DRAFT OZONE ISSUE PAPER OUTLINE

ISSUE

What action should the Administration take with respect to the international and domestic proposals for the control of chemicals that deplete stratospheric ozone?

BACKGROUND

1. Review of the credible scientific findings and projections regarding:

    A. Stratospheric ozone levels

    B. Atmospheric concentrations of ozone-depleting chemicals

    C. Potential effects of ozone depletion (as specific as possible as to what effects are likely for various levels of potential depletion)

2. Description of the ozone-depleting chemicals at issue including domestic and international analysis of:

    A. Production and use levels over time

    B. Breakdown of uses

    C. Chemical cost as a component of a product or of a production process

3. Review of domestic and international actions to date

    A. UNEP negotiations toward protocol

    B. Domestic litigation

    C. Domestic legislative proposals

    D. Importance of proceeding internationally (including description of precedential nature of the protocol)

    E. Interconnection of international and domestic action

OPTIONS

1. Attempt to reach acceptable international agreement on a protocol for the control of ozone-depleting chemicals in the

July 1987 negotiating session. To be acceptable, an agreement would have to provide for satisfactory treatment of the following issues:

A. Measurement of emissions

B. Country coverage (including issues involved with developing countries)

C. Chemical coverage

D. Emissions control levels (including timing)

E. Periodic assessment of scientific, technological and economic developments

F. Trade Aspects

2. Impose domestic controls in lieu of or in addition to an international agreement.

3. Continue international and domestic review and discussion to assemble additional scientific information; delay international or domestic action until such information is available.

Draft Ozone Paper

Issue

What should the Administration's position be regarding the April United Nations negotiations toward an international protocol for control of ozone depleting chemicals?

Overview

Strong international and domestic concern exists over stratospheric ozone depletion caused by emissions of man-made chemicals reacting in the upper atmosphere (stratosphere). Ozone is an essential buffer of ultraviolet light; significant depletion could cause skin cancer, suppress the human immune system, retard crop production and damage aquatic and terrestrial ecosystems. Although stratospheric ozone concentrations have decreased over the past seven years, scientists have not observed significant global depletion to date. Global depletion is expected to occur absent global reduction efforts. Significant depletion (approximately 50 percent) has been observed in the Antarctic in spring of each year since 1985. Antarctic ozone levels have been declining since 1965 with the vertical depth of the ozone hole increasing each year.

The Vienna Convention for the Protection of the Ozone Layer, ratified by the Senate in July 1986, established an international framework for scientific cooperation and initiated negotiations toward a protocol for controls on ozone depleting chemicals. The United States has had a leading role in the negotiations toward a control protocol. The next negotiating session is scheduled for April 27-30, 1987.

There is domestic as well as international movement toward controls on ozone depleting chemicals. Several Senators have proposed a complete phase-out of ozone depleting agents. And in response to a judicial consent decree, EPA must either propose controls or present the basis for taking no action by May 1987.

Industry recognizes the need for some form of control on ozone depleting agents. Yet industry strongly disfavors unilateral domestic controls that would disadvantage U.S. competitiveness.

Ozone Depletion: Causes, Projections and Effects

Causes of Depletion -- Emissions of man-made chemicals are changing the chemical composition of the atmosphere. In

particular, atmospheric concentrations of chemicals known to deplete ozone are increasing. These chemicals are: chlorofluorocarbons (CFCs) 11, 12, and 113; halons 1211 and 1301; methyl chloroform; and carbon tetrachloride. Global atmospheric concentrations of CFCs 11 and 12 have been growing in recent years at a rate of five percent per year. Concentrations of CFC 113 have been increasing at a rate of 10 percent per year. Concentrations of halon 1211 have been increasing by 23 percent a year. No trend estimates have been published for halon 1301. Concentrations of methyl chloroform have been increasing by 7 percent a year, and of carbon tetrachloride by 1 percent a year.

Measurements also show atmospheric increases in ozone enhancing agents. These chemicals are carbon dioixide and methane. Concentrations of nitrogen oxides are also increasing; these chemicals deplete ozone in the upper atmosphere (stratosphere) and enhance ozone in the lower atmosphere (troposphere). Even though emissions of ozone enhancing agents offset total atmospheric depletion, the offset is not sufficient to prevent ozone depletion at current emission rates. Moreover, the ozone enhancing chemicals increase ozone concentrations in the lower atmosphere while depletion occurs in the upper atmosphere altering the vertical distribution of ozone. Ozone in the lower atmosphere can be dangerous as it is a toxic gas and it contributes to global warming.

At current use volumes, CFCs 11 and 12 have the most ozone depleting potential, followed by CFC 113. Industrialized countries have relied heavily on CFCs 11 and 12 for use in aerosol propellants, refrigeration, foam-blowing, and solvents. The following is a proportional breakdown of uses:

CFC 11

Use	World	United States
Rigid Foam	39%	51%
Aerosol	31%	5%
Flexible Slabstock	15%	15%
Flexible Molded	4%	5%
Chillers	3%	6%
Unallocated	8%	18%

CFC 12

Use	World	United States
Aerosol	32%	4%
Mobile Air Conditioning	20%	37%
Rigid Foam	12%	11%
Refrigerators	6%	6%
Chillers	1%	1%
Miscellaneous	7%	10%

Unallocated	22%	31%

While use of CFC 113 has not been as great as use of the other CFCs, 113 is increasingly used in solvents for cleaning electronic equipment.

CFC emissions occur in production of the chemicals, in use of the chemicals (operating losses and leakage) and in destruction of products containing CFCs (e.g. foam crushing). Once emitted into the atmosphere, CFCs have unusually long atmospheric lifetimes of 75 to 100 years. Their chemical stability and unusual persistence enables them to reach the stratosphere where they react with ultraviolet radiation to release ozone-depleting chlorine.

Halons 1211 and 1301 are used in fire extinguishers. Current production of these chemicals is relatively low. However, halons contain bromine which has much greater ozone depleting potential than the chlorine in CFCs.

Scientists are not sure of the cause of the Antarctic ozone hole. Potential causes include man-made ozone depleting chemicals, the solar cycle, and climate change.

Depletion Projections -- Various scientific models have predicted the future ozone depletion expected to result from varying rates of CFC growth. Projections of future depletion are also dependent upon the relative growth rates of the other ozone depleting and ozone enhancing chemicals.

