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DOCUMENT NO. & TYPE	SUBJECT/TITLE	DATE	RESTRICTION
~~1. memo~~	~~Bledsoe to RR re: Nitrogen Oxides (3p)~~ R 11/19/01 NLSF00-040 #1	~~7/29/88~~	~~P1/F1~~

RESTRICTIONS

P-1 National security classified information [(a)(1) of the PRA].
P-2 Relating to appointment to Federal office [(a)(2) of the PRA].
P-3 Release would violate a Federal statute [(a)(3) of the PRA].
P-4 Release would disclose trade secrets or confidential commercial or financial information [(a)(4) of the PRA].
P-5 Release would disclose confidential advice between the President and his advisors, or between such advisors [(a)(5) of the PRA].
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ACID RAIN

CLEAN COAL TECHNOLOGY PROGRAM

The Reagan Administration has taken a number of extraordinary measures to address the issue of acid rain. The President's FY 1989 budget requests $2.5 billion over five years for a program of innovative emissions control technology demonstration projects consistent with the recommendations of the U.S. and Canadian Special Envoys on Acid Rain. The President's FY 1989 budget also continues to provide strong support for continuation of the 10-year research activities of the National Acid Precipitation Assessment Program (NAPAP) on the causes and effects of acidic deposition.

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FUNDING SUMMARY
(in millions of dollars)

	1987 actual	1988 enacted	1989 proposed	1990 estimated	Change 1988 - 1989 amount	Change 1988 - 1989 percent
Budget Authority						
Clean Coal	---	200	525	575	+325	+ 63
NAPAP	86	83	8~~3~~4	8~~3~~4	+ [illegible] 1	+ [illegible] 1
Total BA	86	283	608	658	+325	+ 63
Outlays						
Clean Coal	7	55	163	324	+108	+196
NAPAP	73	80	83	8~~3~~4	+ 3	+ 4
Total Outlays	80	135	246	407	+111	+200

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PROGRAM HISTORY AND CURRENT STATUS

The United States has pioneered air pollution controls. The nation has spent over $225 billion since the passage of the Clean Air Act in 1970 to limit emissions of pollutants identified as precursors of acid rain. As a result, the nation's air is cleaner today than it has been in the last decade.

Sulfur dioxide emissions have dropped about 23% since their peak in 1973, even as the use of coal has increased dramatically.

From FY 1981 through FY 1985, almost $2.2 billion in total research funds were allocated in the United States to develop technologies for cleaner utilization of coal.

In 1986, President Reagan initiated a $400 million Clean

Coal Technology Program in the Department of Energy to provide funds to demonstrate the feasibility of future commercial applications of innovative control technologies. Nine projects have received awards under the program's first solicitation, with another four projects still under negotiation.

In 1986, both President Reagan and Prime Minister Mulroney fully endorsed the Joint Report issued by their Special Envoys on Acid Rain, which recommended that the United States establish a five-year, $5 billion innovative emissions control technology demonstration program with $2.5 billion in federal funds and an equal or greater contribution from private industry.

In 1987, the National Acid Precipitation Assessment Program (NAPAP) released an "Interim Assessment: The Causes and Effects of Acidic Deposition." The report found that damage to lakes is not as extensive as once believed, that forest damage may be due to factors other than acid rain, and that sulfur dioxide emissions are not likely to increase.

In 1987, the President publicly promised to work with Canada to achieve a bilateral accord on air quality.

ADMINISTRATION PROPOSAL

The President's FY 1989 budget proposes a multi-year advance appropriation of $1,775 million for the Clean Coal Technology Program. Along with $725 million already made available for FY 1988 and FY 1989, the request provides for the full share of federal funding for the five-year $2.5 billion innovative control technology program. The projects will be cost-shared with non-federal sponsors, who will provide at least half the funds needed for project design, construction and operation.

The President's FY 1989 budget also requests a total of $86 million to continue the NAPAP research program. This will provide funding to address the remaining environmental uncertainties identified in the Interim Assessment. The results of this effort will be reflected in NAPAP's final assessment, which will be published in 1990.

