.3	3.4	1.6	30.0	737.6	4.9	1.4	2484.6
2075	127.5	155.7	879.1	41.3	3.4	1.6	30.0	737.6	5.0	1.4	2484.6
2080	127.5	155.7	879.1	41.3	3.4	1.6	30.0	737.6	5.0	1.4	2484.6
2085	127.5	155.7	879.1	41.3	3.4	1.6	30.0	737.6	5.0	1.4	2484.6
2090	127.5	155.7	879.1	41.3	3.4	1.6	30.0	737.6	5.0	1.4	2484.6
2095	127.5	155.7	879.1	41.3	3.4	1.6	30.0	737.6	5.0	1.4	2484.6
2100	127.5	155.7	879.1	41.3	3.4	1.6	30.0	737.6	5.0	1.4	2484.6

* Partially-halogenated chlorine-containing chemical substitutes (such as HCFCs 22, 123, 141b, 142b) modeled using the atmospheric characteristics of HCFC-22.

EXHIBIT B-32

100 Percent Reduction with CH3CCl3 Freeze and 100 Percent Participation and 1:2 Substitution (1990)

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCL4	CH3CCL3	H-1211	H-1301	SUBST *
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1	0.0
1990	80.2	153.4	122.2	0.0	3.1	5.4	0.0	606.6	2.7	2.3	324.6
1995	67.2	27.8	165.4	0.0	0.0	3.2	0.0	606.6	2.7	1.9	500.2
2000	65.1	42.4	206.1	0.0	0.0	2.3	0.0	606.6	3.1	1.7	610.9
2005	71.5	63.4	245.4	0.0	0.0	1.7	0.0	606.6	4.5	1.6	716.9
2010	0.0	0.0	280.3	0.0	0.0	0.0	0.0	606.6	0.5	1.8	895.8
2015	0.0	0.0	317.8	0.0	0.0	0.0	0.0	606.6	0.6	0.8	1016.4
2020	0.0	0.0	359.7	0.0	0.0	0.0	0.0	606.6	0.0	0.8	1150.8
2025	0.0	0.0	407.0	0.0	0.0	0.0	0.0	606.6	0.0	0.9	1302.0
2030	0.0	0.0	460.4	0.0	0.0	0.0	0.0	606.6	0.0	0.0	1473.1
2035	0.0	0.0	520.9	0.0	0.0	0.0	0.0	606.6	0.0	0.0	1666.7
2040	0.0	0.0	589.4	0.0	0.0	0.0	0.0	606.6	0.0	0.0	1885.6
2045	0.0	0.0	666.9	0.0	0.0	0.0	0.0	606.6	0.0	0.0	2133.5
2050	0.0	0.0	754.5	0.0	0.0	0.0	0.0	606.6	0.0	0.0	2413.8
2055	0.0	0.0	815.1	0.0	0.0	0.0	0.0	606.6	0.0	0.0	2502.1
2060	0.0	0.0	852.2	0.0	0.0	0.0	0.0	606.6	0.0	0.0	2557.2
2065	0.0	0.0	875.5	0.0	0.0	0.0	0.0	606.6	0.0	0.0	2603.1
2070	0.0	0.0	879.1	0.0	0.0	0.0	0.0	606.6	0.0	0.0	2626.2
2075	0.0	0.0	879.1	0.0	0.0	0.0	0.0	606.6	0.0	0.0	2626.2
2080	0.0	0.0	879.1	0.0	0.0	0.0	0.0	606.6	0.0	0.0	2626.2
2085	0.0	0.0	879.1	0.0	0.0	0.0	0.0	606.6	0.0	0.0	2626.2
2090	0.0	0.0	879.1	0.0	0.0	0.0	0.0	606.6	0.0	0.0	2626.2
2095	0.0	0.0	879.1	0.0	0.0	0.0	0.0	606.6	0.0	0.0	2626.2
2100	0.0	0.0	879.1	0.0	0.0	0.0	0.0	606.6	0.0	0.0	2626.2

* Partially-halogenated chlorine-containing chemical substitutes (such as HCFCs 22, 123, 141b, 142b) modeled using the atmospheric characteristics of HCFC-22.

EXHIBIT B-33

100 Percent Reduction with CH3CCl3 Freeze and Post-2050 Growth with 1:2 Substitution

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCl4	CH3CCl3	H-1211	H-1301	SUBST *
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1	0.0
1990	116.9	186.4	122.2	13.6	4.2	5.5	11.4	615.7	2.8	2.4	289.8
1995	115.3	82.0	165.4	18.5	1.6	3.6	14.2	627.5	3.0	2.1	449.0
2000	123.4	112.2	206.1	23.8	1.9	2.8	16.9	639.4	3.8	2.0	546.8
2005	136.1	141.3	245.4	25.1	2.0	2.4	17.9	645.8	5.6	2.0	645.6
2010	76.1	92.1	280.3	26.5	2.2	0.9	18.9	652.8	2.5	2.3	811.7
2015	81.6	99.4	317.8	28.0	2.3	1.0	20.0	660.5	3.0	1.5	925.9
2020	86.9	105.7	359.7	29.6	2.4	1.0	21.2	668.9	2.7	1.5	1054.5
2025	92.0	112.0	407.0	31.3	2.6	1.1	22.5	678.0	3.0	1.6	1200.0
2030	97.4	118.7	460.4	33.1	2.7	1.1	23.8	687.9	3.2	0.9	1365.0
2035	103.2	125.8	520.9	34.9	2.9	1.2	25.2	698.8	3.4	0.9	1552.2
2040	109.3	133.3	589.4	36.9	3.0	1.3	26.7	710.6	3.6	1.0	1764.4
2045	115.8	141.3	666.9	39.0	3.2	1.4	28.3	723.5	3.9	1.1	2004.4
2050	122.7	149.7	754.5	41.3	3.4	1.4	30.0	737.6	4.2	1.2	2277.6
2055	129.9	158.7	853.6	43.6	3.6	1.5	31.8	752.9	4.5	1.3	2586.6
2060	137.7	168.2	965.8	46.1	3.8	1.6	33.7	769.7	4.8	1.3	2936.9
2065	145.8	178.3	1092.7	48.8	4.1	1.7	35.7	788.0	5.1	1.4	3333.9
2070	154.5	189.0	1236.3	51.5	4.3	1.8	37.9	808.0	5.4	1.5	3783.6
2075	163.7	200.4	1398.9	54.5	4.6	1.9	40.1	829.9	5.7	1.6	4293.0
2080	173.5	212.4	1582.6	57.6	4.8	2.0	42.6	853.7	6.1	1.7	4870.1
2085	183.8	225.2	1790.5	60.9	5.1	2.2	45.1	879.8	6.4	1.8	5524.0
2090	194.8	238.8	2025.8	64.5	5.4	2.3	47.8	908.3	6.8	2.0	6264.4
2095	206.4	253.2	2292.0	68.2	5.8	2.4	50.7	939.4	7.2	2.1	7103.1
2100	218.8	268.4	2593.2	72.1	6.1	2.6	53.7	973.4	7.6	2.2	8052.8

* Partially-halogenated chlorine-containing chemical substitutes (such as HCFCs 22, 123, 141b, 142b) modeled using the atmospheric characteristics of HCFC-22.

EXHIBIT B-34

100 Percent Reduction with CH3CCl3 Freeze and Post-2050 Growth with 1:5 Substitution

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCl4	CH3CCl3	H-1211	H-1301	SUBST *
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1	0.0
1990	116.9	186.4	122.2	13.6	4.2	5.5	11.4	615.7	2.8	2.4	115.9
1995	115.3	82.0	165.4	18.5	1.6	3.6	14.2	627.5	3.0	2.1	179.6
2000	123.4	112.2	206.1	23.8	1.9	2.8	16.9	639.4	3.8	2.0	218.7
2005	136.1	141.3	245.4	25.1	2.0	2.4	17.9	645.8	5.6	2.0	258.2
2010	76.1	92.1	280.3	26.5	2.2	0.9	18.9	652.8	2.5	2.3	324.7
2015	81.6	99.4	317.8	28.0	2.3	1.0	20.0	660.5	3.0	1.5	370.3
2020	86.9	105.7	359.7	29.6	2.4	1.0	21.2	668.9	2.7	1.5	421.8
2025	92.0	112.0	407.0	31.3	2.6	1.1	22.5	678.0	3.0	1.6	480.0
2030	97.4	118.7	460.4	33.1	2.7	1.1	23.8	687.9	3.2	0.9	546.0
2035	103.2	125.8	520.9	34.9	2.9	1.2	25.2	698.8	3.4	0.9	620.9
2040	109.3	133.3	589.4	36.9	3.0	1.3	26.7	710.6	3.6	1.0	705.7
2045	115.8	141.3	666.9	39.0	3.2	1.4	28.3	723.5	3.9	1.1	802.0
2050	122.7	149.7	754.5	41.3	3.4	1.4	30.0	737.6	4.2	1.2	911.0
2055	129.9	158.7	853.6	43.6	3.6	1.5	31.8	752.9	4.5	1.3	1034.7
2060	137.7	168.2	965.8	46.1	3.8	1.6	33.7	769.7	4.8	1.3	1174.8
2065	145.8	178.3	1092.7	48.8	4.1	1.7	35.7	788.0	5.1	1.4	1333.5
2070	154.5	189.0	1236.3	51.5	4.3	1.8	37.9	808.0	5.4	1.5	1513.4
2075	163.7	200.4	1398.8	54.5	4.6	1.9	40.1	829.9	5.7	1.6	1717.2
2080	173.5	212.4	1582.6	57.6	4.8	2.0	42.6	853.7	6.1	1.7	1948.0
2085	183.8	225.2	1790.5	60.9	5.1	2.2	45.1	879.8	6.4	1.8	2209.6
2090	194.8	238.8	2025.8	64.5	5.4	2.3	47.8	908.3	6.8	2.0	2505.8
2095	206.4	253.2	2292.0	68.2	5.8	2.4	50.7	939.4	7.2	2.1	2841.2
2100	218.8	268.4	2593.2	72.1	6.1	2.6	53.7	973.4	7.6	2.2	3221.1

* Partially-halogenated chlorine-containing chemical substitutes (such as HCFCs 22, 123, 141b, 142b) modeled using the atmospheric characteristics of HCFC-22.

EXHIBIT B-35

100 Percent Reduction with CH3CCl3 Freeze and 100 Percent Participation and Post-2050 Growth and 1:2 Substitution

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCl4	CH3CCl3	H-1211	H-1301	SUBST *
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1	0.0
1990	80.2	153.4	122.2	0.0	3.1	5.4	0.0	606.6	2.7	2.3	324.6
1995	67.2	27.8	165.4	0.0	0.0	3.2	0.0	606.6	2.7	1.9	500.2
2000	65.1	42.4	206.1	0.0	0.0	2.3	0.0	606.6	3.1	1.7	610.9
2005	71.5	63.4	245.4	0.0	0.0	1.7	0.0	606.6	4.5	1.6	716.9
2010	0.0	0.0	280.3	0.0	0.0	0.0	0.0	606.6	0.5	1.8	895.8
2015	0.0	0.0	317.8	0.0	0.0	0.0	0.0	606.6	0.6	0.8	1016.4
2020	0.0	0.0	359.7	0.0	0.0	0.0	0.0	606.6	0.0	0.8	1150.8
2025	0.0	0.0	407.0	0.0	0.0	0.0	0.0	606.6	0.0	0.9	1302.0
2030	0.0	0.0	460.4	0.0	0.0	0.0	0.0	606.6	0.0	0.0	1473.1
2035	0.0	0.0	520.9	0.0	0.0	0.0	0.0	606.6	0.0	0.0	1666.7
2040	0.0	0.0	589.4	0.0	0.0	0.0	0.0	606.6	0.0	0.0	1885.6
2045	0.0	0.0	666.9	0.0	0.0	0.0	0.0	606.6	0.0	0.0	2133.5
2050	0.0	0.0	754.5	0.0	0.0	0.0	0.0	606.6	0.0	0.0	2413.8
2055	0.0	0.0	853.6	0.0	0.0	0.0	0.0	606.6	0.0	0.0	2731.0
2060	0.0	0.0	965.8	0.0	0.0	0.0	0.0	606.6	0.0	0.0	3089.9
2065	0.0	0.0	1092.7	0.0	0.0	0.0	0.0	606.6	0.0	0.0	3495.9
2070	0.0	0.0	1236.3	0.0	0.0	0.0	0.0	606.6	0.0	0.0	3955.3
2075	0.0	0.0	1398.8	0.0	0.0	0.0	0.0	606.6	0.0	0.0	4475.1
2080	0.0	0.0	1582.6	0.0	0.0	0.0	0.0	606.6	0.0	0.0	5063.1
2085	0.0	0.0	1790.5	0.0	0.0	0.0	0.0	606.6	0.0	0.0	5728.5
2090	0.0	0.0	2025.8	0.0	0.0	0.0	0.0	606.6	0.0	0.0	6481.2
2095	0.0	0.0	2292.0	0.0	0.0	0.0	0.0	606.6	0.0	0.0	7332.9
2100	0.0	0.0	2593.2	0.0	0.0	0.0	0.0	606.6	0.0	0.0	8296.5

* Partially-halogenated chlorine-containing chemical substitutes (such as HCFCs 22, 123, 141b, 142b) modeled using the atmospheric characteristics of HCFC-22.

EXHIBIT B-36

100 Percent Reduction with CH3CCl3 Freeze and 100 Percent Participation and Post-2050 Growth and 1:5 Substitution

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCl4	CH3CCl3	H-1211	H-1301	SUBST *
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1	0.0
1990	80.2	153.4	122.2	0.0	3.1	5.4	0.0	606.6	2.7	2.3	129.8
1995	67.2	27.8	165.4	0.0	0.0	3.2	0.0	606.6	2.7	1.9	200.1
2000	65.1	42.4	206.1	0.0	0.0	2.3	0.0	606.6	3.1	1.7	244.3
2005	71.5	63.4	245.4	0.0	0.0	1.7	0.0	606.6	4.5	1.6	286.7
2010	0.0	0.0	280.3	0.0	0.0	0.0	0.0	606.6	0.5	1.8	358.3
2015	0.0	0.0	317.8	0.0	0.0	0.0	0.0	606.6	0.6	0.8	406.5
2020	0.0	0.0	359.7	0.0	0.0	0.0	0.0	606.6	0.0	0.8	460.3
2025	0.0	0.0	407.0	0.0	0.0	0.0	0.0	606.6	0.0	0.9	520.8
2030	0.0	0.0	460.4	0.0	0.0	0.0	0.0	606.6	0.0	0.0	589.2
2035	0.0	0.0	520.9	0.0	0.0	0.0	0.0	606.6	0.0	0.0	666.7
2040	0.0	0.0	589.4	0.0	0.0	0.0	0.0	606.6	0.0	0.0	754.3
2045	0.0	0.0	666.9	0.0	0.0	0.0	0.0	606.6	0.0	0.0	853.4
2050	0.0	0.0	754.5	0.0	0.0	0.0	0.0	606.6	0.0	0.0	965.5
2055	0.0	0.0	853.6	0.0	0.0	0.0	0.0	606.6	0.0	0.0	1092.4
2060	0.0	0.0	965.8	0.0	0.0	0.0	0.0	606.6	0.0	0.0	1235.9
2065	0.0	0.0	1092.7	0.0	0.0	0.0	0.0	606.6	0.0	0.0	1398.4
2070	0.0	0.0	1236.3	0.0	0.0	0.0	0.0	606.6	0.0	0.0	1582.1
2075	0.0	0.0	1398.8	0.0	0.0	0.0	0.0	606.6	0.0	0.0	1790.0
2080	0.0	0.0	1582.6	0.0	0.0	0.0	0.0	606.6	0.0	0.0	2025.2
2085	0.0	0.0	1790.5	0.0	0.0	0.0	0.0	606.6	0.0	0.0	2291.4
2090	0.0	0.0	2025.8	0.0	0.0	0.0	0.0	606.6	0.0	0.0	2592.5
2095	0.0	0.0	2292.0	0.0	0.0	0.0	0.0	606.6	0.0	0.0	2933.1
2100	0.0	0.0	2593.2	0.0	0.0	0.0	0.0	606.6	0.0	0.0	3318.6

* Partially-halogenated chlorine-containing chemical substitutes (such as HCFCs 22, 123, 141b, 142b) modeled using the atmospheric characteristics of HCFC-22.