EPA has estimated global ozone depletion in 2075 for six alternative CFC global use scenarios (assuming constant rates for other ozone altering chemicals). For reference in assessing these EPA projections, it may be useful to note that studies of future CFC demand estimate the median annual growth rate for CFCs 11 and 12 as 2.5 percent. The United Nations Environment Program suggested scenario testers use a range of 0% to 5% annual growth for CFCs 11 and 12 for the 1986-2100 period.

CFC Use	Projected Ozone 2075
Decrease 80% by 2010	3% Increase
Constant (1985-2100)	.3% Increase
1.2% Increase 1985-2050 and no growth 2050-2100	4.5% Depletion
2.5% Increase 1985-2050 and no growth 2050-2100	25% Depletion
3.8% Increase 1985-2050 and	

no growth 2050-2100	>50% Depletion
5% Increase 1985-2050 and no growth 2050-2100	>50% Depletion

Questions exist regarding the accuracy of the models. Generally, observational data support model predictions of the atmospheric concentrations of chemicals. Yet there is a 20-50 percent discrepancy between observed and predicted ozone in the upper stratosphere even though the accuracy of ozone predicting models is increasing with time. The models also failed to predict the 50 percent seasonal ozone depletion in Antarctic ozone that scientists confirmed in 1985.

Effects of Depletion -- Depletion of the total amount of atmospheric ozone would increase the amount of harmful ultraviolet radiation reaching the earth. Although many uncertainties exist as to the precise impacts of the increase in ultraviolet radiation, scientific data and/or case studies indicate it would increase nonmelanoma skin tumors, increase cutaneous malignant melanoma, suppress the human immune system, increase cataracts, reduce crop yield, harm aquatic life, accelerate the degradation of polymers, and contribute to global warming and the attendant sea level rise threatening coastal populations.

Of all of the potential adverse effects of ozone depletion, the best scientific data exists for the likely increases in skin cancer. Several studies suggest that the ultraviolet radiation naturally absorbed by ozone is the most important solar radiation component in the incidence of common skin cancer (nonmelanoma tumors). The mortality rate from nonmelanoma skin cancer is two percent. Health projections indicate there will be 500,000 new cases of nonmelanoma skin cancer in 1987 with an expected morality of 10,000. Studies show that a one percent increase in the ultraviolet radiation absorbed by ozone results in a 1.8 - 2.5 percent increase in the incidence of nonmelanoma skin tumors. (A one percent depletion in ozone increases the weighted ultraviolet radiation by about two percent.)

Although there is uncertainty about the relationship between solar radiation and the more serious form of skin cancer, cutaneous malignant melanoma, much evidence supports the link between solar radiation and this disease. Health projections indicate there will be 25,000 new cases of cutaneous malignant melanoma in 1987; the mortality rate from this disease is 30 percent.

Numerous variables affect the incidence of either form of skin cancer including duration of exposure, latitudinal location at time of exposure, time of day, time of year, behavior (clothes and sunscreens) and pigmentation of the skin. White people,

whose skin contains less protective melanin, have higher incidence of skin cancer than people with more melanin. The higher incidence of skin cancer among white people than among non-white populations suggests the increase in skin cancer incidence from ozone depletion may not be as important globally as in the United States and western Europe.

Unfortunately, very little scientific data exists to assess the likely adverse effects of ozone depletion with the greatest potential global impact -- suppression of the immune system and disruption of aquatic and terrestrial ecosystems. These data are not likely to be available for a long time at current research funding levels. Even if the necessary research were undertaken immediately, meaningful results would not be available for years. Case studies suggest the potential effects of immune system suppression and ecosystem disruption would be disastrous and irreversible. In the studies conducted on plants and animals, ultraviolet radiation weakens the immunological system and reduces the ability to resist disease. Several studies also indicate that the immune response of humans is depressed by ultraviolet radiation. There is, however, no evidence as to the magnitude of the risk. Likewise, limited studies of the effect of ultraviolet radiation on crops and aquatics generally show adverse impacts, but are not sufficient to quantify the overall risk.

Status of International and Domestic Actions

International -- The United States, through the State Department and EPA, has played a leading role in the negotiations toward a Protocol to the Vienna Convention on the Control of Chlorofluorocarbons. The State Department received authority to negotiate a protocol pursuant to inter-agency approval of the November 28, 1986 Circular 175 requesting such authority. The Circular 175 authorized the delegation to negotiate a protocol providing for:

I. A near-term freeze on the combined emissions of the most ozone depleting substances;

II. A long-term scheduled reduction of emissions of these chemicals down to the point of eliminating emissions from all but limited uses for which no substitutes are commercially available (such reduction could be as much as 95%), subject to III; and

III. Periodic review of the protocol provisions based upon regular assessment of the science. The review could remove or add chemicals, or change the schedule or the emission reduction target.

The next negotiation toward a protocol is scheduled for April 27-30, 1987. As the Circular 175 authorized, the United States has pressed for a near-term freeze on emissions of CFCs and halons and for long-term emissions reductions of up to 95 percent subject to periodic scientific assessment. A proposed reduction of 95 percent has not been well-received in the negotiations. Short of the 95 percent proposal, countries have various preferences. A significant issue is how to deal with developing countries that have not reaped the economic benefits of CFC use and thus have not caused the ozone depletion problem, yet also threaten to contribute to depletion as they industrialize and use CFCs for aerosols, regrigeration, solvents and foam-blowing.

Domestic: The United States has substantially reduced CFC use in aerosols and is now considering further controls on ozone depleting chemicals. In 1978, the United States unilaterally reduced CFC use as an aersol propellant pursuant to an EPA ban of CFC use in nonessential aerosol spray cans. Prior to 1978, CFC use in aerosols was 56 percent of United States CFC use and 25 percent of world use. Aerosols now represent less than five percent of United States use of CFCs 11 and 12, yet remain the largest single use of CFCs outside of the United States (31 percent).

As a result of a lawsuit by an environmental group against EPA, the agency plans to issue a notice summarizing its findings regarding an ozone protection program by May 1987. The notice will either propose further regulation of ozone depleting chemicals or present the basis for a proposed decision to take no further action at this time.

Proposals for domestic ozone protection programs are largely dependent upon the outcome of the international negotiations toward a protocol on the control of ozone depleting chemicals. EPA's public announcement of its intent to announce its ozone protection plan findings by May 1987 placed considerable emphasis on United States participation in the international discussions. Indeed, the legislative parties drafting ozone protection bills and the environmental parties threatening continued litigation have been attending the international negotiations toward a protocol and have been basing their domestic actions on the progress of international negotiations. In 1980, representatives of U.S. industry formed the Alliance for Responsible CFC Policy. The Alliance has emphasized that any control action must be global in scope to protect the ozone layer and to prevent disadvantaging U.S. industrial competitiveness.