The FY 1989 budget proposals are designed to complement the new regulatory initiatives announced by the President in January. The President approved the recommendations of his Task Force on Regulatory Relief, chaired by the Vice President, to eliminate regulatory barriers to the deployment of innovative emissions control technologies and other cost-effective emissions reduction measures. The specific recommendations include:

A Federal Energy Regulatory Commission (FERC) five-year demonstration program of rate incentives for innovative

DRAFT

MAY 2 1988

The Clean Coal Technology Program

A Cornerstone of the U.S. Acid Rain Strategy

April 1988

U.S. Department of Energy

Contents

Preface

On March 18, 1987, President Reagan offered the nation the opportunity to break the linkage between the increased use of coal, the most abundant energy resource in the U.S., and concern over such environmental disorders as acid rain. That day, the President set into motion three significant actions:

- **an expanded program to demonstrate, in partnership with industry, a new generation of coal-burning technologies—clean, highly efficient concepts that can restore the energy strength of America without compromising its environmental goals;**

- **a model program for deploying these new technological options by removing regulatory obstacles;**

- **a mechanism for domestic and international public participation in shaping and overseeing this national initiative.**

These steps added a new dimension to the Administration's acid rain policy. The intense scientific investigation of acid rain phenomena begun in 1981—the most extensive environmental research program ever undertaken—would now be joined by an equally concentrated effort to develop the technological tools to produce more energy from American coal while actually *reducing* the release of pollutants causing acid rain.

Scientific understanding and new technology, both programs proceeding in parallel, both designed to expand options for the American people, rather than restrict them—these are the cornerstones of the President's acid rain strategy.

For seven years the President has advocated knowledge and understanding over haste and political expediency in dealing with the problem of acid rain. He has strongly supported, and has significantly increased funding for, the National Acid Precipitation Assessment Program, a decade-long effort that has channeled much of the nation's finest scientific talent into resolving key questions regarding the origins and effects of acid rain. Many of these questions are now being answered, and we will know much more when the scientific assessment program concludes in 1990. For example, we now have scientific information that suggests that abrupt environmental damage from acid rain is unlikely. This gives the nation the opportunity to develop more effective control technology that can expand our use of American coal, rebuilding our energy security without compromising our environmental goals.

This is the future offered by the Clean Coal Technology Program. It will expand the nation's options for pollution control for both new and existing power plants. It will give the nation a host of power generating technologies that will operate more cleanly and more economically than today's aging hardware. The Clean Coal Technology Program is a $5 billion national commitment to the technology of the future, a commitment to be shared equally by the government and the private sector.

Together, this comprehensive approach to an acid rain policy – encompassing both scientific study and technological development – will ensure that the U.S. acts responsibly in shaping its energy and environmental future. It builds a solid basis for future actions that, if necessary, will be cost-effective and will represent appropriate taxpayer expenditures.

The Reagan Administration has protected the environment in an even, measured way. Controlling pollution need not shut off jobs and economic opportunity for American families. The Clean Coal Technology Program is a vivid example that America has the opportunity to produce more energy *and* resolve its environmental problems without resorting to the costly burden of new pollution control regulations. This report brings together in a single document President Reagan's Clean Coal Technology strategy – its origins, implementation and potential benefits. It is a strategy we believe makes sense for America.

John S. Herrington
Secretary of Energy

The Administration's Response to Acid Rain

The Reagan Administration is taking the acid rain issue seriously and has established a multi-point response effort to address it. The Clean Coal Technology Program is one component of this response.

This pamphlet provides an overview of the Administration's strategy for dealing with acid rain—a strategy that will present the American people with the widest possible range of options and the most scientifically and technologically sound basis on which to make national policy decisions.

Three principal elements make up the Administration's response to acid rain. They are:

- **To understand the science — the National Acid Precipitation Assessement Program.**

The Administration has maintained that the nation must have a much fuller understanding of the effects and physical processes related to acid rain before it could decide whether to commit massive resources for additional emission reductions. Therefore, the federal government will spend $500 million during this decade for the National Acid Precipitation Assessment Program (NAPAP).