EXHIBIT B-37

90 Percent Reduction Scenario (1998)

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCl4	CH3CCl3	H-1211	H-1301
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1
1990	364.3	440.8	122.2	202.5	15.7	6.9	104.6	738.1	3.3	3.8
1995	359.5	429.5	165.4	184.6	13.9	7.3	94.0	866.4	6.2	5.0
2000	237.1	296.8	206.1	62.1	6.5	6.0	41.9	992.9	9.9	5.8
2005	235.6	256.9	245.4	59.7	4.9	4.7	39.5	1123.4	14.8	6.9
2010	186.6	204.8	280.3	48.0	3.8	3.3	28.4	1271.0	19.7	8.4
2015	166.1	172.6	317.8	49.5	3.7	2.1	29.6	1438.1	24.2	9.9
2020	135.3	165.0	359.7	51.1	3.8	2.0	30.7	1627.0	29.0	11.3
2025	136.6	163.0	407.0	52.8	4.0	1.9	32.0	1840.9	33.6	13.1
2030	136.6	167.8	460.4	54.6	4.1	2.0	33.3	2082.8	38.9	15.1
2035	142.3	174.9	520.9	56.4	4.3	2.0	34.8	2356.5	45.0	17.3
2040	148.4	182.4	589.4	58.4	4.5	2.1	36.3	2666.1	52.0	20.1
2045	154.9	190.4	666.9	60.5	4.7	2.2	37.9	3016.5	60.2	23.4
2050	161.8	198.8	754.5	62.8	4.8	2.3	39.5	3412.9	69.6	27.4
2055	163.5	201.5	815.1	62.8	4.9	2.3	39.5	3412.9	78.7	30.5
2060	164.9	203.1	852.2	62.8	4.9	2.3	39.5	3412.9	86.7	33.1
2065	166.0	204.4	875.5	62.8	4.9	2.4	39.5	3412.9	93.9	35.3
2070	166.6	204.8	879.1	62.8	4.9	2.4	39.5	3412.9	99.4	37.3
2075	166.6	204.8	879.1	62.8	4.9	2.4	39.5	3412.9	100.2	38.8
2080	166.6	204.8	879.1	62.8	4.9	2.4	39.5	3412.9	100.8	39.6
2085	166.6	204.8	879.1	62.8	4.9	2.4	39.5	3412.9	100.8	40.3
2090	166.6	204.8	879.1	62.8	4.9	2.4	39.5	3412.9	100.8	40.5
2095	166.6	204.8	879.1	62.8	4.9	2.4	39.5	3412.9	100.8	40.5
2100	166.6	204.8	879.1	62.8	4.9	2.4	39.5	3412.9	100.8	40.5

EXHIBIT B-38

95 Percent Reduction Scenario (1998)

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCl4	CH3CCl3	H-1211	H-1301
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1
1990	364.3	440.8	122.2	202.5	15.7	6.9	104.6	738.1	3.3	3.8
1995	359.5	429.5	165.4	184.6	13.9	7.3	94.0	866.4	6.2	5.0
2000	226.6	284.8	206.1	52.2	6.0	5.9	38.0	992.9	9.9	5.8
2005	223.7	240.2	245.4	49.8	4.3	4.4	35.6	1123.4	14.8	6.9
2010	171.2	184.5	280.3	37.3	3.1	3.1	23.7	1271.0	19.7	8.4
2015	149.6	149.6	317.8	38.8	3.0	1.7	24.8	1438.1	24.2	9.9
2020	116.3	141.1	359.7	40.4	3.1	1.6	26.0	1627.0	29.0	11.3
2025	117.4	138.6	407.0	42.0	3.3	1.5	27.2	1840.9	33.6	13.1
2030	117.0	143.2	460.4	43.8	3.4	1.6	28.6	2082.8	38.9	15.1
2035	122.8	150.3	520.9	45.7	3.6	1.6	30.0	2356.5	45.0	17.3
2040	128.9	157.8	589.4	47.7	3.8	1.7	31.5	2666.1	52.0	20.1
2045	135.4	165.8	666.9	49.8	3.9	1.8	33.1	3016.5	60.2	23.4
2050	142.2	174.3	754.5	52.0	4.1	1.9	34.8	3412.9	69.6	27.4
2055	144.0	176.9	815.1	52.0	4.2	1.9	34.8	3412.9	78.7	30.5
2060	145.3	178.6	852.2	52.0	4.2	1.9	34.8	3412.9	86.7	33.1
2065	146.4	179.9	875.5	52.0	4.2	2.0	34.8	3412.9	93.9	35.3
2070	147.1	180.3	879.1	52.0	4.2	2.0	34.8	3412.9	99.4	37.3
2075	147.1	180.3	879.1	52.0	4.2	2.0	34.8	3412.9	100.2	38.8
2080	147.1	180.3	879.1	52.0	4.2	2.0	34.8	3412.9	100.8	39.6
2085	147.1	180.3	879.1	52.0	4.2	2.0	34.8	3412.9	100.8	40.3
2090	147.1	180.3	879.1	52.0	4.2	2.0	34.8	3412.9	100.8	40.5
2095	147.1	180.3	879.1	52.0	4.2	2.0	34.8	3412.9	100.8	40.5
2100	147.1	180.3	879.1	52.0	4.2	2.0	34.8	3412.9	100.8	40.5

EXHIBIT B-39

97 Percent Reduction Scenario (1998)

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCl4	CH3CCl3	H-1211	H-1301
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1
1990	364.3	440.8	122.2	202.5	15.7	6.9	104.6	738.1	3.3	3.8
1995	359.5	429.5	165.4	184.6	13.9	7.3	94.0	866.4	6.2	5.0
2000	222.3	280.0	206.1	48.3	5.8	5.9	36.5	992.9	9.9	5.8
2005	219.0	233.5	245.4	45.9	4.0	4.4	34.0	1123.4	14.8	6.9
2010	165.0	176.3	280.3	33.0	2.8	2.9	21.8	1271.0	19.7	8.4
2015	142.9	140.3	317.8	34.5	2.7	1.5	22.9	1438.1	24.2	9.9
2020	108.7	131.6	359.7	36.1	2.8	1.4	24.1	1627.0	29.0	11.3
2025	109.7	128.8	407.0	37.7	3.0	1.3	25.3	1840.9	33.6	13.1
2030	109.2	133.4	460.4	39.5	3.1	1.4	26.7	2082.8	38.9	15.1
2035	114.9	140.5	520.9	41.4	3.3	1.5	28.1	2356.5	45.0	17.3
2040	121.1	148.0	589.4	43.4	3.5	1.5	29.6	2666.1	52.0	20.1
2045	127.5	156.0	666.9	45.5	3.7	1.6	31.2	3016.5	60.2	23.4
2050	134.4	164.5	754.5	47.7	3.8	1.7	32.9	3412.9	69.6	27.4
2055	136.1	167.1	815.1	47.7	3.9	1.7	32.9	3412.9	78.7	30.5
2060	137.5	168.8	852.2	47.7	3.9	1.8	32.9	3412.9	86.7	33.1
2065	138.6	170.1	875.5	47.7	3.9	1.8	32.9	3412.9	93.9	35.3
2070	139.2	170.5	879.1	47.7	3.9	1.8	32.9	3412.9	99.4	37.3
2075	139.2	170.5	879.1	47.7	3.9	1.8	32.9	3412.9	100.2	38.8
2080	139.2	170.5	879.1	47.7	3.9	1.8	32.9	3412.9	100.8	39.6
2085	139.2	170.5	879.1	47.7	3.9	1.8	32.9	3412.9	100.8	40.3
2090	139.2	170.5	879.1	47.7	3.9	1.8	32.9	3412.9	100.8	40.5
2095	139.2	170.5	879.1	47.7	3.9	1.8	32.9	3412.9	100.8	40.5
2100	139.2	170.5	879.1	47.7	3.9	1.8	32.9	3412.9	100.8	40.5

EXHIBIT B-40

100 Percent Reduction Scenario (1998)

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCl4	CH3CCl3	H-1211	H-1301
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1
1990	364.3	440.8	122.2	202.5	15.7	6.9	104.6	738.1	3.3	3.8
1995	359.5	429.5	165.4	184.6	13.9	7.3	94.0	866.4	6.2	5.0
2000	216.0	272.8	206.1	42.4	5.4	5.8	34.1	992.9	9.9	5.8
2005	211.9	223.5	245.4	40.0	3.7	4.2	31.7	1123.4	14.8	6.9
2010	155.8	164.1	280.3	26.5	2.4	2.8	18.9	1271.0	19.7	8.4
2015	133.0	126.5	317.8	28.0	2.3	1.3	20.0	1438.1	24.2	9.9
2020	97.3	117.3	359.7	29.6	2.4	1.2	21.2	1627.0	29.0	11.3
2025	98.2	114.2	407.0	31.3	2.6	1.1	22.5	1840.9	33.6	13.1
2030	97.4	118.7	460.4	33.1	2.7	1.1	23.8	2082.8	38.9	15.1
2035	103.2	125.8	520.9	34.9	2.9	1.2	25.2	2356.5	45.0	17.3
2040	109.3	133.3	589.4	36.9	3.0	1.3	26.7	2666.1	52.0	20.1
2045	115.8	141.3	666.9	39.0	3.2	1.4	28.3	3016.5	60.2	23.4
2050	122.7	149.7	754.5	41.3	3.4	1.4	30.0	3412.9	69.6	27.4
2055	124.4	152.4	815.1	41.3	3.4	1.5	30.0	3412.9	78.7	30.5
2060	125.8	154.0	852.2	41.3	3.4	1.5	30.0	3412.9	86.7	33.1
2065	126.8	155.4	875.5	41.3	3.4	1.6	30.0	3412.9	93.9	35.3
2070	127.5	155.7	879.1	41.3	3.4	1.6	30.0	3412.9	99.4	37.3
2075	127.5	155.7	879.1	41.3	3.4	1.6	30.0	3412.9	100.2	38.8
2080	127.5	155.7	879.1	41.3	3.4	1.6	30.0	3412.9	100.8	39.6
2085	127.5	155.7	879.1	41.3	3.4	1.6	30.0	3412.9	100.8	40.3
2090	127.5	155.7	879.1	41.3	3.4	1.6	30.0	3412.9	100.8	40.5
2095	127.5	155.7	879.1	41.3	3.4	1.6	30.0	3412.9	100.8	40.5
2100	127.5	155.7	879.1	41.3	3.4	1.6	30.0	3412.9	100.8	40.5

EXHIBIT B-41

90 Percent Reduction with 100 Percent Participation (1998)

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCl4	CH3CCl3	H-1211	H-1301
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1
1990	362.6	439.4	122.2	201.4	15.7	6.9	104.1	738.1	3.3	3.8
1995	351.7	421.5	165.4	180.2	13.7	7.2	91.6	866.4	6.2	5.0
2000	213.3	271.0	206.1	49.1	5.7	5.9	34.7	992.9	9.9	5.8
2005	201.1	216.9	245.4	43.3	3.8	4.4	29.4	1123.4	14.8	6.9
2010	126.5	134.5	280.3	23.2	1.9	2.8	10.8	1271.0	19.7	8.4
2015	98.0	88.2	317.8	23.2	1.6	1.3	10.8	1438.1	24.2	9.9
2020	58.9	71.3	359.7	23.2	1.6	1.1	10.8	1627.0	29.0	11.3
2025	52.9	58.6	407.0	23.2	1.6	.9	10.8	1840.9	33.6	13.1
2030	44.5	55.6	460.4	23.2	1.6	.9	10.8	2082.8	38.9	15.1
2035	44.5	55.6	520.9	23.2	1.6	.9	10.8	2356.5	45.0	17.3
2040	44.5	55.6	589.4	23.2	1.6	.9	10.8	2666.1	52.0	20.1
2045	44.5	55.6	666.9	23.2	1.6	.9	10.8	3016.5	60.2	23.4
2050	44.5	55.6	754.5	23.2	1.6	.9	10.8	3412.9	69.6	27.4
2055	44.5	55.6	815.1	23.2	1.6	.9	10.8	3412.9	78.7	30.5
2060	44.5	55.6	852.2	23.2	1.6	.9	10.8	3412.9	86.7	33.1
2065	44.5	55.6	875.5	23.2	1.6	.9	10.8	3412.9	93.9	35.3
2070	44.5	55.6	879.1	23.2	1.6	.9	10.8	3412.9	99.4	37.3
2075	44.5	55.6	879.1	23.2	1.6	.9	10.8	3412.9	100.2	38.8
2080	44.5	55.6	879.1	23.2	1.6	.9	10.8	3412.9	100.8	39.6
2085	44.5	55.6	879.1	23.2	1.6	.9	10.8	3412.9	100.8	40.3
2090	44.5	55.6	879.1	23.2	1.6	.9	10.8	3412.9	100.8	40.5
2095	44.5	55.6	879.1	23.2	1.6	.9	10.8	3412.9	100.8	40.5
2100	44.5	55.6	879.1	23.2	1.6	.9	10.8	3412.9	100.8	40.5

EXHIBIT B-42

95 Percent Reduction with 100 Percent Participation (1998)

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCl4	CH3CCl3	H-1211	H-1301
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1
1990	362.6	439.4	122.2	201.4	15.7	6.9	104.1	738.1	3.3	3.8
1995	351.7	421.5	165.4	180.2	13.7	7.2	91.6	866.4	6.2	5.0
2000	202.2	258.5	206.1	38.9	5.2	5.7	30.7	992.9	9.9	5.8
2005	188.7	199.6	245.4	33.2	3.2	4.1	25.3	1123.4	14.8	6.9
2010	109.0	111.8	280.3	11.6	1.1	2.5	5.4	1271.0	19.7	8.4
2015	79.2	62.4	317.8	11.6	.8	.9	5.4	1438.1	24.2	9.9
2020	37.4	44.5	359.7	11.6	.8	.7	5.4	1627.0	29.0	11.3
2025	31.2	31.0	407.0	11.6	.8	.4	5.4	1840.9	33.6	13.1
2030	22.3	27.8	460.4	11.6	.8	.4	5.4	2082.8	38.9	15.1
2035	22.3	27.8	520.9	11.6	.8	.4	5.4	2356.5	45.0	17.3
2040	22.3	27.8	589.4	11.6	.8	.4	5.4	2666.1	52.0	20.1
2045	22.3	27.8	666.9	11.6	.8	.4	5.4	3016.5	60.2	23.4
2050	22.3	27.8	754.5	11.6	.8	.4	5.4	3412.9	69.6	27.4
2055	22.3	27.8	815.1	11.6	.8	.4	5.4	3412.9	78.7	30.5
2060	22.3	27.8	852.2	11.6	.8	.4	5.4	3412.9	86.7	33.1
2065	22.3	27.8	875.5	11.6	.8	.4	5.4	3412.9	93.9	35.3
2070	22.3	27.8	879.1	11.6	.8	.4	5.4	3412.9	99.4	37.3
2075	22.3	27.8	879.1	11.6	.8	.4	5.4	3412.9	100.2	38.8
2080	22.3	27.8	879.1	11.6	.8	.4	5.4	3412.9	100.8	39.6
2085	22.3	27.8	879.1	11.6	.8	.4	5.4	3412.9	100.8	40.3
2090	22.3	27.8	879.1	11.6	.8	.4	5.4	3412.9	100.8	40.5
2095	22.3	27.8	879.1	11.6	.8	.4	5.4	3412.9	100.8	40.5
2100	22.3	27.8	879.1	11.6	.8	.4	5.4	3412.9	100.8	40.5