Two important scientific studies should be completed this calendar year. First, a team of scientists from NASA, NOAA, industry and universities is evaluating the existing data on the amount of the decline in total atmospheric ozone concentrations over the past several years. The team is reanalyzing the data

with a view toward addressing the inconsistencies and the uncertainties. The team's findings will be ready in late 1987. Second, a team of scientists from government laboratories and universities is analyzing the results of the 1986 National Ozone Expedition in the Antarctic. This team is assessing the most recent measurements of the Antarctic ozone hole and is analyzing the potential causes.

Additional scientific studies are continuing. For example, NASA, NOAA and the Chemical Manufacturers Association are sponsoring the 1987 Airborne Ozone-Hole Campaign to study Antarctic ozone loss in July through September 1987.

OPTIONS

1. Continue Circular 175 Process

The Administration could let the State Department and EPA continue to negotiate toward a protocol on ozone depleting chemicals pursuant to the Circular 175 process. Under this process, the delegation would coordinate the inter-agency review of the U.S. negotiating positions as the international discussions progress.

2. Advise the U.S. Delegation of Desired Positions

The Administration could select a negotiating position for the delegation to take to the next round of talks. This position would be selected from among a range of negotiating options including:

a. Freeze plus 95% reduction in 10-14 years.

b. Freeze plus 40-70% reduction in 6-10 years.

c. Freeze plus 20-40% reduction in 6-10 years.

d. Freeze

Within each alternative negotiating position, sub-options exist for the chemicals to be covered by the agreement, for the processes to be covered by the agreement (production, consumption, adjusted production), and for the countries to be covered by the agreement (i.e. equity issues for developing countries, trade issues with non-parties).

Each potential negotiating position would be subject to future scientific assessment.

3. Impose Domestic Controls Unilaterally

EPA could impose controls on U.S. ozone depleting chemicals while the delegation continues to participate in international discussions.

4. Await Scientific Results for International or Domestic Action

The Administration could delay international agreement or domestic action until there is more scientific certainty about the likely levels of ozone depletion and the causes of depletion.

Interior

1. A USG goal is to prevent harmful depletion of stratospheric ozone.

   A. Atmospheric concentrations of certain ozone-depleting chlorofluorocarbons and halons are increasing.

   B. Credible scientific theories argue that depletion of the stratospheric ozone layer could result in significant adverse health, crop, and environmental effects. Additional science and analysis is necessary to estimate the magnitude of the problem and the posssibility of substitutes.

   C. The scientific findings to date have prompted the United States to take a leadership position in calling for international actions to reduce emissions of ozone depleting chemicals.

2. The USG, which acted unilaterally in 1978 in banning the use of aerosols, believes that the international community must follow suit. At a minimum, they must reduce aerosol use, freeze emissions, and begin the process of significant reductions of the five main aerosol depleting chemicals. Objectives include:

   A. Ensuring progress of the international negotiations toward an agreement.

   B. The international agreement must include all countries including the eastern bloc and developing nations.

   C. The international agreement should cover the five main ozone-depleting chemicals (CFC 11, CFC 12, CFC 113, Halon 1201, Halon 1311).

   D. The international agreement must contain an enforceable trade provision to encourage compliance by parties and to encourage nonparties to join.

   E. The international agreement must provide for periodic scientific assessments to verify or change the scope of the agreement as to reduction targets, reduction schedules, chemical coverage, compliance, and trade.

Issue: What should be the United States position in the April 27-30, 1987 UNEP negotiations toward a protocol for controls on ozone-depleting chemicals?

Background:

- -The ozone problem
- -Domestic and international actions to date
  - -NRDC lawsuit against EPA
  - -Proposed legislation
  - -Vienna Convention (Circular 175)
- -Interconnection of domestic and international action (inter alia, undesirability of unilateral action)
- -Status of international negotiations
- -Status of scientific and economic assessments

Position Options:

Variables within each option:
- -substances to control
- -type of control (production, emissions, adjusted production, consumption)
- -extent of control
- -application of controls worldwide

Negotiating Options: Each option will be subject to scientific assessment and will include emergency review provisions.

Each option could include variants on substances subject to control.

1) Same position (not viable)

2) Stricter position - Freeze in 2 years; 95% in 10-14 years

3) Freeze in 2 years; 40-70% in 6-10 years

4) Freeze in 2 years; 20-40% in 6-10 years

5) Freeze in 2 years (not viable)

6) No controls at this point (not viable)

4/6 - Draft ready for RCB; -- provide to small group late morning.

≈ 4/8± Wkg gp

≈ 4/15 Wkg gp

4/20+ DPC

Domestic Policy Council

Stratospheric Ozone Depletion

Statement of Issue

1. Does the Administration believe that sufficient scientific evidence now exists to adopt the following negotiating position:

   a) adopt a freeze on the production of six CFC and Halogen compounds at 1986 levels;
   b) adopt a phasedown of specific amounts within specific timeframes;
   c) impose trade sanctions with respect to CFC related goods against all non-signatory nations or those violating the international agreement?

2. Should the U.S. unilaterally adopt a freeze and specific phasedown schedule in the absence of an international agreement among CFC producing nations?

Background

The emissions of CFCs react chemically in the upper atmosphere to deplete ozone -- an essential buffer of ultraviolet light.

Significant depletion will cause increased incidence of skin cancer and retard crop production.

At this time no significant depletion is occurring. Fear of depletion exists based on the length of time CFCs remain in the atmosphere and the continued rapid increase in CFC emissions that is expected to occur in the absence of a global effort to reduce them.

- EPA currently predicts a 2.5% annual increase in CFC use. Most of the anticipated adverse environmental effects are due to this growth in CFC use, not current usage.

- Under UNEP a major scientific and data gathering effort is underway using satellites and other measurement efforts.

- Observational evidence indicates that the chemical composition of the atmosphere is changing at a rapid rate on a global scale. However, the scientific community is still grappling with the significance of these changes.

- Of particular interest is the ozone depletion (40%) that has occurred periodically (i.e., since 1957) above the Antarctic. However, it is not yet evident whether the behavior of ozone above the Antarctic is an early warning of future changes in <u>global</u> ozone or whether it will always be a local Antarctic phenomenon because of its special

geophysical conditions.

