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ALASKA
ANCHORAGE DAILY NEWS
September 21, 1987

Hope for the Ozone

Maybe there's hope for the world's vanishing ozone layer after all. In an unprecedented international agreement, thirty-nine nations have agreed to limit production of the chemicals that cause the ozone layer to deteriorate.

The chemicals, known as chlorofluorocarbons, are commonly used in air conditioners, refrigerators, aerosol sprays, and foam products. Scientists say thinner ozone could produce an epidemic of skin cancer and raise the earth's temperature, which could flood coastal areas and transform the world's climate.

The production limits set under Wednesday's agreement are a

ALABAMA
BIRMINGHAM POST HERALD
September 21, 1987

The Ozone Treaty

Can the world's nations cooperate to control the discharge of noxious substances into the atmosphere before the resulting pollution gravely harms mankind? Once we would have said no. Our answer now is a small maybe.

The change comes from an unprecedented accord signed in Montreal last week by the United States, 23 other countries and the 12-member European Community to first freeze and later reduce output of chlorofluorocarbons.

The chemicals, known as CFCs, are widely used in air conditioning, refrigeration, aerosol sprays, puffing up foam products and cleaning computer chips. They have a dangerous side effect: Immigrating to the upper atmosphere, they deplete the ozone layer that protects the Earth from the sun's cancer-causing ultraviolet radiation.

Under the agreement reached at a United Nations-sponsored conference, participating countries will freeze their production of CFCs in 1989 at 1986 levels. Then, in two steps, they will cut consumption by 50 percent by 1999.

"This is the first truly global treaty that offers protection to every single human being," said Mostafa Tolba, the U.N. official in charge.

good start, but they may not be strong enough. U.S. government scientists estimate that use of the chemicals must be cut immediately by 85 percent to prevent long-term damage to the ozone. This agreement will only cut output by 50 percent by the end of the century.

Modest though this treaty may be, it is the first agreement of any kind that limits global air pollution. And considering that industry representatives repeatedly called for more study before restricting the chemicals, getting any agreement at all is a real breakthrough.

His enthusiasm is understandable, but overzealous. Because of loopholes granted to the Soviet Union and poor countries to expand their CFC production, global production could drop only 30 percent to 35 percent by 1999, instead of the treaty's goal of 50 percent.

In addition, the U.S. Environmental Protection Agency calculates that an immediate 85-percent cut in CFC use would be needed to stop the buildup of the long-lived chemicals in the atmosphere. So the world is doing something, but much less than necessary.

On the brighter side, companies in the United States, Japan and Europe will plunge into research to find environmentally safe substitutes for CFCs. And if they succeed, other countries—even those with loopholes—could switch from the harmful chemicals faster than expected.

Though a modest start, the treaty is the first international effort to control an air pollutant. It may very well serve as a pattern for future worldwide drives against threats to the environment, and thus it could prove very important.

The ozone treaty, a modest start

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New life for the ozone

There is reason to be a little more optimistic about our future on this planet because of an agreement of major importance reached this week in Montreal. Negotiators representing 24 industrial countries have signed a protocol that will limit and eventually roll back global use of chemicals that are destroying the Earth's protective ozone layer.

Scientists have been warning for years that widely used chemicals are destroying the Earth's ozone shield—a delicate concentration of gas in the stratosphere that filters out harmful ultraviolet rays. Without this protection, millions of people would develop skin cancer, there would be an increase in eye disease and dramatic changes in world climate that would mean crop damage and a gradual depletion of aquatic resources.

The chemical culprits are chlorofluorocarbons—used in refrigerator coolants, air conditioners, plastic foams and aerosol cans—and halons, used to extinguish fires and to protect high-tech computer and electronic facilities around the world.

Fortunately for mankind, this disastrous course will be altered by what represents a milestone in international environmental cooperation.

The Montreal protocol will reduce consumption of chlorofluorocarbons by 50 percent in a 10-year period beginning in 1990. The protocol would take effect a year after the pact is ratified by at least

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11 countries responsible for two-thirds of the annual 1 million tons produced. Consumptions of halons will be frozen at the 1986 level starting in 1992, pending further research.

The action comes none too soon. Scientists say that 3 percent to 7 percent of the ozone layer already has been depleted. A 40-percent hole has been discovered over the Antarctic.

Participating nations have indeed broken new ground by subordinating economic interests to environmental concerns. This concern should be sustained with a firm commitment to fulfilling provisions of the protocol. If additional data concludes that more than a 50 percent cut in production of these chemicals is warranted, there should be no hesitation in complying.

It is encouraging that politicians and diplomats are cooperating with scientists to address environmental problems. This long-awaited alliance could pave the way for action on a host of other environmental challenges, such as acid rain, toxic waste disposal and the proliferation of pollutants in the air and water, to name a few.

Remarkable advances in science and technology this century have benefited society in many ways. They have, however, resulted in certain threats to the environment. Eventually, we must decide whether the use of hazardous substances to accelerate profits and provide creature comforts are worth the damage they inflict on this planet. Decisions reached in Montreal indicate the problem is getting the attention it deserves.

CALIFORNIA
FRESNO BEE
October 2, 1987

Getting serious about ozone

It was no small thing that 46 governments did in Montreal in approving an agreement to control production of chlorofluorocarbons (CFCs), chemical which as they drift upward into the stratosphere, appear to be damaging the protective layer of ozone above the earth.

For the first time, the international community has committed itself to measurable controls to protect the environment without ironclad proof of the precise nature and extent of the damage being done. Yet despite this laudable prudence, the important question remaining is whether the accord goes far enough.

Environmentalists and a good many scientists think it doesn't.

The agreement will put a cap on production of CFCs—used in a wide range of products such as refrigerators, air conditioners, aerosol containers, chemical solvents and Styrofoam containers—by 1989 and require a reduction of 50 percent by 1999. But there are loopholes that reduce that figure effectively to 35 percent. Developing nations will be allowed to expand their use of CFCs for 10 years, and the Soviet Union will be permitted to complete CFC-producing plants now under construction.

Moreover, it's still unclear whether such important countries as India, which didn't attend the Montreal conference, and China, which did but hasn't yet signed the protocol, will join the agreement.

Even if all countries adhere to the accord—already signed by the United States, Canada, Japan and the 12-member European Community—it's not clear that the curbs will be enough to prevent serious damage to the ozone layer, which lies nine to 30 miles above the earth.

The ozone filters out an estimated 99 percent of the harmful ultraviolet rays emanating from the sun, rays known to cause skin cancer in humans and damage to crops and other forms of life.

Some scientists believe the amount of rays that gets through the ozone layer already has increased from 1 percent to 3 percent and that because CFCs survive for decades, their harmful effects would continue to increase well into the next century even if all production were halted today.

That assumption is disputed by industrial producers, who think a cap at 1986 levels—the first phase of the accord—would be sufficient. Even they concede, however, that a treaty was needed to prevent the chemical industry in any major producing country from gaining an unfair advantage, and to prod manufacturers to hasten the development of suitable alternatives. Some already exist but are either more expensive or in some cases, toxic, which CFCs are not.

What seems to have concentrated minds everywhere, and to have induced governments to take this unprecedented step, is the huge gap in the ozone layer that has appeared over Antarctica in recent years. Scientists don't know exactly what its significance is—whether it's a regional phenomenon only or portends ecological disaster for the whole world. But they, and now most of the world's governments, are convinced that the danger is sufficient to warrant concerted action.

The accord signed in Montreal may have to be tightened as the scientific evidence accumulates, in the meantime, a welcome precedent for other forms of global environmental cooperation has been set. For the moment, at least, there's reassurance in that.

CALIFORNIA
LOS ANGELES HERALD EXAMINER
September 18, 1987

Ozone pact's a good omen

The Reagan administration's vigorous effort to curtail ozone depletion in the upper atmosphere may turn out to be the most significant environmental step forward in the past six years. Indeed, the international protocol signed in Montreal Wednesday offers an excellent precedent for handling other global environmental problems in a way that is mutually beneficial to all nations.

The ozone layer shields the earth from 99 percent of the sun's ultraviolet rays. Reduced levels of ozone would permit damage to plant and animal life, with increased skin cancers being the most direct harm to human beings.

Such reductions are widely believed to be caused by ozone reactions with chlorofluorocarbons, inert chemicals used in aerosol propellants, refrigerator coolants, foam containers and other products.

Although the U.S. and a few other countries banned CFC-based aerosols years ago, the seasonal ozone hole that was discovered above Antarctica last year convinced even cautious observers that more CFC cutbacks were essential. It would hurt American manufacturers, however, if the cutbacks were only observed by the U.S. And few other countries seemed interested at first.

That makes the Montreal accomplishment all the more impressive. Altogether 24 individual nations and the 12-member European Community signed the ozone pact, and 13 others indicated that they also will sign.

If the agreement works, CFC production will be frozen at the 1986 levels in 1990, and then reduced in phases by 50 percent over the next decade. Given the complex nature of the agreement and the tangle of fairness and trade issues involved, the speed with which it was hammered out was almost breathtaking. After the champagne has been downed, however, each signatory country still has the formidable task of working out the details of compliance.

The pact's greatest benefit may be its proof that nations can cooperate on complex matters of common interest before possible harm becomes obvious and irreversible. It offers hope that action can be taken before it's too late to curb another atmospheric threat: the "greenhouse effect" that could catastrophically raise average global temperatures.

CALIFORNIA
SACRAMENTO BEE
September 21, 1987

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Environmentalists and a good many scientists think it doesn't. The agreement will put a cap on production of CFCs—used in a wide range of products such as refrigerators, air conditioners, aerosol containers, chemical solvents and Styrofoam containers—by 1989 and require a reduction of 50 percent by 1999. But there are loopholes that reduce that figure to 35 percent: Developing nations will be allowed to expand use of CFCs for ten years, and the Soviet Union will be permitted to complete CFC-producing plants now under construction. Moreover, it's still unclear whether such important countries as India, which didn't attend the Montreal conference, and China, which did but hasn't yet signed the protocol, will join the agreement.

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skin cancer in humans and damage to crops and other forms of life. Some scientists believe the amount of rays that gets through the ozone layer already has increased from 1 percent to 3 percent, and that because CFCs survive for decades, their harmful effects would continue to increase well into the next century even if all production were halted today.

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CALIFORNIA
SAN FRANCISCO CHRONICLE
October 2, 1987

Ozone Damage

REVELATION OF THE worst Antarctic "ozone hole" ever is cause for real concern. Since the ozone shield protects our earth's surface from harmful ultraviolet radiation from the sun, these dramatic readings have quite properly triggered alarm bells.

The severely cold air and high ice clouds peculiar to Antarctica may be co-culprits along with chemical air pollution. But this is the greatest depletion yet. It is an ominous sign from the frigid south.

The ozone shield protects the earth's surface from harmful ultraviolet radiation from the sun that can contribute to skin cancer and other health problems.

While deeply-puzzling questions still remain about the mechanics involved in erosion of the ozone layer, there seems little doubt that man-made chemicals like the chlorofluorocarbons found in refrigerants, aerosols and similar products, are contributory. The current findings should quite properly increase pressure to ratify a protocol reached in Montreal by 46 nations that would freeze CFC at 1985 levels and then halve its production by 1999.

This is the kind of signal that the world community ignores at its peril.

CALIFORNIA
SAN FRANCISCO EXAMINER
September 21, 1987

Fighting the ozone threat

The Widening rift in the ozone layer above Antarctica, now the size of the continental United States, is a puzzlement and may be a potential world disaster. Is this window to the sun's ultraviolet rays a natural phenomenon? Or is man's expansive economy eroding his most precious ecology—his gaseous stratospheric protection from the sun?

Science has not yet reached full accord that the depleted ozone layer is man's doing, though it is agreed that if the rift continues to widen it could be our undoing. Consensus has been building, though, that the root of this evil takes the name of chlorofluorocarbons. The 1 million tons produced annually are widely used in refrigeration, air conditioning and computer manufacture.

Believing that a principal cause of the rift is known, 46 countries struck a historic agreement in Montreal last week to cut by 50 percent the use of chlorofluorocarbons by the end of the century. The agreement itself was an encouraging sign that threats to global health can force international accord. Soviet scientists are contributing data from stations in Antarctica. Researchers from the National Aeronautics and Space Administration in Mountain View will send jets 60,000 feet above Antarctica this month to collect rarefied gases from the rift.

Results of these tests due in October, promise the best definition so far of the role of chlorofluorocarbons and other man-made gases

in ozone depletion. That could convince signatory nations that the Montreal agreement did not go far enough and suffers a dire rift of its own, a near global loophole.

The agreement allows continued manufacture of chlorofluorocarbons at a rate of 10 percent more each year for 10 years, provided they be exported to underdeveloped countries in need of the technology. Science has determined that a 1 percent decrease in ozone means a 2 percent increase in ultraviolet rays from the sun, or an estimated 30,000 more cases of skin cancer per year in the United States alone. Exemptions for developing nations may make economic sense, but be ecologically destructive.

Sherwood Rowland, the UC-Irvine chemist who three years ago helped alert the world by discovering the ozone thinout, has predicted the depletion would worsen for another 20 years even if all chlorofluorocarbon releases were stopped now. He believes releases should be cut 95 percent, and right now.

Still, the Montreal accord is a reminder that the human survival instinct is the most powerful, overcoming many conflicts of economics, culture and politics. The next round of evidence from the heavens should cause us to consider even more carefully and courageously just what on Earth we are doing.

CALIFORNIA
SAN JOSE MERCURY NEWS
September 21, 1987

To rescue the ozone

An international forum offered solid solutions to a looming crisis

International forums generally aren't the most effective means for dealing with tough issues, but that may be changing—at least where the environment is concerned.

Representatives of more than 75 nations met last week in Montreal to fashion a strategy for curbing the destruction of the fragile ozone layer in the Earth's atmosphere. The gathering, which produced a surprising amount of substantive action, could provide a model for addressing future environmental crises of global proportions.

On one level, the problem tackled in Montreal is simple: The ozone shield around the Earth is being depleted, which means that more ultraviolet radiation is being allowed to rain down on the Earth and its inhabitants.

That's bad because increases in ultraviolet levels mean a greater incidence of skin cancer in man as well as damage to ecosystems.

What to do about the problem, which has manifested itself in an actual hole in the ozone layer above the South Pole, is not as easy as

identifying it. Participants in the Montreal meeting wisely chose to act on the best available scientific evidence, even if it is not yet incontrovertible.

A growing body of scientific data points to the broad industrial use of chlorofluorocarbon chemicals—used in air conditioning and refrigeration, aerosol sprays and packaging—as a key source of the ozone problem.

The Montreal agreement freezes and eventually reduces chlorofluorocarbon use in several steps. It also puts a cap on use of ozone-destroying halons, which are widely used in fire suppressants.

The measure will have a significant impact on the \$2.2 billion-a-year chlorofluorocarbon industry, and mean considerable expense for users.

It is hoped the agreement will spur industry to come up with safer alternatives.

Ozone depletion figures to be a serious problem for years. However, the steps taken thus far to combat it are cause for optimism.

CALIFORNIA
SANTA BARBARA NEWS-PRESS
September 18, 1987

Blue skies, smiling

International accord on ozone sets a cheering precedent

It isn't perfect, but nothing made by the human hand ever is. The world's first environmental clean-up agreement—or, more formal, the Montreal Protocol on Substances that Deplete the Ozone Layer—is an exciting testament to scientific diligence, diplomatic vision and our ability to place self-preservation above economic expediency.

The 24 nations and one coalition who signed the protocol Wednesday account for production of most of the world's chlorofluorocarbons (CFCs) that scientific evidence suggests have depleted the earth's ozone layer by 3 percent to 7 percent already. Even after it banned use of aerosol sprays in the 1970s, the United States still releases 33 percent of all CFCs into the atmosphere. The European Community contributes 42 percent; Japan, 11 percent. The Soviet Union, one of 49 countries that signified a willingness to sign the agreement later, is responsible for 10 percent. With these four entities promising to reduce their 96 percent share of a problem invisible to the unscientific eye, the future of our planet just started to look a few shades brighter.

Depletion of the ozone layer in our atmosphere, strongly believed to be caused by CFCs and halon, slowly strips us of protection from the sun's rays. Results can include increases in skin cancer troubles with our immune system, crop failures and erosion of the ocean's elaborate food chain.

Critics say the accord—to freeze CFC use at 1986 levels, beginning in 1989, and cut use by 50 percent before the century's end—

will only delay the destruction of ozone, not halt it. But industry sources predict that, once their production is restricted, CFCs will become so expensive that manufacturers will be forced to find alternatives. This could mean that developing nations, who have been granted a 10-year grace period to acquire such needed technology as refrigeration, may find themselves the first to be priced out of a shrinking market.

U.S. firms seem to have gracefully accepted the inevitable. Most supported the long, hard search for an international consensus—because they feared that a one-sided ban by our federal government would place them at an unfair disadvantage with overseas competitors. However, researchers at E.I. du Pont de Nemours & Company, our nation's largest CFC producer, predict that the development of a thoroughly tested substitute will take seven years. And it will carry a cost, to just about everybody who likes ice cream or air conditioning.

But place that cost—borne on the shoulders of the world, not just America—against the tremendous potential gains from global cooperation to preserve our small, shared habitat. And on the balance sheet drawn up by our descendants, the bottom line will read: Enlightened survival of a species that conquered its own worst enemy.

CALIFORNIA
SANTA ROSA PRESS DEMOCRAT
September 24, 1987

Lost in the ozone

They laughed when scientists speculated that a chemical compound called chlorofluorocarbons was eroding the ozone layer around the world. They laughed again when the U.S. banned the CFC aerosol propellants in 1978.

But they aren't laughing anymore.

The laughter stopped when scientists in 1985 discovered a measurable depletion of the ozone shield and a hole in the ozone above Antarctica.

In response, 46 nations have agreed to place a moratorium on uses of chlorofluorocarbons—which are used for refrigerants, solvents and plastics—and to reduce their use by half before the turn of the century.

What's so important about ozone? The invisible layer in the stratosphere keeps out damaging ultraviolet rays from the sun.

Scientists say a one percent reduction in the ozone will mean 60,000 additional cases of skin cancer in the U.S. alone, plus damage to crops and marine organisms.

Credit for the Montreal agreement goes to the environmental groups which lobbied other countries, and to the U.S. Environmental Protection Agency which led the fight despite the opposition of Interior Secretary Donald Hodel.

Hodel suggested that people need merely to wear hats and sunglasses to escape the growing intensity of ultraviolet rays. Fortunately, cooler heads in the Reagan administration and 45 other nations recognized a more serious risk.

COLORADO
BOULDER DAILY CAMERA
September 21, 1987

Ozone treaty is breakthrough

The International ozone treaty signed last Wednesday will not garner public attention in the manner of arms-control agreements. But measured in terms of the threat of life on Earth, the Montreal Protocol may be of equal long-term importance.

Scientists have suspected for years that manufactured chlorofluorocarbons deplete the ozone layer that protects animals and plants from harmful ultraviolet rays. In 1977 the United States banned CFCs in aerosol sprays, but other countries did not, and the chemicals continued to be used in refrigeration, insulation, foam containers and industrial products.

Now 43 countries, which account for two-thirds of worldwide production of the chemicals, have agreed to freeze the use of CFCs at current levels and reduce production by 50 percent by the end of the century.

A decade of work went into the treaty, which is expected to be ratified by the individual countries. The U.S. State Department and Environmental Protection Agency played a pivotal role in the agreement, ignoring the foot-dragging earlier this year by Reagan administration officials who were unwilling to antagonize industry.

The breakthrough is particularly meaningful for members of the

Boulder scientific community who are at the forefront of ozone-layer research. Scientists from the National Oceanic and Atmospheric Administration and the National Center for Atmospheric Research are studying the mysterious "hole" in the ozone shield over Antarctica, which galvanized concern after its discovery in 1985.

The Montreal Protocol is intended to prevent further thinning of the ozone, which would allow deadly radiation to reach the Earth. Richard Benedick, chief negotiator for the United States, called it a landmark agreement. "Usually, we're trying to patch up something after disaster has occurred," he said.

Also key to the treaty's significance is the groundwork that has been laid for future cooperation on environmental issues of a global nature. Benedick and other delegates cited the greenhouse effect—the warming of the atmosphere—as another potentially devastating problem that must be addressed internationally.

The United States clearly must be out front on these efforts, just as it is in negotiations involving nuclear weapons. The future of the Earth is riding on both.

COLORADO
DENVER ROCKY MOUNTAIN NEWS
September 21, 1987

Ozone protocol an encouraging step

The Reagan administration has restored a measure of credibility to its stance on curbing ozone in the atmosphere. At a conference in Montreal last week, the United States reduced the height of the barrier it had set up against the protocol, so leading to a successful conclusion.

On Wednesday, delegates to the conference voted to first freeze and then reduce the consumption of chemicals that destroy ozone molecules in the upper atmosphere. Thinning of the ozone layer, it is believed, will increase the incidence of skin cancer and cause other damage to human and plant life. Chlorofluorocarbons are widely used around the world in air conditioning, refrigeration, insulation and aerosol sprays, with an annual production of \$2.2 billion.

Twenty-four nations plus the 12-member European Community signed the protocol and 49 others approved the action without actually signing. The agreement calls for use of chlorofluorocarbons to be frozen at 1986 levels when the protocol goes into effect in 1989; for the level to be reduced by 20% by 1994 and by another 30% by 1999. Developing countries will be held to a lesser standard as an aid to their development, but the expectation is that the tough restraints will accelerate development of substitutes.

Through the negotiations, the U.S. had insisted that unless nations representing at least 90% of world production signed the agreement before it became binding, it would not endorse the protocol. All other delegations opposed that hard line and the U.S. lowered the hurdle to 66%.

Depletion of the ozone has been a concern to scientists for several years though there is as yet no firm evidence of damage. That may be the most significant and encouraging outcome of the complex and difficult negotiations—that the nations of the world could act together in advance of irreparable damage.

The protocol still must be ratified by the individual nations, including the separate members of the European Community. Some of the 49 that did not sign the protocol are expected to do so, though they had not so empowered their delegates.

The pact is the first collective environmental action taken by the world community. It shows growing recognition that very little happens on this planet that does not affect all quarters of it. That should set the stage for other efforts to protect life on Earth while there is yet time to do so.

*CONNECTICUT
HARTFORD COURANT
September 24, 1987*

A life-saving accord on ozone

It may be an overstatement to say that environmental issues make national boundaries moot. But the recent accord on the production and consumption of chemicals that destroy stratospheric ozone makes clear the need for cooperation among nations.

Two dozen governments, plus the European Economic Community, which represents the 12 Common Market members, agreed last week on what the U.S. negotiator called "perhaps the most significant international environmental agreement" ever signed. The accord will take effect in 1989, provided the major ozone producers ratify it.

Stratospheric ozone protects the Earth from harmful ultraviolet radiation. Depletion of the ozone layer could lead to an increase in the incidence of skin cancer and to crop damage, scientists say.

The accord calls for an initial freezing of the use of chlorofluorocarbons or CFCs, followed by a gradual reduction of the chemicals' use. There are several loopholes in the agreement, however. The Soviet Union will be allowed to produce CFCs at plants that are under construction, and developing countries will be exempt if CFC production contributes significantly to their economic growth.

*DISTRICT OF COLUMBIA
WASHINGTON POST
September 18, 1987*

The Ozone Treaty

The Reagan administration deserves enormous credit for the part it played in achieving the world ozone treaty signed this week. On most environmental issues the administration has been more laggard than leader. On this the reverse has been true. Environmental administrator Lee Thomas and Secretary of State George Shultz were able to brush aside the minority of objecting ideologues within the administration and produce a sound position.

The treaty signed in Montreal under U.N. auspices must still be ratified, but that is thought likely. It deals with chlorofluorocarbons, or CFCs, compounds widely used—in air conditioning, refrigeration, the manufacture of a wide variety of foam products and as solvents—because, among their other attributes, they are cheap, durable and neither flammable, nor toxic. But when released into the atmosphere, as almost all eventually are, these compounds rise to mix with and dilute the ozone layer that shields the Earth from ultraviolet radiation. A thinning of the ozone layer is thought likely to lead to more skin cancer, crop and other plant damage and serious climatic changes.

Such loopholes should not exist, but any agreement to reduce ozone production is better than nothing. Researchers estimate that as much as 7 percent of the ozone layer has been destroyed. Forty percent of the ozone layer over Antarctica shows signs of depletion at some times of the year.

Even if the new controls are observed, the ozone layer will be depleted by another 2 percent by the middle of the next century. That could result in catastrophic climatic changes.

Observance of the accord would avert 27 million cancer deaths among people born between 1987 and 2075; according to the U.S. Environmental Protection Agency.