- **To improve the technology — the Clean Coal Technology Program.**

The Clean Coal Technology Program will result in public and private expenditures of at least $5 billion to give America's power plants, factories and businesses cleaner and less expensive options for using the nation's most abundant fossil fuel.

- **To deploy the technology — the Presidential Task Force on Regulatory Relief.**

The recommendations of the Task Force can help eliminate regulatory barriers to the deployment of innovative emission control technologies and to other cost effective emission reduction measures.

It is important to view the Clean Coal Technology Program within this three-pronged acid rain strategy. New coal-based energy options, once demonstrated, can provide more economical environmental control options should the findings of NAPAP warrant accelerating pollution control in the early 1990s. Similarly, the recommendations of the Task Force on Regulatory Relief can help ensure that Americans receive full benefit of new technologies by ensuring their widespread commerical deployment.

I. Understanding the Science — The National Acid Precipitation Assessment Program

The National Acid Precipitation Assessment Program (NAPAP) is a concentrated, 10-year scientific investigation. Its purpose is to resolve unanswered questions about the origins and impacts of acid rain.

NAPAP was authorized by Congress under the Acid Precipitation Act of 1980 (Pub. L. 96-294, Title VII). Its research efforts are guided by an interagency task force consisting of representatives of 12 federal agencies, the directors of four DOE national laboratories, and four Presidential appointees. Nearly 1,000 scientists from 40 universities in the U.S., Canada and England, 11 state research agencies, 18 private research institutions, and federal agencies and national laboratories are involved in this assessment program.

NAPAP's final report, scheduled for 1990, will be the product of a intensive research, data collection and analysis effort expected to cost more than $500 million. It will provide scientifically credible information on the role of acid deposition in causing environmental damage, the extent to which the reduction or mitigation of acid deposition would produce environmental benefits and methods for reducing or mitigating acid deposition. NAPAP, as well as many ongoing state and private research programs (e.g., the Electric Power Research Institute), will produce the analytical data necessary to make the acid rain debate more scientifically credible.

In 1987, the interim report of NAPAP was released. It presented the state of the science in each of its major study areas, drawing not only on NAPAP research but taking into account relevant research done elsewhere in the U.S. and abroad.

Among its findings were the following:

- While some damage due to acid deposition has occurred, available observations and current theory suggest there will not be additional, abrupt changes in aquatic systems, crops or forests at present levels of air pollution.

- Research suggests that most watersheds in the Northeast are at a steady state regarding sulfuric compounds; there is no indication that a significant number of lakes will change their acidity rapidly if deposition loading continues at current levels.

- In the Northeast, the formation of sulfuric acid in cloud water appears to be directly limited by the availability of hydrogen peroxide in winter and perhaps in other seasons as well. Thus, changes in emissions of SO_2 will result in less change in sulfuric acid formation than would otherwise be expected.

- There appears to be no consistent, demonstrable effect of acidic deposition on crop yield. On the other hand, the effect of ozone damage on agricultural crops may amount to as much as one billion dollars of losses each year.

- There continues to be considerable uncertainties, for example regarding potential air pollution effects in forests; yet many of the remaining questions should be resolved and reported in the 1990 NAPAP final report.

NAPAP's interim report contained important implications for the nation's acid rain policy:

First, it provided evidence that the nation is not standing at the edge of an "environmental precipice." Time exists to develop and implement a scientifically-sound approach to acid rain control.

Second, it identified other potential contributors to acid rain, namely volatile organic compounds which serve as the source of oxidants including hydrogen peroxide. Since these compounds are emitted from a variety of natural and man-made sources, the report raised questions about the effectiveness of an acid rain program that does not adequately consider other pollutants as well as sulfur dioxide.

Third, by calling attention to the effect of ozone on crop damage and perhaps on forests, the report underscored the importance of examining the full range of environmental concerns and understanding their interrelationship before adopting a potentially costly control strategy.

The interim NAPAP report also cited the potential benefits of new pollution control technologies:

"Implementation of emerging new technologies having the potential to achieve greater control of sulfur dioxide and nitrogen oxide emissions at lower cost could result in a decline in the emissions of these pollutants over the next half century. These technological advances....may offset any potential emission increases from increased coal use."