- Media concern over the Antarctic ozone hole should not be viewed as synonymous with global ozone depletion. It is a single event with many potential causes and should not obfuscate the global nature of the problem.

- Predictions of rates of ozone depletion, risks of depletion and the health and economic effects of various control options are based on a two dimensional model developed by an EPA contractor. Models are used as tools to predict the extent to which human activities will modify atmospheric ozone and climate. However, these emission models currently have a significant degree of uncertainty which is compounded in making estimates of environmental effects by the uncertainty surrounding those effects.

U.S. Actions to Date

- The U.S. began taking unilateral action in 1978 with a ban of non-essential uses of CFCs (e.g., spray can propellants). Total U.S. emissions were reduced by 30% under this action.

- Most other major users and emitters of CFCs did not follow this lead.

- In 1982, the NRDC sued EPA to take additional measures on the grounds that the Clean Air Act requires action if it may reasonably be assumed that a risk exists. The U.S. has argued that unilateral action would have an insignificant effect in the absence of a global initiative.

- EPA has until May 1987 to determine if additional unilateral regulation is necessary under the Clean Air Act and, if so, what regulatory decision it intends to propose.

International Activities

- In March 1985, a general convention for the protection of the Ozone Layer (referred to as the Vienna group) was adopted under the auspices of UNEP.

- Since then the U.S. has been pushing other nations to negotiate a protocol to the Convention. The current U.S. negotiating posture is:

  -- A freeze at 1986 emission levels for four CFC compounds and two Halogen compounds;

  -- A reduction of up to 95% (i.e., all but essential uses) of these compounds subject to:

  -- Periodic reassessment of the science, costs, and

technical considerations.

- By September 1987, EPA/State Dept. want to conclude negotiations on a protocol that includes a freeze and a phasedown.

Public Perception

- The media has portrayed the U.S. position as a 95% reduction.

- Although no specific phaseout schedule or timetable has ever been approved, U.S. representatives have proposed a specific schedule of reductions as an example. This example is now widely portrayed as the U.S. position by the press, the environmental community and the Congress.

Action Events

- April 27, 1987 - formal negotiating session at which EPA and State want to propose specific phasedown schedule.

- May, 1987 - EPA must decide if unilateral action is merited and, if so, what action.

Discussion of the Issues

Issue 1. Does the Administration believe that sufficient scientific evidence now exists to adopt a phasedown of specific amounts within specific timeframes and impose trade sanctions on non-signatories.

Factors to Consider

- There is widespread agreement within the scientific community that unchecked increases in CFC use will adversely affect the ozone layer. Prudence dictates that immediate steps be taken to hold CFC emissions down and to provide relief later if stringent controls are determined unnecessary.

- There is widespread disagreement within the scientific community over rates of depletion, the risks posed, and the relative importance of different CFC and halogen compounds. Prudence dictates that we know which compounds pose the risks, what the real risks are, who is most affected by our action and, if controls are necessary, what is the best mechanism and timetable for obtaining appropriate substitutes.

- A freeze at 1986 levels will not place U.S. industry in any additional economic jeopardy relative to the disadvantage already incurred in 1978 as a result of unilateral reductions.

- By most estimates, 75% of the health and welfare benefits to be derived from additional reductions occur from a global freeze. However, a global freeze will place developing nations at a distinct disadvantage since per capita use would be expected to rise most dramatically in those nations.

- The benefits of a full 95% reduction, which will minimize the incidence of cancer, may greatly outweigh the costs of the reduction. A cost/benefit test would dictate a full 95% reduction.

- No global initiative will significantly affect the ozone layer until the year 2000, including taking no further action until the scientific uncertainty is resolved.

- The effect of any policy that imposes sanctions is unclear. Who is affected and by how much is unknown and may conflict directly with other foreign policy objectives in lesser developed countries. Issues of verification and measurement remain unresolved.

- Sanctions could have the same effect as import restrictions since the U.S. imports far more CFC related products than it exports.

- An Administration policy that does not include a specific scheduled phasedown will be viewed as a major reversal of current policy. In fact, even a schedule not leading to a 95% reduction in all emissions will be opposed by the U.S. environmental community.

- Since few other nations will likely agree to either a 95% reduction or significant reductions in all identified CFC and halogen compounds - a middle ground may be needed for the April 27, 1987 negotiation if progress toward signing a protocol in September is to be maintained. EPA and State suggest that an interim step of 40-70% reduction over the next 6-10 years be inserted in the U.S. position.

- Any specific timetable for more reductions will clearly lock the Administration into similar unilateral actions in May. While not legally connected, the Administration has argued that our domestic and international position must be identical and have obtained extensions to the court suit to develop them simultaneously.

Issue #2. Should the U.S. unilaterally adopt a freeze and specific phasedown schedule in the absence of widespread agreement among CFC producing nations.

Factors to Consider

- The U.S. can demonstrate its continuing leadership by adopting additional, reasonable and cost-effective control measures.

- Interim and long term reductions similar to those proposed for negotiation will be low in costs; prevent larger economic or technological disruption; will not prematurely retire capital; and will provide an incentive to U.S. manufacturers to develop substitutes, with commensurate long term economic advantages.

- Unilateral action by the U.S. will have no significant positive impact on the ozone layer.

- Unilateral interim and long term measures simply alleviate pressure on other nations to take actions and will even allow them to increase use <u>without</u> affecting world wide total emissions. Unilateral U.S. action in 1978 brought <u>no</u> pressure to bear on other nations.

- Additional unilateral action beyond a freeze will definitely create major economic disadvantages for the U.S. manufacturing sector that provides products containing those compounds. Even if they were to be developed, substitutes would be far more expensive.

- The health and welfare benefits that would be derived from

a global freeze or reduction from current levels do not exist
if adopted unilaterally, rendering any unilateral action cost-ineffective.

Domestic Policy Council

Stratospheric Ozone Depletion

Statement of Issue

1. Does the Administration believe that sufficient scientific evidence now exists to adopt the following negotiating position: for an international position to the Commission for Protection of Ozone Layer.

   a) adopt a freeze on the production of six CFC and Halogen compounds at 1986 levels; AND/OR

   b) adopt a phasedown of specific amounts within specific timeframes; AND/OR

   c) impose trade sanctions with respect to CFC related goods against all non-signatory nations or those violating the international agreement?

2. Should the U.S. unilaterally adopt a freeze and/OR specific phasedown schedule in the absence of an international agreement among CFC producing nations?