Depletion of the ozone layer is only one of many international environmental issues that need attention, including acid rain, dwindling of tropical rain forests and emissions of carbon dioxide. The ozone accord should serve as a useful example of how to reach international agreements on these matters.

The treaty would freeze CFC production in 1990 at 1986 levels, then cut it in half by 1999. By itself this might not be enough to stop attenuation of the ozone layer. But the 50 percent cut is thought likely to stimulate development of alternate compounds, which will then supplant the offending CFCs. The chemical industry feels confident that it can produce such compounds. That may have helped to make this an easier treaty to negotiate; the affected interest group had less to lose. But the industry has behaved in exemplary fashion even so.

Some people hope the ozone treaty will become the example for other such agreements. We don't know if it can, but it is an extraordinary achievement on its own terms, the more so because of how quietly it was brought about. A major environmental threat has apparently been deflected with very little of the shouting that usually accompanies such problems—maybe *because* there was so little shouting. Good for everyone involved.

FLORIDA

FORT LAUDERDALE NEWS and the FORT LAUDERDALE SUN SENTINEL

September 25, 1987

Ozone treaty of vital importance

Twenty-four nations have signed what may prove to be the most important treaty in world history. But the agreement will not end a war or limit the production of arms.

The treaty aims to protect the Earth's environment and the continued existence of the human species by limiting production of chlorofluorocarbons, chemicals commonly called CFCs.

Used as coolants in refrigerators and air conditioners, propellants in aerosol sprays, as solvents for cleaning computer parts and in styrofoam packaging and foam insulation, CFCs eventually drift into the stratosphere 10 to 30 miles above the Earth where the chemicals break down the protective ozone layer of the planet.

Scientists, and now government leaders, from around the world believe that continued erosion of the ozone will contribute to dramatic changes in global climate because unfiltered ultraviolet light from the sun will warm the Earth. Droughts will increase, the polar ice caps will begin to melt and entire countries may be in danger of inundation by the oceans. A dramatic rise in skin cancer also is expected to accompany an increase in ultraviolet radiation.

Already, a hole the size of the continental United States has been

discovered in the ozone layer over the Antarctic, and each year the size of the hole increases.

Time appears to be of the essence, and that is why the treaty's provisions, which still have to be approved by the governments of each signatory nation, call for a strict timetable.

The treaty calls for a freeze in consumption of the five most damaging CFCs, beginning around 1989, a 20 percent cut five years later, and a further 50 percent cut by the end of the century. Countries that don't sign the treaty may face trade sanctions.

The United States and western Europe face a great responsibility in making sure that their governments quickly ratify the treaty since the United States and the countries of the European Economic Community produce 75 percent of the world's CFCs, while consuming only 54 percent of the world supply.

Any hesitancy to approve or any quarrels over the terms of the treaty in any of these nations would further delay prudent and necessary action to protect the life of Planet Earth as we know it.

FLORIDA

MIAMI HERALD

October 5, 1987

Into the ozone

ABOUT a year ago, the world scientific community warned that the ozone layer was in severe danger of depletion by a man-made chemical, chlorofluorocarbons. The ozone shield protects the Earth from the sun's deadly ultraviolet radiation.

It wasn't the first time scientists sounded the ozone alarm. But ozone worries are relatively recent when compared to other environmental hazards, such as acid rain. Acidic rainfall that kills forests and lakes and turns soil nonproductive is an old story. A decade ago, in fact, Congress attached some weak amendments to the Clean Air Act to mollify critics of acid rain's sources: emissions of sulfur dioxide and nitrogen oxide from coal-burning industries and automobiles' toxic exhaust.

That done, Congress and several Administrations dragged their feet. Pleas from Canada, recipient of acid rain caused by U.S. sources, fell on deaf ears until this year, when the President finally agreed to fund preventive research. Actually, prevention is available by installing scrubbers on stacks of coal-burning plants, increasing use of low-sulfur coal, and mandating more refined anti-pollution devices on vehicles. Those remedies have major economic impact however, thus the foot-dragging.

Compare, then, the Government's alacrity on behalf of the ozone layer. The White House was a strong force behind a September agreement by numerous nations to freeze and eventually reduce chlorofluorocarbon production. Safer products can be substituted as a coolant and an aerosol. The chemical industry fussed at first, but yielded.

Meanwhile, Congress dallies over renewing the Clean Air Act. The senate's Environment Committee is now marking up a solid package of bills that address myriad air-pollution sources, including acid rain. Committee member Bob Graham of Florida, however, has suggested weakening a measure that would roll back the allowable acid emissions to the tolerable 1980 level.

Florida suffers some of the most deleterious effects from acid rain in the country. Instead of obstructionism, the senator should join colleagues in finally making acid-rain prevention a priority equal to saving the ozone layer.

To save the future

Sometimes when the world seems bent on self-destruction, a ray of hope pierces the darkness. The historic first international agreement to protect the Earth's ozone layer inspires that kind of encouragement. Delegates from rich and poor nations, gathered in Montreal last week, resolved to work together to safeguard the global environment by preventing depletion of ozone in the stratosphere.

Twenty-four nations plus the European Community signed the protocol to reduce production of synthetic chemicals that float to the stratosphere and erode the ozone layer, the invisible shield that filters out the sun's harmful ultraviolet rays. The world's leading scientists have warned that the continuing destruction of ozone by man-made chemicals would cause sharp increases in skin cancer and cataracts, damage crops, forests and marine life and cause other environmental changes.

In a world whose natural systems are increasingly stressed by reckless human activity, the ozone treaty sets the foundation for other joint efforts to solve world environmental problems. The global warming trend or "greenhouse effect," deforestation and acid rain all need international action to achieve results and protect the Earth for future generations.

U.S. leadership in the ozone agreement was significant, although the Reagan administration a week earlier has threatened to undermine the treaty after months of intricate negotiations. The United States demanded that the international cutback in production of chlorofluorocarbons (CFCs), the ozone-destroying chemicals, not take effect until ratified by 90 percent of the major CFC producers. In subsequent discussions, the United States agreed to accept ratification by at least 11 nations representing at least two-thirds of global use of the chemicals. All the major producing nations are expected to ratify the pact.

Major provisions of the protocol call for participating nations at first to freeze and later roll back their consumption of the CFCs, widely used in air conditioning and refrigeration, aerosol sprays, foam insulation, packaging and solvents. The freeze at 1986 CFC levels will start in 1989, with a 20 percent cutback in consumption by 1994, and an additional 30 percent reduction by 1999.

An important indication of the emerging concern about degradation of the world environment was the immediate announcement by Friends of the Earth that the major fast-food franchises in the United States and some other countries have agreed to abandon CFC-filled foam packaging for safer materials.

Industry in the United States and Europe is confident that safe

alternatives to CFCs can be developed within five years. Their development could advance the schedule for the CFC scaledown. Even now, a scientific expedition is examining an enormous hole in the ozone layer that appears over the Antarctic each September. The United Nations Environmental Program is monitoring the research and will call an emergency meeting to reopen the treaty if new scientific evidence indicates that ozone depletion is accelerating and stronger action is needed.

The Reagan administration's shameful record on domestic environmental programs make the U.S. role in the ozone accord particularly noteworthy. Considering Mr. Reagan's historic right-wing opposition to business regulation, regardless of environmental damage, any support for a global environmental initiative is gratifying. It would have been foolhardy for the United States not to be a leading participant in the ozone protocol; the survival of life on Earth depends upon protection of the ozone.

On the same day that the Montreal treaty was signed, the National Resources Defense Council obtained the draft of an acid rain report that puts Mr. Reagan's hostility to environmental causes in perspective. Prepared by a federal task force, the report defies the scientific evidence of acid rain damage to forests, buildings, fields and streams in the northeastern United States and Canada. It declares that only a small fraction of U.S. lakes and streams have been damaged and that the damage is unlikely to get much worse.

In an attempt to whitewash the Reagan administration's six-and-a-half year stall on acid rain controls, the task force washes out.

Acid rain will not go away any more than destruction of the ozone shield will stop by itself. Both phenomena offer frightening evidence of the environmental dangers the world must confront if future generations are to inherit a livable world.

GEORGIA
SAVANNAH MORNING NEWS
September 10, 1987

A Landmark Treaty

An international treaty that will cut by half the amount of chlorofluorocarbons used worldwide over the next decade is a big step in protecting the earth's environment.

Just how big? If you consider that even a standstill in the current use of the gas will prevent about 1.65 million cases of skin cancer a year, a 50-percent reduction should have a dramatic impact on world health.

In 1978, The United States banned use of chlorofluorocarbons in aerosol sprays, such as deodorants. They are still used, however, in refrigerators and air conditioners and in making foam cups and foam-filled furniture. In fact, the U.S. remains the world's largest producer of the gases, generating about 30 percent of the global total each year.

THE GASES ARE dangerous because they destroy the earth's ozone. That atmospheric blanket helps absorb cancer-causing, ultraviolet rays from the sun.

Already, from 3 to 7 percent of the ozone layer has been depleted because of chlorofluorocarbons. Scientists have even discovered a 40-percent hole in the layer over the Antarctic.

Environmentalists are worried that the treaty, hammered out in Montreal by representatives from the United States and 45 other

countries, may be too little, too late. That is a valid concern, although it can be addressed only after future ozone data are collected and analyzed. That likely will take years.

INDUSTRIES THAT RELY on the gases are trying to develop a safer form or substitute gas. Until then, the chlorofluorocarbons treaty is a necessary move to protect a fragile but key portion of the environment. The U.S. Senate, which must ratify such agreements, should waste no time in approving it. Neither should officials from the other countries that took part in reaching the accord during a meeting in Montreal.

And, should future studies show that the gases continuing to erode the ozone, the nations should consider applying stricter limitations.

THE CURRENT TREATY stands as a landmark of cooperation. For the first time, many nations of the world have agreed to reduce a pollutant by a set amount.

In that respect, the agreement should serve as an impetus to address other environmental problems that affect the world, such as acid rain and disposal of toxic wastes. In today's global village, countries cannot afford to do anything less.

ILLINOIS
BUFFALO GROVE HERALD
September 23, 1987

Protecting our Earth

Twenty-four nations, including the United States, have signed an international agreement to protect the Earth's fragile ozone layer.

Earlier this year Interior Secretary Donald P. Hodel said in jest that people who were worried about an excess of ultraviolet light ought to stock up on wide-brimmed hats, bottles of sun screen and dark glasses. But protecting the atmosphere that protects us really is nothing to joke about.

That's why we welcome Deputy Assistant Secretary of State Richard E. Benedick's attitude toward protecting the ozone. As the primary negotiator for the United States, he went to bat for the air we breathe.

The agreement is significant because it is the first time nations have agreed to limit the production and use of a profitable product before direct evidence of its danger was available.

The pact will limit the use and production of chlorofluorocarbons—CFCs—which are used in refrigeration and as spray-can propellants. Although the United States, Canada and Scandinavian countries voluntarily banned CFCs in the 1970s, Japan and countries in the European community have continued to use the chemicals.

When ultraviolet light in the stratosphere hits the CFC compound, chlorine atoms are freed. One atom of chlorine can destroy 100,000 molecules of ozone.

In the mid-1970s, scientists suspected that CFCs were destroying ozone molecules which make up the layer of atmosphere that protects life on this planet from harmful ultraviolet rays. Scientists are convinced that CFCs are responsible for the huge hole in the ozone layer that appears over Antarctica each September and October.

CFCs released in the atmosphere today could become the bane of tomorrow's existence because of an increase of 3 to 10 degrees in global temperatures, skin cancer, etc.

Environmentalists say the agreement does not go far enough in limiting CFCs, Perhaps. But it's a start.

Ozone conference may save humanity

The news that 46 nations, including the United States, the European Economic Community members and Japan recently agreed to conserve the ozone layer came like a breath of fresh air to those who truly care about preserving life as we know it on earth.

The nations agreed to do this by working together to reduce the level of chlorofluorocarbons (CFCs) in the environment. CFC is an industrial chemical that destroys ozone, the crucial cushion of air that filters the sun's ultraviolet rays. Ozone, a gas, reportedly protects human beings from the various skin cancers and eye damage they might otherwise suffer from ultraviolet rays. The deadly rays also are allegedly harmful to vegetation, animals and regular biological processes. Simply put, this means that too many unfiltered ultraviolet rays may have the power to end life as we know it.

It is very important that the nations of the world unite on this issue because CFCs are present in so many areas of life. For example, they are used daily as cleaners for computer components, cooling agents in refrigerators and air conditioners, in aerosol cans, and in the manufacture of various chemical sprays.

The United Nations deserves great credit for sponsoring the agreement because in so doing, it is ultimately helping every nation to continue and every life form to flourish. The UN Environment Program and its member countries have worked for the past 10 years to find a solution to the threat of excessive solar radiation destroying the ozone layer. Therefore, the conference was definitely a step in the right direction.

It is also noteworthy that the UN showed great insight and con-

cern in putting the issue before the world's leaders, encouraging them to discuss pros and cons and urging them to come to an agreement on how they would address the problem. That is indeed admirable.

Another reason we like the accord is that the conferees set goals and timetables for the action they plan to take. The pact encourages all nations to freeze CFC production at 1986 levels until Jan. 1, 1990. After that date, the agreement calls for CFC production to be reduced by 50 percent by 1999. Such details are crucial because no strategy is effective if its specifics are not clearly defined and structured by tentative cut-off periods. Too often, "the best laid plans of mice and men" go awry because the necessary details are not clearly established and acted upon.

It must also be noted that the governments of those nations involved still must ratify the agreement. We strongly encourage them to make it one of their top priorities. It is most important that ratification occurs soon since the 11 CFC consumer countries involved have a combined consumption of at least two-thirds of the international production of CFC.

We urge the conferees and their governments to follow through on their initial plans so destruction to the ozone layer can be gradually reduced. Perhaps the part which is currently damaged will repair itself over time after the danger from CFCs is eliminated. But that, of course, will remain to be seen.

Saving the world from chemicals

Considering the chances of this happening: A chemical so widely used that it is found around the world in everything from cars and refrigerators to hair spray and plastic cups becomes environmentally suspect. Growing numbers of scientists are concerned that the chemical may pose a threat to all life on Earth. Not all scientists agree, and the bad effects haven't begun showing up. Nevertheless, nations around the world—rich and poor, east and west—get together and decide to freeze and then later reduce the consumption of the chemical.

Such a scenario may sound impossible in the face of the economic interests of powerful international corporations that manufacture and use the chemical, the generally lower environmental sensitivity of the Soviet bloc and developing nations, and the demands of developing not to be denied the economic benefits made possible by the use of the chemical.

But it's not a pipe dream. In fact, two dozen nations have signed protocols—and four dozen more are expected to sign—reducing the consumption of chlorofluorocarbons. CFCs as they are widely known, are suspected of destroying upper atmosphere ozone, which shields life on Earth from the sun's harmful ultraviolet radiation. In hardly an overstatement, Deputy Assistant Secretary of State Richard E. Benedick called the agreement "perhaps the most historically significant international environmental agreement."

Under the agreement, participating nations, including the United States and probably the Soviet Union, will freeze use of CFCs in

1989 at 1986 levels. By 1994, consumption must be reduced by 20 percent, and by 1999 it must be cut another 30 percent.

Developing countries will be allowed to increase consumption if it will help their economic development, and developed countries will be allowed to increase their production by as much as 10 percent annually over the next decade to meet that growing demand. That makes the developing countries a key to the success of the pact.

The solution to that problem, of course, is to develop acceptable substitutes. The technology is not expected to be a great problem, and common sense dictates that a multibillion-dollar market will not simply disappear. Indeed, several corporations, such as E.I. du Pont de Nemours Co. and Allied-Signal Inc., already are developing alternatives. As always, the cost will be passed on to consumers, but only the most entrenched manufacturers and users of CFCs would have everyone believe that the added cost will be more than minor.

For some environmentalists, the agreement may not go far enough. They have a point because the dynamics of how CFCs affect the environment are far from well understood. That, however, doesn't make the agreement any less significant.

The agreement will become effective when at least 11 nations representing at least two-thirds of global use of the chemicals sign on. That isn't expected to be a problem. Not signing, though, could create a problem of cataclysmic proportions.

ILLINOIS
CHICAGO TRIBUNE
September 24, 1987

A historic bridge from Earth to ozone

An international treaty to reduce the use of chlorofluorocarbons does not sound like very exciting stuff. But it already is being called probably the most historically significant agreement of its kind ever reached, and that is probably right.

The goal is to cut world consumption of industrial chlorofluorocarbons 50 percent by 1999. The hope is to ease their destructive impact on the Earth's ozone layer, the protective shield against the sun's damaging ultraviolet rays. Depletion of the layer—already by perhaps 7 percent—is linked to everything from skin cancer to changes in the climate.

The agreement wasn't easy. Twenty-four nations and the European Community signed the accord after months of negotiations on a host of scientific, geographic and economic issues. Twenty-five more are expected to sign on later. Its significance is that many nations—rich and poor—found common ground on an unseen and still poorly understood environmental threat, and faced it before it worsened.

KANSAS
WICHITA EAGLE-BEACON
September 21, 1987

World unites to save ozone shield

For the first time, the responsible governments of the world have banded together to deal with a global environmental problem—ultraviolet rays, once screened by a band of ozone high in the atmosphere, now reach Earth due to chemical depletion of the ozone layer. The treaty, signed last week in Montreal, phases in worldwide cuts in production of the chemicals believed to cause ozone-depletion. The 46 nations that negotiated it, including the United States and the Soviet Union, have cleared the way for worldwide treaties to fight global environmental problems—over-population, for example, or rain-forest destruction.

The chemicals in question, called chlorofluorocarbons (CFCs), are among the most useful mankind has invented. In the form of refrigerants they're used in every auto air conditioner in the world. In solid form, they provide excellent insulation, and provide the fast-food industry many of its containers. But recent research has led many scientists to believe that CFCs, which enter the atmosphere as solid materials decompose and gases escape from refrigeration equipment, break down as they move aloft. Freed chlorine atoms turn ozone into oxygene—which doesn't screen radiation.

The agreement isn't perfect. Undeveloped countries will be allowed to increase production by up to 10 percent a year for 10 years; the Soviet Union will be allowed to complete chlorofluorocarbon plants already planned or under construction. But the betting is that with the major producing countries cutting back, market forces will spur manufacturers into quicker production of safer substitutes. And there is great optimism that the agreement will be a catalyst for more global attention to similar global problems.

The irony is that the United States took the lead in forging the agreement under an administration seen as a pariah in the environmental community. It is one of 11 nations—representing two-thirds of the use of chlorofluorocarbons—that must ratify the treaty to put it in effect. That is a job for the U.S. Senate, which should not delay in keeping this country in the lead.

It's especially significant that the signatory nations—which include industrialized and developing nations—acted so decisively once they'd grasped the danger of CFCs. It took less than a year for a treaty to emerge from the United Nations-sponsored global negotiations. The treaty will take effect one year after 11 nations that produce most of the world's CFCs sign it.

It's a reasonable treaty. Scientifically conclusive proof that CFCs are responsible for ozone-depletion hasn't yet been offered. But the preponderance of evidence gathered thus far strongly suggest CFCs are the culprit. That's why the treaty stops short of a phased-in global ban, and calls instead for a 50-percent reduction in CFCs during the decade of the 1990s. According to U.S. Environmental Protection Agency Administrator Lee Thomas, the signatories understand that sterner measures would be enacted if ozone depletion worsened.

For now, it's enough that the world has united to address a problem that could alter life on Earth in such unpleasant ways as damaged crops and increased skin cancers. Such events add credence to the belief that humanity, in the end, will do what it must to assure its survival—and the Earth's.

LOUISIANA
NEW ORLEANS TIMES—PICAYUNE
October 5, 1987

Environmental double-whammy

Ozone is a deadly gas at ground level—despite the picturesque local designation of the bracing piney-woods air north of the lake as the Ozone Belt—but high in the atmosphere it is a shield that protects surface life from deadly ultraviolet radiation. So there is good reason for concern about newly discovered problems with the atmospheric ozone layer. The problem is that the problems are as yet poorly understood.

A major alarm was sounded in 1985, when a “hole” in the ozone layer over Antarctica was discovered and research indicated that it was an annual event that begun in the mid 1970’s. The hole has since been the object of intense research, and in mid-September, according to a NASA team, the ozone over Antarctica was only half of what is normal at the beginning of August.

The amount of ozone apparently goes up and down, but is trending downward. The hole itself is not a direct threat; it is taken as an indication of the ozone layer’s fragility and a warning that the entire layer may be under threat.

The attention to the hole was enough to spur international agreement at Montreal Sept. 15 to reduce by 50 percent use of chlorofluorocarbons. Used in aerosols, plastics, solvents and refrigeration fluids, the compound escapes, rises and reacts with ozone. Scientists estimate that a 1 percent decline in ozone can bring a 5 to 6 percent increase in skin cancer.

But the cause and effect of damage to the ozone layer are controversial among scientists. The NASA team emphasized that its findings had not been independently critiqued and should not be used for policy-making.

MASSACHUSETTS
PITTSFIELD BERKSHIRE EAGLE
September 9, 1987

Saving the ozone layer

In the long-term fight to maintain a livable planet Earth the Reagan administration has few battle ribbons to show off, but it may be winning one this week in Montreal. That is where representatives of 50 nations are gathered to complete an international pact that would restrict the use of ozone-depleting chemicals.

The ozone layer of the stratosphere is a blanket composed of this form of oxygen that shields the earth from most of the sun’s harmful ultraviolet radiation. Any depletion of this layer raises the danger of increased skin cancer among human beings and possible disruption of photosynthesis in plants.

Back in the 1970s, scientists began raising alarms that certain very stable chemicals, known as chlorofluorocarbons, set off chemical reactions in the atmosphere that destroy the ozone. The first use of these chemicals that was restricted in the United States was as a propellant in aerosol containers. But chlorofluorocarbons are also used in refrigerators, air conditioners, the foam used in cushions and fast-food containers. Finding substitutes for these other applications has not been as cheap or easy as replacing CFCs in aerosol propellants.

The threat that ozone depletion poses has taken on new dimensions in years as scientists have observed a disturbing phenomenon each fall over the South Pole: the formation of nothing less than an enormous ozone hole. A new expedition in Antarctica this fall will

try to determine whether the hole is spreading and whether it is caused by man-made chemicals such as CFCs.

The subject is certainly not simple. The role of manmade carbons in damaging the ozone layer seems universally accepted as proven, but natural processes are also involved—notably that most capricious of processes, weather. Robert Watson, head of the NASA researchers, says that the Antarctic climate is changing.

“There is an exquisite interplay between meteorology and chemistry,” he said. “It is clear that meteorology sets up the special conditions required for the perturbed chemistry. Can we separately quantify the contributions of chlorine and meteorology? At this moment in time we cannot.”

A separate study of a mile-long ice core sampling 160,000 years of Antarctic climate has tracked the rise and fall of carbon dioxide in the atmosphere and its relation to changing temperatures—the higher the temperatures, the more carbon dioxide.

Scientists believe the Earth’s temperature is rising now, and man-made carbon dioxide in air pollution is also increasing. Carbon dioxide is what produces the greenhouse effect, letting sunlight in but keeping surface heat from escaping. Theoretically, at a certain point, the effect is irreversible and the Earth could fry forever like Venus.

A worst-case conclusion would be that mankind is giving itself a double-whammy by not controlling potentially harmful carbon compounds that, once introduced into the atmosphere, become part of a process that cannot be controlled. A best-case hope would be that the warning is heard and work begun to protect our planet, our fellow creatures and ourselves.

try to determine whether the hole is spreading and whether it is caused by man-made chemicals such as CFCs.

If the administration has a better record on this environmental issue than on others, it is due largely to the resolve of Lee Thomas, administrator of the Environmental Protection Agency. Earlier this year, Mr. Thomas fought off attempts to weaken the U.S. position on ozone depletion by officials in the administration who are opposed to any regulation that carries a price for industry.

The challenge now is to confront supporters of the affected industries from around the world. While there is general agreement in Montreal to produce a treaty, the crucial issue is the seriousness of the sanctions it will contain against countries that do not abide by the accord’s terms.

If the administration and its allies in the international environmental community succeed in getting the countries gathered in Montreal to sign a tough treaty, it could become a model for addressing other complex issues of atmospheric pollution. The most worrisome of these is the “greenhouse effect,” mankind’s production of carbon dioxide through fossil-fuel combustion that threatens to cause a greenhouse-like warming of the planet with unpredictable effects on agriculture and water supplies. Spaceship Earth is still a long way from being shipshape.