EXHIBIT B-43

97 Percent Reduction with 100 Percent Participation (1998)

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCl4	CH3CCl3	H-1211	H-1301
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1
1990	362.6	439.4	122.2	201.4	15.7	6.9	104.1	738.1	3.3	3.8
1995	351.7	421.5	165.4	180.2	13.7	7.2	91.6	866.4	6.2	5.0
2000	197.8	253.5	206.1	34.8	5.0	5.7	29.0	992.9	9.9	5.8
2005	183.7	192.6	245.4	29.1	2.9	4.0	23.7	1123.4	14.8	6.9
2010	102.0	102.7	280.3	7.0	.8	2.4	3.2	1271.0	19.7	8.4
2015	71.7	52.1	317.8	7.0	.5	.7	3.2	1438.1	24.2	9.9
2020	28.9	33.8	359.7	7.0	.5	.5	3.2	1627.0	29.0	11.3
2025	22.5	19.9	407.0	7.0	.5	.3	3.2	1840.9	33.6	13.1
2030	13.4	16.7	460.4	7.0	.5	.3	3.2	2082.8	38.9	15.1
2035	13.4	16.7	520.9	7.0	.5	.3	3.2	2356.5	45.0	17.3
2040	13.4	16.7	589.4	7.0	.5	.3	3.2	2666.1	52.0	20.1
2045	13.4	16.7	666.9	7.0	.5	.3	3.2	3016.5	60.2	23.4
2050	13.4	16.7	754.5	7.0	.5	.3	3.2	3412.9	69.6	27.4
2055	13.4	16.7	815.1	7.0	.5	.3	3.2	3412.9	78.7	30.5
2060	13.4	16.7	852.2	7.0	.5	.3	3.2	3412.9	86.7	33.1
2065	13.4	16.7	875.5	7.0	.5	.3	3.2	3412.9	93.9	35.3
2070	13.4	16.7	879.1	7.0	.5	.3	3.2	3412.9	99.4	37.3
2075	13.4	16.7	879.1	7.0	.5	.3	3.2	3412.9	100.2	38.8
2080	13.4	16.7	879.1	7.0	.5	.3	3.2	3412.9	100.8	39.6
2085	13.4	16.7	879.1	7.0	.5	.3	3.2	3412.9	100.8	40.3
2090	13.4	16.7	879.1	7.0	.5	.3	3.2	3412.9	100.8	40.5
2095	13.4	16.7	879.1	7.0	.5	.3	3.2	3412.9	100.8	40.5
2100	13.4	16.7	879.1	7.0	.5	.3	3.2	3412.9	100.8	40.5

EXHIBIT B-44

100 Percent Reduction with 100 Percent Participation (1998)

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCl4	CH3CCl3	H-1211	H-1301
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1
1990	362.6	439.4	122.2	201.4	15.7	6.9	104.1	738.1	3.3	3.8
1995	351.7	421.5	165.4	180.2	13.7	7.2	91.6	866.4	6.2	5.0
2000	191.1	246.0	206.1	28.7	4.7	5.6	26.6	992.9	9.9	5.8
2005	176.2	182.2	245.4	23.0	2.5	3.9	21.3	1123.4	14.8	6.9
2010	91.6	89.1	280.3	.0	.4	2.2	.0	1271.0	19.7	8.4
2015	60.4	36.6	317.8	.0	.0	.5	.0	1438.1	24.2	9.9
2020	16.0	17.8	359.7	.0	.0	.3	.0	1627.0	29.0	11.3
2025	9.5	3.3	407.0	.0	.0	.0	.0	1840.9	33.6	13.1
2030	.0	.0	460.4	.0	.0	.0	.0	2082.8	38.9	15.1
2035	.0	.0	520.9	.0	.0	.0	.0	2356.5	45.0	17.3
2040	.0	.0	589.4	.0	.0	.0	.0	2666.1	52.0	20.1
2045	.0	.0	666.9	.0	.0	.0	.0	3016.5	60.2	23.4
2050	.0	.0	754.5	.0	.0	.0	.0	3412.9	69.6	27.4
2055	.0	.0	815.1	.0	.0	.0	.0	3412.9	78.7	30.5
2060	.0	.0	852.2	.0	.0	.0	.0	3412.9	86.7	33.1
2065	.0	.0	875.5	.0	.0	.0	.0	3412.9	93.9	35.3
2070	.0	.0	879.1	.0	.0	.0	.0	3412.9	99.4	37.3
2075	.0	.0	879.1	.0	.0	.0	.0	3412.9	100.2	38.8
2080	.0	.0	879.1	.0	.0	.0	.0	3412.9	100.8	39.6
2085	.0	.0	879.1	.0	.0	.0	.0	3412.9	100.8	40.3
2090	.0	.0	879.1	.0	.0	.0	.0	3412.9	100.8	40.5
2095	.0	.0	879.1	.0	.0	.0	.0	3412.9	100.8	40.5
2100	.0	.0	879.1	.0	.0	.0	.0	3412.9	100.8	40.5

EXHIBIT B-45

90 Percent Reduction with CH3CCl3 Freeze and 100 Percent Participation (1998)

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCl4	CH3CCl3	H-1211	H-1301
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1
1990	362.6	439.4	122.2	201.4	15.7	6.9	104.1	641.3	3.3	3.8
1995	351.7	421.5	165.4	180.2	13.7	7.2	91.6	660.9	6.2	5.0
2000	213.3	271.0	206.1	49.1	5.7	5.9	34.7	664.0	9.9	5.8
2005	201.1	216.9	245.4	43.3	3.8	4.4	29.4	664.0	14.8	6.9
2010	126.5	134.5	280.3	23.2	1.9	2.8	10.8	664.0	19.7	8.4
2015	98.0	88.2	317.8	23.2	1.6	1.3	10.8	664.0	24.2	9.9
2020	58.9	71.3	359.7	23.2	1.6	1.1	10.8	664.0	29.0	11.3
2025	52.9	58.6	407.0	23.2	1.6	.9	10.8	664.0	33.6	13.1
2030	44.5	55.6	460.4	23.2	1.6	.9	10.8	664.0	38.9	15.1
2035	44.5	55.6	520.9	23.2	1.6	.9	10.8	664.0	45.0	17.3
2040	44.5	55.6	589.4	23.2	1.6	.9	10.8	664.0	52.0	20.1
2045	44.5	55.6	666.9	23.2	1.6	.9	10.8	664.0	60.2	23.4
2050	44.5	55.6	754.5	23.2	1.6	.9	10.8	664.0	69.6	27.4
2055	44.5	55.6	815.1	23.2	1.6	.9	10.8	664.0	78.7	30.5
2060	44.5	55.6	852.2	23.2	1.6	.9	10.8	664.0	86.7	33.1
2065	44.5	55.6	875.5	23.2	1.6	.9	10.8	664.0	93.9	35.3
2070	44.5	55.6	879.1	23.2	1.6	.9	10.8	664.0	99.4	37.3
2075	44.5	55.6	879.1	23.2	1.6	.9	10.8	664.0	100.2	38.8
2080	44.5	55.6	879.1	23.2	1.6	.9	10.8	664.0	100.8	39.6
2085	44.5	55.6	879.1	23.2	1.6	.9	10.8	664.0	100.8	40.3
2090	44.5	55.6	879.1	23.2	1.6	.9	10.8	664.0	100.8	40.5
2095	44.5	55.6	879.1	23.2	1.6	.9	10.8	664.0	100.8	40.5
2100	44.5	55.6	879.1	23.2	1.6	.9	10.8	664.0	100.8	40.5

EXHIBIT B-46

95 Percent Reduction with CH3CCl3 Freeze and 100 Percent Participation (1998)

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCl4	CH3CCl3	H-1211	H-1301
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1
1990	362.6	439.4	122.2	201.4	15.7	6.9	104.1	641.3	3.3	3.8
1995	351.7	421.5	165.4	180.2	13.7	7.2	91.6	660.9	6.2	5.0
2000	202.2	258.5	206.1	38.9	5.2	5.7	30.7	664.0	9.9	5.8
2005	188.7	199.6	245.4	33.2	3.2	4.1	25.3	664.0	14.8	6.9
2010	109.0	111.8	280.3	11.6	1.1	2.5	5.4	664.0	19.7	8.4
2015	79.2	62.4	317.8	11.6	.8	.9	5.4	664.0	24.2	9.9
2020	37.4	44.5	359.7	11.6	.8	.7	5.4	664.0	29.0	11.3
2025	31.2	31.0	407.0	11.6	.8	.4	5.4	664.0	33.6	13.1
2030	22.3	27.8	460.4	11.6	.8	.4	5.4	664.0	38.9	15.1
2035	22.3	27.8	520.9	11.6	.8	.4	5.4	664.0	45.0	17.3
2040	22.3	27.8	589.4	11.6	.8	.4	5.4	664.0	52.0	20.1
2045	22.3	27.8	666.9	11.6	.8	.4	5.4	664.0	60.2	23.4
2050	22.3	27.8	754.5	11.6	.8	.4	5.4	664.0	69.6	27.4
2055	22.3	27.8	815.1	11.6	.8	.4	5.4	664.0	78.7	30.5
2060	22.3	27.8	852.2	11.6	.8	.4	5.4	664.0	86.7	33.1
2065	22.3	27.8	875.5	11.6	.8	.4	5.4	664.0	93.9	35.3
2070	22.3	27.8	879.1	11.6	.8	.4	5.4	664.0	99.4	37.3
2075	22.3	27.8	879.1	11.6	.8	.4	5.4	664.0	100.2	38.8
2080	22.3	27.8	879.1	11.6	.8	.4	5.4	664.0	100.8	39.6
2085	22.3	27.8	879.1	11.6	.8	.4	5.4	664.0	100.8	40.3
2090	22.3	27.8	879.1	11.6	.8	.4	5.4	664.0	100.8	40.5
2095	22.3	27.8	879.1	11.6	.8	.4	5.4	664.0	100.8	40.5
2100	22.3	27.8	879.1	11.6	.8	.4	5.4	664.0	100.8	40.5

EXHIBIT B-47

97 Percent Reduction with CH3CCl3 Freeze and 100 Percent Participation (1998)

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCl4	CH3CCl3	H-1211	H-1301
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1
1990	362.6	439.4	122.2	201.4	15.7	6.9	104.1	641.3	3.3	3.8
1995	351.7	421.5	165.4	180.2	13.7	7.2	91.6	660.9	6.2	5.0
2000	197.8	253.5	206.1	34.8	5.0	5.7	29.0	664.0	9.9	5.8
2005	183.7	192.6	245.4	29.1	2.9	4.0	23.7	664.0	14.8	6.9
2010	102.0	102.7	280.3	7.0	.8	2.4	3.2	664.0	19.7	8.4
2015	71.7	52.1	317.8	7.0	.5	.7	3.2	664.0	24.2	9.9
2020	28.9	33.8	359.7	7.0	.5	.5	3.2	664.0	29.0	11.3
2025	22.5	19.9	407.0	7.0	.5	.3	3.2	664.0	33.6	13.1
2030	13.4	16.7	460.4	7.0	.5	.3	3.2	664.0	38.9	15.1
2035	13.4	16.7	520.9	7.0	.5	.3	3.2	664.0	45.0	17.3
2040	13.4	16.7	589.4	7.0	.5	.3	3.2	664.0	52.0	20.1
2045	13.4	16.7	666.9	7.0	.5	.3	3.2	664.0	60.2	23.4
2050	13.4	16.7	754.5	7.0	.5	.3	3.2	664.0	69.6	27.4
2055	13.4	16.7	815.1	7.0	.5	.3	3.2	664.0	78.7	30.5
2060	13.4	16.7	852.2	7.0	.5	.3	3.2	664.0	86.7	33.1
2065	13.4	16.7	875.5	7.0	.5	.3	3.2	664.0	93.9	35.3
2070	13.4	16.7	879.1	7.0	.5	.3	3.2	664.0	99.4	37.3
2075	13.4	16.7	879.1	7.0	.5	.3	3.2	664.0	100.2	38.8
2080	13.4	16.7	879.1	7.0	.5	.3	3.2	664.0	100.8	39.6
2085	13.4	16.7	879.1	7.0	.5	.3	3.2	664.0	100.8	40.3
2090	13.4	16.7	879.1	7.0	.5	.3	3.2	664.0	100.8	40.5
2095	13.4	16.7	879.1	7.0	.5	.3	3.2	664.0	100.8	40.5
2100	13.4	16.7	879.1	7.0	.5	.3	3.2	664.0	100.8	40.5

EXHIBIT B-48

100 Percent Reduction with CH3CCL3 Freeze and 100 Percent Participation (1998)

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCl4	CH3CCl3	H-1211	H-1301
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1
1990	362.6	439.4	122.2	201.4	15.7	6.9	104.1	641.3	3.3	3.8
1995	351.7	421.5	165.4	180.2	13.7	7.2	91.6	660.9	6.2	5.0
2000	191.1	246.0	206.1	28.7	4.7	5.6	26.6	664.0	9.9	5.8
2005	176.2	182.2	245.4	23.0	2.5	3.9	21.3	664.0	14.8	6.9
2010	91.6	89.1	280.3	.0	.4	2.2	.0	664.0	19.7	8.4
2015	60.4	36.6	317.8	.0	.0	.5	.0	664.0	24.2	9.9
2020	16.0	17.8	359.7	.0	.0	.3	.0	664.0	29.0	11.3
2025	9.5	3.3	407.0	.0	.0	.0	.0	664.0	33.6	13.1
2030	.0	.0	460.4	.0	.0	.0	.0	664.0	38.9	15.1
2035	.0	.0	520.9	.0	.0	.0	.0	664.0	45.0	17.3
2040	.0	.0	589.4	.0	.0	.0	.0	664.0	52.0	20.1
2045	.0	.0	666.9	.0	.0	.0	.0	664.0	60.2	23.4
2050	.0	.0	754.5	.0	.0	.0	.0	664.0	69.6	27.4
2055	.0	.0	815.1	.0	.0	.0	.0	664.0	78.7	30.5
2060	.0	.0	852.2	.0	.0	.0	.0	664.0	86.7	33.1
2065	.0	.0	875.5	.0	.0	.0	.0	664.0	93.9	35.3
2070	.0	.0	879.1	.0	.0	.0	.0	664.0	99.4	35.3
2075	.0	.0	879.1	.0	.0	.0	.0	664.0	100.2	38.8
2080	.0	.0	879.1	.0	.0	.0	.0	664.0	100.8	39.6
2085	.0	.0	879.1	.0	.0	.0	.0	664.0	100.8	40.3
2090	.0	.0	879.1	.0	.0	.0	.0	664.0	100.8	40.5
2095	.0	.0	879.1	.0	.0	.0	.0	664.0	100.8	40.5
2100	.0	.0	879.1	.0	.0	.0	.0	664.0	100.8	40.5