Background

The emissions of CFCs react chemically in the upper atmosphere to deplete ozone -- an essential buffer of ultraviolet light.

Significant depletion will cause increased incidence of skin cancer and retard crop production and how other adverse effects. DUE TO CFC's BEING OBSERVED

At this time no significant depletion is occurring. Fear of depletion exists based on the length of time CFCs remain in the atmosphere and the continued rapid increase in CFC emissions that is expected to occur in the absence of a global effort to reduce them.

- EPA currently predicts a 2.5% annual increase in CFC use. Most of the anticipated adverse environmental effects are due to this growth in CFC use, not current usage.

BUT ISSUE IS GLOBAL NOT LIMITED TO US

- Under UNEP a major scientific and data gathering effort is underway using satellites and other measurement efforts.

- Observational evidence indicates that the chemical composition of the atmosphere is changing at a rapid rate on a global scale. However, the scientific community is still grappling with the significance of these changes.

- Of particular interest is the ozone depletion (40%) that has occurred periodically (i.e., since 1957) above the Antarctic. However, it is not yet evident whether the behavior of ozone above the Antarctic is an early warning of future changes in <u>global</u> ozone or whether it will always be a local Antarctic phenomenon because of its special

geophysical conditions.

- Media concern over the Antarctic ozone hole should not be viewed as synonymous with global ozone depletion. It is a single event with many potential causes and should not obfuscate the global nature of the problem.

- Predictions of rates of ozone depletion, risks of depletion and the health and economic effects of various control options are based on a two dimensional model developed by an EPA contractor. Models are used as tools to predict the extent to which human activities will modify atmospheric ozone and climate. However, these emission models currently have a significant degree of uncertainty which is compounded in making estimates of environmental effects by the uncertainty surrounding those effects.

U.S. Actions to Date

- The U.S. began taking unilateral action in 1978 with a ban of non-essential uses of CFCs (e.g., spray can propellants). Total U.S. emissions were reduced by 30% under this action.

- Most other major users and emitters of CFCs did not follow this lead.

- In 1982, the NRDC sued EPA to take additional measures on the grounds that the Clean Air Act requires action if it may reasonably be assumed that a risk exists. The U.S. has argued that unilateral action would have an insignificant effect in the absence of a global initiative.

- EPA has until May 1987 to determine if additional unilateral regulation is necessary under the Clean Air Act and, if so, what regulatory decision it intends to propose.

International Activities

- In March 1985, a general convention for the protection of the Ozone Layer (referred to as the Vienna group) was adopted under the auspices of UNEP.

- Since then the U.S. has been pushing other nations to negotiate a protocol to the Convention. The current U.S. negotiating posture is:

  -- A freeze at 1986 emission levels for four CFC compounds and two Halogen compounds;

  WITHIN — YEARS

  -- A reduction of up to 95% (i.e., all but essential uses) of these compounds subject to:

  -- Periodic reassessment of the science, costs, and

technical considerations.

- By September 1987, EPA/State Dept. want to conclude negotiations on a protocol that includes a freeze and a phasedown.

Public Perception

- The media has portrayed the U.S. position as a 95% reduction.

- Although no specific phaseout schedule or timetable has ever been approved, U.S. representatives have proposed a specific schedule of reductions as an example. This example is now widely portrayed as the U.S. position by the press, the environmental community and the Congress.

Action Events

- April 27, 1987 - formal negotiating session at which EPA and State want to propose specific phasedown schedule.

- May, 1987 - EPA must decide if unilateral action is merited and, if so, what action.

Discussion of the Issues

Issue 1. Does the Administration believe that sufficient scientific evidence now exists to adopt a phasedown of specific amounts within specific timeframes and impose trade sanctions on non-signatories.

Factors to Consider

- There is widespread agreement within the scientific community that unchecked increases in CFC use will adversely affect the ozone layer. Prudence dictates that immediate steps be taken to hold CFC emissions down and to provide relief later if stringent controls are determined unnecessary.

- There is widespread disagreement within the scientific community over rates of depletion, the risks posed, and the relative importance of different CFC and halogen compounds. Prudence dictates that we know which compounds pose the risks, what the real risks are, who is most affected by our action and, if controls are necessary, what is the best mechanism and timetable for obtaining appropriate substitutes.

- A freeze at 1986 levels will not place U.S. industry in any additional economic jeopardy relative to the disadvantage already incurred in 1978 as a result of unilateral reductions.

- By most estimates, 75% of the health and welfare benefits to be derived from additional reductions occur from a global freeze. However, a global freeze will place developing nations at a distinct disadvantage since per capita use would be expected to rise most dramatically in those nations.

- The benefits of a full 95% reduction, which will minimize the incidence of cancer, may greatly outweigh the costs of the reduction. A cost/benefit test would dictate a full 95% reduction.

MEASURE DEATHS

GET CEA BLESS

- No global initiative will significantly affect the ozone layer until the year 2000, including taking no further action until the scientific uncertainty is resolved.

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- The effect of any policy that imposes sanctions is unclear. Who is affected and by how much is unknown and may conflict directly with other foreign policy objectives in lesser developed countries. Issues of verification and measurement remain unresolved.

- Sanctions could have the same effect as import restrictions since the U.S. imports far more CFC related products than it exports.

by the environmental community and some foreign governments.

- An Administration policy that does not include a specific scheduled phasedown will be viewed as a major reversal of current policy. In fact, even a schedule not leading to a 95% reduction in all emissions will be opposed by the U.S. environmental community.

- Since few other nations will likely agree to either a 95% reduction or significant reductions in all identified CFC and halogen compounds - a middle ground may be needed for the April 27, 1987 negotiation if progress toward signing a protocol in September is to be maintained. EPA and State suggest that an interim step of 40-70% reduction over the next 6-10 years be inserted in the U.S. position.

- Any specific timetable for more reductions will clearly lock the Administration into similar unilateral actions in May. While not legally connected, the Administration has argued that our domestic and international position must be identical and have obtained extensions to the court suit to develop them simultaneously.

Issue #2. Should the U.S. unilaterally adopt a freeze and specific phasedown schedule in the absence of widespread agreement among CFC producing nations.

Factors to Consider

- The U.S. can demonstrate its continuing leadership by adopting additional, reasonable and cost-effective control measures.