MISSOURI
KANSAS CITY TIMES
September 23, 1987

An Accord on Ozone

An international agreement to curb production of ozone-destroying chemical is among the most significant environmental actions ever taken. The nations that use the most chemicals and, consequently, do the most damage to the environment have decided to take a step back. This is a positive sign in a world that too often neglects the effects of its obsessive use of chemicals to bring about easier life.

But the stakes in this fight are extremely high because they involve protection of the earth's ozone shield. Erode it and skin cancer increases. Other effects are unknown, but could include such disasters as killing crops, animals and forests.

So the pressure was on negotiators from dozens of developing nations as they met on the subject in 1986 and early this year. Here's what the version approved by top leaders in Montreal will do, after it is ratified by those nations which use two-thirds of the damaging chemicals.

NEW YORK
BUFFALO NEWS
September 21, 1987

A Treaty for the Planet

OZONE, LIKE a lot of other substances, is very good in certain places and very bad in others. The same substances that disturbs human lungs when there is too much of it at ground level is vital to survival of life on the planet in its own ozone layer in the upper atmosphere.

Something of the same principle applies, in reverse, to the class of chemicals known as chlorofluorocarbons. They are useful at ground level, where they make aerosol sprays more effective and are effective cooling agents.

But when they are released into the air, they have a bad habit of not staying on the ground. They almost inevitably make their way to the upper atmosphere, where they wreak havoc with the ozone layer that shields the earth from ultraviolet solar rays.

The whole process is no mystery to scientists who sounded the alarm years ago about the destruction CFCs could do to the ozone layer.

The United States government listened, banning use of CFCs in aerosol sprays in 1977. But it isn't only from American spray cans that the chlorofluorocarbons have been starting their trip toward the sky.

In a historic agreement signed last week, the world's major developed nations made action on ozone international. They established a program for protecting ozone by cutting back on CFCs.

The proposal freezes use of chlorofluorocarbons at levels of 1986. The material is most often used in refrigeration, foam insulation and air conditioning. It's also used in spray cans outside the United States. The agreement mandates that the consumption of chlorofluorocarbons must be cut by 30 percent or more by 1999.

One concern exists. Some underdeveloped countries will still be allowed to increase their use of the material if it will help their economic development. That's the wrong course to take. The better move is to have substitute materials mandated for the developing nations, also. The Earth's ozone isn't really particular about where the destruction is coming from.

Thanks to international cooperation, nations are on the verge of protecting the environment in an important way. The task is to keep up the momentum, to reach further accord on problems such as hazardous waste and air pollution. Those are even better ways to maintain a world where we can all live.

The protocol is monumental not only for the ozone layer but for what it could come to mean for future environmental issues.

The agreement was signed by 46 nations, including the United States, European Economic Community members and Japan. A compromise also brought in the Soviet Union.

The agreement says that CFC production will be frozen at 1986 levels (except in the Soviet Union, where the freeze won't happen until 1990) and then reduced in the 1990s to 50 percent of that level.

The level of compromise the agreement entails is disappointing. The ozone layer needs the protection of a more comprehensive ban, and there is a lot at stake. Skin cancer and eye diseases will increase if ozone thins, and weather and crops could be affected worldwide.

But the fact that there is such an agreement at all is remarkable. The nations of the world have not been noticeably effective in getting together to save the environment; too much trade competition is usually at world.

If the earth's burgeoning population is to continue to survive, more scientific messages will have to get through, as the one on ozone has, to the political leaders who can make environmental protection happen.

The Ozone Accord

THE INTERNATIONAL PROTOCOL limiting production of chlorofluorocarbons, signed last week by 24 countries meeting in Montreal, represents an important step in dealing with a crucial environmental problem that is beyond the ability of any one nation to control.

Ever since researchers discovered almost a decade ago that these man-made chemicals can eat away at the ozone layer that protects the earth from the sun's harmful ultraviolet rays, the question of curbing the release of chlorofluorocarbons into the atmosphere has ranked among the world's most critical environmental problems. The United States took the lead in attacking it, banning aerosol sprays using the chemical as a propellant in 1978. But that action has proven ineffectual, because other countries have been slow to take similar steps. Total worldwide production of CFCs, which are used primarily as refrigerants and cleaning agents, has continued to rise.

Under the new treaty, which over 50 nations have indicated their willingness to sign, most countries are required to freeze production of CFCs at the 1986 level by 1990. They would then have to cut output in half by the end of the century. The Soviets gained a special provision allowing them to freeze production at 1990 levels, arguing that their current five-year plan is too far along to tinker with. The treaty also calls for a freeze on production of halons, a group of chemicals used largely in firefighting.

Reducing output of CFCs will be expensive. Although annual CFC sales in the United States are only about \$750 million, tens of billions of dollars worth of air conditioners, refrigerators and other machinery requiring CFCs are currently in use. Some of this equipment may be able to use the new CFC substitutes now under

development at several chemical companies. Some of it, however, will have to be junked. In addition, industries entirely dependent upon CFC-based products, such as the makers and installers of polyurethane foam insulation, will be forced to find other lines of work if substitutes are not developed soon enough.

But while it imposes significant adjustment costs, the ozone treaty also offers significant economic opportunities. A new generation of cooling equipment not using chemical refrigerants is now under development by entrepreneurs around the country. Are helium-powered air conditioners the wave of the future? A more intense search for alternatives to CFCs will help us find out.

Such products will undoubtedly be needed, because almost no one expects that this new protocol will be the last word on chlorofluorocarbons. Although the U.S. chemical industry contends no rollback in CFC production is required, many environmental experts worry that a 50% reduction in output will not be enough to stop the damage to the ozone layer. New data on the status of the layer will be released late this fall. If they show that the problem continues to worsen, pressure on Congress to mandate even sharper reductions in U.S. production of chlorofluorocarbons will remain strong.

The ozone problem is critical. Cutting back CFC production even further than the new protocol requires is a desirable goal. Nonetheless, Congress should resist the calls for tighter U.S. standards now. A wiser approach would set a timetable for additional reductions in CFC output in the United States, but make it contingent upon similar steps by other countries. Tougher regulations in one country alone can do little to resolve what is truly the world's problem.

The Hole at the Bottom of the World

High in the atmosphere, a frail, invisible layer of ozone screens out damaging ultraviolet rays from the sun. Without it, life on earth would be severely harmed. Yet governments for years have ridiculed the fear, first voiced by two scientists in 1964, that the ozone shield was being eroded by industrial chemicals called chlorofluorocarbons, or CFC's. A remarkable reversal of attitude occurred this week in Montreal.

Some 40 countries have agreed on a plan to freeze the present use of CFC's and then to halve consumption by 1999. This giant step toward protecting the ozone layer would help avert a projected 130 million extra cases of skin cancer over the next century. It will require development of substitutes and major changes in a \$2 billion industry that produces CFC's for refrigerants, solvents and plastics.

Such changes are not easily agreed on, especially for the sake of far-off dangers that skeptics can pooh-pooh as conjectural. The Environmental Protection Agency banned the use of aerosol propellants in 1978, but European countries failed to follow suit, deriding the ozone hypothesis as an ill-founded panic.

What changed opinion was the discovery in 1985 of a continent-sized ozone hole over the Antarctic. This 40 percent depletion of the ozone shield occurs every September and October. Though the cause is still uncertain—other factors may contribute—the hole's

sudden and frightening appearance made it seem foolish to take a chance with CFC's. If the world's ozone were to be depleted that much, the flux of ultraviolet rays would become deadly. "Looking at the ozone hole is like staring at a picture where you watch the future of the human race go down a big black hole," says Michael Oppenheimer of the Environmental Defense Fund.

The hole aside, the ozone shield worldwide is projected to erode 6 percent from continued CFC production by the year 2025. That would result in an 18 percent increase in ultraviolet rays. The reductions agreed on at Montreal will cut the expected erosion to 1 percent, maybe more depending on how fast CFC substitutes take over.

The agreement yet to be ratified, came about through American leadership, particularly by the Environmental Protection Agency and the State Department. These agencies fended off ludicrous proposals by senior Administration officials that it would be better to let people rely on more sunglasses and suntan oil than to restrict the CFC industry. Groups like the Environmental Defense Fund, the Natural Resources Defense Council and the World Resources Institute helped their European counterparts to change the recalcitrant attitude of their governments. Under the threat of the ozone hole, the countries meeting in Montreal have been frightened into salutary action.

NEW YORK
ROCHESTER TIMES-UNION
September 30, 1987

Ozone

Treaty is only a start toward protecting nature's sunscreen

Evidence has been accumulating for years that chlorofluorocarbons are likely to blame for the mysterious hole in the earth's ozone shield that opens every September, and that unchecked depletion of the vital layer that screens out some of the sun's ultraviolet rays could have dire effects on humans and animals, on agriculture and climate.

So it's good news that 46 nations agreed in Montreal recently to limit chlorofluorocarbons. Only a year ago, many of the nations opposed any controls at all on producing and using them.

Still, the treaty is only a something-is-better-than-nothing treatment of the problem, one that offers industry a nifty way to stop putting profits before people: put profits on a par with people.

THE ACCORD will not stop ozone depletion. It allows production of these chemicals to go up by as much as 10 percent a year for the next 10 years to meet possible needs of "developing" countries. Developing countries are to limit and then cut their consumption. However, the Soviet Union may complete plants under construction or contract.

How can increasing production and shifting consumption from rich countries to poor ones save the ozone layer? U.S. officials predict that industry will develop safer alternatives which will drive chlorofluorocarbons off the market.

But Canadian officials predict that the ozone layer will be thinned another two percent by the middle of the next century, which would cause, among other things, some 7 million extra skin cancer cases among people born between now and 2075.

PROTECTING PROFITS, if not people, was a big issue at the Montreal meeting.

NEW YORK
STATEN ISLAND ADVANCE
September 21, 1987

Mutuality reaches the ozone

In a world partitioned by international rivalries and separate agendas, where competition is the standard and discord the norm, it is nothing short of remarkable when 49 nations can willingly agree on any sort of common goal. It is an occurrence made even more amazing by the fact that attaining the goal may adversely affect the economies of some of these nations.

Nevertheless, suspicion and short-term self-interest were set aside in Montreal last week when more than four dozen of the world's richest and poorest nations agreed to curb their production and use of chemicals that have been shown to damage the Earth's vital ozone layer.

Ozone, a form of oxygen, provides a thin, upper-atmosphere barrier that protects life on Earth from the carcinogenic effects of the sun's radiation. Scientists have known for decades that ozone can be destroyed by some persistent chemicals, such as chlorofluorocarbons, or CFCs, and halons—chemicals commonly used as, among other things, aerosol propellants and fire extinguishers.

The chemicals don't break down easily, and tend to drift off into the environment, where they eventually do their damage.

The U.S., the world's largest producer of chlorofluorocarbons with 30 percent of the market, at first refused to sign the treaty unless 90 percent of the world's producers also signed, then settled for about 75 percent.

When all was said and done, a U.S. industry lobbyist called the accord a "significant step," but said the 1989-99 compliance scheduled may be "too tight" and may not give the U.S. "a level playing field" in world markets.

WITH ALL THIS, you might get the impression that chlorofluorocarbons are only slightly less essential to our existence than the ozone layer they are destroying. But they are used primarily in air conditioning, refrigeration, aerosol sprays, cleaning agents for electronic products and plastic foam.

While no "developed" country should be without a climate-controlled shopping mall or a good deodorant, chlorofluorocarbons already are being replaced. McDonald's, for example, has decided to nestle its hamburgers in containers made of safer hydrocarbon-based agents.

The U.S. banned chlorofluorocarbons aerosols several years ago. Industry representative say Japan and European countries should be able to meet almost all their treaty obligations simply by such a ban.

Put in this light (incandescent, not ultraviolet), perhaps the best that can be said about this "historic" treaty is that the nations have promised to return to the table if further research shows the controls are not stringent enough.

If it's not too late by then.

Signatories to the accord agreed to freeze their use of the offending chemicals in 1989, and then to essentially cut their consumption by half within a decade.

The U.S. curbed the use of CFCs in the late 1970s, a move that put some American products at a price disadvantage.

The economic incentives to keep using CFCs were finally overwhelmed by the growing evidence of the chemicals' harmful nature. The international agreement drew wide praise from such diverse quarters as environmentalists and industry, which must now come up with workable substitutes for the chemicals.

What makes this agreement such a milestone in international cooperation is the fact that it was reached to combat a global hazard that is largely invisible and not completely understood. It remains to be seen, of course, how diligently the pact is adhered to.

But the fact that it occurred at all is significant, if only because it suggests there is hope for agreement on the many other universal issues facing our beleaguered planet.

**NORTH CAROLINA
DURHAM MORNING HERALD**
September 20, 1987

Protecting The Ozone

A great many—the *Herald* included—are hailing the hard-won accord on ozone that stratospheric layer that protects life from harmful ultraviolet radiation.

Not that it's perfect. Would that all harmful chemicals considered the culprits in depletion of ozone could be eliminated at once. But the practical considerations of industry and development preclude such an event. Indeed, such a sudden restriction would not be fair. It would cut billion-dollar sales and cause a howl of protest as solvents used as propellants in aerosols, refrigerants, plastic foams and fire extinguishers disappeared before unoffending replacements could be found.

But gradual reduction, which is what this new accord calls for, is promising. In 1989, when the agreement takes effect, participating nations—and that category is expected to include all the major producers of offending chemicals—are to freeze use of chlorofluorocarbons at levels of 1986.

By 1994, consumption must be rolled back by 20 percent, and by 1999, consumption is to be cut 30 percent more, for a total reduction of 50 percent. Use of halons, chemicals used as fire suppressants, is to be frozen at 1986 levels by 1994, but further rollback would not be required.

**NORTH CAROLINA
WILMINGTON MORNING STAR**
September 18, 1987

A welcome step against pollution

At the urging of the United States, praise be, 49 countries have agreed to limit production of chemicals that damage the earth's ozone layer. Ozone is important because it filters out rays of the sun that cause cancer and cataracts and might damage crops, forests and animals.

In theory, the treaty would cut production of the ozone-eating chemicals almost in half by the year 2000.

Environmentalists say that's gratifying, but still not good enough. They predict that even with the controls, the ozone will continue to deteriorate, causing about 7 million additional skin cancer cases among those born between now and 2075.

Even so, the treaty should make important gains. The biggest gain of all might be that for the first time scores of the world's nations

Indeed, the protocol allows developing countries to increase their use of such chemicals by as much as 10 percent if it will help their economic development. But all of the developed nations must limit and then reduce chlorofluorocarbon production.

The result is that total emissions of the chemicals could decline by something less than 50 percent by 2000, depending on how much is used by poor countries.

And that's good news, for holes in the ozone layer, which were first detected over Antarctica, are considered to be harmful to human life and plant life. Ozone shields the earth by blocking some of the ultraviolet radiation from the sun. Thus, if the ozone layer is thinning or being penetrated in spots, as scientists say it is, we can expect an increase in skin cancer and damage to crops, forests and other natural systems.

It's a serious matter—so serious that scientists here in our own back yard at Duke Forest are engaging in a multi-million-dollar project to study the effects of acid rain *and ozone* on plant life. The president and substantial portions of Congress had put themselves on record as favoring an accord that would do more than just wring hands over the problem.

Now we have it. It must be implemented.

have agreed that they have a common environmental problem and that they need to work together to solve it.

This ought to set a precedent for coping with other pollutants that cross national boundaries. The sulfurous smoke from coal-burning power plants, for example, blows from the United States into Canada, and from eastern Europe into Western Europe, bringing with it acid rain. Rivers such as the Rhine flow through many countries, often picking up poisons as they go.

We are all on this earth together. If some of us poison it, all of us pay the price. If all of us clean it up, all of us benefit.

Maybe, just maybe, we have started down the road to mutual cooperation and mutual benefit.

OHIO
AKRON BEACON JOURNAL
September 21, 1987

Sunscreen for the Earth

THERE ARE more glamorous issues than protecting the Earth's ozone layer. But few are as important in the long run. That's why it was encouraging to see dozens of nations join last week in an agreement intended to reduce global consumption of chemicals that are destroying the ozone.

At ground level, ozone is a pollutant, but miles above the Earth it has a beneficial effect. It screens out nearly all the sun's harmful ultraviolet radiation. When the ozone layer is diminished, as has been the case in recent years, more radiation reaches the Earth's surface, causing increased incidences of skin cancer and other harm to humans, crops, forests and other natural systems.

Chlorofluorocarbons (CFCs) are the culprit of this story. One million tons of the chemicals are produced worldwide each year. They have a wide range of uses, including refrigeration, aerosol sprays, foam insulation, air conditioning and cleaning solvents. Unfortunately, when they rise in the Earth's atmosphere, CFCs are

broken apart by the sunlight, causing a chemical reaction that depletes the ozone.

The agreement reached last week calls for a gradual reduction in the use of CFCs, amounting to a 50 percent cut by 1999. That's not as much as the Reagan administration wanted—it, along with most environmentalists, was looking for a 95 percent reduction. Loopholes exist allowing developing countries and the Soviet Union to complete CFC production plants that are important to their economies. But the accord is a significant beginning.

Lee Thomas, the head of the U.S. Environmental Protection Agency, rightly argued that the agreement creates a framework for future cooperation in dealing with other environmental problems. Moreover, it's an example of sound stewardship of the Earth's resources. The cost of a refrigerator or air conditioner may go up as the use of CFCs diminishes but the reward is inestimable: the good health of the Earth.

OHIO
CANTON REPOSITORY
September 19, 1987

Ozone shield pact a positive step

This week 24 nations and the European Economic Community signed an agreement to reduce the use of chlorofluorocarbons and to search for alternatives in hopes of protecting the planet's ozone shield.

This agreement—signed in Montreal after tough negotiations—is significant for several reasons.

It demonstrates that nations can work in concert to find solutions to problems that affect the entire planet.

Because the exact dimensions of the ozone depletion problem is unknown, the agreement is proof that the hunt for answers to potentially disastrous problems can begin before the crisis is upon earth's inhabitants.

And the accord is evidence that this generation has concern for those who will inhabit the earth in the near future. By acting now to reduce chlorofluorocarbon consumption by 50 percent and to force manufacturers to find effective substitutes within a few years (something they say they can do), future generations will be protected from ozone depletion damage.

Facts pushing the delegates to an agreement included the scientific consensus that 3 to 7 percent of the ozone layer has been depleted, and each additional 1 percent loss could result in a 5 percent increase in skin cancer.

Also, there was great concern over the fact that the problem is cumulative because chlorofluorocarbons can remain in the atmosphere for up to a century.

It is good to end the week on a positive note stemming from the world's first environmental cleanup treaty.

OHIO
CINCINNATI ENQUIRER
September 28, 1987

The Environment

America should be the first to ratify the ozone agreement

The proposed landmark agreement by 24 rich and poor nations and the European Community (EC) to save Earth's ozone shield comes not a moment too soon. The United States should be among the first to ratify it.

Dermatologists have increasingly warned sun-worshipping Americans of the mounting risks of skin cancer. That's one tip-off to the thinning ozone layer that guards human beings against skin cancer and other health problems. The ozone layer also protects crops and forests. Increased ultraviolet radiation from the vanishing layer could also hurt other natural systems.

Government officials from the 24 countries and the EC, meeting in Montreal, drafted an agreement to reduce the chlorofluorocarbons believed to be a major factor in thinning the ozone layer. Culprits are also thought to include carbon dioxide and other gases that may have to be regulated under subsequent agreements.

Chlorofluorocarbons are used for such purposes as air conditioning and refrigeration, aerosol sprays, packaging, solvents and insulation. The United States, Canada and Scandinavian countries

in the 1970s halted chlorofluorocarbon use in aerosol sprays, though Japan and the EC didn't.

With exception of poor countries, nations in the agreement must begin in 1989 to restrict chlorofluorocarbons. To meet their needs for development, poor countries could increase production by up to 10% annually the next 10 years. The major reduction must come in those countries producing the most now. The agreement will go into effect when at least 11 countries responsible for at least two-thirds of the world's chlorofluorocarbon use have ratified it.

The American chlorofluorocarbon industry helped spark the international agreement, partly to avert congressional action that could give its foreign competitors an advantage. So there should be scant opposition, if any, in the Senate. Once in force, the document should spur the development globally of substitutes.

Clearly it should, for there is no substitute for the ozone shield.

OHIO
CINCINNATI POST
September 18, 1987

The ozone treaty

Can the world's nations cooperate to control the discharge of noxious substances into the atmosphere before the resulting pollution gravely harms mankind? Once we would have said no. Our answer now is a small maybe.

The change comes from an unprecedented accord signed in Montreal Wednesday by the United States, 23 other countries and the 12-member European Community to first freeze and later reduce output of chlorofluorocarbons.

The chemicals, known as CFCs, are widely used in air conditioning, refrigeration, aerosol sprays and a few other products. They have a dangerous side effect: emigrating to the upper atmosphere, they deplete the ozone layer that protects the earth from the sun's cancer-causing ultraviolet radiation.

Under the agreement reached at a United Nations-sponsored conference, participating countries will freeze their production of CFCs in 1989 at 1986 levels. Then, in two steps, they will cut consumption by 50 percent by 1999.

"This is the first truly global treaty that offers protection to every single human being," said Mostafa Tolba, the U.N. official in charge.

His enthusiasm is understandable, but overdone. Because of loopholes granted to the Soviet Union and poor countries to expand their CFC production, global production could drop only 30 percent to 35 percent by 1999.

In addition, the U.S. Environmental Protection Agency calculates that an immediate 85-percent cut in CFC use would be needed to stop the buildup of the long-lived chemicals in the atmosphere. So the world is doing something, but much less than necessary.

On the brighter side, companies in the United States, Japan and Europe will plunge into research to find environmentally safe substitutes for CFCs. And if they succeed, other countries could adopt them quickly.

Though a modest start, the treaty is the first international effort to control an air pollutant. It may well serve as a pattern for future worldwide drives against threats to the environment, and thus it could prove very important.

OHIO
CLEVELAND PLAIN DEALER
September 24, 1987

Mending the ozone shield

Nobody knows how many skin cancers and cataracts have been caused by depletion of the Earth's ozone shield. But everybody knows that the widespread use of chlorofluorocarbons (CFCs) is a major cause of the ozone problem. And everybody knows that without international controls on the manufacture and use of CFCs, millions more cancers will result. As the ozone layer loses its ability to block the sun's ultraviolet radiation, damage to livestock, crops, forests and marine fisheries also will occur, along with critical disruptions in the world's weather and agricultural patterns.

In response to that threat, 49 countries agreed last week in Montreal to reduce their CFC consumption. The treaty states that by 1990, participating industrialized nations must freeze their CFC use at 1986 levels. They then must cut their CFC use 20% by 1994 and by an additional 30% by 1999. That's no small sacrifice: CFCs are widely used in aerosol cans (although not in the United States), for air conditioning and refrigeration systems, and in high-tech solvents and cleansers.

The treaty is not as powerful as it could have been. The Soviet Union, which accounts for about 10% of the world's CFCs, will freeze its use at 1990, not 1986, levels. Further, the manufacture of CFCs will be allowed to increase 10% in order to fill the needs of developing nations. As a result, the treaty will only cut CFC use by about 40%, half the amount needed to stabilize the ozone shield. Experts fear the ozone shield might shrink another 2% by 2050 anyway, resulting in 27 million extra skin cancers by 2075.

OHIO
COLUMBUS DISPATCH
September 19, 1987

Easy on the ozone

In a responsible move to protect the fragile veil of ozone that covers the upper stratosphere, delegates from 46 nations have reached an agreement to reduce the use of chlorofluorocarbons that deplete the ozone.

After compromising on issues that divided them, the delegates' accord shows how representatives from countries large and small can ignore other differences to cooperate on an environmental measure essential to the whole Earth.

Chlorofluorocarbons are used in foam cups, refrigerators, car air conditioners and cushioned egg cartons. While environmentally safe in the lower atmosphere, these chemicals have a disastrous impact on the ozone that forms a belt around the earth 10 to 30 miles up and protects us from the searing effects of ultraviolet light.

The United States banned the use of the chemicals in aerosols in 1978, and Canada and Scandinavia quickly followed suit. But use of chlorofluorocarbons in other products continued to increase, endangering the atmosphere to a greater degree each year.

Still, the ozone treaty is both a valuable document and a valuable lesson. Without it, the damage of constantly rising CFC use would grow at an exponential rate, with very real and dire consequences. Moreover, the treaty contains provisions for review and re-enforcement if ozone monitoring indicates that the present reductions are insufficient. That's a wise proviso. Although experts accept that CFCs are environmentally unsound, there is wide dispute over how to balance the needs of developing nations and the chemical industry against environmental interests. In that way, the reductions are a starting point. If they are sufficient, fine. If they are inadequate, the signatories can adjust them.