II. Improving the Technology — The Clean Coal Technology Program

On December 19, 1985, Congress passed Public Law 99-190 which provided nearly $400 million in federal funds to demonstrate the commercial feasibility of an emerging array of advanced coal concepts. Fifteen months later, on March 18, 1987, President Reagan called on Congress to expand the Clean Coal Technology Program by adding nearly $2.5 billion in federal funding for fiscal years 1988 through 1992.

It would be easy to conclude from these two events that America's national consciousness about environmental quality emerged during the 1980s. But such a conclusion would be wrong. The United States' concern about its environmental quality—and that of its international neighbors—dates back several decades.

Background

In many ways, two events in the 1970s have served as the foundation of the nation's commitment to environmental protection and to the Clean Coal Technology Program. One was passage in 1970 of the Clean Air Act, one of the most complex and extensive environmental protection laws passed by any nation. The other was the 1973 Arab oil embargo which set into motion a renewed effort to develop more effective technologies for using domestic coal as a substitute for imported crude oil.

The Clean Air Act

Few federal laws have had such far-reaching effects as the Clean Air Act passed in 1970 to "protect and enhance" the nation's air quality. The Act has permitted the U.S. to enjoy improved air quality while accommodating large increases in the use of coal.

The Clean Air Act directed the Environmental Protection Agency (EPA) to promulgate primary and secondary national ambient air quality standards to *"protect health and welfare,"* and for states and EPA to develop emission control limits for new and existing sources of air pollution.

EPA established health and welfare standards for sulfur dioxide (SO_2), nitrogen oxides (NO_x) and several other pollutants in 1971. Shortly thereafter, states began to develop emission standards to meet the Federal requirements, and in late 1971, EPA established the first *New Source Performance Standards*

(NSPS) restricting SO_2, NO_x and other emissions from new fossil-fired utility and large industrial boilers.

The Clean Air Act was amended in 1977 to apply more stringent emission standards to new or modified facilities. For electric steam generators, the NSPS imposed further requirements of a percentage reduction in SO_2 emissions from new coal-burning facilities. It also added a new program that applied to all major new pollution sources to *"prevent significant deterioration"* of air quality in areas already complying with the ambient air quality standards mandated in 1970.

Because of the Clean Air Act, the quality of the nation's air is better today than it has been in more than a decade. SO_2 emissions have declined dramatically. From 1973 to 1985, national SO_2 emissions dropped from about 30 million tons annually to 23 million tons. Coal-fired power plants nationwide have reduced their SO_2 emissions by 11.4 percent from their peak in 1977, while at the same time steadily *increasing* coal consumption. From 1973 to 1985, the use of coal by U.S. electric utilities increased by 78 percent, from 389 million tons per year to 693 million tons per year.

Reductions in sulfur emissions from coal-fired power plants in the northeast quadrant of the U.S. have been even more dramatic, dropping by 19 percent from 1975 to 1985 even as coal consumption in this region in-