- Interim and long term reductions similar to those proposed for negotiation will be low in costs; prevent larger economic or technological disruption; will not prematurely retire capital; and will provide an incentive to U.S. manufacturers to develop substitutes, with commensurate long term economic advantages.

- Unilateral action by the U.S. will have LESS significant positive impact on the ozone layer.

- Unilateral interim and long term measures simply alleviate pressure on other nations to take actions and will even allow them to increase use <u>without</u> affecting world wide total emissions. Unilateral U.S. action in 1978 brought <u>no</u> pressure to bear on other nations.

- Additional unilateral action beyond a freeze will definitely create major economic disadvantages for the U.S. manufacturing sector that provides products containing those compounds. Even if they were to be developed, substitutes would be far more expensive.

- The health and welfare benefits that would be derived from

a global freeze or reduction from current levels do not exist

if adopted unilaterally, rendering any unilateral action ~~cost-~~ineffective.

LGSS

Draft Ozone Paper

ISSUE

What should the Administration's position be regarding the April United Nations negotiations toward an international protocol for control of ozone depleting chemicals?

BACKGROUND

Strong international and domestic concern exists over ozone depletion caused by emissions of chlorofluorocarbons (CFCs) reacting in the upper atmosphere (stratosphere). Ozone is an essential buffer of ultraviolet light; significant depletion could cause skin cancer, suppress the human immune system, retard crop production and damage aquatic and terrestrial ecosystems.

Although stratospheric ozone concentrations have decreased over the past seven years, it is unclear whether any significant change in natural ozone levels has occurred. The only area where scientists have observed significant depletion is Antarctica. There, ozone depletion of approximately 50 percent has been found every spring since 1985. Scientists are not sure of the cause of the Antarctic depletion. Potential causes include chemical emissions, the solar cycle and climate change. Global depletion is expected to occur absent global reduction efforts.

Scientists are unable to predict when depletion will occur or what levels of chemical emissions will trigger significant depletion. Yet the sudden unexplained appearance of the Antarctic ozone hole suggests large global changes could occur before scientists observe them. Further complicating the problem is the fact that substantial CFC emissions will continue for years after a decision to curb emissions. This is because the industrial transition to CFC substitutes and emissions controls will take time, and products containing CFCs (e.g. refrigerators and air conditioners) may continue to emit the ozone depleting gases for years during use. There is also a question as to how soon ozone would recover after significant depletion; CFCs have an atmospheric lifetime of 75 to 100 years.

The Vienna Convention for the Protection of the Ozone Layer, ratified by the Senate in July 1986, established an international framework for scientific cooperation and initiated negotiations toward a protocol for controls on ozone depleting chemicals. The United States has had a leading role in the negotiations toward a control protocol. The next negotiating session is scheduled for April 27-30, 1987. The last negotiating session is tentatively scheduled for July 1987, with the diplomatic signing ceremony tentatively scheduled for September in Canada.

There is domestic as well as international movement toward controls on ozone depleting chemicals. Several Senators have proposed a complete phase-out of ozone depleting agents. And in response to a judicial consent decree, EPA must either propose controls or present the basis for taking no action by May 1987.

Industry recognizes the need for some form of control on ozone depleting agents. The industrial Alliance for Responsible CFC Policy favors reducing the growth of CFC production rather than reducing emissions and strongly disfavors unilateral domestic controls that would disadvantage U.S. competitiveness.

DISCUSSION

Causes of Depletion

Emissions of man-made chemicals are changing the chemical composition of the atmosphere. In particular, atmospheric concentrations of chemicals known to deplete ozone are increasing. These chemicals are: chlorofluorocarbons (CFCs) 11, 12, and 113; halons 1211 and 1301; methyl chloroform; and carbon tetrachloride. Global atmospheric concentrations of CFCs 11 and 12 have been growing in recent years at a rate of five percent per year. Concentrations of CFC 113 have been increasing at a rate of 10 percent per year. Concentrations of halon 1211 have been increasing by 23 percent a year. No trend estimates have been published for halon 1301. Concentrations of methyl chloroform have been increasing by 7 percent a year, and of carbon tetrachloride by 1 percent a year.

Measurements also show atmospheric increases in ozone enhancing agents. These chemicals are carbon dioixide and methane. Concentrations of nitrogen oxides are also increasing; these chemicals deplete ozone in the upper atmosphere (stratosphere) and enhance ozone in the lower atmosphere (troposphere). Even though emissions of ozone enhancing agents offset total atmospheric depletion, the offset is not sufficient to prevent ozone depletion at current emission rates. Moreover, the ozone enhancing chemicals increase ozone concentrations in the lower atmosphere while depletion occurs in the upper atmosphere altering the vertical distribution of ozone. Ozone in the lower atmosphere can be dangerous as it is a toxic gas and it contributes to global warming.

At current use volumes, CFCs 11 and 12 have the most ozone depleting potential, followed by CFC 113. Industrialized countries have relied heavily on CFCs 11 and 12 for use in aerosol propellants, refrigeration, foam-blowing, and solvents. The following is a proportional breakdown of uses:

CFC 11

Use	World	United States
Rigid Foam	39%	51%
Aerosol	31%	5%
Flexible Slabstock	15%	15%
Flexible Molded	4%	5%
Chillers	3%	6%
Unallocated	8%	18%

CFC 12

Use	World	United States
Aerosol	32%	4%
Mobile Air Conditioning	20%	37%
Rigid Foam	12%	11%
Refrigerators	6%	6%
Chillers	1%	1%
Miscellaneous	7%	10%
Unallocated	22%	31%

While use of CFC 113 has not been as great as use of the other CFCs, 113 is increasingly used in solvents for cleaning electronic equipment.

CFC emissions occur in production of the chemicals, in use of the chemicals (operating losses and leakage) and in destruction of products containing CFCs (e.g. foam crushing). Once emitted into the atmosphere, CFCs have unusually long atmospheric lifetimes of 75 to 100 years. Their chemical stability and unusual persistence enables them to reach the stratosphere where they react with ultraviolet radiation to release ozone-depleting chlorine.

Halons 1211 and 1301 are used in fire extinguishers. Current production of these chemicals is relatively low. However, halons contain bromine which has much greater ozone depleting potential than the chlorine in CFCs.

Scientists are not sure of the cause of the Antarctic ozone hole. Potential causes include man-made ozone depleting chemicals, the solar cycle, and climate change.

Depletion Projections

Various scientific models have predicted the future ozone depletion expected to result from varying rates of CFC growth. Projections of future depletion are also dependent upon the relative growth rates of the other ozone depleting and ozone enhancing chemicals.