Given the indisputable damage caused by CFCs, a compelling argument can be made for tighter standards. For the moment, though, critics will have to settle for the precedent the treaty sets. It acknowledges that tighter standards might be needed at some future point, which is the best that can be expected from 49 relatively diverse nations. And it sets a precedent for both national and international policies that acknowledge atmospheric problems in the absence of "perfect knowledge." Now that the United States has admitted it doesn't need absolute proof to take costly actions to preserve the environment, maybe it will review its obstructionist position on acid rain controls.

After tough negotiating sessions, delegates fashioned a treaty that will freeze consumption and production of the chemicals at 1986 levels by 1990; and cut back another 50 percent in two steps by 1999.

It's especially commendable that so many countries can reach essential agreement when scientific studies of ozone are still in their infancy. For instance, scientists cannot yet explain why a hole that opened in the ozone over the Arctic last year has already disappeared. Depletion of ozone in the Antarctic, however, is much more severe, but thankfully is occurring in a much less densely populated part of the globe.

If depletion of ozone were to continue unabated, the instance of skin cancer throughout the world would increase at an alarming rate. Thus it's reassuring to see world in this field going along on two tracks: patient diplomats working out environmentally sound agreements while scientists intensify their search for answers in the puzzle of how potentially dangerous chemicals react in the upper atmosphere.

OKLAHOMA
TULSA TRIBUNE
September 18, 1987

Everybody's ozone

This time the cry 'Wolf!' was valid

Environmental doomsayers cry "Wolf!" so easily that when the fear was raised that compressible gases in our refrigerators and aerosol cans might injure the upper atmosphere's ozone layer most of us yawned.

But mounting evidence indicates the yawns were misplaced. Chlorofluorocarbons discovered 50 years ago and hailed for their non-toxic, non-flammable and non-corrosive qualities, are harmless when released at low altitude. But, scientists claim, when these gases rise to the 25-mile-thick ozone layer beginning 10 miles above the Earth, one chlorine atom contained in every chlorofluorocarbon molecule can destroy up to 10,000 ozone molecules. The ozone layer has a role in shielding the Earth from sun rays that cause skin cancer.

This week, representatives of 46 nations meeting in Montreal signed a pact designed to reduce the production of the chemical by 50 percent in the 12 years. Sen. John H. Chafee, R-R.I., says the agreement is a good "first start" but adds that more stringent regulation is necessary.

Illustrative of the difficulty in bringing the entire world to a standard is the fact that when the danger was first pointed out the United States, Canada and Scandinavian countries immediately banned offending aerosol propellants while other nations kept increasing their use at the rate of about 5 percent a year. The pact gives the

PENNSYLVANIA
THE PHILADELPHIA INQUIRER
September 18, 1987

Good news for humanity

This week's international agreement to protect Earth's life-sustaining ozone layer is a leap in the right direction.

More than 40 countries—including the United States and the Soviet Union—agreed on a plan and timetable to slow the dangerous depletion of our planet's ozone layer at a meeting in Montreal. "It's a happy day for humanity," declared Michael Oppenheimer, senior scientist for the Environmental Defense Fund. He called the pact as significant as an arms control agreement in bringing humankind "a step back from the brink of self-destruction."

The "protocol" signed Wednesday—which must be ratified by the legislative bodies of each country—calls for gradually reducing the production and consumption of chlorofluorocarbons (CFCs) by a total of 50 percent by January 1999.

CFCs—used in aerosols, refrigerator coolants and plastic foam—can float into the stratosphere and attack the ozone layer, the protective shield that screens out most of the cancer-causing ultraviolet rays of the sun.

Scientists now estimate that 3 to 7 percent of the world's ozone layer has been destroyed, and a huge hole the size of the continental United States now forms each spring in the layer above Antarctica. The Environmental Protection Agency estimates that at current rates of depletion, an additional 800,000 deaths from skin cancer will occur in the next 88 years.

Russians permission to continue to expand production for a limited time, the argument being made that under their planned economy new plants already under construction cannot be dismantled.

In the meantime, foam cups and foam filled furniture may soon be on the way out in some countries, since fluorocarbons are released when the foam is burned. The McDonald food chain is already replacing it's cups.

Pacts of this kind are new in diplomatic experience, but modern chemistry sometimes takes strange twists. With an estimated 3 percent of the ozone layer already gone and with "holes" indicating a loss of up to 40 percent in the polar regions, the hazard to persons exposed to heavy doses of sunlight is obvious. Sunbathers may need more than tanning oil.

We all share the same ozone, or lack of it. The day is coming when foot-dragging cannot be tolerated.

The agreement for stopping this is imperfect. Actually halting the buildup of CFCs would require at least 85 percent reduction in their use, according to scientific consensus. However, Paul Allen of the Natural Resources Defense Council said environmentalists consider the 50 percent reduction more than halfway there because chemical manufacturers will have no other choice but to develop alternatives.

Japan and the Soviet Union have been reluctant participants in the two years of U.N. sponsored meetings on the issue. The U.S. government, encouraged by environmental groups, took a leadership role early on in proposing a 95 percent phase-out of these chemicals.

However, the Reagan administration, as recently as last week, made proposals that would have undermined the effectiveness of the agreement. One would have delayed the date on which the agreement goes into effect. Thus, it seemed to work against what it should have held up as its greatest environmental accomplishment.

Congress should pick up the administration's initial leadership on this issue by quickly ratifying the pact.

Timely action on threat to ozone layer

After years of complex debate and protracted negotiations, 24 nations (the United States among them) plus the 12-member European Community recently signed in Montreal an historic international agreement aimed at cutting down on the production and use of a class of chemicals called chlorofluorocarbons, or CFCs.

CFCs contribute much to improving the standard of living worldwide; they are useful to a wide variety of products, from styrofoam to refrigerator compressors. They are cheaper, simpler and safer to use than presently known substitutes.

But they are also a threat to the earth's ozone shield. And a thinning of that layer of ozone molecules in the earth's upper atmosphere, which blocks out some of the sun's ultraviolet radiation, could produce serious harm to humans (for example, by increasing the incidence of skin cancers) and the natural environment.

Many environmentalists claim the Montreal measures do not go far enough or quickly enough. Most representatives of industry, on the other hand, feel it is too rigid in its goals and timetables.

However, none of this should draw attentions from the landmark nature of the Montreal agreement. It represents the first time the world community has committed itself to deal with an environmental issue which poses the potential for irreversible catastrophe—and to do so *before* there is conclusive evidence that the situation has actually become dangerous.

CFCs threaten the ozone shield, but nobody knows how much damage they cause. Severe thinning of the ozone layer would have

enormous negative environmental effects, but nobody knows how great such damage would have to be before it becomes a serious problem. In fact, according to noted American atmospheric physicist S. Fred Singer, even now "there is no reliable evidence that the total amount of ozone has decreased." As for the well-publicized "hole" in the ozone layer over Antarctica, scientists are not sure whether it is caused by man-made substances (like CFCs) or by natural factors (such as periodic showers of high-energy subatomic particles from space).

In most situations, solid evidence should be required before establishing environmental programs that will cause enormous dislocations—in terms of money, jobs, and human convenience. But on rare occasions, as with the ozone problem, it would be unwise to insist on certainty before taking action. Trying to adapt after the evidence of damage actually starts to come in may be too late.

In such rare circumstances, strong preventive measures are in order. The Montreal agreement indicates the nations of the world may be learning that lesson.

Good pact on ozone

Despite some concern early this year that U.S. negotiators were wavering in their commitment to acting now in order to safeguard the stratosphere for the future, they stood firm this week in calling for a major reduction in the production of chemicals that are eating away at the protective layer of ozone gases. As a result, delegates representing 24 of the world's industrialized nations have agreed to limit and eventually roll back consumption of chlorofluorocarbons—used to manufacture refrigerants, solvents, plastic foams and for a wide variety of other purposes—and halons, which are used as fire suppressants.

There appears to be little doubt now that the agreement will be ratified by the majority of industrialized nations. The agreement—although a qualified success, as pointed out by columnist Gwynne Dyer elsewhere on this page—proves that the industrialized nations are capable of agreeing on matters that affect world health and safety. The protocol has been hailed as a milestone that could set an example for global collaboration on other environmental problems.

Ozone shield the earth's surface from ultraviolet radiation, which researchers say leads to cancer, eye disease and neurological damage in humans. Even more frightening is the possibility that, as the shield dissolves, weather patterns would change and damage crops, forests and aquatic life.

Beginning no later than Jan. 1 1990, the agreement would freeze all consumption of chlorofluorocarbons at levels prevailing in 1986. Chlorofluorocarbon use would then be rolled back gradually through the turn of the century when production is supposed to be cut by as much as half.

The United States has already drastically cut production of CFCs. The example that this country has set has been instrumental in focusing world attention on the ozone-depletion problem. By standing firm during the negotiations calling for a worldwide cut in CFCs production, the United States has led the way in taking action on a global scale to reduce that threat.

*SOUTH CAROLINA
COLUMBIA RECORD
September 24, 1987*

Ozone layer Treaty sets significant precedent

While the issue of nuclear arms control continues to dominate the headlines, a less publicized international agreement on the use of hazardous chemicals has been reached in Montreal, Canada. In one sense, the Montreal pact might be just as important.

Out of the meeting has come a proposed treaty to limit the use of chlorofluorocarbons, chemical compounds believed to be breaking down the ozone layer in the upper atmosphere, especially over the continent of Antarctica. This layer is essential in protecting the Earth from harmful solar radiation.

*TENNESSEE
MEMPHIS COMMERCIAL APPEAL
September 21, 1987*

A modest beginning

CAN the world's nations cooperate to control the discharge of noxious substances into the atmosphere before the resulting pollution gravely harms mankind? Once we would have said no. Our answer now is a small maybe.

The change comes from an unprecedented accord signed in Montreal last week by the United States, 23 other countries and the 12-member European Community to first freeze and later reduce output of chlorofluorocarbons (CFCs).

These chemicals are widely used in air conditioning, refrigeration, aerosol sprays, puffing up foam products and cleaning computer chips. They have a dangerous effect: Emigrating to the upper atmosphere, they deplete the ozone layer that protects the Earth from the sun's cancer-causing ultraviolet radiation.

Under the agreement reached at a United Nations-sponsored conference, participating countries will freeze their production of CFCs in 1989 at 1986 levels. Then in two steps, they will cut consumption by 50 percent by 1999.

"This is the first truly global treaty that offers protection to every single human being," said Mostafa Tolba, the U.N. official in charge.

Almost a third of the world's chlorofluorocarbons are made in the United States. The Montreal pact calls for reducing these chemicals, used in the manufacture of aerosols, refrigerators, air conditioners and certain insulation products, by 50 percent over the next 10 years. Ground also was broken for the nations to enter into further talks to control other harmful pollutants.

Lee Thomas, a South Carolinian and administrator of the U.S. Environmental Protection Agency, called the pact an environmental "milestone" and urged the senate to approve the treaty forthwith. Certainly, this country should lead the way.

His enthusiasm is understandable, but overdone. Because of loopholes granted to the Soviet Union and poor countries to expand their CFC production, global production could drop only 30-35 percent by 1999, instead of the treaty's goal of 50 percent.

In addition, the U.S. Environmental Protection Agency calculates that an immediate 85-percent cut in CFC use would be needed to stop the buildup of the long-lived chemicals in the atmosphere. So the world is doing something, but much less than necessary.

On the brighter side, companies in the United States, Japan and Europe will plunge into research to find environmentally safe substitutes for CFCs. And if they succeed, other countries—even those with loopholes—could switch from the harmful chemicals faster than expected.

Though a modest start, the treaty is the first international effort to control an air pollutant. It may very well serve as a pattern for future worldwide drives against threats to the environment, and thus it could prove very important.

TENNESSEE
NASHVILLE BANNER
October 3, 1987

Good first step in ozone protection

It may be providential that ozone made the news in more ways than one during September.

First, representative of 49 nations adopted a landmark treaty in Montreal on Sept. 16 aimed at producing a 50 percent reduction in the use of ozone-depleting chlorofluorocarbons (CFCs) by the end of the century. Then, on Thursday, the National Aeronautics and Space Administration (NASA) announced that more of the earth's ozone layer over the Antarctic continent disappeared during September than ever before during a single month.

NASA said high-altitude ozone fell to half the normal level in the middle of the month—about the time the agreement was being signed. This compared with previous percentages of 40 percent in 1985 and 35 percent last year, all in the Antarctic. In our part of the world, scientists estimate there has been about a 3 percent reduction in the ozone layer.

While hailed worldwide as a major step toward protecting the environment, the agreement signed in Montreal has a number of weak places. Representatives of only 24 of the countries plus the 12-member European Community signed the actual agreement. Representatives of the other countries merely signed an endorsement of it.

Nevertheless, those countries that did sign—including the U.S., Canada and the European nations—represent the biggest producers and consumers of CFCs. Developing countries would have a 10-year grace period under the pact, and the Soviet Union would be allowed to expand production by opening plants it cannot cancel under its centrally planned economy.

TENNESSEE, NASHVILLE
THE TENNESSEAN
September 19, 1987

Pact protects ozone layer

ENVIRONMENTAL victories are so scarce that the few that are won should be loudly heralded.

The earth won a tremendous victory this week when representatives of 24 nations plus the 12-member European Community signed an agreement to protect the ozone layer. Forty-nine countries signed an endorsement of the treaty, but many of the representatives were not authorized to sign the actual protocol.

Ozone in the upper atmosphere shields the earth from the most dangerous ultraviolet radiation from the sun. Chemical gases called chlorofluorocarbons, or CFCs, leak upward and destroy protective ozone cells.

Scientists estimate that three to seven per cent of the upper-atmospheric ozone has already been depleted, and just over the Antarctic there is a 40 per cent reduction. Every one per cent of ozone lost could mean a five per cent increase in skin cancer. Ozone depletion also has a dire climatic repercussions.

CFCs have numerous uses, including refrigeration, aerosol sprays, and insulation. The United States, Canada and Scandinavian nations voluntarily ended the use of CFCs in aerosol sprays in the 1978, but their use in other products is more difficult to replace.

The treaty calls for a CFC freeze by 1989 to 1986 levels. It stipulates that consumption must be cut 20% by 1994 and an additional 30% by 1999. It also stipulates that the use of halons, which are chemicals used as fire suppressants, be frozen at 1986 levels by 1994.

The main stumbling block is the fact that the treaty will prove costly for everyone involved in terms of money. CFCs are used for refrigerators and air conditioners, as blowing agents for insulating foams and as a cleaning agent in the electronics industry. More than a million tons of the chemicals are produced worldwide each year. Manufacturers would have to produce substitutes for the CFCs and the added costs would be passed on to the consumer.

The treaty calls for a freeze in CFC consumption at 1986 levels beginning July 1, 1990. There would be a 20 percent reduction in consumption by June 30, 1994, and another 30 percent reduction by June 30, 1999. The U.S. had hoped for a 95 percent reduction by the end of the century.

Statistics show how important each small reduction is. Ozone, a pollutant at ground level, is a protector in the stratosphere. Produced from oxygen by sunlight, it screens out 97 percent of the sun's harmful ultraviolet radiation. Scientists say that for every 1 percent increase in ultraviolet, there will be as many as 30,000 extra cases of skin cancer in the U.S. alone. Increased ultraviolet radiation would also have deleterious effects on aquatic organisms that live near the surface, on agriculture crops and on the climate.

The treaty lacks ratification by the countries involved, and Congress will be holding hearings on the proposal soon. While not a cheerful prospect from a standpoint of cost to the consumer, the plan would prove much more costly if ozone depletion is allowed to continue.

The treaty is excellent—but not perfect. It made a deep bow to the economic development of poor nations by allowing them a 10-year grace period and by stipulating that developing nations could increase their use of CFCs if it would help their economies.

The treaty also could be costly. More than one million people worldwide work in industries that now depend on CFCs. Their job status will depend on the substitute products that are developed. And the development of those products will be costly for chemical manufacturers, and that cost will be passed on to consumers.

But those are small prices to pay considering the benefits of CFC reduction. The United Nations Environmental Program predicts that even a standstill in CFC use could prevent 1.65 million cases of skin cancer each year.

Although many environmental problems can become global in scope, attempts to tackle those problems on a global or even regional scale traditionally dissolve into finger-pointing about what nation is responsible for how much damage. The greatest significance in the ozone pact may not in its pure scientific implications, although they are considerable, but in the fact that it is the first international effort to clean up the earth. With any luck, it won't be the last.

TEXAS
AUSTIN AMERICAN STATESMAN
September 10, 1987

Ozone-protection treaty needs firm U.S. support

Even as diplomats from 50 countries are gathering in Montreal to begin final negotiations on what could be a historic global treaty to control chemicals that deplete the Earth's protective ozone layer, there are reports that the White House is trying to torpedo or weaken the agreement. The White House denies the reports, but the Reagan administration has shifted back and forth on this issue. It should support the strongest possible ozone agreement, regardless of the chemical industry's feelings.

David Wirth of the Natural Resources Defense Counsel told *The New York Times* that the U.S. is trying to "torpedo" the proposed ozone protocol with a provision to give any of the countries which are major producers of ozone-depleting chemicals the power to block the agreement. An administration official told the newspaper, however, that the U.S. had proposed that all the "major parties" involved in production agree to the protocol before it takes effect.

The easy way to solve this disagreement is for the United States to support the strongest possible agreement, which a Reagan administration official told the *Times* it will. The proposed protocol would keep worldwide production of chlorofluorocarbons at 1986 levels. Under a tentative agreement reached earlier this year, production of the chemicals, widely used for refrigerations, plastics and in electronics production, would later be halved. A final agreement is to be signed by the major producing countries next week.

Although the United States and several other countries banned the use of chlorofluorocarbons in aerosol cans in the late 1970s, the worldwide use of ozone-depleting chemicals has been growing.

TEXAS
THE DALLAS MORNING NEWS
September 22, 1987

Ozone Layer

Countries finally attacking this problem seriously

World-threatening catastrophes make for good movies and good books, but most modern folk don't lay awake at night worrying that Chicago really will get eaten by a gene-splicing experiment run amok. Environmentalists who go about suggesting new ice ages or melting polar ice caps generally get short shrift. Individuals may worry that radon is leaking into their basements, or that a nuclear waste dump will set them all aglow, but the big-scale cataclysms seem the province of Chicken Littles.

A recent exception has been the hole in the ozone layer. Scientists, whose disagreements over causes and effects often undermine their own warnings, all agree there is a hole in the ozone layer. The ozone layer apparently is being weakened by chlorofluorocarbons released into the atmosphere from aerosols and refrigeration units. This, in turn, is increasing the amount of ultraviolet rays reaching the earth, which is not healthful for human or vegetable life.

In recent days, however, 24 nations accounting for about 70 percent of chlorofluorocarbon consumption have agreed to freeze 1990 production at 1986 levels, then reduce that amount by 50 percent by 1999.

Besides propelling aerosol sprays, the family of chemicals is used to cool refrigerators and air conditioners, clean computer chips, put out fires and propel the foam used in cushions and fast-food containers. Scientists are concerned that the ultimate effect of the chemicals upon the ozone layer will be revealed in disrupted photosynthesis in plants, reduced crop yields and disruption of plankton, the tiny plants that form the foundation of the ocean food web and ultimately support the world's fisheries.

In the latest draft, the treaty would cut production of the dangerous chemicals by 50 percent in the next 8 to 10 years. Such a reduction would represent a substantial step, but it would only slow ozone depletion, not stop it. The Environmental Protection Agency estimates that an immediate 85 percent cut would be needed to stabilize the situation. Industry has developed non-depletive substitutes for many of the chemicals, but they are not now used because of higher costs.

If the final document has teeth, it would be the first effective agreement to control any pollutant on a global basis. Since the U.S. has been a driving force for major reduction of ozone-depleting chemicals, a tough treaty will stand as the most outstanding environmental accomplishment of the Reagan administration and the EPA under Lee Thomas. The administration should ensure that its representatives fight for a strong ozone-protection treaty.

This recognition that humans can alter their environment on a planetary scale is long overdue. The agreement likely will force higher costs on industries making heavy use of ozone-destroying chemicals, but the compromise agreement was one that industry representatives themselves helped work out in recognition that something must be done. The salutary result may be the avoidance of 130 million additional cases of skin cancer over the next century.

The cooperation shown in working out this agreement could lead to international negotiations on other pressing environmental concerns. Deforestation, for example, is an excellent candidate for international cooperation. Common sense tells us we cannot reduce the world's rain forests by millions of square miles and not radically alter weather and crop patterns.

One need not be a prophet of apocalypse or a Chicken Little to realize that modern industrial society can wreak adverse changes on the world. Prudence demands a serious approach. The ozone treaty is a sign that cooperative world efforts can help protect and preserve an environment that has been very good to us.

A tentative stab at saving ozone

Can the world's nations cooperate to control the discharge of noxious substances into the atmosphere before the resulting pollution gravely harms mankind? Once we would have said no. Our answer now is a small maybe.

The change comes from an unprecedented accord signed in Montreal last week by the United States, 23 other countries and the 12-member European Economic Community to first freeze and later reduce output of chlorofluorocarbons.

The chemicals, known as CFCs, are used in air conditioning, refrigeration, aerosol sprays, puffing up foam products and cleaning computer chips. They have a dangerous side effect: Migrating to the upper atmosphere, they deplete the ozone layer that protects the Earth from the sun's cancer-causing ultraviolet radiation.

Under the agreement reached at a United Nations-sponsored conference, participating countries will freeze their production of CFCs in 1989 at 1986 levels. Then, in two steps, they will cut consumption by 50 percent by 1999.

"This is the first truly global treaty that offers protection to every single human being," said Mostafa Tolba, the U.N. official in charge.

His enthusiasm is understandable, but overdone. Because of loopholes granted to the Soviet Union and poor countries to expand

their CFC production, global production could drop only 30 percent to 35 percent by 1999, instead of the treaty's goal of 50 percent.

In addition, the U.S. Environmental Protection Agency calculates that an immediate 85-percent cut in CFC use would be needed to stop the buildup of the long-lived chemicals in the atmosphere. So the world is doing something, but much less than necessary.

On the brighter side, companies in the United States, Japan and Europe will plunge into research to find environmentally safe substitutes for CFCs. And if they succeed, other countries—even those with loopholes—could switch from the harmful chemicals faster than expected.

Though a modest start, the treaty is the first international effort to control an air pollutant. It may very well serve as a pattern for future worldwide drives against threats to the environment, and thus it could prove very important.

At any rate, this tentative stab at a worldwide agreement is far better than some of the silly schemes offered this year, most infamous of which was Interior Secretary Donald Hodel's suggestion that people wear hats and sunglasses to protect themselves from the sun's ultraviolet rays.

Pact to Protect Ozone Layer Can Serve as Global Model

For most people, protecting the Earth's ozone shield is probably pretty esoteric stuff, a great big "ho-hum".

Realization, however, that the stratospheric ozone layer shields all of us from solar ultraviolet radiation, which would otherwise cause severe damage to living organisms on the Earth's surface, makes the Montreal Protocol, signed by 49 nations, a very important instrument in protecting everyone's health.

The protocol outlines a schedule for the signatory nations to freeze and later roll back, by an eventual 50 percent their use of ozone-destroying chemicals, mostly chlorofluorocarbons (CFCs).

It is a move that assures international cooperation in reducing a major threat, the thinning of the ozone layer that will cause skin cancer and other harm to humans as well as damage to crops, forests and other natural systems, scientists say.

The U.S. Environmental Protection Agency's computer studies, for example, have projected that the actions required by the protocol will work to avert 132 million cases of skin cancer and melanoma and 27 million deaths from skin cancer worldwide that would otherwise occur among people born before 2075. The data also show that about 1.5 million cases of eye cataracts would be averted.

CFCs, widely used in applications such as air conditioning and refrigeration, aerosol sprays, foam insulation, packaging and solvents, have long been cited as a threat to the ozone layer. It was 23 years ago that American scientists F. Sherwood Rowland and Marion J. Molina hypothesized the destruction of the ozone layer by chlorofluorocarbons.

Since then several countries, among them the United States, Canada and the Scandinavian countries have voluntarily ended the use of CFCs in aerosol sprays. But other industrial countries,

including Japan and those in the European Community, continue to use them, and the use of CFCs for refrigeration and air conditioning continues in those countries foresaking their use in aerosol sprays. Now the Montreal Protocol mandates that these uses be phased out or sharply reduced by the year 2000.

Most notable during the debate over how, when, or even, if CFCs should be phased out is the turnabout that industry has effected. Once staunchly opposed to ridding the world of CFCs, especially as refrigerants, industry now has become an almost, emphasis on *almost*, enthusiastic supporters of their elimination.

Industrial representatives have expressed reservations about the practicality of the phase-out but readily acknowledge that substitutes can, and will be produced. One industrial spokesman said, "By our estimates, any substitution will take about seven years to develop."