EXHIBIT B-49

90 Percent Reduction with CH3CCl3 Freeeze and 100 Percent Participation and 1:2 Substitution (1998)

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCL4	CH3CCL3	H-1211	H-1301	SUBST *
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1	0.0
1990	362.6	439.4	122.2	201.4	15.7	6.9	104.1	641.3	3.3	3.8	40.4
1995	351.7	421.5	165.4	180.2	13.7	7.2	91.6	660.9	6.2	5.0	161.1
2000	213.3	271.0	206.1	49.1	5.7	5.9	34.7	664.0	9.9	5.8	422.5
2005	201.1	216.9	245.4	43.3	3.8	4.4	29.4	664.0	14.8	6.9	575.3
2010	126.5	134.5	280.3	23.2	1.9	2.8	10.8	664.0	19.7	8.4	765.3
2015	98.0	88.2	317.8	23.2	1.6	1.3	10.8	664.0	24.2	9.9	923.3
2020	58.9	71.3	359.7	23.2	1.6	1.1	10.8	664.0	29.0	11.3	1085.7
2025	52.9	58.6	407.0	23.2	1.6	0.9	10.8	664.0	33.6	13.1	1246.3
2030	44.5	55.6	460.4	23.2	1.6	0.9	10.8	664.0	38.9	15.1	1423.0
2035	44.5	55.6	520.9	23.2	1.6	0.9	10.8	664.0	45.0	17.3	1616.6
2040	44.5	55.6	589.4	23.2	1.6	0.9	10.8	664.0	52.0	20.1	1835.6
2045	44.5	55.6	666.9	23.2	1.6	0.9	10.8	664.0	60.2	23.4	2083.4
2050	44.5	55.6	754.5	23.2	1.6	0.9	10.8	664.0	69.6	27.4	2363.8
2055	44.5	55.6	815.1	23.2	1.6	0.9	10.8	664.0	78.7	30.5	2452.0
2060	44.5	55.6	852.2	23.2	1.6	0.9	10.8	664.0	86.7	33.1	2507.1
2065	44.5	55.6	875.5	23.2	1.6	0.9	10.8	664.0	93.9	35.3	2553.0
2070	44.5	55.6	879.1	23.2	1.6	0.9	10.8	664.0	99.4	37.3	2576.1
2075	44.5	55.6	879.1	23.2	1.6	0.9	10.8	664.0	100.2	38.8	2576.1
2080	44.5	55.6	879.1	23.2	1.6	0.9	10.8	664.0	100.8	39.6	2576.1
2085	44.5	55.6	879.1	23.2	1.6	0.9	10.8	664.0	100.8	40.3	2576.1
2090	44.5	55.6	879.1	23.2	1.6	0.9	10.8	664.0	100.8	40.5	2576.1
2095	44.5	55.6	879.1	23.2	1.6	0.9	10.8	664.0	100.8	40.5	2576.1
2100	44.5	55.6	879.1	23.2	1.6	0.9	10.8	664.0	100.8	40.5	2576.1

* Partially-halogenated chlorine-containing chemical substitutes (such as HCFCs 22, 123, 141b, 142b) modeled using the atmospheric characteristics of HCFC-22.

EXHIBIT B-50

95 Percent Reduction with CH3CCl3 Freeze and 100 Percent Participation and 1:2 Substitution (1998)

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCL4	CH3CCL3	H-1211	H-1301	SUBST *
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1	0.0
1990	362.6	439.4	122.2	201.4	15.7	6.9	104.1	641.3	3.3	3.8	40.4
1995	351.7	421.5	165.4	180.2	13.7	7.2	91.6	660.9	6.2	5.0	161.1
2000	202.2	258.5	206.1	38.9	5.2	5.7	30.7	664.0	9.9	5.8	434.3
2005	188.7	199.6	245.4	33.2	3.2	4.1	25.3	664.0	14.8	6.9	590.2
2010	109.0	111.8	280.3	11.6	1.1	2.5	5.4	664.0	19.7	8.4	785.4
2015	79.2	62.4	317.8	11.6	0.8	0.9	5.4	664.0	24.2	9.9	945.6
2020	37.4	44.5	359.7	11.6	0.8	0.7	5.4	664.0	29.0	11.3	1109.9
2025	31.2	31.0	407.0	11.6	0.8	0.4	5.4	664.0	33.6	13.1	1270.9
2030	22.3	27.8	460.4	11.6	0.8	0.4	5.4	664.0	38.9	15.1	1448.0
2035	22.3	27.8	520.9	11.6	0.8	0.4	5.4	664.0	45.0	17.3	1641.6
2040	22.3	27.8	589.4	11.6	0.8	0.4	5.4	664.0	52.0	20.1	1860.6
2045	22.3	27.8	666.9	11.6	0.8	0.4	5.4	664.0	60.2	23.4	2108.4
2050	22.3	27.8	754.5	11.6	0.8	0.4	5.4	664.0	69.6	27.4	2388.8
2055	22.3	27.8	815.1	11.6	0.8	0.4	5.4	664.0	78.7	30.5	2477.0
2060	22.3	27.8	852.2	11.6	0.8	0.4	5.4	664.0	86.7	33.1	2532.1
2065	22.3	27.8	875.5	11.6	0.8	0.4	5.4	664.0	93.9	35.3	2578.0
2070	22.3	27.8	879.1	11.6	0.8	0.4	5.4	664.0	99.4	37.3	2601.1
2075	22.3	27.8	879.1	11.6	0.8	0.4	5.4	664.0	100.2	38.8	2601.1
2080	22.3	27.8	879.1	11.6	0.8	0.4	5.4	664.0	100.8	39.6	2601.1
2085	22.3	27.8	879.1	11.6	0.8	0.4	5.4	664.0	100.8	40.3	2601.1
2090	22.3	27.8	879.1	11.6	0.8	0.4	5.4	664.0	100.8	40.5	2601.1
2095	22.3	27.8	879.1	11.6	0.8	0.4	5.4	664.0	100.8	40.5	2601.1
2100	22.3	27.8	879.1	11.6	0.8	0.4	5.4	664.0	100.8	40.5	2601.1

* Partially-halogenated chlorine-containing chemical substitutes (such as HCFCs 22, 123, 141b, 142b) modeled using the atmospheric characteristics of HCFC-22.

EXHIBIT B-51

97 Percent Reduction with CH3CCl3 Freeze and 100 Percent Participation and 1:2 Substitution (1998)

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCL4	CH3CCL3	H-1211	H-1301	SUBST *
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1	0.0
1990	362.6	439.4	122.2	201.4	15.7	6.9	104.1	641.3	3.3	3.8	40.4
1995	351.7	421.5	165.4	180.2	13.7	7.2	91.6	660.9	6.2	5.0	161.1
2000	197.8	253.5	206.1	34.8	5.0	5.7	29.0	664.0	9.9	5.8	439.0
2005	183.7	192.6	245.4	29.1	2.9	4.0	23.7	664.0	14.8	6.9	596.2
2010	102.0	102.7	280.3	7.0	0.8	2.4	3.2	664.0	19.7	8.4	793.5
2015	71.7	52.1	317.8	7.0	0.5	0.7	3.2	664.0	24.2	9.9	954.5
2020	28.9	33.8	359.7	7.0	0.5	0.5	3.2	664.0	29.0	11.3	1119.5
2025	22.5	19.9	407.0	7.0	0.5	0.3	3.2	664.0	33.6	13.1	1280.8
2030	13.4	16.7	460.4	7.0	0.5	0.3	3.2	664.0	38.9	15.1	1458.0
2035	13.4	16.7	520.9	7.0	0.5	0.3	3.2	664.0	45.0	17.3	1651.6
2040	13.4	16.7	589.4	7.0	0.5	0.3	3.2	664.0	52.0	20.1	1870.6
2045	13.4	16.7	666.9	7.0	0.5	0.3	3.2	664.0	60.2	23.4	2118.4
2050	13.4	16.7	754.5	7.0	0.5	0.3	3.2	664.0	69.6	27.4	2398.8
2055	13.4	16.7	815.1	7.0	0.5	0.3	3.2	664.0	78.7	30.5	2437.0
2060	13.4	16.7	852.2	7.0	0.5	0.3	3.2	664.0	86.7	33.1	2542.1
2065	13.4	16.7	875.5	7.0	0.5	0.3	3.2	664.0	93.9	35.3	2588.0
2070	13.4	16.7	879.1	7.0	0.5	0.3	3.2	664.0	99.4	37.3	2611.1
2075	13.4	16.7	879.1	7.0	0.5	0.3	3.2	664.0	100.2	38.8	2611.1
2080	13.4	16.7	879.1	7.0	0.5	0.3	3.2	664.0	100.8	39.6	2611.1
2085	13.4	16.7	879.1	7.0	0.5	0.3	3.2	664.0	100.8	40.3	2611.1
2090	13.4	16.7	879.1	7.0	0.5	0.3	3.2	664.0	100.8	40.5	2611.1
2095	13.4	16.7	879.1	7.0	0.5	0.3	3.2	664.0	100.8	40.5	2611.1
2100	13.4	16.7	879.1	7.0	0.5	0.3	3.2	664.0	100.8	40.5	2611.1

* Partially-halogenated chlorine-containing chemical substitutes (such as HCFCs 22, 123, 141b, 142b) modeled using the atmospheric characteristics of HCFC-22.

EXHIBIT B-52

100 Percent Reduction with CH3CCl3 Freeze and 100 Percent Participation and 1:2 Substitution (1998)

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCL4	CH3CCL3	H-1211	H-1301	SUBST *
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1	0.0
1990	362.6	439.4	122.2	201.4	15.7	6.9	104.1	641.3	3.3	3.8	40.4
1995	351.7	421.5	165.4	180.2	13.7	7.2	91.6	660.9	6.2	5.0	161.1
2000	191.1	246.0	206.1	28.7	4.7	5.6	26.6	664.0	9.9	5.8	446.1
2005	176.2	182.2	245.4	23.0	2.5	3.9	21.3	664.0	14.8	6.9	605.1
2010	91.6	89.1	280.3	0.0	0.4	2.2	0.0	664.0	19.7	8.4	805.5
2015	60.4	36.6	317.8	0.0	0.0	0.5	0.0	664.0	24.2	9.9	967.9
2020	16.0	17.8	359.7	0.0	0.0	0.3	0.0	664.0	29.0	11.3	1133.9
2025	9.5	3.3	407.0	0.0	0.0	0.0	0.0	664.0	33.6	13.1	1295.6
2030	0.0	0.0	460.4	0.0	0.0	0.0	0.0	664.0	38.9	15.1	1473.1
2035	0.0	0.0	520.9	0.0	0.0	0.0	0.0	664.0	45.0	17.3	1666.7
2040	0.0	0.0	589.4	0.0	0.0	0.0	0.0	664.0	52.0	20.1	1885.6
2045	0.0	0.0	666.9	0.0	0.0	0.0	0.0	664.0	60.2	23.4	2133.5
2050	0.0	0.0	754.5	0.0	0.0	0.0	0.0	664.0	69.6	27.4	2413.8
2055	0.0	0.0	815.1	0.0	0.0	0.0	0.0	664.0	78.7	30.5	2502.1
2060	0.0	0.0	852.2	0.0	0.0	0.0	0.0	664.0	86.7	33.1	2557.2
2065	0.0	0.0	875.5	0.0	0.0	0.0	0.0	664.0	93.9	35.3	2603.1
2070	0.0	0.0	879.1	0.0	0.0	0.0	0.0	664.0	99.4	37.3	2626.2
2075	0.0	0.0	879.1	0.0	0.0	0.0	0.0	664.0	100.2	38.8	2626.2
2080	0.0	0.0	879.1	0.0	0.0	0.0	0.0	664.0	100.8	39.6	2626.2
2085	0.0	0.0	879.1	0.0	0.0	0.0	0.0	664.0	100.8	40.3	2626.2
2090	0.0	0.0	879.1	0.0	0.0	0.0	0.0	664.0	100.8	40.5	2626.2
2095	0.0	0.0	879.1	0.0	0.0	0.0	0.0	664.0	100.8	40.5	2626.2
2100	0.0	0.0	879.1	0.0	0.0	0.0	0.0	664.0	100.8	40.5	2626.2

* Partially-halogenated chlorine-containing chemical substitutes (such as HCFCs 22, 123, 141b, 142b) modeled using the atmospheric characteristics of HCFC-22.

EXHIBIT B-53

90 Percent Reduction with CH3CCl3 Freeze and 100 Percent Participation and 1:5 Substitution (1998)

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCL4	CH3CCL3	H-1211	H-1301	SUBST *
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1	0.0
1990	362.6	439.4	122.2	201.4	15.7	6.9	104.1	641.3	3.3	3.8	16.2
1995	351.7	421.5	165.4	180.2	13.7	7.2	91.6	660.9	6.2	5.0	64.4
2000	213.3	271.0	206.1	49.1	5.7	5.9	34.7	664.0	9.9	5.8	169.0
2005	201.1	216.9	245.4	43.3	3.8	4.4	29.4	664.0	14.8	6.9	230.1
2010	126.5	134.5	280.3	23.2	1.9	2.8	10.8	664.0	19.7	8.4	306.1
2015	98.0	88.2	317.8	23.2	1.6	1.3	10.8	664.0	24.2	9.9	369.3
2020	58.9	71.3	359.7	23.2	1.6	1.1	10.8	664.0	29.0	11.3	434.3
2025	52.9	58.6	407.0	23.2	1.6	0.9	10.8	664.0	33.6	13.1	498.5
2030	44.5	55.6	460.4	23.2	1.6	0.9	10.8	664.0	38.9	15.1	569.2
2035	44.5	55.6	520.9	23.2	1.6	0.9	10.8	664.0	45.0	17.3	646.6
2040	44.5	55.6	589.4	23.2	1.6	0.9	10.8	664.0	52.0	20.1	734.2
2045	44.5	55.6	666.9	23.2	1.6	0.9	10.8	664.0	60.2	23.4	833.4
2050	44.5	55.6	754.5	23.2	1.6	0.9	10.8	664.0	69.6	27.4	945.5
2055	44.5	55.6	815.1	23.2	1.6	0.9	10.8	664.0	78.7	30.5	980.8
2060	44.5	55.6	852.2	23.2	1.6	0.9	10.8	664.0	86.7	33.1	1002.8
2065	44.5	55.6	875.5	23.2	1.6	0.9	10.8	664.0	93.9	35.3	1021.2
2070	44.5	55.6	879.1	23.2	1.6	0.9	10.8	664.0	99.4	37.3	1030.4
2075	44.5	55.6	879.1	23.2	1.6	0.9	10.8	664.0	100.2	38.8	1030.4
2080	44.5	55.6	879.1	23.2	1.6	0.9	10.8	664.0	100.8	39.6	1030.4
2085	44.5	55.6	879.1	23.2	1.6	0.9	10.8	664.0	100.8	40.3	1030.4
2090	44.5	55.6	879.1	23.2	1.6	0.9	10.8	664.0	100.8	40.5	1030.4
2095	44.5	55.6	879.1	23.2	1.6	0.9	10.8	664.0	100.8	40.5	1030.4
2100	44.5	55.6	879.1	23.2	1.6	0.9	10.8	664.0	100.8	40.5	1030.4

* Partially-halogenated chlorine-containing chemical substitutes (such as HCFCs 22, 123, 141b, 142b) modeled using the atmospheric characteristics of HCFC-22.