EPA has estimated global ozone depletion in 2075 for six alternative CFC global use scenarios (assuming constant rates for other ozone altering chemicals). For reference in assessing these EPA projections, it may be useful to note that studies of future CFC demand estimate the median annual growth rate for CFCs 11 and 12 as 2.5 percent. The United Nations Environment Program suggested scenario testers use a range of 0% to 5% annual growth for CFCs 11 and 12 for the 1986-2100 period.

CFC Use	Projected Ozone 2075
Decrease 80% by 2010	3% Increase
Constant (1985-2100)	.3% Increase
1.2% Increase 1985-2050 and no growth 2050-2100	4.5% Depletion
2.5% Increase 1985-2050 and no growth 2050-2100	25% Depletion
3.8% Increase 1985-2050 and no growth 2050-2100	>50% Depletion
5% Increase 1985-2050 and no growth 2050-2100	>50% Depletion

Questions exist regarding the accuracy of the models. Generally, observational data support model predictions of the atmospheric concentrations of chemicals. Yet there is a 20-50 percent discrepancy between observed and predicted ozone in the upper stratosphere even though the accuracy of ozone predicting models is increasing with time. The models also failed to predict the 50 percent seasonal ozone depletion in Antarctic ozone that scientists confirmed in 1985.

Effects of Depletion

Depletion of the total amount of atmospheric ozone would increase the amount of harmful ultraviolet radiation reaching the earth. Although many uncertainties exist as to the precise impacts of the increase in ultraviolet radiation, scientific data and/or case studies indicate it would increase nonmelanoma skin tumors, increase cutaneous malignant melanoma, suppress the human immune system, increase cataracts, reduce crop yield, harm aquatic life, accelerate the degradation of polymers, and contribute to global warming and the attendant sea level rise threatening coastal populations.

Of all of the potential adverse effects of ozone depletion, the best scientific data exists for the likely increases in skin cancer. Several studies suggest that the ultraviolet radiation

naturally absorbed by ozone is the most important solar radiation component in the incidence of common skin cancer (nonmelanoma tumors). The mortality rate from nonmelanoma skin cancer is two percent. Health projections indicate there will be 500,000 new cases of nonmelanoma skin cancer in 1987 with an expected morality of 10,000. Studies show that a one percent increase in the ultraviolet radiation absorbed by ozone results in a 1.8 - 2.5 percent increase in the incidence of nonmelanoma skin tumors. (A one percent depletion in ozone increases the weighted ultraviolet radiation by about two percent.)

Although there is uncertainty about the relationship between solar radiation and the more serious form of skin cancer, cutaneous malignant melanoma, much evidence supports the link between solar radiation and this disease. Health projections indicate there will be 25,000 new cases of cutaneous malignant melanoma in 1987; the mortality rate from this disease is 30 percent.

Numerous variables affect the incidence of either form of skin cancer including duration of exposure, latitudinal location at time of exposure, time of day, time of year, behavior (clothes and sunscreens) and pigmentation of the skin. White people, whose skin contains less protective melanin, have higher incidence of skin cancer than people with more melanin. The higher incidence of skin cancer among white people than among non-white populations suggests the increase in skin cancer incidence from ozone depletion may not be as important globally as in the United States and western Europe.

Unfortunately, very little scientific data exists to assess the likely adverse effects of ozone depletion with the greatest potential global impact -- suppression of the immune system and disruption of aquatic and terrestrial ecosystems. These data are not likely to be available for a long time at current research funding levels. Even if the necessary research were undertaken immediately, meaningful results would not be available for years. Case studies suggest the potential effects of immune system suppression and ecosystem disruption would be disastrous and irreversible. In the studies conducted on plants and animals, ultraviolet radiation weakens the immunological system and reduces the ability to resist disease. Several studies also indicate that the immune response of humans is depressed by ultraviolet radiation. There is, however, no evidence as to the magnitude of the risk. Likewise, limited studies of the effect of ultraviolet radiation on crops and aquatics generally show adverse impacts, but are not sufficient to quantify the overall risk.

Status of International and Domestic Actions

(Status of Int'l & Domestic Actions)

International -- The United States, through the State Department and EPA, has played a leading role in the negotiations toward a Protocol to the Vienna Convention on the Control of Chlorofluorocarbons. The State Department received authority to negotiate a protocol pursuant to inter-agency approval of the November 28, 1986 Circular 175 requesting such authority. The Circular 175 authorized the delegation to negotiate a protocol providing for:

I. A near-term freeze on the combined emissions of the most ozone depleting substances;

II. A long-term scheduled reduction of emissions of these chemicals down to the point of eliminating emissions from all but limited uses for which no substitutes are commercially available (such reduction could be as much as 95%), subject to III; and

III. Periodic review of the protocol provisions based upon regular assessment of the science. The review could remove or add chemicals, or change the schedule or the emission reduction target.

The next negotiation toward a protocol is scheduled for April 27-30, 1987. As the Circular 175 authorized, the United States has pressed for a near-term freeze on emissions of CFCs and halons and for long-term emissions reductions of up to 95 percent subject to periodic scientific assessment. A proposed reduction of 95 percent has not been well-received in the negotiations. Short of the 95 percent proposal, countries have various preferences. A significant issue is how to deal with developing countries that have not reaped the economic benefits of CFC use and thus have not caused the ozone depletion problem, yet also threaten to contribute to depletion as they industrialize and use CFCs for aerosols, regrigeration, solvents and foam-blowing.

Domestic -- The United States has substantially reduced CFC use in aerosols and is now considering further controls on ozone depleting chemicals. In 1978, the United States unilaterally reduced CFC use as an aersol propellant pursuant to an EPA ban of CFC use in nonessential aerosol spray cans. Prior to 1978, CFC use in aerosols was 56 percent of United States CFC use and 25 percent of world use. Aerosols now represent less than five percent of United States use of CFCs 11 and 12, yet remain the largest single use of CFCs outside of the United States (31 percent).

As a result of a lawsuit by an environmental group against EPA, the agency plans to issue a notice summarizing its findings regarding an ozone protection program by May 1987. The notice will either propose further regulation of ozone depleting chemicals or present the basis for a proposed decision to take no

further action at this time.