Seven years? It will be 13 years before the protocol is fully effective—nearly double the time it will take industry to develop an effective and safe substitute for CFCs. This is a time frame that hardly seems onerous to the chemical industry.

Concluded after complex and difficult scientific, economic and geographic negotiations, the Montreal Protocol is the only way the threat to the Earth-encircling ozone layer could be abated, by the international system of risk assessment and risk management provided in the agreement. The true significance of the protocol then lies in its potential: a model for solving not only global environmental problems, but a host of others that, by their very nature, must be dealt with on a global scale.

WASHINGTON
SEATTLE POST-INTELLIGENCER
September 20, 1987

Ozone layer treaty signed none too soon

Chicken Little was almost right. The sky is failing.

The ozone layer that protects living things from the sun's intolerable radiation is evaporating, thanks to the chemicals we use to cool refrigerators, pad our chairs, package our hamburgers, insulate our houses, and spray all manner of things.

That so ubiquitous and innocent an item as a Styrofoam coffee cup could endanger the planet seems downright droll. But here we are, with at least 3 and perhaps as much as 7 percent of the ozone layer already vanished, and over Antarctica, an ominous, gaping hole in the layer as large as the United States.

To put it badly, this is not good news for the human race.

But here is something that is:

Scores of nations have agreed to put aside economic considerations and stop the suicidal practice of using chlorofluorocarbons and halons. The villainous concoctions eat the molecules that make up the shield protecting us from skin cancer, for one prosaic example.

WISCONSIN
MILWAUKEE SENTINEL
September 19, 1987

Global ozone accord sets good precedent

Perhaps the most significant thing about an international agreement to protect the ozone layer that shields the Earth is that it shows nations can act for a common good when faced with a real threat.

Delegates from all over the world approved the agreement in Montreal Wednesday. Twenty-four nations signed the accord, others backed it.

The agreement calls for participating nations to first freeze and later reduce consumption of widely used chemicals that, according to many scientists, destroy ozone molecules in the upper atmosphere. Weakening of the ozone layer can cause increased skin cancer and other harm to humans as well as damage to crops, forests and other natural systems.

"This is perhaps the most historically significant international environmental agreement," said Deputy Asst. Secretary of State Richard E. Benedick. "For the first time the international community has initiated controls on production of an economically valuable commodity before there was tangible evidence of damage."

An international treaty signed last week in Montreal establishes a timetable for ridding the globe of these chemicals. "Without this treaty, we were on a crash course for disaster," said Peter Usher, meteorologist with the United Nations Environment Program.

The treaty is by no means perfect. But it is nevertheless just short of astonishing that both rich and poor countries could come to an agreement when money is at stake, and that they could do it so quickly.

The proof, of course, will be in the performance of promises. But it is heartening to see such international cooperation on matters of global survival. Let's hope it's habit forming.

Environmentalists also hailed the agreement, although some said it didn't go far enough. To answer that point, the executive director of the United Nations Environment Program said he would call an emergency meeting to reopen the protocol if needed.

The agreement is important in itself. A weak ozone layer is a threat to every nation, to every citizen of every nation. It is a global threat that requires a global response. And it has received one.

But the agreement also shows, as Benedick said, that nations can work together. That they can sit down and work out an answer to a worldwide problem.

As such, it can serve as a model for addressing other environmental issues—acid rain—and perhaps eventually non-environmental issues such as international terrorism.

That's admittedly a ways down the road. But the Montreal conference can serve not only as a model, but as a hope for the future as well.

The ozone shield

There is good reason to rejoice today over the signing in Montreal of an international treaty to protect the earth's ozone layer. The grounds for celebration lie not so much in what the agreement will accomplish (it might have been a good deal more) as in the fact that it marks the first attempt to control a global pollutant.

We like to think that this moves us down the road to the day when industry and the environment will not be locked in combat, each blindly defending or promoting a set of interests. But even with the achievement of bringing 43 nations to the treaty table and persuading them to sign, it will be no easy road to travel. Fifteen years of growing awareness that the earth's ozone layer is being worn away, most likely by the presence of man-made chlorofluorocarbons (CFCs), may have brought the nations to the treaty table; it hasn't necessarily brought them to their senses.

The unmistakable sound of dragging feet attended the process to make amends for tearing a hole in the planet's protective layer—this despite much persuasive evidence that CFCs, ascending through the atmosphere from a variety of human activities, are giving freer entry to harmful ultraviolet radiations from the sun. (World production of CFCs, used in the production of foam rubber and plastics and in spray cans and refrigerators, runs at about 800 million tonnes a year.) The risk of a severe increase in skin cancer and harm to plant and animal life has not convinced everyone equally that this cavalier treatment of the earth's shield should stop.

So the treaty, which appeared to survive by the skin of its teeth, arrives showing the scars of compromise and condition. Earth's defensive move—to aim for a 50-per-cent cut in the use of ozone-destroying chemicals by 1999—is unlikely to do more than slow the rate of ozone destruction.

WINDSOR, ONTARIO
THE WINDSOR STAR
September 17, 1987

Ecology

Protecting the ozone

THE AGREEMENT REACHED this week by 200 delegates from 46 nations to control production of chemicals that are destroying the ozone layers is a remarkable achievement even if it fell short of its main goal.

Those attending the meeting sponsored by the United Nations Environment Program in Montreal, made history when they agreed to what is, in effect, a law of the atmosphere. That law, still to be ratified by governments, is specifically designed to protect the earth's ozone layer but opens the door to many more applications, including the protection of people and property from the ravages of acid rain.

The agreement has been in the making for five years. It took that long for the United Nations to persuade the nations involved in the manufacture of the chemicals of the need for controls. As it is, the meeting came none too soon after the discovery of huge holes in the ozone belt that protects the earth from harmful ultraviolet radiation from the sun. Increased ultraviolet radiation produces skin cancer on human beings, damages the eyes, stunts crops and other vegetation and contributes to the warming of the earth's atmosphere which could produce a disastrous greenhouse effect.

It is not difficult to perceive in this battle similarities to other struggles involving industry and the environment—the deepening scientific suspicion that all is not well, the defensive lobbying by the industry, the contradictory research findings, the arguments that nothing has been proved to the hilt and the warning that remedies will be ruinously expensive. It has been pointed out in the case of curtailing CFC production that some countries have more to lose than others if they take up the fight.

This all conspires to slow the application of remedies. At the Montreal conference, organized by the United Nations Environment Program, we were treated to more jockeying and hesitation. Both the Soviet Union and the United States balked at some features of the draft treaty, and obstacles were raised by the European Community.

In the early stages of preparing countermeasures, the United States appeared to be leading the way, as its Environmental Protection Agency pressed for a reduction of as much as 95 percent in CFCs as quickly as possible. Something appeared to alter this attitude—industry lobbying, perhaps, or a sudden realization that the economic impact could be severe. At any rate, with the brakes applied to U.S. resolve, the general pace has slackened, and it appears that a 50-per-cent reduction in the offending chemicals is considered “realistic.”

Scientific research shows that Canadians today have an 8- to 16-per-cent greater chance of getting skin cancer than they did in 1950. To those in whom it is diagnosed, this is all too realistic. There is nevertheless cause for celebration: a hold-the-line proposal is better than none at all. As citizens of a planet that now spends much more defending itself against less palpable threats, let's build on it.

The ozone belt is slowly destroyed by rising chlorofluorocarbons (CFCs), chemicals used as cooling agents in air conditioners and refrigerators, as propellants in spray cans, and in the manufacture of foams used in containers and insulation.

Since ozone depletion is more severe at high latitudes, Canada and other northern nations have a special interest in seeing the manufacture of CFCs controlled.

According to the agreement, production of CFCs will be reduced to 50 percent of 1986 levels by the year 1999. Ideally, we would have liked to see a total ban on these chemicals, but even this compromise is far more acceptable than the uncontrolled production and use of the chemicals that we have now.

A total ban may still come in the future if CFC producers succeed in developing safer alternatives to those chemicals by the 1999 deadline. But for the time being we have to be satisfied with a 50-per-cent solution and the knowledge that our very diverse world can come together and governments of vastly different political persuasions may reach consensus in dealing with a threat to human health. It is a sign that common sense and well-being are still with us.

Saving The Ozone Layer

The Reagan administration deserves enormous credit for the part it played in achieving the world ozone treaty signed this week. On most environmental issues the administration has been more laggard than leader. On this the reverse has been true. Environmental administrator Lee Thomas and Secretary of State George Shultz were able to brush aside the minority of objecting ideologues within the administration and produce a sound position.

The treaty signed in Montreal under U.N. auspices must still be ratified, but that is thought likely. It deals with chlorofluorocarbons, or CFCs, compounds widely used—in air conditioning, refrigeration, the manufacture of a wide variety of foam products and as solvents—because, among their other attributes, they are cheap, durable and neither flammable, nor toxic. But when released into the atmosphere, as almost all eventually are, these compounds rise to mix with and dilute the ozone layer that shields the Earth from ultraviolet radiation. A thinning of the ozone layer is thought likely to lead to more skin cancer, crop and other plant damage and serious climatic changes.

The treaty would freeze CFC production in 1990 at 1986 levels, then cut it in half by 1999. By itself this might not be enough to stop attenuation of the ozone layer. But the 50 percent cut is thought likely to stimulate development of alternate compounds, which will then supplant the offending CFCs. The chemical industry feels confident that it can produce such compounds. That may have helped to make this an easier treaty to negotiate; the affected interest group had less to lose. But the industry has behaved in exemplary fashion even so.

Some people hope the ozone treaty will become the example for other such agreements. We don't know if it can, but it is an extraordinary achievement on its own terms, the more so because of how quietly it was brought about. A major environmental threat has apparently been deflected with very little of the shouting that usually accompanies such problems—maybe *because* there was so little shouting. Good for everyone involved.

—*THE WASHINGTON POST*



SCIENCE ASSESSMENT

Ever since the question of whether CFCs damage the ozone layer was raised in 1974, science, industry and government have engaged in intensive efforts to determine the facts.

The research has focused primarily on the highly complex chemistry of the stratosphere. It is known that ozone acts as a giant filter to screen out some of the sun's harmful ultraviolet rays. The belief is that depletion of the ozone layer could result in increased incidence of some forms of skin cancer and damage to certain food crops and aquatic life.

Studying the stratosphere is extremely difficult, not only because of its distance from the earth (from eight to 30 miles) but also because the concentrations of ozone it contains are subject to frequent and often large natural fluctuations. However, by analysis of samples taken at various places and times through computer modeling, a great deal has been learned about stratospheric chemistry.

It appears that the amount and distribution of ozone in the atmosphere are maintained by a dynamic balance between production (from solar ultraviolet radiation), destruction (by radicals derived from several trace gases) and transport by atmospheric motion. The process is not completely understood.

It is evident, however, that industrial, agricultural and natural processes play a part in production of the trace gases. For example, carbon dioxide is increasing in the atmosphere due to increased burning of fossil fuels. Methane levels are also rising from sources thought to be natural wetlands, rice paddies and fermentation processes in cattle and other ruminants.

A 1986 report to Congress by the National Aeronautics and Space Administration (NASA) and the World Meteorological Organization (WMO) describes the current status of atmospheric science: what has been learned, what remains scientifically uncertain and what research still needs to be done. The NASA/WMO Report remains the definitive work available today on the global ozone depletion issue.

While scientists have been able to gather significant atmospheric measurements and observations during the last decade to improve their understanding of the stratosphere, much of the key analytical work is still done using sophisticated computer models that simulate the complex interactions that are theorized to occur. Discrepancies between observations and calculations limit somewhat the scientist's confidence in the predictive capability of the models.

The graphs that follow in this report represent the model calculated effectiveness of the Montreal Protocol. These calculations show that the key to future protection of the ozone layer is the limitation of the rate of growth in the use of CFCs, which the Protocol achieves. The analysis also shows that the calculated environmental benefit of the reduction steps is not nearly as great as the limitation on growth. Additionally, the analysis shows that attempts in the U.S. to go beyond the Protocol measures will produce no significant environmental benefit. (The U.S. economic impact of such unilateral action is significant, however. See Section V.) In sum, the Montreal Protocol provides a substantial margin of protection beyond what is environmentally necessary.

Two expeditions have now been completed to Antarctica to study the causes of the significant ozone reductions that have been observed during the spring season. Preliminary reports from the 1987 Airborne Antarctic Ozone Expedition have indicated that the evidence strongly suggests that both chemical and meteorological mechanisms perturbed the ozone. Additionally, it is clear that meteorology sets up the special conditions required for the perturbed chemistry."

The scientists will be analyzing this information gathered during the 1987 expedition and preparing peer-reviewed reports in 1988. These reports will be available for the first scheduled meetings of scientists in 1989 as part of the Protocol's ongoing assessment process.

The following pages summarize the current scientific understanding of the ozone depletion issue.

OZONE MEASUREMENTS

- Analyses of about 30 years of data from a globally distributed network of monitoring stations show that there has been no persistent change in the total amount of ozone.
- The 30 year data record shows that total ozone increases and decreases on time scales of days to a decade. Since 1979, total ozone amounts have been in a decreasing phase. This decrease is within the range of previously observed variability which is likely due to poorly understood natural causes.
- There are concerns about the validity of the reports of a declining trend in ozone observed by a satellite-borne instrument. A large part of the ozone decreases observed by the satellite instrument could be due to instrument degradation. Information supporting the degradation theory is provided by an analysis presented in a recently published, peer-reviewed scientific paper that shows that ozone values measured by the satellite instrument are declining compared to those measured by the ground-based network of instruments.
- A team of government, academic and industry scientists are reevaluating all ozone measurements that are now available. Their conclusions should be reported early next year.

ANTARCTIC OZONE

- Preliminary findings of the recent Airborne Antarctic Ozone Experiment indicate that a combination of meteorology and unusual chemistry is responsible for the seasonal decreases of ozone above Antarctica.
- The new information indicates that meteorology contributes directly to some of the ozone decreases. Thus, an ozone "hole" of some proportion would probably be present even if man-made chlorine compounds had never been emitted into the atmosphere.
- The unique meteorology over Antarctica established a "containment vessel" in which chemistry contributes to seasonal ozone decreases.
- It is unlikely that conditions which would duplicate the Antarctic Ozone "hole" phenomenon can exist anywhere else on the globe. Even in the most similar region of the world, the Arctic, the meteorology effectively precludes a similar situation.
- It is unknown whether any significant environmental effects can be attributed to the seasonal ozone reduction over Antarctica. It should be noted, however, that even with the measured ozone reductions, the level of UVb radiation exposure at noon on an October day in the Antarctic is less than the level of exposure at noon on a summer day in Washington, D.C.

MODEL RESULTS

The effect of the control provisions of the Montreal Protocol on atmospheric chlorine concentrations and global ozone change has been estimated based on calculations from several atmospheric models. The model results from emissions allowed under the Montreal Protocol have been compared with those from the following alternative CFC/Halon emissions scenarios: (1) the 2.5 percent compounded annual growth rate that had been assumed for a number of pre-Protocol model calculations, (2) a true global freeze of CFC/Halon emissions, and (3) the Montreal Protocol provisions plus an 85 percent phaseout of CFC/Halon emissions in the U.S.

Figure 1 depicts atmospheric chlorine concentrations and Figures 2, 3, and 4 ozone changes for the periods 1960-2080 under the several assumptions.

The best current scientific evidence supports the following conclusions:

- Calculated changes in global ozone amounts based on a true global freeze at 1986 levels are smaller than natural ozone variations that have been observed over the past 30 years.
- The Montreal Protocol provides a reassuring measure of environmental protection by imposing emission controls that go beyond what current science indicates is necessary.
- There is no need to move towards greater reduction or shorter time periods than those set forth in the Protocol.

Because uncertainties in the science remain, the Protocol requires periodic review of scientific, environmental, technical and economic information to assess the adequacy of the CFC emission controls. This review provision provides an effective mechanism to change the CFC control measures and to assure that stratospheric ozone is protected if new scientific evidence shows that a change is needed.

Chlorine in the Atmosphere

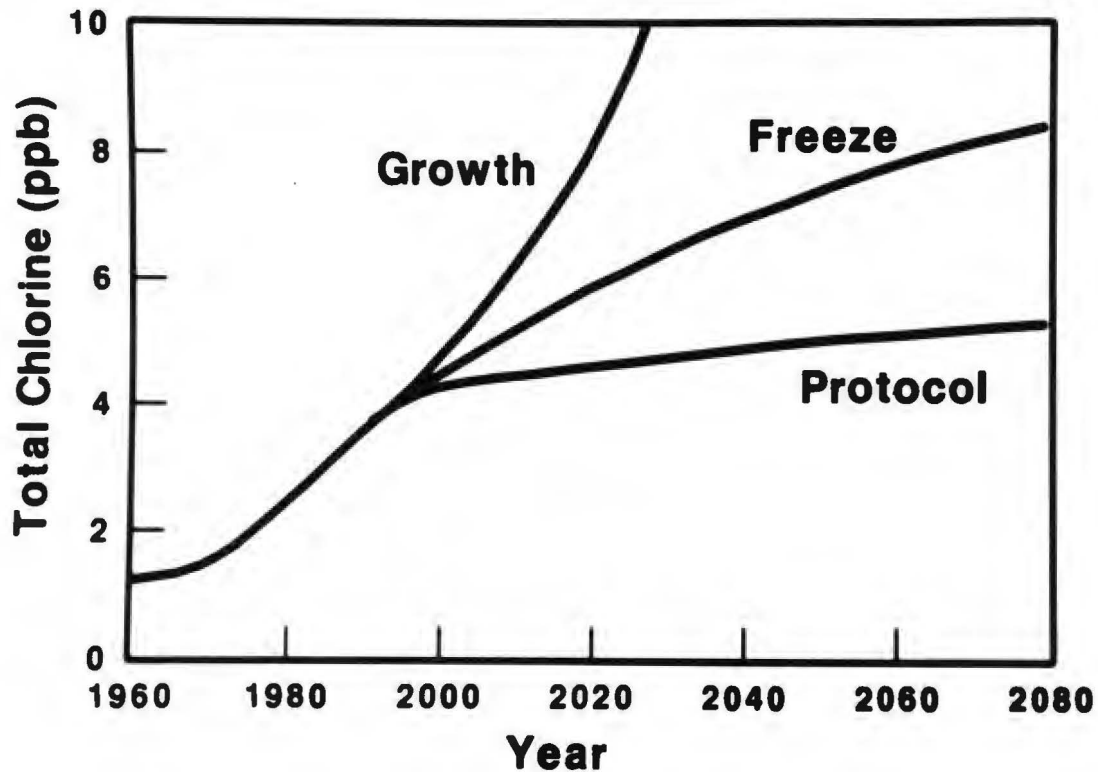


FIGURE 1

Future concentrations of organic chlorine compounds in the atmosphere are significantly reduced by the Montreal Protocol. Atmospheric concentrations of the total organic chlorine—chlorine that can reach the ozone layer—are shown for three cases:

- (1) 2.5 percent per year compounded growth in global emissions of CFCs after 1986,
- (2) a true global freeze of global emissions of CFCs at the 1986 rate, and
- (3) global emissions of CFCs as specified by the Protocol.

Note that by the year 2025, total atmospheric chlorine for the Protocol case is only about one-half that for the growth case.

Comparison of Growth vs. Montreal Protocol

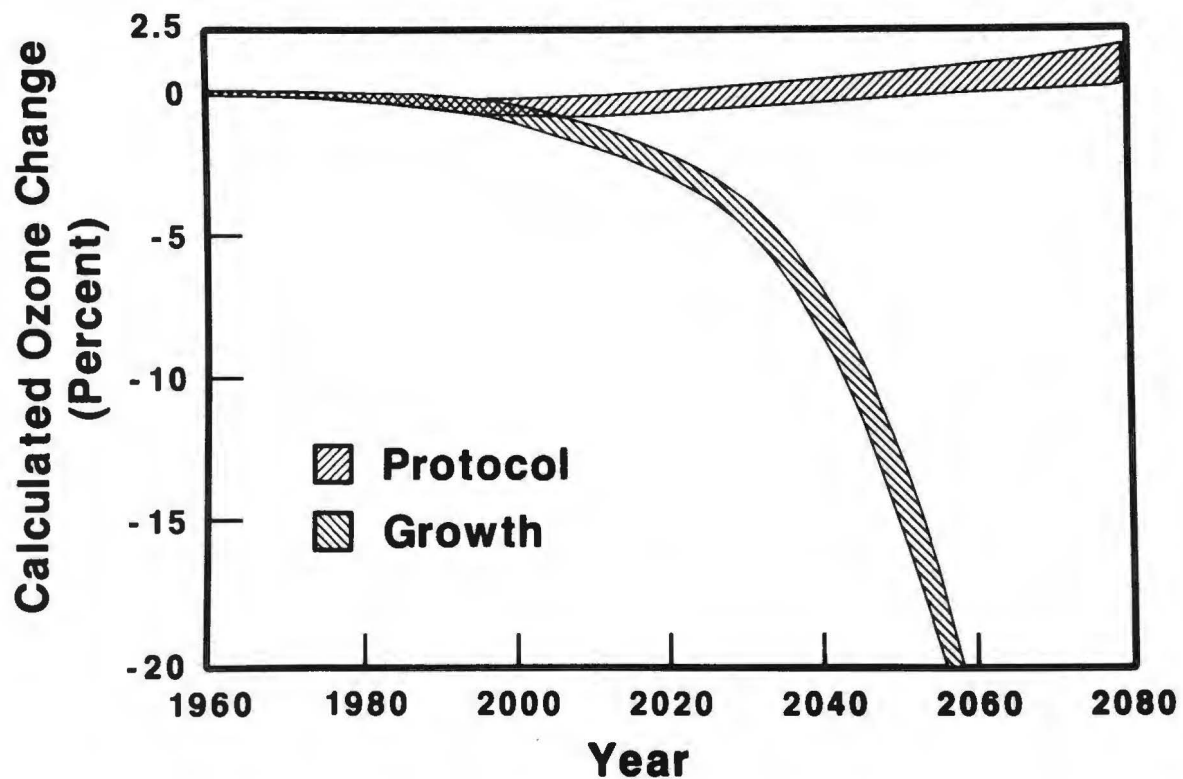


FIGURE 2

The computer model results shown in the figure demonstrate the effectiveness of the Montreal Protocol at protecting the ozone layer. Estimates of the range of model calculated ozone changes are presented for two cases: emissions of CFCs and Halons as prescribed by the Montreal Protocol and compounded growth of the compounds at 2.5 percent per year. All computer model simulations of the atmosphere predict that sustained growth in the emissions of fully halogenated CFCs could lead to appreciable ozone depletion during the next century. However, if all nations of the world comply with the provisions of the Protocol, computer model results indicate that total ozone levels might first decline slightly and then slowly increase over the next century.

Comparison of Global Freeze vs. Montreal Protocol

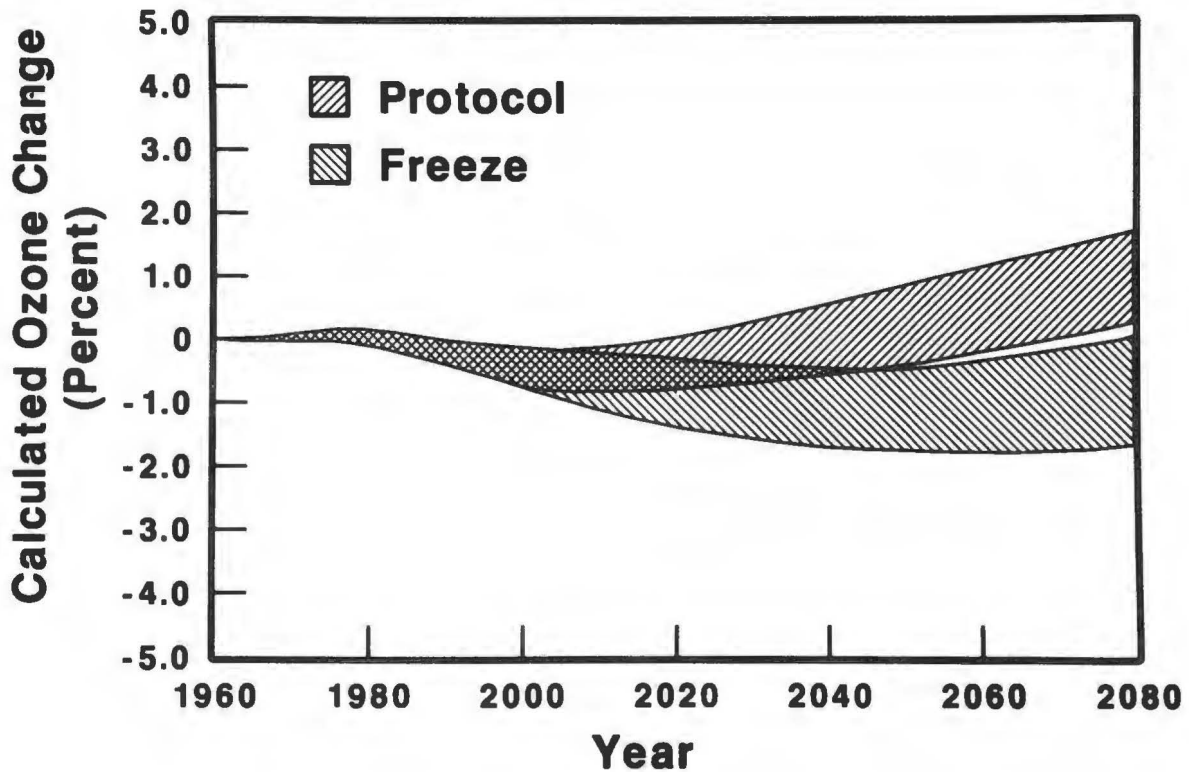


FIGURE 3

The Montreal Protocol provides a reassuring margin of protection by requiring reductions of CFC emissions. Estimates of the range of model calculated ozone changes are presented for two cases; emissions reductions as prescribed by the Montreal Protocol and a true global freeze of CFC emissions. With the emissions reductions, computer model simulations of the atmosphere predict ozone increases over the next century. Based on a freeze of emissions rates, models predict ozone changes that are smaller than the 3 percent to 4 percent changes that have been observed over the past 30 years.