EXHIBIT B-54

95 Percent Reduction with CH3CCl3 Freeze and 100 Percent Participation and 1:5 Substitution (1998)

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCL4	CH3CCL3	H-1211	H-1301	SUBST *
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1	0.0
1990	362.6	439.4	122.2	201.4	15.7	6.9	104.1	641.3	3.3	3.8	16.2
1995	351.7	421.5	165.4	180.2	13.7	7.2	91.6	660.9	6.2	5.0	64.4
2000	202.2	258.5	206.1	38.9	5.2	5.7	30.7	664.0	9.9	5.8	173.7
2005	188.7	199.6	245.4	33.2	3.2	4.1	25.3	664.0	14.8	6.9	236.1
2010	109.0	111.8	280.3	11.6	1.1	2.5	5.4	664.0	19.7	8.4	314.2
2015	79.2	62.4	317.8	11.6	0.8	0.9	5.4	664.0	24.2	9.9	378.2
2020	37.4	44.5	359.7	11.6	0.8	0.7	5.4	664.0	29.0	11.3	443.9
2025	31.2	31.0	407.0	11.6	0.8	0.4	5.4	664.0	33.6	13.1	508.4
2030	22.3	27.8	460.4	11.6	0.8	0.4	5.4	664.0	38.9	15.1	579.2
2035	22.3	27.8	520.9	11.6	0.8	0.4	5.4	664.0	45.0	17.3	656.6
2040	22.3	27.8	589.4	11.6	0.8	0.4	5.4	664.0	52.0	20.1	744.2
2045	22.3	27.8	666.9	11.6	0.8	0.4	5.4	664.0	60.2	23.4	843.4
2050	22.3	27.8	754.5	11.6	0.8	0.4	5.4	664.0	69.6	27.4	955.5
2055	22.3	27.8	815.1	11.6	0.8	0.4	5.4	664.0	78.7	30.5	990.8
2060	22.3	27.8	852.2	11.6	0.8	0.4	5.4	664.0	86.7	33.1	1012.8
2065	22.3	27.8	875.5	11.6	0.8	0.4	5.4	664.0	93.9	35.3	1031.2
2070	22.3	27.8	879.1	11.6	0.8	0.4	5.4	664.0	99.4	37.3	1040.4
2075	22.3	27.8	879.1	11.6	0.8	0.4	5.4	664.0	100.2	38.8	1040.4
2080	22.3	27.8	879.1	11.6	0.8	0.4	5.4	664.0	100.8	39.6	1040.4
2085	22.3	27.8	879.1	11.6	0.8	0.4	5.4	664.0	100.8	40.3	1040.4
2090	22.3	27.8	879.1	11.6	0.8	0.4	5.4	664.0	100.8	40.5	1040.4
2095	22.3	27.8	879.1	11.6	0.8	0.4	5.4	664.0	100.8	40.5	1040.4
2100	22.3	27.8	879.1	11.6	0.8	0.4	5.4	664.0	100.8	40.5	1040.4

* Partially-halogenated chlorine-containing chemical substitutes (such as HCFCs 22, 123, 141b, 142b) modeled using the atmospheric characteristics of HCFC-22.

EXHIBIT B-55

97 Percent Reduction with CH3CCl3 Freeze and 100 Percent Participation and 1:5 Substitution (1998)

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCL4	CH3CCL3	H-1211	H-1301	SUBST *
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1	0.0
1990	362.6	439.4	122.2	201.4	15.7	6.9	104.1	641.3	3.3	3.8	16.2
1995	351.7	421.5	165.4	180.2	13.7	7.2	91.6	660.9	6.2	5.0	64.4
2000	197.8	253.5	206.1	34.8	5.0	5.7	29.0	664.0	9.9	5.8	175.6
2005	183.7	192.6	245.4	29.1	2.9	4.0	23.7	664.0	14.8	6.9	238.5
2010	102.0	102.7	280.3	7.0	0.8	2.4	3.2	664.0	19.7	8.4	317.4
2015	71.7	52.1	317.8	7.0	0.5	0.7	3.2	664.0	24.2	9.9	381.8
2020	28.9	33.8	359.7	7.0	0.5	0.5	3.2	664.0	29.0	11.3	447.8
2025	22.5	19.9	407.0	7.0	0.5	0.3	3.2	664.0	33.6	13.1	512.3
2030	13.4	16.7	460.4	7.0	0.5	0.3	3.2	664.0	38.9	15.1	583.2
2035	13.4	16.7	520.9	7.0	0.5	0.3	3.2	664.0	45.0	17.3	660.6
2040	13.4	16.7	589.4	7.0	0.5	0.3	3.2	664.0	52.0	20.1	748.2
2045	13.4	16.7	666.9	7.0	0.5	0.3	3.2	664.0	60.2	23.4	847.4
2050	13.4	16.7	754.5	7.0	0.5	0.3	3.2	664.0	69.6	27.4	959.5
2055	13.4	16.7	815.1	7.0	0.5	0.3	3.2	664.0	78.7	30.5	994.8
2060	13.4	16.7	852.2	7.0	0.5	0.3	3.2	664.0	86.7	33.1	1016.8
2065	13.4	16.7	875.5	7.0	0.5	0.3	3.2	664.0	93.9	35.3	1035.2
2070	13.4	16.7	879.1	7.0	0.5	0.3	3.2	664.0	99.4	37.3	1044.4
2075	13.4	16.7	879.1	7.0	0.5	0.3	3.2	664.0	100.2	38.8	1044.4
2080	13.4	16.7	879.1	7.0	0.5	0.3	3.2	664.0	100.8	39.6	1044.4
2085	13.4	16.7	879.1	7.0	0.5	0.3	3.2	664.0	100.8	40.3	1044.4
2090	13.4	16.7	879.1	7.0	0.5	0.3	3.2	664.0	100.8	40.5	1044.4
2095	13.4	16.7	879.1	7.0	0.5	0.3	3.2	664.0	100.8	40.5	1044.4
2100	13.4	16.7	879.1	7.0	0.5	0.3	3.2	664.0	100.8	40.5	1044.4

* Partially-halogenated chlorine-containing chemical substitutes (such as HCFCs 22, 123, 141b, 142b) modeled using the atmospheric characteristics of HCFC-22.

EXHIBIT B-56

100 Percent Reduction with CH3CCl3 Freeze and 100 Percent Participation and 1:5 Substitution (1998)

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCL4	CH3CCL3	H-1211	H-1301	SUBST *
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1	0.0
1990	362.6	439.4	122.2	201.4	15.7	6.9	104.1	641.3	3.3	3.8	16.2
1995	351.7	421.5	165.4	180.2	13.7	7.2	91.6	660.9	6.2	5.0	64.4
2000	191.1	246.0	206.1	28.7	4.7	5.6	26.6	664.0	9.9	5.8	178.4
2005	176.2	182.2	245.4	23.0	2.5	3.9	21.3	664.0	14.8	6.9	242.0
2010	91.6	89.1	280.3	0.0	0.4	2.2	0.0	664.0	19.7	8.4	322.2
2015	60.4	36.6	317.8	0.0	0.0	0.5	0.0	664.0	24.2	9.9	387.1
2020	16.0	17.8	359.7	0.0	0.0	0.3	0.0	664.0	29.0	11.3	453.6
2025	9.5	3.3	407.0	0.0	0.0	0.0	0.0	664.0	33.6	13.1	518.2
2030	0.0	0.0	460.4	0.0	0.0	0.0	0.0	664.0	38.9	15.1	589.2
2035	0.0	0.0	520.9	0.0	0.0	0.0	0.0	664.0	45.0	17.3	666.7
2040	0.0	0.0	589.4	0.0	0.0	0.0	0.0	664.0	52.0	20.1	754.3
2045	0.0	0.0	666.9	0.0	0.0	0.0	0.0	664.0	60.2	23.4	853.4
2050	0.0	0.0	754.5	0.0	0.0	0.0	0.0	664.0	69.6	27.4	965.5
2055	0.0	0.0	815.1	0.0	0.0	0.0	0.0	664.0	78.7	30.5	1000.8
2060	0.0	0.0	852.2	0.0	0.0	0.0	0.0	664.0	86.7	33.1	1022.9
2065	0.0	0.0	875.5	0.0	0.0	0.0	0.0	664.0	93.9	35.3	1041.2
2070	0.0	0.0	879.1	0.0	0.0	0.0	0.0	664.0	99.4	37.3	1050.5
2075	0.0	0.0	879.1	0.0	0.0	0.0	0.0	664.0	100.2	38.8	1050.5
2080	0.0	0.0	879.1	0.0	0.0	0.0	0.0	664.0	100.8	39.6	1050.5
2085	0.0	0.0	879.1	0.0	0.0	0.0	0.0	664.0	100.8	40.3	1050.5
2090	0.0	0.0	879.1	0.0	0.0	0.0	0.0	664.0	100.8	40.5	1050.5
2095	0.0	0.0	879.1	0.0	0.0	0.0	0.0	664.0	100.8	40.5	1050.5
2100	0.0	0.0	879.1	0.0	0.0	0.0	0.0	664.0	100.8	40.5	1050.5

* Partially-halogenated chlorine-containing chemical substitutes (such as HCFCs 22, 123, 141b, 142b) modeled using the atmospheric characteristics of HCFC-22.

EXHIBIT B-57

90 Percent Reduction with CH3CCl3 Freeze and 100 Percent Participation and Post-2050 Growth and 1:2 Substitution (1998)

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCL4	CH3CCL3	H-1211	H-1301	SUBST *
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1	0.0
1990	362.6	439.4	122.2	201.4	15.7	6.9	104.1	641.3	3.3	3.8	40.4
1995	351.7	421.5	165.4	180.2	13.7	7.2	91.6	660.9	6.2	5.0	161.1
2000	213.3	271.0	206.1	49.1	5.7	5.9	34.7	664.0	9.9	5.8	422.5
2005	201.1	216.9	245.4	43.3	3.8	4.4	29.4	664.0	14.8	6.9	575.3
2010	126.5	134.5	280.3	23.2	1.9	2.8	10.8	664.0	19.7	8.4	765.3
2015	98.0	88.2	317.8	23.2	1.6	1.3	10.8	664.0	24.2	9.9	923.3
2020	58.9	71.3	359.7	23.2	1.6	1.1	10.8	664.0	29.0	11.3	1085.7
2025	52.9	58.6	407.0	23.2	1.6	0.9	10.8	664.0	33.6	13.1	1246.3
2030	44.5	55.6	460.4	23.2	1.6	0.9	10.8	664.0	38.9	15.1	1423.0
2035	44.5	55.6	520.9	23.2	1.6	0.9	10.8	664.0	45.0	17.3	1616.6
2040	44.5	55.6	589.4	23.2	1.6	0.9	10.8	664.0	52.0	20.1	1835.6
2045	44.5	55.6	666.9	23.2	1.6	0.9	10.8	664.0	60.2	23.4	2083.4
2050	44.5	55.6	754.5	23.2	1.6	0.9	10.8	664.0	69.6	27.4	2363.8
2055	44.5	55.6	853.6	23.2	1.6	0.9	10.8	664.0	80.2	31.7	2680.9
2060	44.5	55.6	965.8	23.2	1.6	0.9	10.8	664.0	92.0	36.4	3039.8
2065	44.5	55.6	1092.7	23.2	1.6	0.9	10.8	664.0	105.2	41.7	3445.9
2070	44.5	55.6	1236.3	23.2	1.6	0.9	10.8	664.0	119.9	47.6	3905.3
2075	44.5	55.6	1398.8	23.2	1.6	0.9	10.8	664.0	135.7	54.1	4425.0
2080	44.5	55.6	1582.6	23.2	1.6	0.9	10.8	664.0	153.6	61.4	5013.0
2085	44.5	55.6	1790.5	23.2	1.6	0.9	10.8	664.0	173.8	69.7	5698.4
2090	44.5	55.6	2025.8	23.2	1.6	0.9	10.8	664.0	196.7	78.9	6431.2
2095	44.5	55.6	2292.0	23.2	1.6	0.9	10.8	664.0	222.5	89.2	7282.8
2100	44.5	55.6	2593.2	23.2	1.6	0.9	10.8	664.0	251.8	101.0	8246.4

* Partially-halogenated chlorine-containing chemical substitutes (such as HCFCs 22, 123, 141b, 142b) modeled using the atmospheric characteristics of HCFC-22.

EXHIBIT B-58

95 Percent Reduction with CH3CCl3 Freeze and 100 Percent Participation and Post-2050 Growth and 1:2 Substitution (1998)

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCL4	CH3CCL3	H-1211	H-1301	SUBST *
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1	0.0
1990	362.6	439.4	122.2	201.4	15.7	6.9	104.1	641.3	3.3	3.8	40.4
1995	351.7	421.5	165.4	180.2	13.7	7.2	91.6	660.9	6.2	5.0	161.1
2000	202.2	258.5	206.1	38.9	5.2	5.7	30.7	664.0	9.9	5.8	434.3
2005	188.7	199.6	245.4	33.2	3.2	4.1	25.3	664.0	14.8	6.9	590.2
2010	109.0	111.8	280.3	11.6	1.1	2.5	5.4	664.0	19.7	8.4	785.4
2015	79.2	62.4	317.8	11.6	0.8	0.9	5.4	664.0	24.2	9.9	945.6
2020	37.4	44.5	359.7	11.6	0.8	0.7	5.4	664.0	29.0	11.3	1109.9
2025	31.2	31.0	407.0	11.6	0.8	0.4	5.4	664.0	33.6	13.1	1270.9
2030	22.3	27.8	460.4	11.6	0.8	0.4	5.4	664.0	38.9	15.1	1448.0
2035	22.3	27.8	520.9	11.6	0.8	0.4	5.4	664.0	45.0	17.3	1641.6
2040	22.3	27.8	589.4	11.6	0.8	0.4	5.4	664.0	52.0	20.1	1860.6
2045	22.3	27.8	666.9	11.6	0.8	0.4	5.4	664.0	60.2	23.4	2108.4
2050	22.3	27.8	754.5	11.6	0.8	0.4	5.4	664.0	69.6	27.4	2388.8
2055	22.3	27.8	853.6	11.6	0.8	0.4	5.4	664.0	80.2	31.7	2705.9
2060	22.3	27.8	965.8	11.6	0.8	0.4	5.4	664.0	92.0	36.4	3064.8
2065	22.3	27.8	1092.7	11.6	0.8	0.4	5.4	664.0	105.2	41.7	3470.9
2070	22.3	27.8	1236.3	11.6	0.8	0.4	5.4	664.0	119.9	47.6	3930.3
2075	22.3	27.8	1398.8	11.6	0.8	0.4	5.4	664.0	135.7	54.1	4450.0
2080	22.3	27.8	1582.6	11.6	0.8	0.4	5.4	664.0	153.6	61.4	5038.0
2085	22.3	27.8	1790.5	11.6	0.8	0.4	5.4	664.0	173.8	69.7	5703.4
2090	22.3	27.8	2025.8	11.6	0.8	0.4	5.4	664.0	196.7	78.9	6456.2
2095	22.3	27.8	2292.0	11.6	0.8	0.4	5.4	664.0	222.5	89.2	7307.8
2100	22.3	27.8	2593.2	11.6	0.8	0.4	5.4	664.0	251.8	101.0	8271.4

* Partially-halogenated chlorine-containing chemical substitutes (such as HCFCs 22, 123, 141b, 142b) modeled using the atmospheric characteristics of HCFC-22.