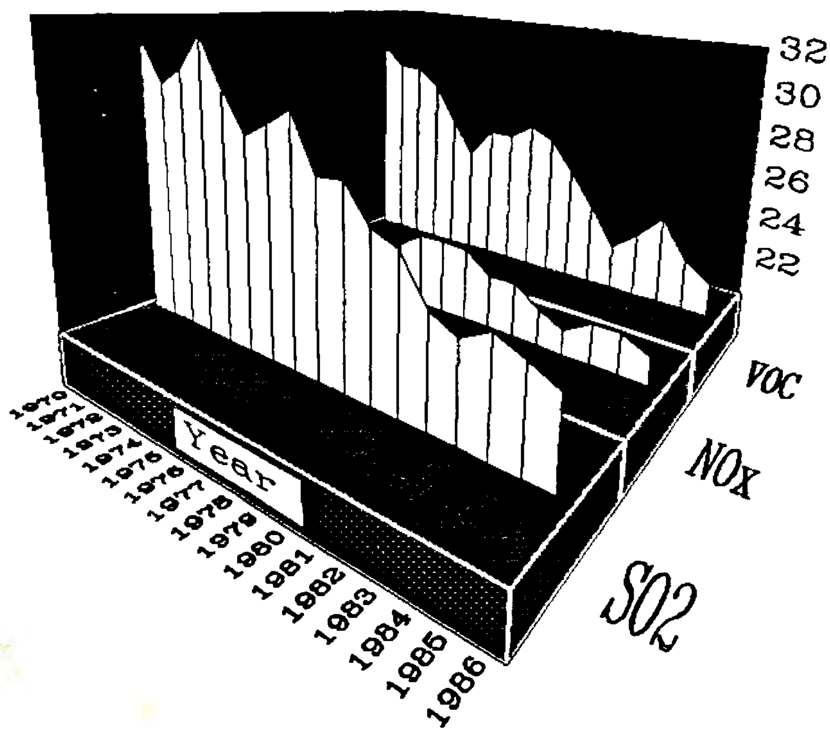

Table 1

Since passage of the Clean Air Act in 1970, total U.S. emissions of the three major pollutants associated with acid rain — sulfur dioxide (SO_2), nitrogen oxides (NO_x), and volatile organic compounds (VOC) — have generally declined. This chart depicts the deline in millions of short tons emitted annually.

creased by 23 percent. As a result of these reductions and emission controls, the National Academy of Sciences reported in 1986 that SO_2 emissions in the Northeast are comparable today to SO_2 emissions in the early 1900s and 1930s, and substantially below levels emitted in the 1920s, 1940s, and 1960s.

The environmental progress set into motion by the Clean Air Act, however, has not been achieved without cost.

Since the Act was passed, U.S. industry has spent well over $225 billion to control air emissions. Much of this expenditure has been made by the electric utility industry to generate power cleanly from coal. Since 1975 (through 1985), the nation's utilities have spent more than $60 billion for SO_2 capture alone. According to the President's Council on Environmental Quality, the overall cost for all air pollution controls in the U.S. now exceeds $29 billion each year. EPA has estimated that the electric utility industry alone spends about $10 billion annually for pollution control.

These expenditures have been made on the three primary options for controlling SO_2 available during this timeframe:

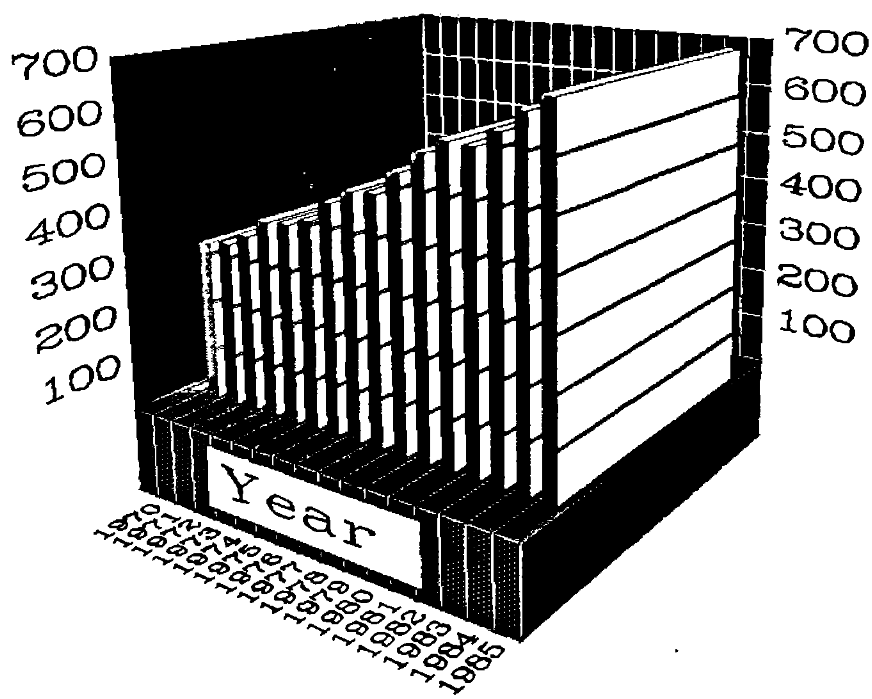

Table 2

While emissions of acid rain-causing pollutants have generally declined since the 1970s, coal consumption by the nation's utilities has increased markedly. This chart shows the steady increase in terms of millions of short tons used annually by U.S. coal-burning power plants. In 1985, coal met one-fourth of America's energy needs, including 57 percent of electric power generation.