Comparison of Montreal Protocol vs. Montreal Protocol Plus an 85 Percent U.S. Phaseout

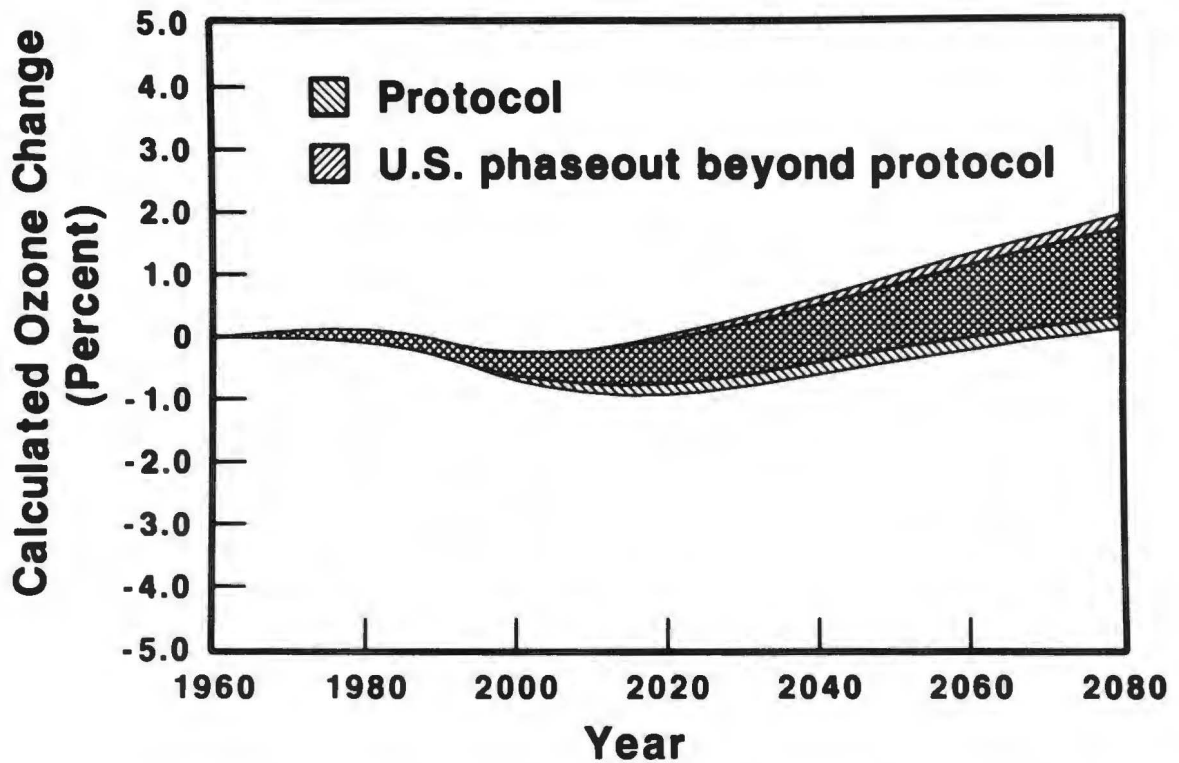


FIGURE 4

Unilateral action by the U.S. that goes beyond the Protocol is ineffective at providing additional protection of stratospheric ozone. Estimates of the range of model calculated ozone changes are presented for two cases; emissions reductions as prescribed by the Montreal Protocol and emissions reductions as prescribed by the Protocol plus an additional phaseout in the U.S. to only 15 percent of the 1986 emission rates. The results show that the marginal increase in calculated ozone resulting from the unilateral action is much smaller than the range of results that are calculated by the different models for the Protocol case.

ECONOMIC ANALYSIS

Introduction

CFCs have played an important role in many of the social, demographic, and technological changes and advancements that have occurred in the United States over the last 30 years. These compounds are very much a contributor to a high-tech economy.

Developments such as the demographic growth in the Sun Belt, an increasingly mobile population, construction of vast indoor office, retail and recreational complexes, were made possible because of the availability of relatively inexpensive climate conditioning technology made possible by CFCs. The era of computerization, and the rapid miniaturization of electronic parts, was greatly enhanced by the cleaning capabilities of CFC solvents. Additional examples are too numerous to list.

Unilateral action to control CFCs in the United States would have a significant negative impact on many key U.S. industries, industries that contribute to the quality of life in the United States and enhance our position in the global economy. Many developing nations are desirous of having the technologies that CFCs make possible, and many of our global competitors are anxious to provide these technologies to these countries and everywhere else.

The United States initiated unilateral action on CFCs in the late 1970's, singling out specific uses (aerosols), that received little support from other major CFC users around the world. A better solution was needed, one that addressed the environmental need and recognized the economic facts and produced an economic stimulus to resolve that environmental need.

The Montreal Protocol attempts to strike this balance. The following material provides the reader with an understanding of the widespread use of CFCs in our society. The economic analysis, prepared by Putnam, Hayes and Bartlett, Inc. of Washington, D.C., summarizes the expected costs of the Montreal Protocol to the U.S. economy, points out how effective the agreement will be in stimulating the development of new CFCs and CFC-utilizing technologies, and shows that any attempts to accelerate the Protocol's control measures, while providing little or no additional environmental benefit, would significantly increase the costs to U.S. citizens.

CFC Uses in the United States

By any measurement, CFCs are important to modern life:

- They help us meet basic needs—food, shelter, health care, communications, leisure, transportation.
- They contribute immeasurably to our comfort, safety and productivity.
- In the United States alone, CFCs are used by some 5,000 businesses at nearly 375,000 locations to produce goods and services worth more than \$28 billion a year. CFC-related jobs total 715,000. The estimated value of installed products relying on CFCs is more than \$135 billion.

Major CFC applications are described here, beginning with the one that started it all: refrigeration.



Refrigeration

\$6 billion*	52,000 jobs**
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The first commercial CFC was compounded in 1931, the result of an intensive research effort by a refrigerator manufacturer (General Motors) to find an efficient, safe refrigerant for home use. Ammonia, sulfur dioxide and other refrigerants then in use were considered toxic or presented other hazards.

The new compound revolutionized the industry.

The first refrigerant, ice, served well for its time. It kept foods cool so they would last longer, and iced railroad cars made possible the shipment of perishables from distant points. But ice melts and has to be replaced, and that pan under the icebox always seemed to need emptying.

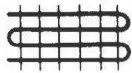
Early chemical refrigerants eliminated these drawbacks and performed the cooling job more efficiently, but their toxicity was an ever-present hazard. Also, some were explosive and/or flammable and most were corrosive.

*Value of products/services, per year.

**Direct CFC-related industry employment. Refrigeration and air conditioning servicing adds \$5.5 billion in value and 472,000 jobs.

CFCs captured the home refrigeration market because they are efficient, safe, stable and cost-effective. Another advantage is that they are chemically inert, so they do not damage gaskets, seals or lubricating oils in the refrigeration system. Today 75 percent of the food we eat depends upon the use of CFC refrigerants at some point in the production and distribution chain. In fact, many foods we enjoy would not be available in stores or would cost much more were it not for refrigeration.

Because of their unsurpassed cooling efficiency, CFCs are also widely used in commercial and industrial refrigeration and freezing equipment. Today, with energy efficiency a prime consideration, refrigeration engineers rely on the properties of CFCs in designing units that provide more cooling with less electric current than was thought possible a few years ago.



Air Conditioning

\$12.9 billion	150,000 jobs
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Air conditioning makes the difference between comfort and misery when the weather is hot and sticky, but because we take it so much for granted, many of the other benefits it has brought us may not be evident. Consider:

- Air conditioning in hospitals and nursing homes means a more healthful, comfortable environment, more conducive to healing.
- Air conditioned offices and factories make it possible for people to perform at peak efficiency even in the hottest weather.
- A number of important industries could not operate at all without air conditioning: manufacture of pharmaceuticals and photographic and printing films, computer installations, production of electronic equipment, telecommunications.
- Businesses, theaters, shopping malls, sports arenas now operate successfully year-round, regardless of the climate or weather.
- Air conditioning in cars means not only more comfortable travel, but highway safety studies show it contributes to driving safety by reducing heat stress and fatigue.
- CFCs and air conditioning technology have led to development of energy-efficient heat pumps, solar heat systems and other heat recovery devices.

All these benefits have been made possible largely by CFCs. Air conditioning technology has been based on them, and there are no safe, suitable substitutes.



Plastic Foams

\$2 billion	40,000 jobs
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CFCs are important as blowing agents in making insulating, food packaging and cushioning foams out of plastic materials.

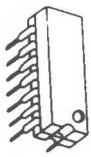
Insulating foams made with CFCs have twice the insulating value of fiberglass of the same thickness and also insulate better than foams made with other compounds. The foams are used in refrigerators and freezers, walls and roofs of houses and buildings, refrigerated railway cars and trucks, and in many industrial applications. They save substantial amounts of energy and reduce heating and cooling costs.

Because of the foams' efficiency, insulating walls can be thinner, which saves materials and provides more usable space. The foams' light weight is also a space and energy-saving advantage, particularly in insulated trucks and railway cars.

CFC food packaging foams provide insulating value for hot and cold foods and do not absorb liquids or grease. Foam meat trays are becoming familiar in supermarkets. Foam egg cartons cushion the eggs so there is less breakage than with conventional cartons.

Cushioning foams are rapidly replacing the old spring-and-padding construction of mattresses and upholstered furniture, and the lower cost and greater comfort are boons for the consumer. In cars, airplanes and trains, CFC-blown foams provide superior cushioning in seats and padded areas, such as automobile dashboards.

While other blowing agents are often used for cushioning foams, those made with CFCs provide more softness, resiliency and durability.



Cleaning Agents

Products valued in the billions of dollars. More than 10,000 jobs

As microchips and other components of electronic equipment have become smaller and more sophisticated, the need for absolute cleanliness in manufacturing has become critical. CFCs are the cleaning agents of choice, because they remove the smallest contaminants and leave a clean, dry surface. Also, CFCs are safer to use than other cleaning agents, which are more toxic and/or flammable.

In many other industries as well, CFCs are used as cleaning solvents and degreasers, providing the advantage of thorough cleaning without the volume of wastes generated by water and other solvents.



Food Freezants

\$0.4 billion More than 500 jobs

The food we eat today is more varied year-round, more nutritious and better tasting than it used to be because of freezing, and CFCs deserve much of the credit. The frozen food revolution was made possible by CFCs, which made refrigerators and freezers safe for home use.

Now, CFC food freezants provide ultrafast, direct contact freezing of many foods that could not be frozen satisfactorily by the usual "air blast" method. CFCs have energy-saving advantages over other freezants, which require up to eight times the energy needed with the CFC system.



Sterilants

\$0.1 billion More than 500 jobs

CFCs mixed with a sterilizing agent are widely used in hospitals and in the manufacture of medical equipment and devices. The CFCs make the sterilizing agent nonflammable without affecting its sterilizing ability. Gloves, syringes, catheters and tubing, anesthetic and respiratory equipment, pharmaceuticals and other medical supplies are made sterile by these mixtures.

Fumigants, Pesticides CFCs blended with other chemicals are used as fumigants and pesticides in granaries, warehouses and the holds of ships.

CFCs: The Benefits Are Many

The preceding section mentioned many specific ways in which CFCs benefit society.

In sum, CFCs make important contributions in a number of critical areas today:

Public safety Because CFCs are not flammable, explosive or reactive with other substances and have low toxicity, they are ideal for use in places where substitute compounds might be hazardous to the public.

Public Health A year-round supply of nutritious, healthful foods is dependent to a large extent on CFC refrigerants and freezants. Air conditioning creates more healthful indoor environments. Health care facilities and the pharmaceutical industry would be hard put to operate without the benefits made possible by CFCs.

Energy The efficient heat transfer properties of CFCs save substantial amounts of energy in refrigeration, air conditioning and insulation uses. It has been estimated that a United States ban on CFCs could, after 10 years, mean an annual energy penalty equal to 9-12 billion gallons of fuel oil, due to the forced use of less efficient materials.

The economy Besides the goods, services, businesses and jobs made possible by chlorofluorocarbons, products based on CFCs are important exports for the United States, contributing strongly to the nation's balance of trade.

Technology The availability of CFCs has led to important technological innovations, such as energy recuperators, hot water heat pumps, a solar heating system, an innovative cleaning system for electronic components, and a promising new method of cleaning coal which dramatically reduces ash and other pollutants when the coal is burned.

**ECONOMIC IMPLICATIONS OF
POTENTIAL CHLOROFLUOROCARBON RESTRICTIONS
FINAL REPORT**

Prepared for
Alliance for Responsible CFC Policy

Prepared by
Putnam, Hayes & Bartlett, Inc.
Economic and Management Counsel
Washington, D.C.
December 2, 1987

BACKGROUND

The recently adopted international protocol (Montreal Protocol) requires substantial reductions in the use of chlorofluorocarbons (CFCs) starting in 1990. In our analysis, we assume implementation of the Protocol requiring:

- A consumption freeze in 1990 at 1986 levels (consumption is defined in the Protocol as production plus imports minus exports),
- A 20 percent reduction in 1994, and
- A 50 percent reduction in 1999.

By December 1, 1987, the Environmental Protection Agency (EPA) is expected to propose regulations designed to reduce the use of CFCs in accordance with the Protocol.

Pending congressional legislation would unilaterally reduce the use of CFCs further than is called for in the Montreal Protocol.

To determine the economic and policy implications of CFC restrictions, the Alliance for Responsible CFC Policy (Alliance) retained Putnam, Hayes & Bartlett, Inc. (PHB), to evaluate the economic impact on CFC producers and consumers. This work involved:

- Estimating the timing and magnitude of future CFC price rises resulting from the restrictions called for in the Montreal Protocol;
- Determining the cost to society* of implementing the Montreal Protocol and the cost of implementing various legislative proposals to further restrict CFC usage;
- Determining the level of wealth transfer* away from consumers and user industries, which must pay higher CFC prices as a result of the regulation-induced shortages;
- Assessing the level of CFC-substitute usage under various scenarios;
- Comparing the impact of unilateral restriction on CFC usage to that of the Montreal Protocol;
- Examining the trade implications of the Montreal Protocol and various legislative proposals; and
- Comparing the economic efficiency of alternative methods for implementing the Protocol.

CFCs are used in a wide variety of products and applications, including

- Solvent applications in:
 - Electronic components cleansing
 - Metal Cleaning.
- Foam-blowing applications in:
 - Polyurethane rigid foams used in home insulation
 - Polyurethane flexible foams used in furniture cushioning
 - Polyurethane foams used in insulation and packaging.
- Refrigerant applications in:
 - Mobile (Car and Truck) air conditioners
 - Chillers (e.g., office air conditioning)
 - Commercial and home refrigerators.
- Miscellaneous applications, such as:
 - Sterilization
 - Liquid food freezing.

* See definition on page V-5

METHODOLOGY

Our methodology consisted of five elements (separately bound Appendix with details on the approach available):

1. Interviews and analyses conducted with numerous industry experts in 44 different CFC-using segments (more than 100 representatives of 93 companies and associations were contacted).
2. Projections of CFC usage in each segment in the absence of regulation.
3. Evaluations of different options for reducing CFC usage in each segment, including process controls, chemical substitutes, and alternative (non-CFC-using) end products, many of which were outlined in preliminary analysis documents prepared by EPA.
4. Projections of CFC usage in each segment with regulation-induced CFC price increases.
5. General assumptions:
 - A production quota or equivalent type of regulation is used to implement the Montreal Protocol. The impact of alternative types of regulations are contrasted with a production quota.
 - CFC restrictions are implemented on a weighted basis (weights from Annex A of the Montreal Protocol).
 - The restrictions cover five CFCs: CFC-11, CFC-12, CFC-113, CFC-114, and CFC-115. In addition, uses of R-500 and R-502 (azeotropes that contain CFC-12 and CFC-115, respectively) are also restricted. The impact of separate restrictions on halons is not evaluated.
 - Social costs and wealth transfers are measures of economic impact used in this analysis. In quantifying costs and transfers, we have adopted the standard economic definitions also used by EPA:
 - *Social costs are defined as the incremental real resource costs incurred by society in order to comply with CFC restrictions; for example, the cost of process controls, more expensive chemical substitutes, or more expensive non-CFC-using alternate products.
 - *Wealth transfers represent the incremental cost of CFCs to users who purchase restricted CFCs at the higher prices that will occur as a result of restrictions.
 - Costs and prices are presented in 1987 constant dollars. Social costs are discounted at a five percent rate. Wealth transfers are also discounted at a five percent rate.

SUMMARY OF FINDINGS

1. The Montreal Protocol will require substantial reductions in CFC usage since demand for CFCs is growing rapidly. In the absence of restrictions, CFC use would grow by 48 percent from 1986 to 1999 and by 119 percent from 1986 to 2010.
2. The severity of the Protocol's economic impact is highly dependent on the timing and commercial availability of non-ozone-depleting chemical substitutes for CFCs.
3. Even under optimistic assumptions concerning the availability of potential CFC substitutes (i.e., substitutes are commercially available in 1994), the economic impact of the Protocol will be very large:
 - A. CFC prices will rise significantly for user industries and consumers; for example, CFC-11 will rise from \$0.50 in 1986 to almost \$2.00 in 1994.
 - B. In 1999, when the 50 percent reduction is required, a substantial price rise (i.e., price "spike") is expected. The price spike, which is caused by the inability of substitutes, process controls, and conservation measures to satisfy the 50 percent target level, would cause major market disruptions.
 - C. Social cost to the U.S. economy will be \$5.5 billion between 1990 and 2010. Over \$9 billion (present value) of wealth will be transferred away from consumers and user industries between 1990 and 2010.
 - U.S. CFC consumption will be reduced by over 11 billion weighted pounds between 1990 and 2010 or the equivalent of more than 18 years of current U.S. production of these compounds.
4. If substitutes are not commercially available for widespread use by 1994 (when the 20 percent reduction is required), an economically disruptive price "spike" would likewise occur and continue until substitutes are commercially available.
5. CFC reductions induced by the Protocol will not be equally distributed among user industries. Some of the least price-sensitive users (e.g., electronic solvents, mobile air conditioning) can increase their CFC use, relative to 1986 levels, at the expense of more price-sensitive users (e.g., plastic foam users) or users that have available substitutes.
6. Substantial economic costs would be incurred if just the freeze or only the freeze and the 20 percent reduction were implemented.
 - A. The price rise induced by the Protocol reduction scenario, the freeze only, and the freeze with 20 percent reduction would all induce significant price rises; however, only the 50 percent reduction step of the Protocol causes the price spike.
 - B. The social costs and wealth transfers of each step are also substantial. Social costs are about \$2 billion for the freeze alternative and \$3 billion for the freeze with 20 percent reduction alternative.
 - C. The Protocol, the freeze-only, and the freeze-with-20-percent-reduction alternatives would all spur development and high usage of CFC substitutes in response to much higher CFC prices. Since the 20 percent reduction will provide sufficient price incentives to use CFC substitutes, the costs associated with the additional 30 percent reduction in the Protocol should be considered as part of the Protocol's ongoing scientific, technological, and economic evaluation process.
7. Proposed legislation unilaterally reducing CFC usage more than required by the Protocol would substantially increase the economic cost of CFC restrictions.
 - Pending legislation calls for a 95 percent reduction by 1993. The cost of this legislation would be extraordinary and extends beyond our ability to reliably forecast CFC prices.
 - As an alternative, we examined a hypothetical unilateral action that required a 30 percent CFC reduction in 1990, increasing to 50 percent in 1995 and 70 percent by 2005. This hypothetical action to further restrict U.S. CFC usage could increase costs from \$5.5 billion in the Protocol to almost \$10 billion, while only reducing worldwide emissions by another 7.3 percent.
8. The impact of the Montreal Protocol on international trade will depend heavily on implementation. However, if U.S. unilateral reductions beyond the Protocol are required, then potentially severe trade impacts could occur, especially if the availability of CFCs to trade-sensitive segments is curtailed.
9. The method of implementing the Protocol in the U.S. could affect costs. Relative to a production quota, an auction-permit system could result in increased market uncertainty, higher CFC prices, and a higher-cost regulation.

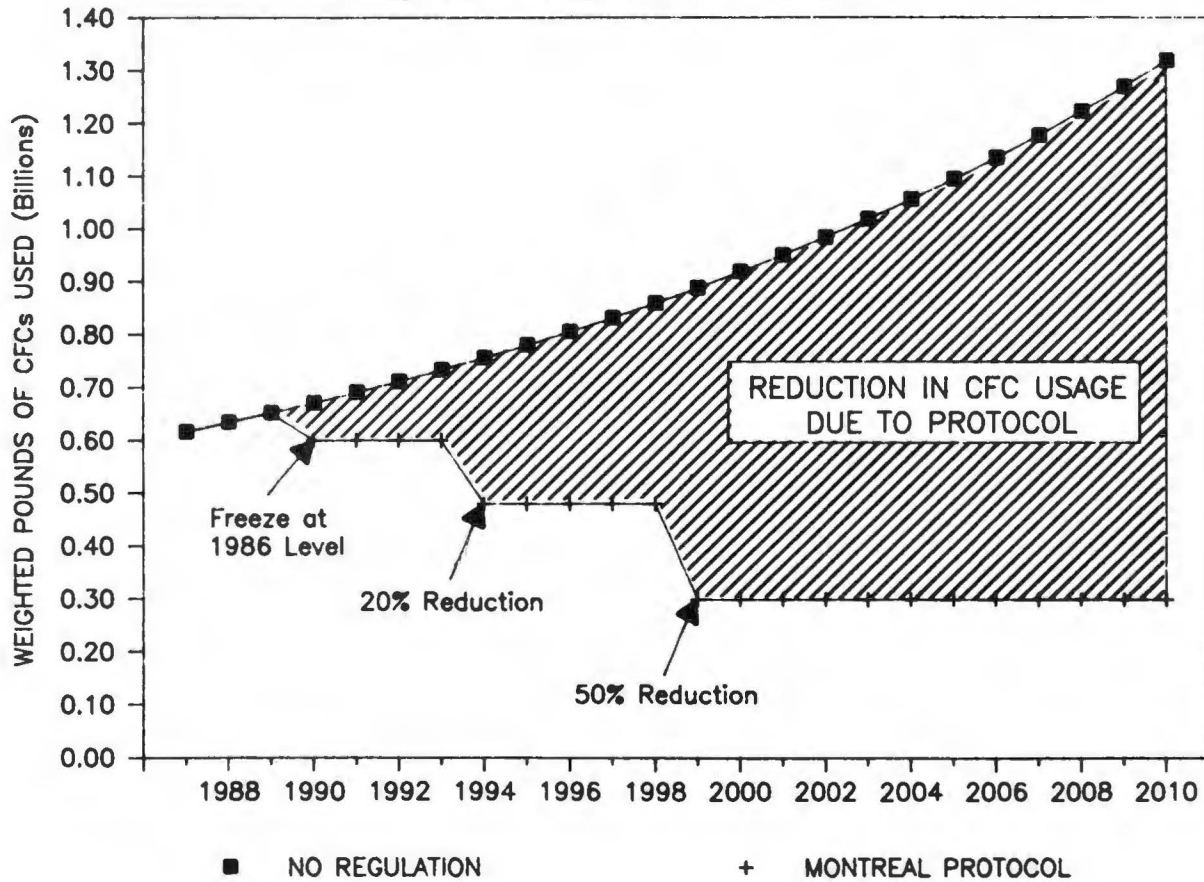
The following sections elaborate on the findings summarized above.