EXHIBIT B-59

97 Percent Reduction with CH3CCl3 Freeze and 100 Percent Participation and Post-2050 Growth and 1:2 Substitution (1998)

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCL4	CH3CCL3	H-1211	H-1301	SUBST *
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1	0.0
1990	362.6	439.4	122.2	201.4	15.7	6.9	104.1	641.3	3.3	3.8	40.4
1995	351.7	421.5	165.4	180.2	13.7	7.2	91.6	660.9	6.2	5.0	161.1
2000	197.8	253.5	206.1	34.8	5.0	5.7	29.0	664.0	9.9	5.8	439.0
2005	183.7	192.6	245.4	29.1	2.9	4.0	23.7	664.0	14.8	6.9	596.2
2010	102.0	102.7	280.3	7.0	0.8	2.4	3.2	664.0	19.7	8.4	793.2
2015	71.7	52.1	317.8	7.0	0.5	0.7	3.2	664.0	24.2	9.9	954.5
2020	28.9	33.8	359.7	7.0	0.5	0.5	3.2	664.0	29.0	11.3	1119.5
2025	22.5	19.9	407.0	7.0	0.5	0.3	3.2	664.0	33.6	13.1	1280.8
2030	13.4	16.7	460.4	7.0	0.5	0.3	3.2	664.0	38.9	15.1	1458.0
2035	13.4	16.7	520.9	7.0	0.5	0.3	3.2	664.0	45.0	17.3	1651.6
2040	13.4	16.7	589.4	7.0	0.5	0.3	3.2	664.0	52.0	20.1	1870.6
2045	13.4	16.7	666.9	7.0	0.5	0.3	3.2	664.0	60.2	23.4	2118.4
2050	13.4	16.7	754.5	7.0	0.5	0.3	3.2	664.0	69.6	27.4	2398.8
2055	13.4	16.7	853.6	7.0	0.5	0.3	3.2	664.0	80.2	31.7	2715.9
2060	13.4	16.7	965.8	7.0	0.5	0.3	3.2	664.0	92.0	36.4	3074.8
2065	13.4	16.7	1092.7	7.0	0.5	0.3	3.2	664.0	105.2	41.7	3480.9
2070	13.4	16.7	1236.3	7.0	0.5	0.3	3.2	664.0	119.9	47.6	3940.3
2075	13.4	16.7	1398.8	7.0	0.5	0.3	3.2	664.0	135.7	54.1	4460.0
2080	13.4	16.7	1582.6	7.0	0.5	0.3	3.2	664.0	153.6	61.4	5048.0
2085	13.4	16.7	1790.5	7.0	0.5	0.3	3.2	664.0	173.8	69.7	5713.4
2090	13.4	16.7	2025.8	7.0	0.5	0.3	3.2	664.0	196.7	78.9	6466.2
2095	13.4	16.7	2292.0	7.0	0.5	0.3	3.2	664.0	222.5	89.2	7317.8
2100	13.4	16.7	2593.2	7.0	0.5	0.3	3.2	664.0	251.8	101.0	8281.4

* Partially-halogenated chlorine-containing chemical substitutes (such as HCFCs 22, 123, 141b, 142b) modeled using the atmospheric characteristics of HCFC-22.

EXHIBIT B-60

100 Percent Reduction with CH3CCl3 Freeze and 100 Percent Participation and Post-2050 Growth and 1:2 Substitution (1998)

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCL4	CH3CCL3	H-1211	H-1301	SUBST *
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1	0.0
1990	362.6	439.4	122.2	201.4	15.7	6.9	104.1	641.3	3.3	3.8	40.4
1995	351.7	421.5	165.4	180.2	13.7	7.2	91.6	660.9	6.2	5.0	161.1
2000	191.1	246.0	206.1	28.7	4.7	5.6	26.6	664.0	9.9	5.8	446.1
2005	176.2	182.2	245.4	23.0	2.5	3.9	21.3	664.0	14.8	6.9	605.1
2010	91.6	89.1	280.3	0.0	0.4	2.2	0.0	664.0	19.7	8.4	805.5
2015	60.4	36.6	317.8	0.0	0.0	0.5	0.0	664.0	24.2	9.9	967.9
2020	16.0	17.8	359.7	0.0	0.0	0.3	0.0	664.0	29.0	11.3	1133.9
2025	9.5	3.3	407.0	0.0	0.0	0.0	0.0	664.0	33.6	13.1	1295.6
2030	0.0	0.0	460.4	0.0	0.0	0.0	0.0	664.0	38.9	15.1	1473.1
2035	0.0	0.0	520.9	0.0	0.0	0.0	0.0	664.0	45.0	17.3	1666.7
2040	0.0	0.0	589.4	0.0	0.0	0.0	0.0	664.0	52.0	20.1	1885.6
2045	0.0	0.0	666.9	0.0	0.0	0.0	0.0	664.0	60.2	23.4	2133.5
2050	0.0	0.0	754.5	0.0	0.0	0.0	0.0	664.0	69.6	27.4	2413.8
2055	0.0	0.0	853.6	0.0	0.0	0.0	0.0	664.0	80.2	31.7	2731.0
2060	0.0	0.0	965.8	0.0	0.0	0.0	0.0	664.0	92.0	36.4	3089.9
2065	0.0	0.0	1092.7	0.0	0.0	0.0	0.0	664.0	105.2	41.7	3495.9
2070	0.0	0.0	1236.3	0.0	0.0	0.0	0.0	664.0	119.9	47.6	3955.3
2075	0.0	0.0	1398.8	0.0	0.0	0.0	0.0	664.0	135.7	54.1	4475.1
2080	0.0	0.0	1582.6	0.0	0.0	0.0	0.0	664.0	153.6	61.4	5063.1
2085	0.0	0.0	1790.5	0.0	0.0	0.0	0.0	664.0	173.8	69.7	5728.5
2090	0.0	0.0	2025.8	0.0	0.0	0.0	0.0	664.0	196.7	78.9	6481.2
2095	0.0	0.0	2292.0	0.0	0.0	0.0	0.0	664.0	222.5	89.2	7332.9
2100	0.0	0.0	2593.2	0.0	0.0	0.0	0.0	664.0	251.8	101.0	8296.5

* Partially-halogenated chlorine-containing chemical substitutes (such as HCFCs 22, 123, 141b, 142b) modeled using the atmospheric characteristics of HCFC-22.

EXHIBIT B-61

90 Percent Reduction with CH3CCl3 Freeze and 100 Percent Participation and Post-2050 Growth and 1:5 Substitution (1998)

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCL4	CH3CCL3	H-1211	H-1301	SUBST *
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1	0.0
1990	362.6	439.4	122.2	201.4	15.7	6.9	104.1	641.3	3.3	3.8	16.2
1995	351.7	421.5	165.4	180.2	13.7	7.2	91.6	660.9	6.2	5.0	64.4
2000	213.3	271.0	206.1	49.1	5.7	5.9	34.7	664.0	9.9	5.8	169.0
2005	201.1	216.9	245.4	43.3	3.8	4.4	29.4	664.0	14.8	6.9	230.1
2010	126.5	134.5	280.3	23.2	1.9	2.8	10.8	664.0	19.7	8.4	306.1
2015	98.0	88.2	317.8	23.2	1.6	1.3	10.8	664.0	24.2	9.9	369.3
2020	58.9	71.3	359.7	23.2	1.6	1.1	10.8	664.0	29.0	11.3	434.3
2025	52.9	58.6	407.0	23.2	1.6	0.9	10.8	664.0	33.6	13.1	498.5
2030	44.5	55.6	460.4	23.2	1.6	0.9	10.8	664.0	38.9	15.1	569.2
2035	44.5	55.6	520.9	23.2	1.6	0.9	10.8	664.0	45.0	17.3	646.6
2040	44.5	55.6	589.4	23.2	1.6	0.9	10.8	664.0	52.0	20.1	734.2
2045	44.5	55.6	666.9	23.2	1.6	0.9	10.8	664.0	60.2	23.4	833.4
2050	44.5	55.6	754.5	23.2	1.6	0.9	10.8	664.0	69.6	27.4	945.5
2055	44.5	55.6	853.6	23.2	1.6	0.9	10.8	664.0	80.2	31.7	1072.4
2060	44.5	55.6	965.8	23.2	1.6	0.9	10.8	664.0	92.0	36.4	1215.9
2065	44.5	55.6	1092.7	23.2	1.6	0.9	10.8	664.0	105.2	41.7	1378.3
2070	44.5	55.6	1236.3	23.2	1.6	0.9	10.8	664.0	119.9	47.6	1562.1
2075	44.5	55.6	1398.8	23.2	1.6	0.9	10.8	664.0	135.7	54.1	1770.0
2080	44.5	55.6	1582.6	23.2	1.6	0.9	10.8	664.0	153.6	61.4	2005.2
2085	44.5	55.6	1790.5	23.2	1.6	0.9	10.8	664.0	173.8	69.7	2271.4
2090	44.5	55.6	2025.8	23.2	1.6	0.9	10.8	664.0	196.7	78.9	2572.5
2095	44.5	55.6	2292.0	23.2	1.6	0.9	10.8	664.0	222.5	89.2	2913.1
2100	44.5	55.6	2593.2	23.2	1.6	0.9	10.8	664.0	251.8	101.0	3298.6

* Partially-halogenated chlorine-containing chemical substitutes (such as HCFCs 22, 123, 141b, 142b) modeled using the atmospheric characteristics of HCFC-22.

EXHIBIT B-62

95 Percent Reduction with CH3CCl3 Freeze and 100 Percent Participation and Post-2050 Growth and 1:5 Substitution (1998)

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCL4	CH3CCL3	H-1211	H-1301	SUBST *
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1	0.0
1990	362.6	439.4	122.2	201.4	15.7	6.9	104.1	641.3	3.3	3.8	16.2
1995	351.7	421.5	165.4	180.2	13.7	7.2	91.6	660.9	6.2	5.0	64.4
2000	202.2	258.5	206.1	38.9	5.2	5.7	30.7	664.0	9.9	5.8	173.7
2005	188.7	199.6	245.4	33.2	3.2	4.1	25.3	664.0	14.8	6.9	236.1
2010	109.0	111.8	280.3	11.6	1.1	2.5	5.4	664.0	19.7	8.4	314.2
2015	79.2	62.4	317.8	11.6	0.8	0.9	5.4	664.0	24.2	9.9	378.2
2020	37.4	44.5	359.7	11.6	0.8	0.7	5.4	664.0	29.0	11.3	443.9
2025	31.2	31.0	407.0	11.6	0.8	0.4	5.4	664.0	33.6	13.1	508.4
2030	22.3	27.8	460.4	11.6	0.8	0.4	5.4	664.0	38.9	15.1	579.2
2035	22.3	27.8	520.9	11.6	0.8	0.4	5.4	664.0	45.0	17.3	656.6
2040	22.3	27.8	589.4	11.6	0.8	0.4	5.4	664.0	52.0	20.1	744.2
2045	22.3	27.8	666.9	11.6	0.8	0.4	5.4	664.0	60.2	23.4	843.4
2050	22.3	27.8	754.5	11.6	0.8	0.4	5.4	664.0	69.6	27.4	955.5
2055	22.3	27.8	853.6	11.6	0.8	0.4	5.4	664.0	80.2	31.7	1082.4
2060	22.3	27.8	965.8	11.6	0.8	0.4	5.4	664.0	92.0	36.4	1225.9
2065	22.3	27.8	1092.7	11.6	0.8	0.4	5.4	664.0	105.2	41.7	1388.3
2070	22.3	27.8	1236.3	11.6	0.8	0.4	5.4	664.0	119.9	47.6	1572.1
2075	22.3	27.8	1398.8	11.6	0.8	0.4	5.4	664.0	135.7	54.1	1780.0
2080	22.3	27.8	1582.6	11.6	0.8	0.4	5.4	664.0	153.6	61.4	2015.2
2085	22.3	27.8	1790.5	11.6	0.8	0.4	5.4	664.0	173.8	69.7	2281.4
2090	22.3	27.8	2025.8	11.6	0.8	0.4	5.4	664.0	196.7	78.9	2582.5
2095	22.3	27.8	2292.0	11.6	0.8	0.4	5.4	664.0	222.5	89.2	2923.1
2100	22.3	27.8	2593.2	11.6	0.8	0.4	5.4	664.0	251.8	101.0	3308.6

* Partially-halogenated chlorine-containing chemical substitutes (such as HCFCs 22, 123, 141b, 142b) modeled using the atmospheric characteristics of HCFC-22.

EXHIBIT B-63

97 Percent Reduction with CH3CCl3 Freeze and 100 Percent Participation and Post-2050 Growth and 1:5 Substitution (1998)

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCL4	CH3CCL3	H-1211	H-1301	SUBST *
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1	0.0
1990	362.6	439.4	122.2	201.4	15.7	6.9	104.1	641.3	3.3	3.8	16.2
1995	351.7	421.5	165.4	180.2	13.7	7.2	91.6	660.9	6.2	5.0	64.4
2000	197.8	253.5	206.1	34.8	5.0	5.7	29.0	664.0	9.9	5.8	175.6
2005	183.7	192.6	245.4	29.1	2.9	4.0	23.7	664.0	14.8	6.9	238.5
2010	102.0	102.7	280.3	7.0	0.8	2.4	3.2	664.0	19.7	8.4	317.4
2015	71.7	52.1	317.8	7.0	0.5	0.7	3.2	664.0	24.2	9.9	381.8
2020	28.9	33.8	359.7	7.0	0.5	0.5	3.2	664.0	29.0	11.3	447.8
2025	22.5	19.9	407.0	7.0	0.5	0.3	3.2	664.0	33.6	13.1	512.3
2030	13.4	16.7	460.4	7.0	0.5	0.3	3.2	664.0	38.9	15.1	583.2
2035	13.4	16.7	520.9	7.0	0.5	0.3	3.2	664.0	45.0	17.3	660.6
2040	13.4	16.7	589.4	7.0	0.5	0.3	3.2	664.0	52.0	20.1	748.2
2045	13.4	16.7	666.9	7.0	0.5	0.3	3.2	664.0	60.2	23.4	847.4
2050	13.4	16.7	754.5	7.0	0.5	0.3	3.2	664.0	69.6	27.4	959.5
2055	13.4	16.7	853.6	7.0	0.5	0.3	3.2	664.0	80.2	31.7	1086.4
2060	13.4	16.7	965.8	7.0	0.5	0.3	3.2	664.0	92.0	36.4	1229.9
2065	13.4	16.7	1092.7	7.0	0.5	0.3	3.2	664.0	105.2	41.7	1392.3
2070	13.4	16.7	1236.3	7.0	0.5	0.3	3.2	664.0	119.9	47.6	1576.1
2075	13.4	16.7	1398.8	7.0	0.5	0.3	3.2	664.0	135.7	54.1	1784.0
2080	13.4	16.7	1582.6	7.0	0.5	0.3	3.2	664.0	153.6	61.4	2019.2
2085	13.4	16.7	1790.5	7.0	0.5	0.3	3.2	664.0	173.8	69.7	2285.4
2090	13.4	16.7	2025.8	7.0	0.5	0.3	3.2	664.0	196.7	78.9	2586.5
2095	13.4	16.7	2292.0	7.0	0.5	0.3	3.2	664.0	222.5	89.2	2927.1
2100	13.4	16.7	2593.2	7.0	0.5	0.3	3.2	664.0	251.8	101.0	3312.6

* Partially-halogenated chlorine-containing chemical substitutes (such as HCFCs 22, 123, 141b, 142b) modeled using the atmospheric characteristics of HCFC-22.