- **Flue gas scrubbing** – a chemical process that removes large amounts of SO_2 from coal combustion gases before they are released by a power plant into the atmosphere.

- **Coal cleaning** – a pre-combustion process that removes a portion of the sulfur and other impurities in coal typically through physical separation techniques such as washing.

- **Coal switching** – the substitution of a typically higher priced, lower sulfur coal in a power plant that previously burned high sulfur coal.

Today's technologies can achieve the current pollution control requirements of the Clean Air Act, albeit with some trade-offs. For example, flue gas desulfurization devices – or stack gas "scrubbers" – can remove 90-95 percent of the sulfur pollutants from the combustion gases of coal. But they are very costly and have virtually no effect on nitrogen oxide emissions. Scrubbers also consume some of the power plant's energy, reducing efficiency and raising the cost of electricity. The most common commercial scrubber – the "wet" scrubbing system – also produces large amounts of waste that is difficult to handle and environmentally damaging if not disposed of properly.

Conventional coal cleaning has only a limited ability to remove sulfur impurities, typically only 10-30 percent of the total sulfur in coal, and therefore cannot, by itself, achieve the Clean Air Act standards. Coal switching likewise cannot be used to meet the standards for new or modified plants, and even if applied to existing plants, often results in increased costs (since low-sulfur coal is typically more expensive than higher-sulfur coal) and diminished boiler performance.

The limitations of conventional controls are compounded by the wide diversity of the nation's utility boiler population (in terms of boiler designs, ages, sizes, etc.) as well as the type of coal consumed. These factors can limit the effectiveness in applying today's conventional emission control options.

Concepts expected to emerge from the Clean Coal Technology Program could remove many of the limitations of today's pollution control devices and accelerate the downward emission trends set into motion by the Clean Air Act. Innovative technologies will be less sensitive to fuel type and can retain acceptable economies over a wide range of boiler sizes and types. Many new technologies also offer the advantage of significant NO_x control, and all produce a solid waste that is more easily disposed of, or in some cases, can be marketed as a by-product.

The Early Research Efforts

Like America's commitment to environmental quality, the chronology of federally-supported research to develop new, cleaner coal-based technologies begins well before the decade of the 1980s.

The prototypes of today's emerging clean coal technologies either originated in the aftermath of the 1973 oil embargo or gained greater prominence as a result of the sharp rise in oil prices and increasing concern over the vulnerability of oil imports.

For example, improved combustion processes, such as fluidized bed technology, originated in the 1960s as an adaptation of a concept used initially for breaking down the dense components of crude oil. A small, 500-kilowatt atmospheric pressure unit built in 1965 at Alexandria, Virginia, served as one of the earliest test beds for this innovation. Similarly, new burner designs that incorporate NO_x reducing techniques along with the injection of sulfur-absorbing limestone were originally tested in the late 1960s and early 1970s by the Environmental Protection Agency and its predecessors. Advanced "slag-rejecting" combustors were a spinoff of research in the late 1970s and early 1980s to develop ultra-high temperature coal combustors.

Many of the technologies first developed in the 1970s for other purposes—primarily to displace liquid fuels—also had the benefits of improved environmental performance. When acid rain became recognized as an important bilateral environmental problem in the latter half of the decade, these technologies took on an added degree of importance as pollution control options.

Thus, the technical groundwork laid in the 1960s and 1970s has been critical in gauging the readiness of emerging technologies for scale up and eventual commercialization. Based on what has been learned in hundreds of public and private research laboratories, the nation now has the data to make much better projections of the reliability, costs and environmental performance of a new generation of clean coal technologies. This progress, in fact, provided the technological basis for the 1986 recommendations of the Special Envoys on Acid Rain.

The Special Envoys on Acid Rain

On March 17 and 18, 1985, President Reagan and Canada's Prime Minister Mulroney met in Quebec City in what subsequently has been referred to as the "Shamrock Summit."