1. SUBSTANTIAL REDUCTIONS ARE REQUIRED BY PROTOCOL

The Montreal Protocol will require substantial reduction in CFC usage, since the use of CFCs is growing rapidly. CFC usage would be expected to continue growing at an average rate of 3.3 percent per year in the absence of regulation, for a cumulative increase of 119 percent between 1986 and 2010. U.S. CFC consumption will be reduced, according to the Protocol schedule, by over 11 billion weighted pounds between 1990 and 2010, or the equivalent of more than 18 years of current U.S. production of these compounds.

EFFECT OF PROTOCOL ON CFC USAGE

Weighted CFC Usage of Covered Compounds



2. THE PROTOCOL'S IMPACT DEPENDS ON SUBSTITUTE AVAILABILITY

CFC prices will rise in response to regulation-induced shortages.

The degree to which CFC prices will rise in accordance with the Montreal Protocol depends on:

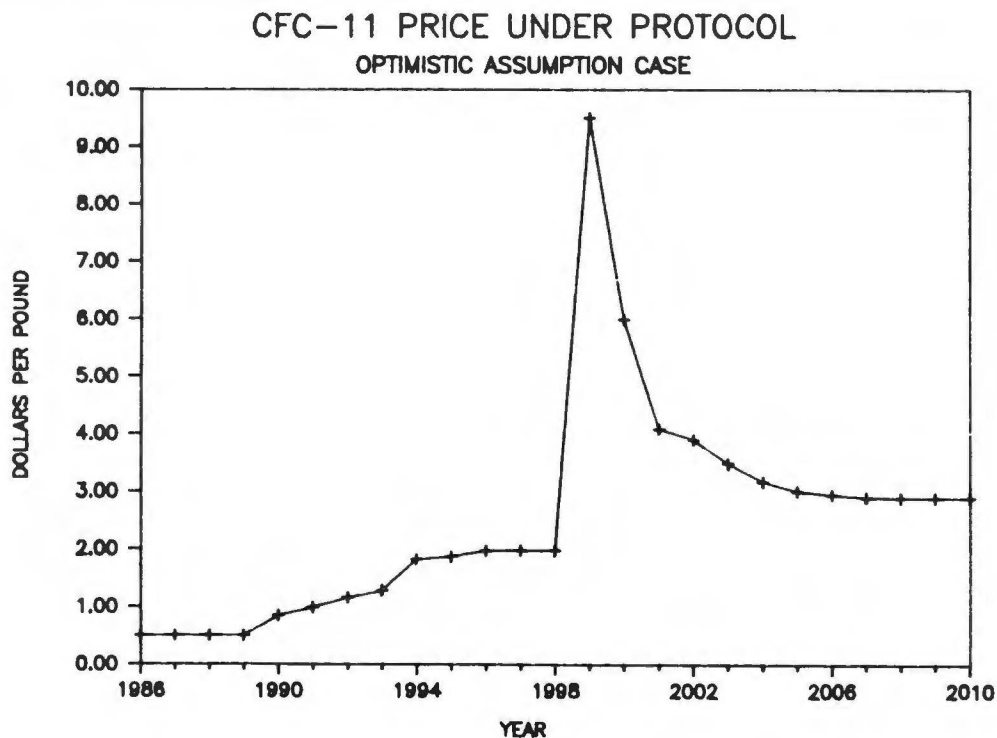
- The timing and magnitude of the regulation-induced shortages;
- The availability and cost of chemical substitutes for CFCs, especially potential new non-ozone-depleting CFCs;
- The availability and cost of control technologies and conservation measures; and
- The extent to which price increases will induce industry and consumers to reduce their demand for products containing CFCs and switch to non-CFC products. For example, CFC home insulation foam product prices will rise as CFC prices rise. As a consequence, consumers will purchase less CFC insulation foam and may switch to other non-CFC insulation products.

We have studied each of these four factors extensively with the assistance of industry experts.

3. EVEN IF SUBSTITUTES ARE AVAILABLE, THE PROTOCOL'S IMPACT WILL BE LARGE

A. CFC Prices Will Rise Significantly

Assuming CFC substitutes are commercially available by 1994 (these assumptions might be optimistic, as discussed below), CFC-11 prices would double from \$0.50 to about \$1.00 under a freeze, increase to almost \$2.00 (a fourfold increase) when the 20 percent phasedown becomes effective, and rise rapidly ("spike") in 1999 when the 50 percent reduction becomes effective.



Under a weighted pounds production quota, the price behavior of CFC-11 is essentially identical to the behavior of CFC-12 and CFC-113. The price profile of other CFCs is given in the Appendix.

The large increases in CFC prices resulting from the freeze in 1990 and the 20 percent reduction in 1994 will have severe ramifications on CFC-using industries.

Those end-user industries without a short-term CFC substitute will have to invest in CFC conservation measures or absorb the total price increase and the accompanying reduction in demand for their end-use products. At these high CFC prices, some firms may become bankrupt if there is competition from non-CFC products in their end uses.

In the longer term, as CFC substitutes become available, the end-use industries that survive will become effectively shielded from further price increases. However, at the expected price level of the substitutes (three to five times higher), demand for those end-use products will be less.

The price spike in 1999 is caused by the inability of CFC substitutes and conservation measures to satisfy the 50 percent rollback target. Hence, prices are bid up by relatively price-insensitive users until quantity is reduced to meet the Protocol-required reductions.

The issue of how much CFC prices will rise in response to regulation has been extensively studied by EPA as well as by PHB; our price projections differ from EPA's projections.

- EPA has previously estimated that very large percentage reductions in CFC usage will be forthcoming with very small increases in CFC prices—for example, a 30 percent reduction in CFC usage with a price rise of only 7 cents per pound (EPA Preliminary Analysis of April 13, 1987).
- Our CFC price projections are substantially higher than EPA's April 13 estimates, primarily because our analyses and work with industry experts indicate that EPA's Preliminary Analysis substantially overestimated the low-cost CFC-reducing measures that will be quickly adopted.

3. EVEN IF SUBSTITUTES ARE AVAILABLE, THE PROTOCOL'S IMPACT WILL BE LARGE (Continued)

If CFC prices rise by a small amount, as EPA projects, then the impact on the CFC industries will be less than we estimate. However, if CFC prices increase significantly, as we expect, then the economic impact will be substantial and potentially severe.

- Sound regulatory policy would recognize the risk that CFC prices might rise significantly and, therefore, would seek to prevent any costly and avoidable economic disruptions that those significantly higher prices might precipitate.

B. The Substantial Price Spike in 1999 Would Cause Major Market Disruptions

A sudden increase in price might result in bankruptcy for marginal firms—those that depend on CFCs and have relatively price-sensitive applications. In effect, those firms that cannot sustain the losses associated with the spike will be driven out of business.

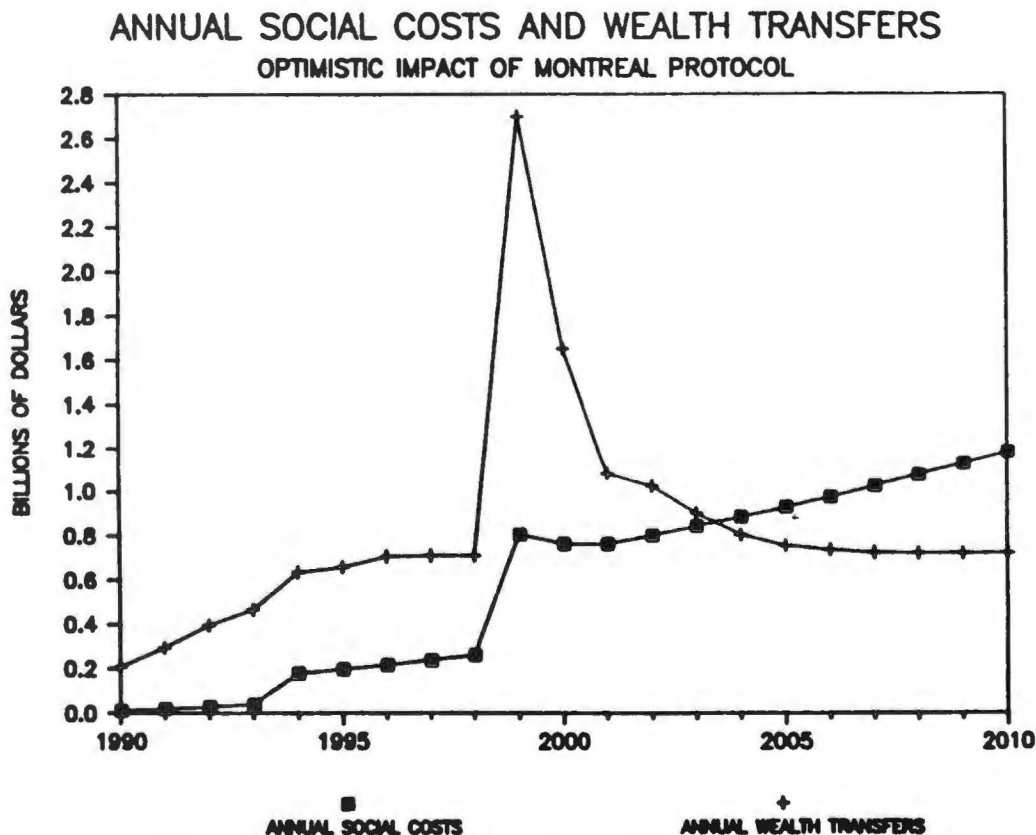
These bankruptcies will yield job losses, premature capital obsolescence, and, correspondingly, a loss in U.S. productivity and competitiveness. These significant economic impacts are not reflected in the social-cost calculation, although social costs are also very large.

The rapid increase in price could dissipate the societal consensus for CFC restriction. For example, if auto air conditioners on many cars were inoperative, then consumer dissatisfaction could undermine the basis for regulation.

After 1999, CFC-substitute use increases to the point where the price rise is moderated.

C. The Social Costs and Wealth Transfers Caused by the Protocol Are Substantial

The annual costs to society of implementing the Montreal Protocol, even given optimistic assumptions concerning CFC substitute availability, are substantial. The present value of social costs from 1990 to 2010 is \$5.5 billion; the present value of wealth transfers is \$9 billion. The Montreal Protocol will reduce cumulative U.S. CFC consumption by 11 billion weighted pounds between 1990 and 2010, or the equivalent of 18 years of current U.S. production of these compounds.



Examples of the effects of CFC restrictions are:

- Commercial and home refrigeration manufacturers will spend more than three times current amounts for CFC refrigerant in the mid-1990s.
- Car manufacturers will make large capital and retooling expenditures in the 1990s to allow the use of CFC substitutes in mobile air conditioners.
- Food processors will abandon liquid food freezing as CFC price rises make these frozen foods noncompetitive with lower-quality frozen products and fresh produce shipped from warmer climates.
- Medical equipment suppliers will make large capital investments in order to recycle the CFCs used in sterilant gas.
- Consumers will pay higher prices for CFC home insulation products and will reduce their demand for these products.
- Manufacturers employing CFC-113 for metal degreasing will install more conservation equipment where possible (e.g., covered openings, thermostats, refrigerated freeboard), install hot vapor recycle in new systems, and revert to methyl chloroform or emulsion cleaning in some cases.
- Furniture manufactures will employ higher density foam or switch to alternate cushioning material.
- Foam-packaging manufacturers will switch to CFC-22 or hydrocarbons as a blowing agent.
- Manufacturers or builders using spray or pour-in-place insulation will switch to non-CFC-using materials, or they will pay substantially higher prices for products blown with potential new CFC substitutes, if and when substitutes are available.
- Commercial air conditioning manufacturers will make large retooling expenditures in the middle to late 1990s in order to switch to potential new refrigerants, if viable refrigerants are available.

4. IF SUBSTITUTES ARE NOT AVAILABLE, ADDITIONAL DISRUPTIONS WOULD OCCUR

The previous CFC price projections (see page V-9) assumed that the potential new substitutes for CFC-11 and CFC-12 would be available in 1994 at a price of \$1.50 per pound and \$3.00 per pound, respectively. Since potential CFC substitutes are not certain to be available at that time or at that price, our CFC price forecast is optimistic.

Our analysis indicates that a 1994 substitute availability and the CFC-substitute price assumption might be optimistic for the following reasons:

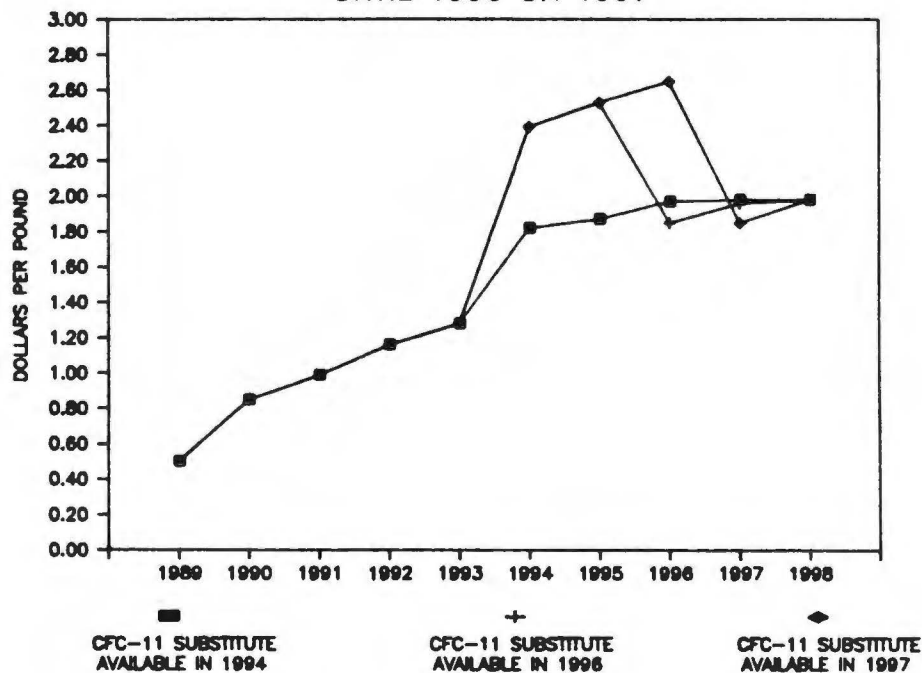
- CFC substitutes have not been tested in most applications, and testing requires time;
- CFC substitutes might pose toxicological concerns or may require costly workplace exposure controls or emission controls;
- Producers might experience difficulties in developing commercial production facilities for the CFC substitutes; and
- Applications testing may show that the most promising candidates (CFC-123, CFC-134a, CFC-141b) are not viable substitutes for some or all uses.

If the most promising substitutes are not viable, then at a minimum, several additional years would be needed to develop other viable substitutes.

CFC prices might also be higher in the short term if the price sensitivity of CFC end users is less than we have estimated.

If a viable substitute for CFC-11 does not become available until 1996 or 1997, then prices will rise more rapidly during the 1994-1997 period. These price rises will cause additional economic disruptions in the form of job losses, bankruptcy, and so forth.

PRICE OF CFC-11 IF SUBSTITUTE NOT AVAILABLE UNTIL 1996 OR 1997

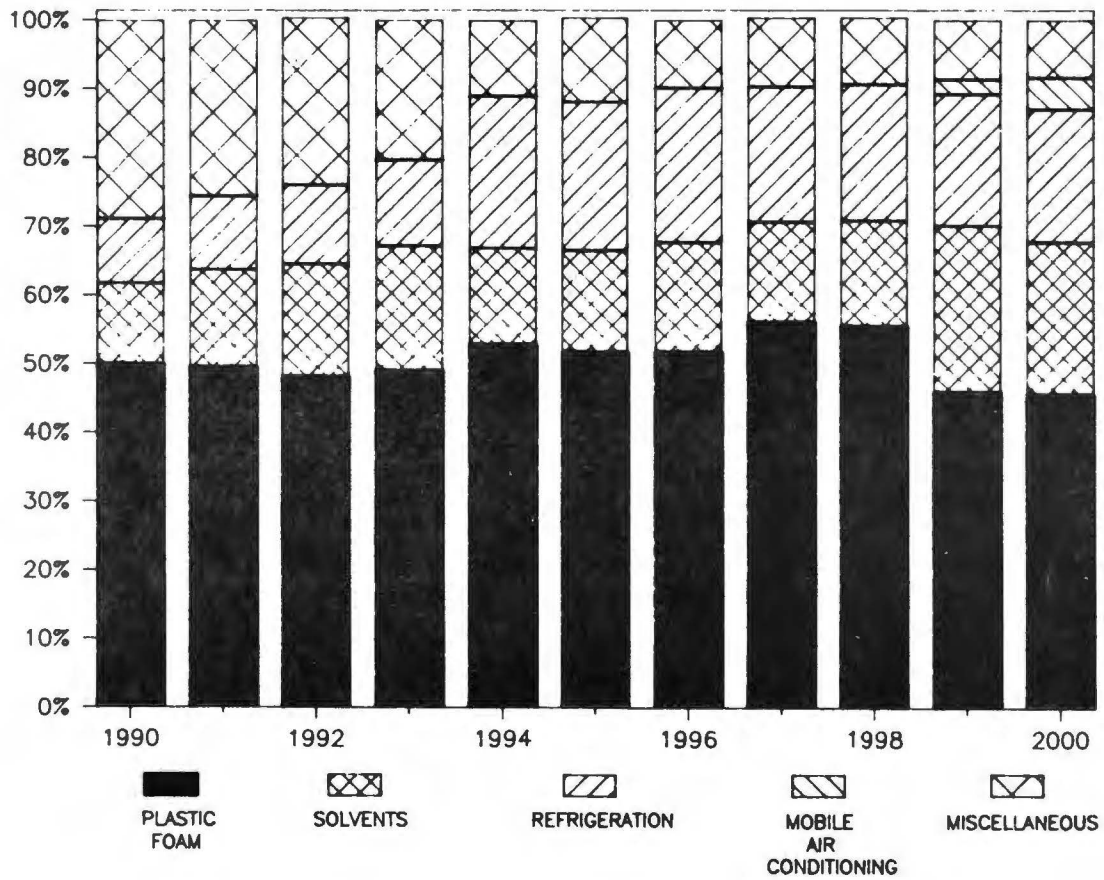


Under a weighted pounds production quota, the price behavior of CFC-11 is essentially identical to the behavior of CFC-12 and CFC-113.

5. UNDER THE PROTOCOL, CFC REDUCTIONS ARE NOT EQUALLY DISTRIBUTED

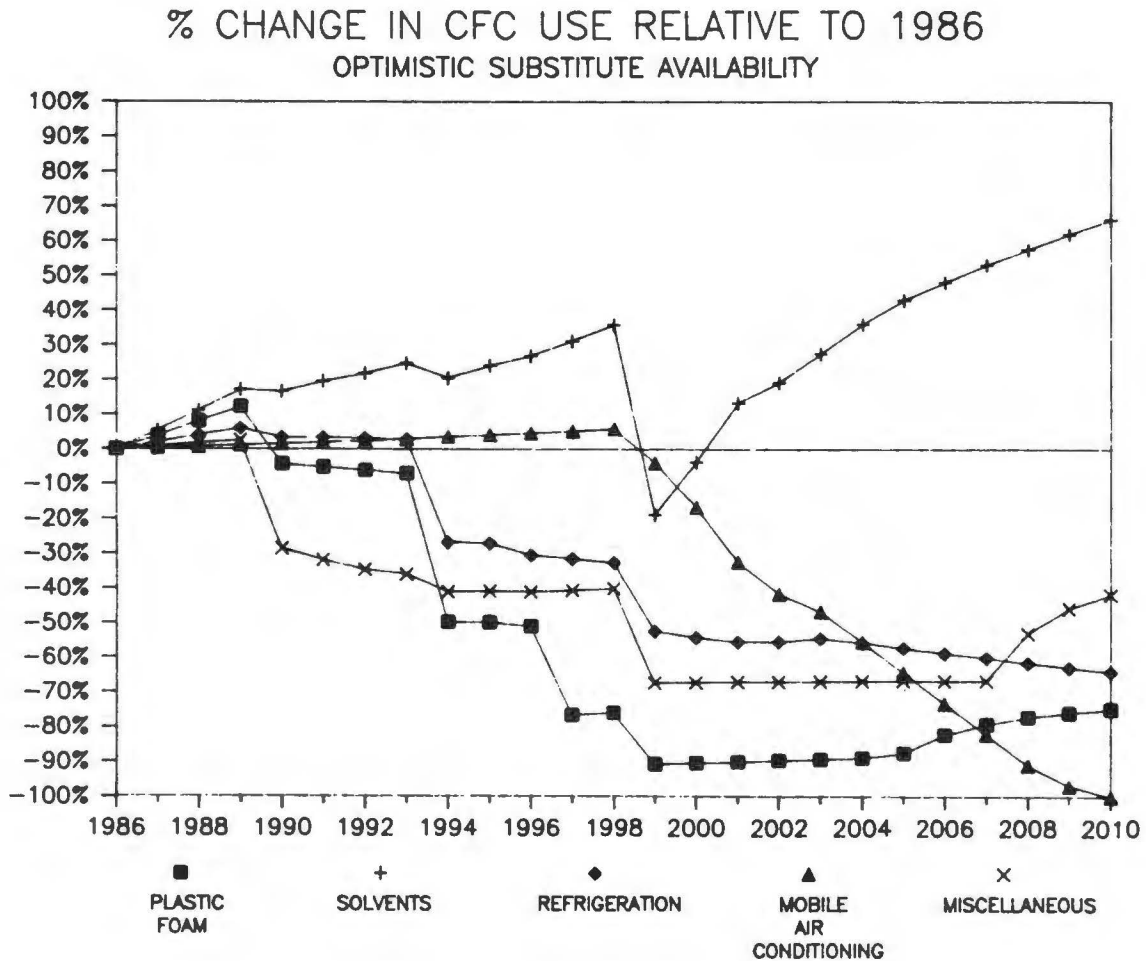
The plastic foam industry and miscellaneous uses (e.g., sterilants, liquid food freezing) account for most of the reduction in the early years. The foam and refrigeration industries account for most of the reductions in later years.

% OF WEIGHTED REDUCTION BY END USE
OPTIMISTIC ASSUMPTION CASE



5. UNDER THE PROTOCOL, CFC REDUCTIONS ARE NOT EQUALLY DISTRIBUTED (Continued)

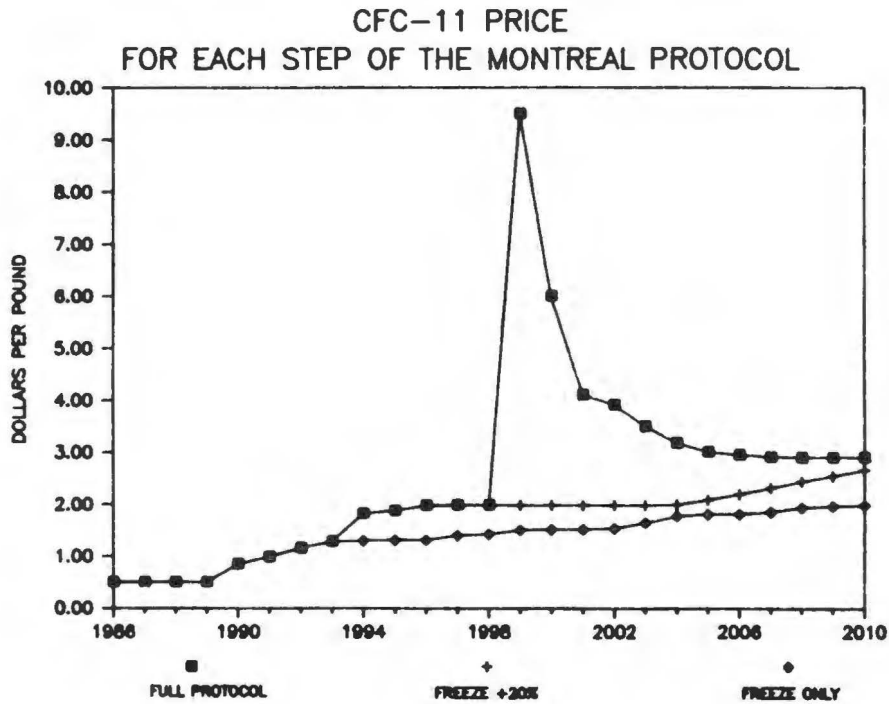
Solvent, mobile air conditioning (until 1999), and refrigeration (until 1994) applications increase use of CFCs relative to 1986 levels (although their use is less than it would have been in the absence of regulation), while other applications decrease CFC use.