EXHIBIT B-64

100 Percent Reduction with CH3CCl3 Freeze and 100 Percent Participation and Post-2050 Growth and 1:5 Substitution (1998)

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCL4	CH3CCL3	H-1211	H-1301	SUBST *
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1	0.0
1990	362.6	439.4	122.2	201.4	15.7	6.9	104.1	641.3	3.3	3.8	16.2
1995	351.7	421.5	165.4	180.2	13.7	7.2	91.6	660.9	6.2	5.0	64.4
2000	191.1	246.0	206.1	28.7	4.7	5.6	26.6	664.0	9.9	5.8	178.4
2005	176.2	182.2	245.4	23.0	2.5	3.9	21.3	664.0	14.8	6.9	242.0
2010	91.6	89.1	280.3	0.0	0.4	2.2	0.0	664.0	19.7	8.4	322.2
2015	60.4	36.6	317.8	0.0	0.0	0.5	0.0	664.0	24.2	9.9	387.1
2020	16.0	17.8	359.7	0.0	0.0	0.3	0.0	664.0	29.0	11.3	453.6
2025	9.5	3.3	407.0	0.0	0.0	0.0	0.0	664.0	33.6	13.1	518.2
2030	0.0	0.0	460.4	0.0	0.0	0.0	0.0	664.0	38.9	15.1	589.2
2035	0.0	0.0	520.9	0.0	0.0	0.0	0.0	664.0	45.0	17.3	666.7
2040	0.0	0.0	589.4	0.0	0.0	0.0	0.0	664.0	52.0	20.1	754.3
2045	0.0	0.0	666.9	0.0	0.0	0.0	0.0	664.0	60.2	23.4	853.4
2050	0.0	0.0	754.5	0.0	0.0	0.0	0.0	664.0	69.6	27.4	965.5
2055	0.0	0.0	853.6	0.0	0.0	0.0	0.0	664.0	80.2	31.7	1092.4
2060	0.0	0.0	965.8	0.0	0.0	0.0	0.0	664.0	92.0	36.4	1235.9
2065	0.0	0.0	1092.7	0.0	0.0	0.0	0.0	664.0	105.2	41.7	1398.4
2070	0.0	0.0	1236.3	0.0	0.0	0.0	0.0	664.0	119.9	47.6	1582.1
2075	0.0	0.0	1398.8	0.0	0.0	0.0	0.0	664.0	135.7	54.1	1790.0
2080	0.0	0.0	1582.6	0.0	0.0	0.0	0.0	664.0	153.6	61.4	2025.2
2085	0.0	0.0	1790.5	0.0	0.0	0.0	0.0	664.0	173.8	69.7	2291.4
2090	0.0	0.0	2025.8	0.0	0.0	0.0	0.0	664.0	196.7	78.9	2592.5
2095	0.0	0.0	2292.0	0.0	0.0	0.0	0.0	664.0	222.5	89.2	2933.1
2100	0.0	0.0	2593.2	0.0	0.0	0.0	0.0	664.0	251.8	101.0	3318.6

* Partially-halogenated chlorine-containing chemical substitutes (such as HCFCs 22, 123, 141b, 142b) modeled using the atmospheric characteristics of HCFC-22.

EXHIBIT B-65

100 Percent Reduction with CH3CCl3 Freeze and 100 Percent Participation and Post-2050 Growth and 1:2.5 Substitution (1998)

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCL4	CH3CCL3	H-1211	H-1301	SUBST *
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1	0.0
1990	362.6	439.4	122.2	201.4	15.7	6.9	104.1	641.3	3.3	3.8	32.3
1995	351.7	421.5	165.4	180.2	13.7	7.2	91.6	660.9	6.2	5.0	128.8
2000	191.1	246.0	206.1	28.7	4.7	5.6	26.6	664.0	9.9	5.8	356.8
2005	176.2	182.2	245.4	23.0	2.5	3.9	21.3	664.0	14.8	6.9	484.1
2010	91.6	89.1	280.3	0.0	0.4	2.2	0.0	664.0	19.7	8.4	644.4
2015	60.4	36.6	317.8	0.0	0.0	0.5	0.0	664.0	24.2	9.9	774.3
2020	16.0	17.8	359.7	0.0	0.0	0.3	0.0	664.0	29.0	11.3	907.1
2025	9.5	3.3	407.0	0.0	0.0	0.0	0.0	664.0	33.6	13.1	1036.5
2030	0.0	0.0	460.4	0.0	0.0	0.0	0.0	664.0	38.9	15.1	1178.4
2035	0.0	0.0	520.9	0.0	0.0	0.0	0.0	664.0	45.0	17.3	1333.3
2040	0.0	0.0	589.4	0.0	0.0	0.0	0.0	664.0	52.0	20.1	1508.5
2045	0.0	0.0	666.9	0.0	0.0	0.0	0.0	664.0	60.2	23.4	1706.8
2050	0.0	0.0	754.5	0.0	0.0	0.0	0.0	664.0	69.6	27.4	1931.0
2055	0.0	0.0	853.6	0.0	0.0	0.0	0.0	664.0	80.2	31.7	2184.8
2060	0.0	0.0	965.8	0.0	0.0	0.0	0.0	664.0	92.0	36.4	2471.9
2065	0.0	0.0	1092.7	0.0	0.0	0.0	0.0	664.0	105.2	41.7	2796.7
2070	0.0	0.0	1236.3	0.0	0.0	0.0	0.0	664.0	119.9	47.6	3164.2
2075	0.0	0.0	1398.8	0.0	0.0	0.0	0.0	664.0	135.7	54.1	3580.0
2080	0.0	0.0	1582.6	0.0	0.0	0.0	0.0	664.0	153.6	61.4	4050.4
2085	0.0	0.0	1790.5	0.0	0.0	0.0	0.0	664.0	173.8	69.7	4582.8
2090	0.0	0.0	2025.8	0.0	0.0	0.0	0.0	664.0	196.7	78.9	5185.0
2095	0.0	0.0	2292.0	0.0	0.0	0.0	0.0	664.0	222.5	89.2	5866.3
2100	0.0	0.0	2593.2	0.0	0.0	0.0	0.0	664.0	251.8	101.0	6637.2

* Partially-halogenated chlorine-containing chemical substitutes (such as HCFCs 22, 123, 141b, 142b) modeled using the atmospheric characteristics of HCFC-22.

EXHIBIT B-66

100 Percent Reduction with CH3CCl3 Freeze and 100 Percent Participation and Post-2050 Growth and 1:3 Substitution (1998)

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCL4	CH3CCL3	H-1211	H-1301	SUBST *
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1	0.0
1990	362.6	439.4	122.2	201.4	15.7	6.9	104.1	641.3	3.3	3.8	26.9
1995	351.7	421.5	165.4	180.2	13.7	7.2	91.6	660.9	6.2	5.0	107.4
2000	191.1	246.0	206.1	28.7	4.7	5.6	26.6	664.0	9.9	5.8	297.4
2005	176.2	182.2	245.4	23.0	2.5	3.9	21.3	664.0	14.8	6.9	403.4
2010	91.6	89.1	280.3	0.0	0.4	2.2	0.0	664.0	19.7	8.4	537.0
2015	60.4	36.6	317.8	0.0	0.0	0.5	0.0	664.0	24.2	9.9	645.2
2020	16.0	17.8	359.7	0.0	0.0	0.3	0.0	664.0	29.0	11.3	755.9
2025	9.5	3.3	407.0	0.0	0.0	0.0	0.0	664.0	33.6	13.1	863.7
2030	0.0	0.0	460.4	0.0	0.0	0.0	0.0	664.0	38.9	15.1	982.0
2035	0.0	0.0	520.9	0.0	0.0	0.0	0.0	664.0	45.0	17.3	1111.1
2040	0.0	0.0	589.4	0.0	0.0	0.0	0.0	664.0	52.0	20.1	1257.1
2045	0.0	0.0	666.9	0.0	0.0	0.0	0.0	664.0	60.2	23.4	1422.3
2050	0.0	0.0	754.5	0.0	0.0	0.0	0.0	664.0	69.6	27.4	1609.2
2055	0.0	0.0	853.6	0.0	0.0	0.0	0.0	664.0	80.2	31.7	1820.6
2060	0.0	0.0	965.8	0.0	0.0	0.0	0.0	664.0	92.0	36.4	2059.9
2065	0.0	0.0	1092.7	0.0	0.0	0.0	0.0	664.0	105.2	41.7	2330.6
2070	0.0	0.0	1236.3	0.0	0.0	0.0	0.0	664.0	119.9	47.6	2636.9
2075	0.0	0.0	1398.8	0.0	0.0	0.0	0.0	664.0	135.7	54.1	2983.4
2080	0.0	0.0	1582.6	0.0	0.0	0.0	0.0	664.0	153.6	61.4	3375.4
2085	0.0	0.0	1790.5	0.0	0.0	0.0	0.0	664.0	173.8	69.7	3819.0
2090	0.0	0.0	2025.8	0.0	0.0	0.0	0.0	664.0	196.7	78.9	4320.8
2095	0.0	0.0	2292.0	0.0	0.0	0.0	0.0	664.0	222.5	89.2	4888.6
2100	0.0	0.0	2593.2	0.0	0.0	0.0	0.0	664.0	251.8	101.0	5531.0

* Partially-halogenated chlorine-containing chemical substitutes (such as HCFCs 22, 123, 141b, 142b) modeled using the atmospheric characteristics of HCFC-22.

EXHIBIT B-67

100 Percent Reduction with CH3CCl3 Freeze and 100 Percent Participation (1990)

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCL4	CH3CCL3	H-1211	H-1301
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1
1990	148.3	212.8	122.2	17.3	5.1	5.5	21.4	641.3	3.3	3.8
1995	154.2	128.1	165.4	24.7	3.0	3.8	26.1	660.9	6.2	5.0
2000	79.1	75.1	206.1	.0	.6	2.9	.0	664.0	9.9	5.8
2005	81.1	71.4	245.4	.0	.0	1.9	.0	664.0	14.8	6.9
2010	18.5	21.3	280.3	.0	.0	.4	.0	664.0	19.7	8.4
2015	15.3	18.3	317.8	.0	.0	.2	.0	664.0	24.2	9.9
2020	.0	.0	359.7	.0	.0	.0	.0	664.0	29.0	11.3
2025	.0	.0	407.0	.0	.0	.0	.0	664.0	33.6	13.1
2030	.0	.0	460.4	.0	.0	.0	.0	664.0	38.9	15.1
2035	.0	.0	520.9	.0	.0	.0	.0	664.0	45.0	17.3
2040	.0	.0	589.4	.0	.0	.0	.0	664.0	52.0	20.1
2045	.0	.0	666.9	.0	.0	.0	.0	664.0	60.2	23.4
2050	.0	.0	754.5	.0	.0	.0	.0	664.0	69.6	27.4
2055	.0	.0	815.1	.0	.0	.0	.0	664.0	78.7	30.5
2060	.0	.0	852.2	.0	.0	.0	.0	664.0	86.7	33.1
2065	.0	.0	875.5	.0	.0	.0	.0	664.0	93.9	35.3
2070	.0	.0	879.1	.0	.0	.0	.0	664.0	99.4	37.3
2075	.0	.0	879.1	.0	.0	.0	.0	664.0	100.2	38.8
2080	.0	.0	879.1	.0	.0	.0	.0	664.0	100.8	39.6
2085	.0	.0	879.1	.0	.0	.0	.0	664.0	100.8	40.3
2090	.0	.0	879.1	.0	.0	.0	.0	664.0	100.8	40.5
2095	.0	.0	879.1	.0	.0	.0	.0	664.0	100.8	40.5
2100	.0	.0	879.1	.0	.0	.0	.0	664.0	100.8	40.5

EXHIBIT B-68

100 Percent Reduction with CH3CCl3 Freeze and 100 Percent Participation (1993)

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCl4	CH3CCl3	H-1211	H-1301
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1
1990	362.6	439.4	122.2	201.4	15.7	6.9	104.1	641.3	3.3	3.8
1995	171.8	218.5	165.4	24.7	5.0	5.2	26.1	660.9	6.2	5.0
2000	169.4	167.9	206.1	28.7	3.1	4.0	26.6	664.0	9.9	5.8
2005	95.5	97.2	245.4	.0	.5	2.6	.0	664.0	14.8	6.9
2010	70.6	38.7	280.3	.0	.0	.5	.0	664.0	19.7	8.4
2015	17.8	21.0	317.8	.0	.0	.3	.0	664.0	24.2	9.9
2020	11.9	4.2	359.7	.0	.0	.0	.0	664.0	29.0	11.3
2025	.0	.0	407.0	.0	.0	.0	.0	664.0	33.6	13.1
2030	.0	.0	460.4	.0	.0	.0	.0	664.0	38.9	15.1
2035	.0	.0	520.9	.0	.0	.0	.0	664.0	45.0	17.3
2040	.0	.0	589.4	.0	.0	.0	.0	664.0	52.0	20.1
2045	.0	.0	666.9	.0	.0	.0	.0	664.0	60.2	23.4
2050	.0	.0	754.5	.0	.0	.0	.0	664.0	69.6	27.4
2055	.0	.0	815.1	.0	.0	.0	.0	664.0	78.7	30.5
2060	.0	.0	852.2	.0	.0	.0	.0	664.0	86.7	33.1
2065	.0	.0	875.5	.0	.0	.0	.0	664.0	93.9	35.3
2070	.0	.0	879.1	.0	.0	.0	.0	664.0	99.4	37.3
2075	.0	.0	879.1	.0	.0	.0	.0	664.0	100.2	38.8
2080	.0	.0	879.1	.0	.0	.0	.0	664.0	100.8	39.6
2085	.0	.0	879.1	.0	.0	.0	.0	664.0	100.8	40.3
2090	.0	.0	879.1	.0	.0	.0	.0	664.0	100.8	40.5
2095	.0	.0	879.1	.0	.0	.0	.0	664.0	100.8	40.5
2100	.0	.0	879.1	.0	.0	.0	.0	664.0	100.8	40.5

EXHIBIT B-69

100 Percent Reduction with CH3CCl3 Freeze and 100 Percent Participation (1996)

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCl4	CH3CCl3	H-1211	H-1301
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1
1990	362.6	439.4	122.2	201.4	15.7	6.9	104.1	641.3	3.3	3.8
1995	351.7	421.5	165.4	180.2	13.7	7.2	91.6	660.9	6.2	5.0
2000	181.6	178.4	206.1	28.7	3.1	4.9	26.6	664.0	9.9	5.8
2005	169.2	176.6	245.4	23.0	2.5	3.5	21.3	664.0	14.8	6.9
2010	83.7	71.8	280.3	.0	.0	1.8	.0	664.0	19.7	8.4
2015	20.2	23.8	317.8	.0	.0	.4	.0	664.0	24.2	9.9
2020	14.7	16.2	359.7	.0	.0	.2	.0	664.0	29.0	11.3
2025	.0	.0	407.0	.0	.0	.0	.0	664.0	33.6	13.1
2030	.0	.0	460.4	.0	.0	.0	.0	664.0	38.9	15.1
2035	.0	.0	520.9	.0	.0	.0	.0	664.0	45.0	17.3
2040	.0	.0	589.4	.0	.0	.0	.0	664.0	52.0	20.1
2045	.0	.0	666.9	.0	.0	.0	.0	664.0	60.2	23.4
2050	.0	.0	754.5	.0	.0	.0	.0	664.0	69.6	27.4
2055	.0	.0	815.1	.0	.0	.0	.0	664.0	78.7	30.5
2060	.0	.0	852.2	.0	.0	.0	.0	664.0	86.7	33.1
2065	.0	.0	875.5	.0	.0	.0	.0	664.0	93.9	35.3
2070	.0	.0	879.1	.0	.0	.0	.0	664.0	99.4	37.3
2075	.0	.0	879.1	.0	.0	.0	.0	664.0	100.2	38.8
2080	.0	.0	879.1	.0	.0	.0	.0	664.0	100.8	39.6
2085	.0	.0	879.1	.0	.0	.0	.0	664.0	100.8	40.3
2090	.0	.0	879.1	.0	.0	.0	.0	664.0	100.8	40.5
2095	.0	.0	879.1	.0	.0	.0	.0	664.0	100.8	40.5
2100	.0	.0	879.1	.0	.0	.0	.0	664.0	100.8	40.5