From that wide-ranging discussion of bilateral issues came the appointment of two Special Envoys with the charge to report in a year with new recommendations for reducing concerns between the two nations over the transboundary problem of acid rain.

Drew Lewis, former U.S. Secretary of Transportation, and William Davis, former premier of Quebec, were the envoys named by their respective governments.

In January 1986, the Envoys presented their findings and recommendations. Beyond their recognition of the international nature of acid rain, the Envoys made three key recommendations:

1) the initiation of a five-year, $5 billion program in the U.S. for commercial demonstration of innovative clean coal technologies;

2) a commitment to ongoing cooperative activities, including bilateral consultations and information exchange; and

3) a greater emphasis on carrying out research essential to resolving transboundary acid rain issues.

The U.S. technology demonstration program was the centerpiece of the recommendations included in the report. By recommending that the U.S. government share the costs of a $5 billion demonstration program with industry, the Special Envoys believed that the commercial availability of more cost-effective control technologies would be accelerated. According to the report,

"If the menu of control options were expanded, and if the new options were significantly cheaper, yet highly efficient, it would be easier to formulate an acid rain control plan that would have broader public appeal."

Moreover, the Envoys said, the demonstration of innovative control technologies should lead to some near-term emission reductions, thus reducing present acid deposition by some degree in both Canada and the United States.

Because this technology demonstration program would be meant as part of a long-term response to the transboundary acid rain problem, the Envoys recommended that prospective projects be evaluated according to several specific criteria:

- *The federal government should co-fund projects that have the potential for the largest emission reductions, measured as a percentage of SO_2 or NO_x removed.*

- *Among projects with similar potential, government funding should go to those that reduce emissions at the cheapest cost per ton;*

- *More consideration should be given to projects that demonstrate retrofit technologies applicable to the largest number of existing sources, especially existing sources that, because of their size and location, contribute to transboundary air pollution.*

- *Special consideration should be given to technologies that can be applied to facilities currently dependent on the use of high-sulfur coal.*

In March 1986, President Reagan endorsed the Special Envoys' recommendations. Simultaneously, the Department of Energy (DOE) was carrying out a Congressionally-directed competition to select an initial set of Clean Coal demonstration projects.

The President's endorsement of the Envoys' report set into motion a year-long effort within the department to develop an expanded Clean Coal Technology Program that would build on the initial Congressional effort, reflect ongoing state and privately initiated efforts, and be fashioned, as fully as practicable, from the guidelines recommended by the Special Envoys.

By March of 1987, DOE had completed its initial selections of first-round projects under the Congressional program and had finished a detailed inventory of private and state clean coal technology initiatives. It had also undertaken an effort to canvass the private sector for prospective project ideas that would match the criteria outlined by the Special Envoys. With this information in hand, an expanded Clean Coal Technology Program could be initiated.

On March 18, 1987, President Reagan commissioned the expanded effort. He directed three major steps designed to carry out the Special Envoys' proposals:

- The first was to seek the full amount of the government's share of funding recommended by the Joint Envoys – $2.5 billion – for demonstration of innovative control technology over a five year period. Industry would be encouraged to invest an equal or greater amount over this period.

- The second step was to direct the Secretary of Energy to establish an advisory panel. This panel, which would include participation by state governments and by the government of Canada, would advise the Secretary of Energy on funding and selection of innovative control technology projects. Projects would be selected, as fully as practicable, using the criteria recommended by the Joint Envoys.

- The third step was a request to the Vice President to have the Presidential Task Force on Regulatory Relief review federal and state economic and regulatory programs to identify opportunities for addressing environmental concerns under existing laws. The Task Force would examine incentives and disincentives to the deployment of new emission control technologies and other cost-effective, innovative emission reduction measures now inhibited by various federal, state and local regulations.

As President Reagan stated in announcing the March 18, 1987 actions:

> *"I feel these steps will help both countries understand and address this shared environmental problem, so that future specific actions that are taken will be cost-effective, and represent appropriate taxpayer expenditures."*

The Emerging Technology of Clean Coal

The Clean Coal Technology Program can dramatically change our perception of coal's compatibility with the environment, and by doing so, contribute significantly to the long-term energy security of the U.S.