6. EACH STEP OF THE PROTOCOL CAUSES SUBSTANTIAL ECONOMIC IMPACTS

A. The Price Rise Induced by Each Step Is Significant

The CFC price rise is substantial in each Protocol step. Only the 50 percent reduction step causes the price spike.



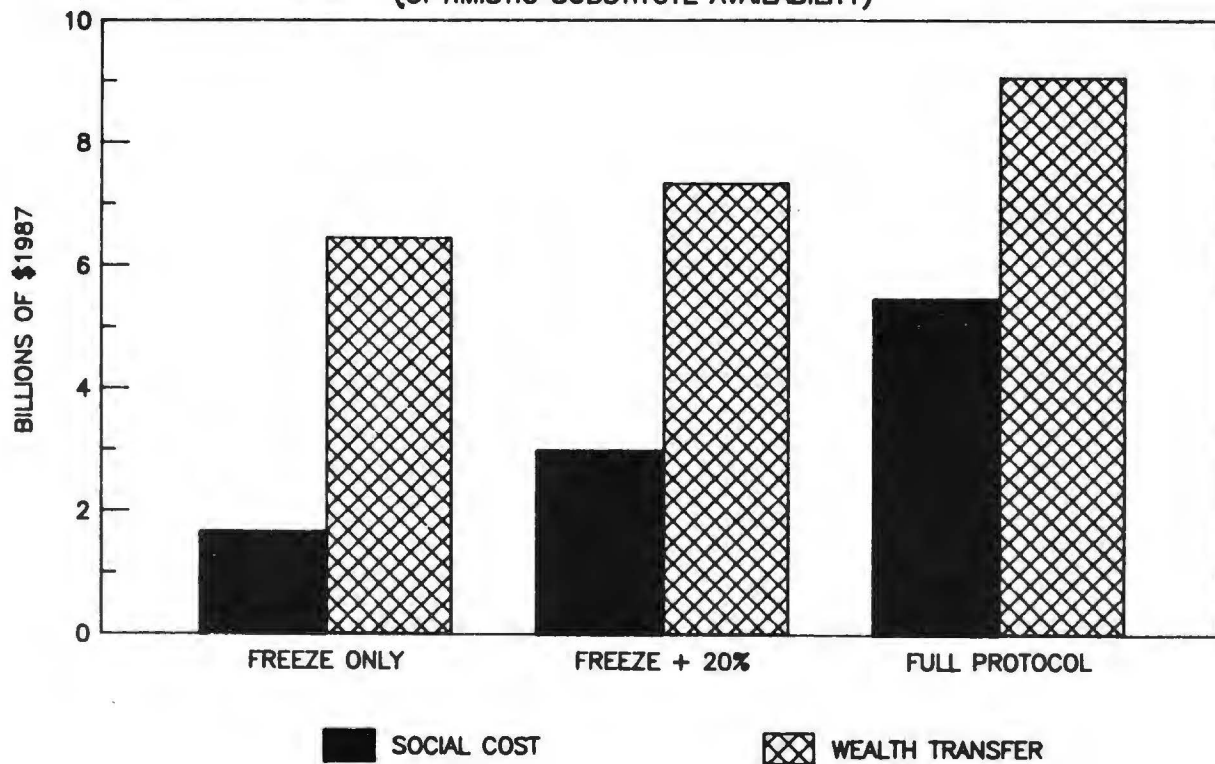
The price behavior of CFC-11 is used to illustrate the impact of each step. The price behavior of CFC-12 and CFC-113 is essentially identical.

6. EACH STEP OF THE PROTOCOL CAUSES SUBSTANTIAL ECONOMIC IMPACTS (Continued)

B. The Social Costs and Wealth Transfers of Each Step are Also Substantial

Social costs and wealth transfers would be less, although still high, if only the freeze or the freeze-plus-20-percent-reduction steps of the protocol were implemented.

**SOCIAL COST AND WEALTH TRANSFER
FOR EACH STEP OF THE MONTREAL PROTOCOL
(OPTIMISTIC SUBSTITUTE AVAILABILITY)**



6. EACH STEP OF THE PROTOCOL CAUSES SUBSTANTIAL ECONOMIC IMPACTS (Continued)

C. The Freeze and Freeze-Plus-20-Percent-Reduction Steps Both Spur Substitute Development

The CFC price rise induced by the freeze and freeze-plus-20-percent-reduction requirement will spur development of commercial quantities of potential new CFC substitutes.

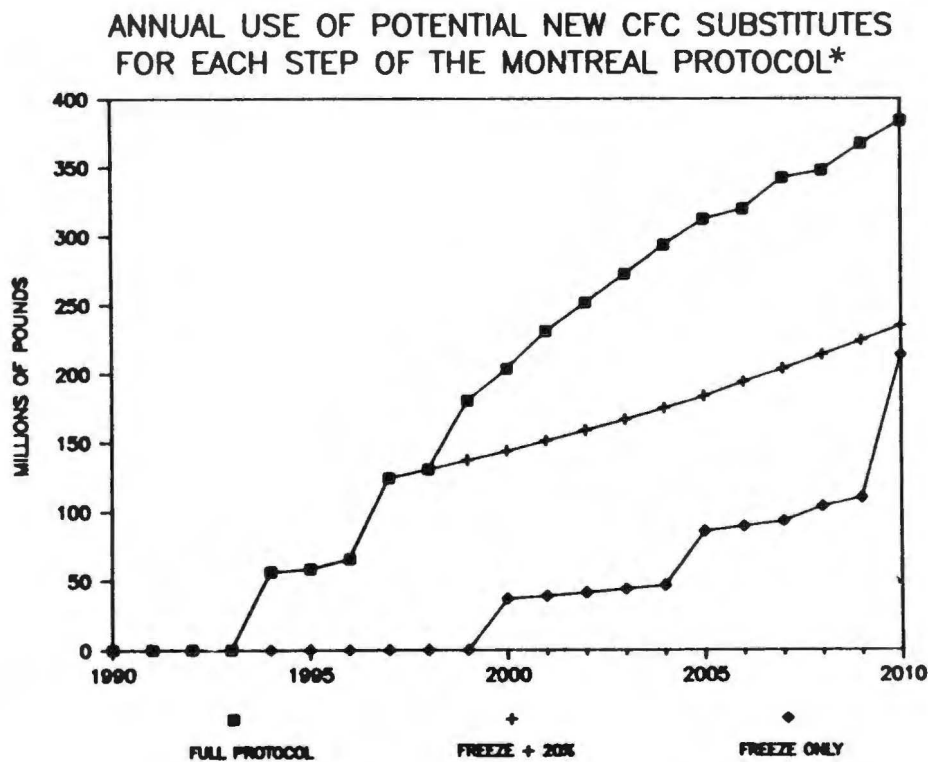
Our analysis indicates that even without the 50 percent reduction step, CFC prices still would rise to the levels necessary to support introduction of CFC-123 and CFC-141b—potential substitutes for CFC-11—and CFC-134a—a potential substitute for CFC-12.

- The time at which each potential substitute becomes competitive depends on the rate at which CFC prices rise, on each substitute's production economics, and on the price sensitivity of each user group.

Higher CFC prices would:

- Provide sufficient incentives for conservation technologies to be applied by industry and
- Reduce CFCs in some applications (e.g., fiber board might be used in building insulation instead of CFC insulating rigid foam, in spite of the reduced insulation efficiency).

The use of potential new substitute CFCs, which may include CFC-123, CFC-134a, and CFC-141b, is expected to grow substantially under the full Protocol and under the freeze-plus-20-percent-reduction step alone.



*Includes projected use of three potential CFC substitutes: CFC-123, CFC-134a, and CFC-141b. Does not include the use of chemicals that are commercially available currently and that may be suitable chemical substitutes in some applications.

7. UNILATERAL ACTION WOULD IMPOSE SUBSTANTIAL COSTS

Pending legislation calls for a 95 percent reduction in CFC use by 1993. The costs of this legislation would be extraordinary compared to the cost of the Protocol and extend beyond our ability to reliably forecast CFC-related impacts.

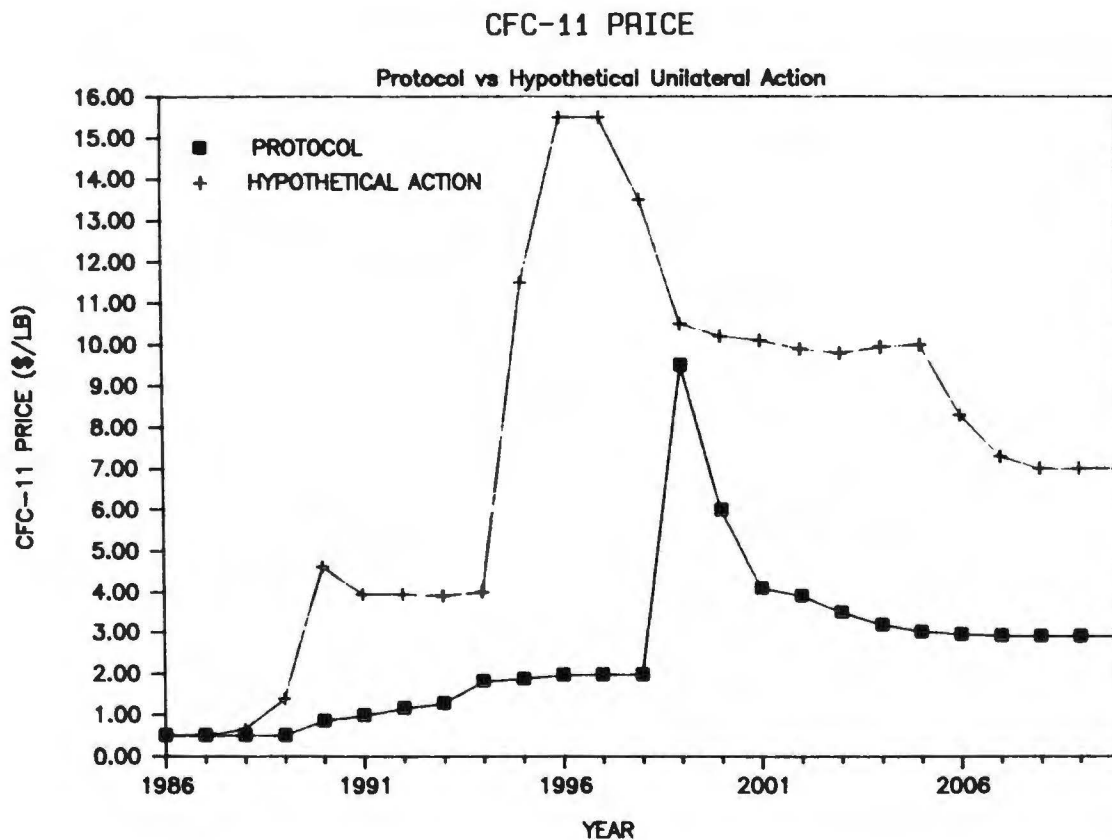
If enacted, pending legislation would be vastly more costly but would not be much more effective in reducing global emissions relative to the Protocol. For example, a 95 percent reduction by 1993, while beyond our model's ability to reliably predict impact, we believe would cost the U.S. economy at least \$20 billion—about four times the cost of the Protocol. Recent scientific analysis indicates such a requirement would have a negligible effect on ozone depletion compared to the significant effect of the Protocol.

As an alternative to the pending legislation, we examined a hypothetical unilateral action that required:

- A 30 percent reduction in 1990,
- A 50 percent reduction in 1995, and
- Increasing reductions to 70 percent by 2005.

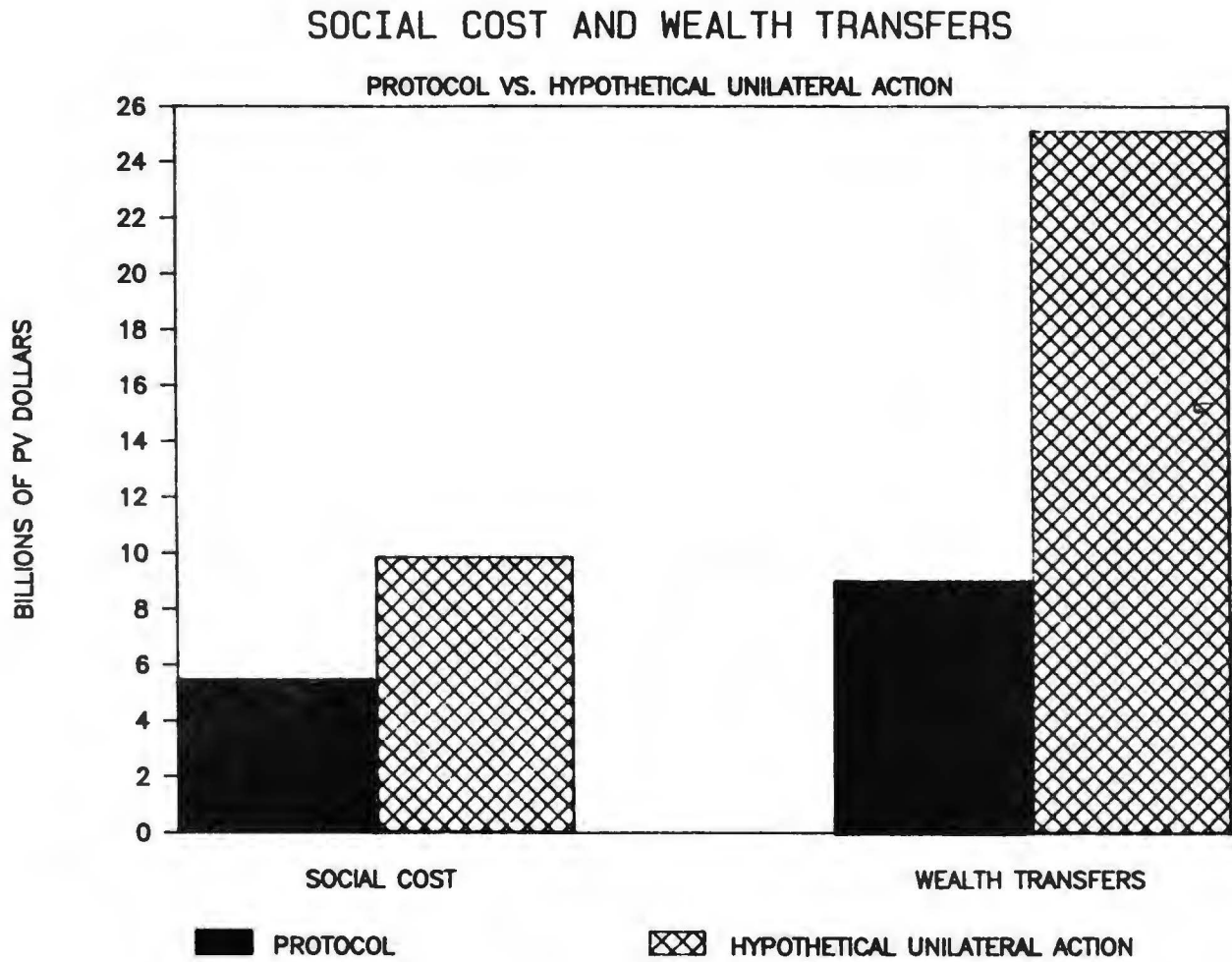
As the following exhibits show, this hypothetical action almost doubles the economic costs of regulation from \$5.5 billion to almost \$10 billion, while only reducing worldwide emissions by 7.3 percent.

Unilateral action will result in substantially higher prices than the Protocol. Assuming CFC substitutes are available by 1994, CFC prices would rise to almost \$16.00 by 1996 and would remain above \$7.00 throughout the analysis period. Relative to the Montreal Protocol, under the assumed hypothetical unilateral action scenario, U.S. and world emissions would be reduced by 24.6 percent and 7.3 percent, respectively.



7. UNILATERAL ACTION WOULD IMPOSE SUBSTANTIAL COSTS (Continued)

The cost to society of this hypothetical unilateral action is almost double the cost of the Montreal Protocol (\$9.9 billion versus \$5.5 billion). The wealth transfers almost triple from \$9 billion to \$25 billion.



8. IMPACT ON INTERNATIONAL TRADE

The impact of the Montreal Protocol will depend heavily on implementation. Under Article 3, beginning in 1993, CFC exports to Non-Parties are excluded from the consumption calculation (i.e., the exporting nation is charged with consumption). Article 4 provides for four types of controls on trade with Non-Parties:

- A ban on CFC imports one year after entry into force.
- A ban on CFC exports by Developing Countries beginning 1 January 1993.
- A ban on import of CFC-containing products within four years after entry into force, but only if listed in an annex that has yet to be created.
- A ban on imports of products produced with CFCs within six years after entry into force, but only if listed in an annex that has yet to be created.

Implementing the Protocol trade provisions presents a number of difficult issues; however, implementation procedures have yet to be defined.

- Since the important controls on CFC-containing and CFC-produced products will not be addressed until after the Protocol takes effect, some adverse trade impacts are possible but difficult to ascertain at this time.

However, if unilateral CFC restrictions beyond the Protocol are implemented, important adverse trade impacts are likely.

Examples of potential adverse impacts include the following:

- Unilateral action would cause higher domestic CFC prices, leading to higher prices for final products using CFCs thus putting U.S. firms involved in international trade at a competitive disadvantage.
- The impact of the CFC price rise would vary according to the amount of CFC used in the end product, as well as the price of the end product.
- Unilateral action could cost U.S. industry foreign customers, as these customers switch to lower-cost foreign suppliers.
- Unilateral action would place U.S. industry at a competitive disadvantage since end users would face higher input prices as well as the costs of retooling their production lines in advance of foreign industries.
- Unilateral restrictions beyond the protocol would further damage the U.S. industry's international competitiveness. U.S. end users have already made significant reductions in their CFC usage as a result of previously mandated cutbacks. Under the Protocol alone, industry will need to reduce its CFC usage in applications far beyond those required of other signatories.
- Additional U.S. legislative action beyond the Protocol could precipitate capital flight as end-use industries shift production facilities offshore to postpone adjustment. This could mean the loss of jobs in the United States.
- If U.S. industry were rushed into developing substitute products, it would face the possibility of greater servicing requirements and costs. This is because some CFC substitutes will place greater strains on equipment, which could in turn make U.S. products less competitive in nations that have the option of purchasing systems with CFCs or their chemical substitutes.
- Unilateral action could restrict the availability of CFCs to trade-sensitive industry segments (e.g., electronics and air conditioning).

Lost export sales would seriously injure domestic industry. For example, the commercial refrigeration sector exported approximately \$145 million in 1986. With growing international demand for commercial refrigeration products, limiting industry's access to CFCs could result in either significant losses in foreign sales or a shift to overseas production.

9. COMPARISON OF PRODUCTION QUOTA WITH AUCTION-PERMIT SYSTEM

The analysis in this study is based on the assumption that CFC restrictions would be implemented using a production-quota type of regulation. An auction-permit system is another regulatory approach under consideration by EPA.

An auction-permit system would differ from a production quota in that the rights to purchase and use CFCs would be acquired through a government-sponsored auction. The proceeds of the auction would be retained by the government. Hence, wealth would be transferred from end users to the government.

Both a production quota and an auction-permit system are considered economically efficient by economists. Many drawbacks of the auction-permit system relative to a production quota stem from uncertainty with respect to how the government would operate such a system.

The principal concerns and problems with an auction-permit system are:

- Prices might be more volatile than under a production quota. In a production quota, producers can adjust market prices to reflect changes in demand and supply of CFCs. Periodic auctions do not have this flexibility; hence, buyers may bid prices up higher than expected under a production quota to assure supply.
- Prices would rise higher than under a production quota if speculators rather than just users or producers were allowed to purchase permits.
- Prices would also be higher if the government sold permits to the highest bidders at the prices offered in the bids, rather than at the price that would be just sufficient to sell the number of permits to be auctioned. This type of auction would also increase the cost of regulation.
- The timing or duration of the permit could cause a variety of problems. If permit duration were too short, prices could rise higher than they might otherwise so users could obtain a secure supply. If duration were too long, incentives for switching to CFC substitutes may be reduced.
- The act of auctioning permits might induce bidding strategies that result in a less efficient allocation than the production quota. This effect would increase the total cost of regulation. Such a situation could occur if some users underestimate the likely permit prices and do not acquire sufficient quantities of CFCs in the auction.
- Small businesses who are less capable of obtaining information on the operation of the auction-permit system may not participate in an auction as effectively as their larger business competitors.
- With up to 10,000 major CFC buyers and as many as 375,000 users, the administration of an auction-permit system could be cumbersome and costly. Management and enforcement of this type of system would require many more EPA staff than under a production-quota regulation.

In summary, relative to a production quota, an auction-permit system could result in increased market uncertainty, higher CFC prices, and higher-cost regulation. Further analysis of an auction-permit system would require more specific information on how such a system would operate.

SUMMARY OF FINDINGS

1. The Montreal Protocol will require substantial reductions in CFC usage since demand for CFCs is growing rapidly. In the absence of restrictions, CFC use would grow by 48 percent from 1986 to 1999 and by 119 percent by 1986 to 2010.
2. The severity of the Protocol's economic impact is highly dependent on the timing and commercial availability of non-ozone-depleting chemical substitutes for CFCs.
3. Even under optimistic assumptions concerning the availability of potential CFC substitutes (i.e., substitutes are commercially available in 1994), the economic impact of the Protocol will be very large:
 - A. CFC prices will rise significantly for user industries and consumers; for example, CFC-11 will rise from \$0.50 in 1986 to almost \$2.00 in 1994.
 - B. In 1999, when the 50 percent reduction is required, a substantial price rise (i.e., price "spike") is expected. The price spike, which is caused by the inability of substitutes, process controls, and conservation measures to satisfy the 50 percent target level, would cause major market disruptions.
 - C. Social cost to the U.S. economy will be \$5.5 billion between 1990 and 2010. Over \$9 billion (present value) of wealth will be transferred away from consumers and user industries between 1990 and 2010.
 - U.S. CFC consumption will be reduced by over 11 billion weighted pounds between 1990 and 2010 or the equivalent of more than 18 years of current U.S. production of these compounds.
4. If substitutes are not commercially available for widespread use by 1994 (when the 20 percent reduction is required), an economically disruptive price "spike" would likewise occur and continue until substitutes are commercially available.
5. CFC reductions induced by the Protocol will not be equally distributed among user industries. Some of the least price-sensitive users (e.g., electronic solvents, mobile air conditioning) can increase their CFC use, relative to 1986 levels, at the expense of more price-sensitive users (e.g., plastic foam users) or users that have available substitutes.
6. Substantial economic costs would be incurred if just the freeze or only the freeze and the 20 percent reduction were implemented.
 - A. The price rise induced by the Protocol reduction scenario, the freeze only, and the freeze with 20 percent reduction would all induce significant price rises; however, only the 50 percent reduction step of the Protocol causes the price spike.
 - B. The social costs and wealth transfers of each step are also substantial. Social costs are about \$2 billion for the freeze alternative and \$3 billion for the freeze with 20 percent reduction alternative.
 - C. The Protocol, the freeze-only, and the freeze-with-20-percent-reduction alternative would all spur development and high usage of CFC substitutes in response to much higher CFC prices. Since the 20 percent reduction will provide sufficient price incentives to use CFC substitutes, the costs associated with the additional 30 percent reduction in the Protocol should be considered as part of the Protocol's ongoing scientific, technological, and economic evaluation process.
7. Proposed legislation unilaterally reducing CFC usage more than required by the Protocol would substantially increase the economic cost of CFC restrictions.
 - Pending legislation calls for a 95 percent reduction by 1993. The cost of this legislation would be extraordinary and extends beyond our ability to reliably forecast CFC prices.
 - As an alternative, we examined a hypothetical unilateral action that required a 30 percent CFC reduction in 1990, increasing to 50 percent in 1995 and 70 percent by 2005. This hypothetical action to further restrict U.S. CFC usage could increase costs from \$5.5 billion in the Protocol to almost \$10 billion, while only reducing worldwide emissions by another 7.3 percent.
8. The impact of the Montreal Protocol on international trade will depend heavily on implementation. However, if U.S. unilateral reductions beyond the Protocol are required, then potentially severe trade impacts could occur, especially if the availability of CFCs to trade-sensitive segments is curtailed.
9. The method of implementing the Protocol in the U.S. could affect costs. Relative to a production quota, an auction-permit system could result in increased market uncertainty, higher CFC prices, and a higher-cost regulation.