EXHIBIT B-70

100 Percent Reduction with CH3CCl3 Freeze and 100 Percent Participation (1998)

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCl4	CH3CCl3	H-1211	H-1301
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1
1990	362.6	439.4	122.2	201.4	15.7	6.9	104.1	641.3	3.3	3.8
1995	351.7	421.5	165.4	180.2	13.7	7.2	91.6	660.9	6.2	5.0
2000	191.1	246.0	206.1	28.7	4.7	5.6	26.6	664.0	9.9	5.8
2005	176.2	182.2	245.4	23.0	2.5	3.9	21.3	664.0	14.8	6.9
2010	91.6	89.1	280.3	.0	.4	2.2	.0	664.0	19.7	8.4
2015	60.4	36.6	317.8	.0	.0	.5	.0	664.0	24.2	9.9
2020	16.0	17.8	359.7	.0	.0	.3	.0	664.0	29.0	11.3
2025	9.5	3.3	407.0	.0	.0	.0	.0	664.0	33.6	13.1
2030	.0	.0	460.4	.0	.0	.0	.0	664.0	38.9	15.1
2035	.0	.0	520.9	.0	.0	.0	.0	664.0	45.0	17.3
2040	.0	.0	589.4	.0	.0	.0	.0	664.0	52.0	20.1
2045	.0	.0	666.9	.0	.0	.0	.0	664.0	60.2	23.4
2050	.0	.0	754.5	.0	.0	.0	.0	664.0	69.6	27.4
2055	.0	.0	815.1	.0	.0	.0	.0	664.0	78.7	30.5
2060	.0	.0	852.2	.0	.0	.0	.0	664.0	86.7	33.1
2065	.0	.0	875.5	.0	.0	.0	.0	664.0	93.9	35.3
2070	.0	.0	879.1	.0	.0	.0	.0	664.0	99.4	37.3
2075	.0	.0	879.1	.0	.0	.0	.0	664.0	100.2	38.8
2080	.0	.0	879.1	.0	.0	.0	.0	664.0	100.8	39.6
2085	.0	.0	879.1	.0	.0	.0	.0	664.0	100.8	40.3
2090	.0	.0	879.1	.0	.0	.0	.0	664.0	100.8	40.5
2095	.0	.0	879.1	.0	.0	.0	.0	664.0	100.8	40.5
2100	.0	.0	879.1	.0	.0	.0	.0	664.0	100.8	40.5

EXHIBIT B-71

100 Percent Reduction with CH3CCl3 Freeze and 100 Percent Participation (2003)

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCl4	CH3CCl3	H-1211	H-1301
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1
1990	362.6	439.4	122.2	201.4	15.7	6.9	104.1	641.3	3.3	3.8
1995	351.7	421.5	165.4	180.2	13.7	7.2	91.6	660.9	6.2	5.0
2000	368.7	446.6	206.1	191.5	13.2	7.6	91.6	664.0	9.9	5.8
2005	197.7	259.5	245.4	23.0	4.1	5.5	21.3	664.0	14.8	6.9
2010	172.1	174.0	280.3	23.0	2.4	3.5	21.3	664.0	19.7	8.4
2015	81.2	86.6	317.8	.0	.4	2.1	.0	664.0	24.2	9.9
2020	58.2	33.2	359.7	.0	.0	.4	.0	664.0	29.0	11.3
2025	13.7	16.9	407.0	.0	.0	.3	.0	664.0	33.6	13.1
2030	9.5	3.3	460.4	.0	.0	.0	.0	664.0	38.9	15.1
2035	.0	.0	520.9	.0	.0	.0	.0	664.0	45.0	17.3
2040	.0	.0	589.4	.0	.0	.0	.0	664.0	52.0	20.1
2045	.0	.0	666.9	.0	.0	.0	.0	664.0	60.2	23.4
2050	.0	.0	754.5	.0	.0	.0	.0	664.0	69.6	27.4
2055	.0	.0	815.1	.0	.0	.0	.0	664.0	78.7	30.5
2060	.0	.0	852.2	.0	.0	.0	.0	664.0	86.7	33.1
2065	.0	.0	875.5	.0	.0	.0	.0	664.0	93.9	35.3
2070	.0	.0	879.1	.0	.0	.0	.0	664.0	99.4	37.3
2075	.0	.0	879.1	.0	.0	.0	.0	664.0	100.2	38.8
2080	.0	.0	879.1	.0	.0	.0	.0	664.0	100.8	39.6
2085	.0	.0	879.1	.0	.0	.0	.0	664.0	100.8	40.3
2090	.0	.0	879.1	.0	.0	.0	.0	664.0	100.8	40.5
2095	.0	.0	879.1	.0	.0	.0	.0	664.0	100.8	40.5
2100	.0	.0	879.1	.0	.0	.0	.0	664.0	100.8	40.5

EXHIBIT B-72

100 Percent Reduction with CH3CCl3 Freeze and 100 Percent Participation (2008)

Global Emissions (Millions of Kilograms)

	CFC-11	CFC-12	HCFC-22	CFC-113	CFC-114	CFC-115	CCl4	CH3CCl3	H-1211	H-1301
1985	278.3	363.8	73.8	150.5	14.3	4.7	87.4	813.8	1.4	2.1
1990	362.6	439.4	122.2	201.4	15.7	6.9	104.1	641.3	3.3	3.8
1995	351.7	421.5	165.4	180.2	13.7	7.2	91.6	660.9	6.2	5.0
2000	368.7	446.6	206.1	191.5	13.2	7.6	91.6	664.0	9.9	5.8
2005	375.3	460.0	245.4	185.8	12.7	7.5	86.3	664.0	14.8	6.9
2010	193.6	251.3	280.3	23.0	4.0	5.1	21.3	664.0	19.7	8.4
2015	161.7	171.5	317.8	23.0	2.4	3.4	21.3	664.0	24.2	9.9
2020	79.0	83.2	359.7	.0	.4	2.1	.0	664.0	29.0	11.3
2025	55.8	32.4	407.0	.0	.0	.4	.0	664.0	33.6	13.1
2030	13.7	16.9	460.4	.0	.0	.3	.0	664.0	38.9	15.1
2035	9.5	3.3	520.9	.0	.0	.0	.0	664.0	45.0	17.3
2040	.0	.0	589.4	.0	.0	.0	.0	664.0	52.0	20.1
2045	.0	.0	666.9	.0	.0	.0	.0	664.0	60.2	23.4
2050	.0	.0	754.5	.0	.0	.0	.0	664.0	69.6	27.4
2055	.0	.0	815.1	.0	.0	.0	.0	664.0	78.7	30.5
2060	.0	.0	852.2	.0	.0	.0	.0	664.0	86.7	33.1
2065	.0	.0	875.5	.0	.0	.0	.0	664.0	93.9	35.3
2070	.0	.0	879.1	.0	.0	.0	.0	664.0	99.4	37.3
2075	.0	.0	879.1	.0	.0	.0	.0	664.0	100.2	38.8
2080	.0	.0	879.1	.0	.0	.0	.0	664.0	100.8	39.6
2085	.0	.0	879.1	.0	.0	.0	.0	664.0	100.8	40.3
2090	.0	.0	879.1	.0	.0	.0	.0	664.0	100.8	40.5
2095	.0	.0	879.1	.0	.0	.0	.0	664.0	100.8	40.5
2100	.0	.0	879.1	.0	.0	.0	.0	664.0	100.8	40.5

APPENDIX C

APPENDIX C

OZONE DEPLETION ESTIMATES

This appendix presents estimates of ozone depletion for several emission and trace gas scenarios. The model used to estimate ozone depletion is described in Connell (1986) and EPA (1987). In light of the recent findings of the Ozone Trends Panel (1988), ozone depletion estimates based on results from 1-D models are called into question. Consequently, the ozone depletion estimates presented here may be considerable underestimates of potential near term depletion.

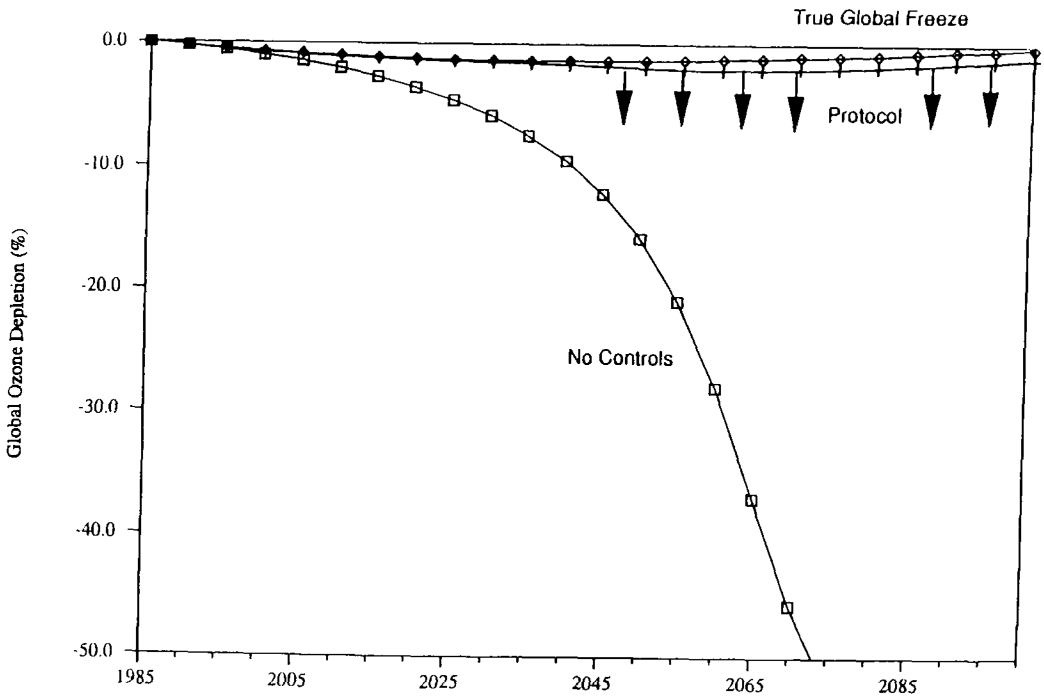
Exhibit C-1 displays estimated ozone depletion for the following three scenarios: No Controls; Protocol; and True Global Freeze. The No Controls scenario assumes that compound use will grow at an annual average rate of 2.8 percent per year through 2050, followed by no growth. As shown in the exhibit, such unconstrained growth is expected to lead to significant depletion. The Protocol and True Global Freeze scenarios are estimated to result in much less depletion, although as is indicated in the exhibit by the arrows, the values for these cases may be underestimated. The Protocol scenario has the following participation assumptions: U.S. participation; 94 percent of other developed nations; and 65 percent of developing nations. The True Global Freeze scenario assumes that all chlorine-containing compounds are frozen in 1989 at their 1986 levels, and that 100 percent global participation is achieved.

The ozone depletion estimates are influenced not only by emissions of chlorine-containing compounds, but also by the future concentrations of key greenhouse gases: carbon dioxide (CO2); nitrous oxide (N2O); and methane (CH4). Although the chlorine concentrations in the Protocol and True Global Freeze scenarios are increasing through 2100, the ozone depletion expected from these scenarios is declining by 2100 due to increasing concentrations of these greenhouse gases, and their associated global warming. If the concentrations of these gases are lower than currently expected, either due to less than expected growth in emissions or due to international agreements to limit emissions in order to reduce future levels of greenhouse warming, then the expected amount of ozone depletion would be higher than the levels shown in Exhibit C-1.

Exhibit C-2 shows estimates of ozone depletion with alternative assumptions about future concentrations of the greenhouse gases. The Low Trace Gas Scenario assumes that concentrations grow more slowly than currently expected. The 2°C Scenario assumes that the greenhouse gas concentrations will be controlled sufficiently so that equilibrium global warming is limited to 2°C by 2075. As shown in the exhibit, the alternative trace gas assumptions have a significant influence on the estimates of ozone depletion over the long term.

EXHIBIT C-1

SIMULATED GLOBAL AVERAGE TOTAL COLUMN OZONE DEPLETION: NO CONTROLS; PROTOCOL; AND TRUE GLOBAL FREEZE



Assumptions:

No Controls: Compound use grows at an average annual rate of 2.8 percent from 1985 to 2050, with no growth thereafter.

Protocol: U.S. participation; 94 percent participation in other developed nations; 65 percent participation in developing nations. Use of compounds not covered by the Protocol grows at the rates in the No Controls scenario. Growth rates among non-participants are reduced to 37.5 percent (developed nations) and 50 percent (developing nations) of their baseline values.

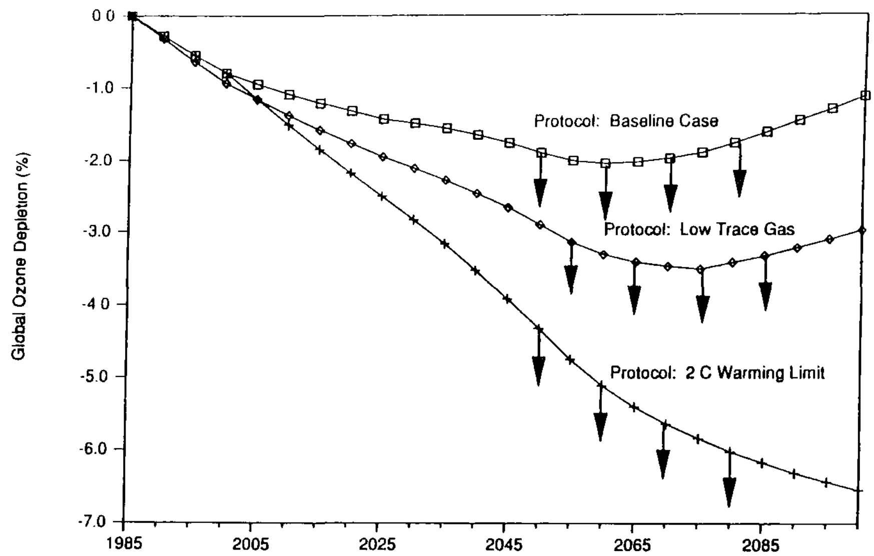
True Global Freeze: The use of all chlorine-containing compounds is frozen at 1986 levels starting in 1990, and 100 percent participation is achieved worldwide.

Other Trace Gases: CH4 grows at 0.017 ppm/year; N2O grows at 0.2 percent/year; CO2 grows at the 50th percentile rate reported by the NAS (about 0.6 percent/year).

Arrows indicate that ozone depletion estimates may be underestimated.

EXHIBIT C-2

SIMULATED GLOBAL AVERAGE TOTAL COLUMN OZONE DEPLETION:
PROTOCOL SCENARIO WITH ALTERNATIVE TRACE GAS ASSUMPTIONS



Assumptions:

Protocol: U.S. participation; 94 percent participation in other developed nations; 65 percent participation in developing nations. Use of compounds not covered by the Protocol grows at the rates in the No Controls scenario. Growth rates among non-participants are reduced to 37.5 percent (developed nations) and 50 percent (developing nations) of their baseline values. Compound use assumed constant after 2050.

Other Trace Gases:

- o Base Scenario: CH_4 grows at 0.017 ppm/year; N_2O grows at 0.2 percent/year; CO_2 grows at the 50th percentile rate reported by the NAS (about 0.6 percent/year).

- o Low Scenario: CH_4 grows at 0.01275 ppm/year (75 percent of the base scenario value); N_2O grows at 0.15 percent/year; CO_2 grows at the 25th percentile rate reported by NAS (about 0.4 percent/year).

- o 2°C Warming Limited: Assuming a 3°C climate sensitivity to doubled CO_2, trace gas growth is limited so that projected equilibrium warming equals 2°C by 2075. Average rates of growth from 1985 to 2075 are: CH_4: 0.24 percent/year; N_2O: 0.06 percent/year; CO_2: 0.15 percent/year.

Arrows indicate that ozone depletion estimates may be underestimated.