Proposals for domestic ozone protection programs are largely dependent upon the outcome of the international negotiations toward a protocol on the control of ozone depleting chemicals. EPA's public announcement of its intent to announce its ozone protection plan findings by May 1987 placed considerable emphasis on United States participation in the international discussions. Indeed, the legislative parties drafting ozone protection bills and the environmental parties threatening continued litigation have been attending the international negotiations toward a protocol and have been basing their domestic actions on the progress of international negotiations. In 1980, representatives of U.S. industry formed the Alliance for Responsible CFC Policy. The Alliance has emphasized that any control action must be global in scope to protect the ozone layer and to prevent disadvantaging U.S. industrial competitiveness.

Two important scientific studies should be completed this calendar year. First, a team of scientists from NASA, NOAA, industry and universities is evaluating the existing data on the amount of the decline in total atmospheric ozone concentrations over the past several years. The team is reanalyzing the data with a view toward addressing the inconsistencies and the uncertainties. The team's findings will be ready in late 1987. Second, a team of scientists from government laboratories and universities is analyzing the results of the 1986 National Ozone Expedition in the Antarctic. This team is assessing the most recent measurements of the Antarctic ozone hole and is analyzing the potential causes.

Additional scientific studies are continuing. For example, NASA, NOAA and the Chemical Manufacturers Association are sponsoring the 1987 Airborne Ozone-Hole Campaign to study Antarctic ozone loss in July through September 1987.

OPTIONS

1. Continue Circular 175 Process

The Administration could let the State Department and EPA continue to negotiate toward a protocol on ozone depleting chemicals pursuant to the Circular 175 process. Under this process, the delegation would coordinate the inter-agency review of the U.S. negotiating positions as the international discussions progress.

(Delineation of elements of options and pro's and con's is still to come.)

2. Advise the U.S. Delegation of Desired Positions

The Administration could select a negotiating position for the delegation to take to the next round of talks. This position would be selected from among a range of negotiating options including:

a. Freeze plus 95% reduction in 10-14 years.

b. Freeze plus 40-70% reduction in 6-10 years.

c. Freeze plus 20-40% reduction in 6-10 years.

d. Freeze only

Within each alternative negotiating position, sub-options exist for the chemicals to be covered by the agreement, for the processes to be covered by the agreement (production, consumption, adjusted production), and for the countries to be covered by the agreement (i.e. equity issues for developing countries, trade issues with non-parties).

Each potential negotiating position would be subject to future scientific assessment.

3. Impose Domestic Controls Unilaterally

EPA could impose controls on U.S. ozone depleting chemicals while the delegation continues to participate in international discussions.

4. Await Scientific Results for International or Domestic Action

The Administration could delay international agreement or domestic action until there is more scientific certainty about the likely levels of ozone depletion and the causes of depletion.

Draft Ozone Paper

Issue

What should the Administration's position be regarding the April United Nations negotiations toward an international protocol for control of ozone depleting chemicals?

~~Overview~~ Background.

Strong international and domestic concern exists over stratospheric ozone depletion caused by emissions of man-made chemicals reacting in the upper atmosphere (stratosphere). Ozone is an essential buffer of ultraviolet light; significant depletion could cause skin cancer, suppress the human immune system, retard crop production and damage aquatic and terrestrial ecosystems. Although stratospheric ozone concentrations have decreased over the past seven years, scientists have not observed significant global depletion to date. Global depletion is expected to occur absent global reduction efforts. Significant depletion (approximately 50 percent) has been observed in the Antarctic in spring of each year since 1985. Antarctic ozone levels have been declining since 1965 with the vertical depth of the ozone hole increasing each year.

The Vienna Convention for the Protection of the Ozone Layer, ratified by the Senate in July 1986, established an international framework for scientific cooperation and initiated negotiations toward a protocol for controls on ozone depleting chemicals. The United States has had a leading role in the negotiations toward a control protocol. The next negotiating session is scheduled for April 27-30, 1987. Mention subsequent meetings & dates also.

There is domestic as well as international movement toward controls on ozone depleting chemicals. Several Senators have proposed a complete phase-out of ozone depleting agents. And in response to a judicial consent decree, EPA must either propose controls or present the basis for taking no action by May 1987.

Industry recognizes the need for some form of control on ozone depleting agents. Yet industry strongly disfavors unilateral domestic controls that would disadvantage U.S. competitiveness.

Ozone Depletion: Causes, ~~Projections and Effects~~

Causes of Depletion -- Emissions of man-made chemicals are changing the chemical composition of the atmosphere. In

particular, atmospheric concentrations of chemicals known to deplete ozone are increasing. These chemicals are: chlorofluorocarbons (CFCs) 11, 12, and 113; halons 1211 and 1301; methyl chloroform; and carbon tetrachloride. Global atmospheric concentrations of CFCs 11 and 12 have been growing in recent years at a rate of five percent per year. Concentrations of CFC 113 have been increasing at a rate of 10 percent per year. Concentrations of halon 1211 have been increasing by 23 percent a year. No trend estimates have been published for halon 1301. Concentrations of methyl chloroform have been increasing by 7 percent a year, and of carbon tetrachloride by 1 percent a year.

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At current use volumes, CFCs 11 and 12 have the most ozone depleting potential, followed by CFC 113. Industrialized countries have relied heavily on CFCs 11 and 12 for use in aerosol propellants, refrigeration, foam-blowing, and solvents. The following is a proportional breakdown of uses:

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Chillers	3%	6%
Unallocated	8%	18%

CFC 12

Use	World	United States
Aerosol	32%	4%
Mobile Air Conditioning	20%	37%
Rigid Foam	12%	11%
Refrigerators	6%	6%
Chillers	1%	1%
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While use of CFC 113 has not been as great as use of the other CFCs, 113 is increasingly used in solvents for cleaning electronic equipment.

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Unfortunately, very little scientific data exists to assess the likely adverse effects of ozone depletion with the greatest potential global impact -- suppression of the immune system and disruption of aquatic and terrestrial ecosystems. These data are not likely to be available for a long time at current research funding levels. Even if the necessary research were undertaken immediately, meaningful results would not be available for years. Case studies suggest the potential effects of immune system suppression and ecosystem disruption would be disastrous and irreversible. In the studies conducted on plants and animals, ultraviolet radiation weakens the immunological system and reduces the ability to resist disease. Several studies also indicate that the immune response of humans is depressed by ultraviolet radiation. There is, however, no evidence as to the magnitude of the risk. Likewise, limited studies of the effect of ultraviolet radiation on crops and aquatics generally show adverse impacts, but are not sufficient to quantify the overall risk.

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Pros & Cons for each