Today the U.S. stands at the threshold of a new technological era in the production of energy from coal. In recent years, dramatic improvements have been made in techniques that remove potential pollutants from coal at various stages between the mine and the power plant. The President's Clean Coal Technology Program will capitalize on these advancements.

The program is *not* a research and development effort. Rather, it is a cost-sharing effort with industry to select improved coal-based technologies that have been proven to work at smaller scales and move them into large-scale demonstration where their market viability and commercial-scale performance can be assessed.

In this manner, the Clean Coal Technology Program serves as a "bridge" between the research laboratory and the marketplace. Unlike prior government-sponsored, commercial-scale technology efforts, the Clean Coal Technology program is not an attempt to manipulate the market through price supports or loan guarantees. Instead, candidate projects are selected for direct financial assistance for a specific period of design, construction and operation. The private sponsor, who must contribute at least half the costs of the demonstration effort, must then assess commercial risks and make appropriate market decisions.

Clean coal technologies generally fall into four primary categories:

- **Pre-combustion** -- cleaning coal of many of its potential pollutants before it reaches the boiler; techniques include physical, chemical and biochemical processes;

- **Combustion** -- changing the way coal is burned so that pollutants are removed during the combustion process; technologies include fluidized bed combustion, limestone injection, natural gas reburning and staged combustion;

- **Post-combustion** -- removing pollutants from flue (or stack) gases after the coal is burned; technologies include improved flue gas scrubbers, in-duct sorbent injection, particulate removal devices and nitrogen oxide controls.

- **Conversion** -- techniques that bypass or eliminate the coal combustion process altogether by converting coal into gas or liquid form which can then be cleaned of its impurities; examples include both surface and underground coal gasification, liquefaction, and coal-oil co-processing.

For the most part, clean coal technologies either achieve higher pollutant removal efficiencies at similar costs to conventional technologies or comparable removal efficiencies at lower costs.

The typical "standard" for conventional SO_2 control is flue gas desulfurization—employed in stack gas "scrubbers"—which is a proven technology for reducing SO_2 emissions by 90-95 percent. Today's scrubbers are relatively expensive to install and may increase the cost of electricity by nine to 11 mills per kilowatt-hour. Low-nitrogen oxide burners are also commercially available to reduce NO_x emissions from new and some existing coal-fired power plants by about 50 percent.

Fluidized bed combustion technology is an example of an emerging clean coal technology that offers an alternative to the conventional scrubber for SO_2 control while also lowering NO_x emissions. *Atmospheric* (pressure) *fluidized bed combustors* (AFBC) can reduce SO_2 emissions by 90-95 percent and NO_x by 70-90 percent during the combustion process itself. Incremental costs for pollution control are in the range of six to eight mills per kilowatt-hour.

Pressurized fluidized bed combustion (PFBC) technology is also entering the demonstration phase, with prospects of higher pollutant removal efficiences. PFBC can be used for new power plants or to replace obsolete boilers in older power plants.

As a replacement, or *repowering*, technology, PFBC can also increase the power output of the original plant, and although capital costs are higher than AFBC, the increased generating capacity of the plant results in lower incremental pollution costs, around four to six mills per kilowatt-hour.

Integrated gasification combined cycle (IGCC) technologies—so-named because they link coal gasifiers to a "combined cycle" arrangment of gas and steam turbines—can potentially achieve 99+ percent reduction of SO_2 emissions and 95 percent reduction of NO_x emissions. Although capital costs for equipment installation are the highest of the clean coal technologies, the IGCC process is also one of the most efficient. In a repowering application, it results in the largest increase in power output, as much as 170 percent of the original plant capacity, and therefore, has incremental costs for pollution control of from zero to two mills per kilowatt-hour depending upon the application.

A variety of other technologies are becoming available as *retrofit* options for existing coal-burning plants or to be used in combinations for new plants. Retrofit options are principally for pollution control and include:

- *Advanced coal cleaning* which goes significantly beyond today's state-of-the-art in removing sulfur and mineral matter as a pre-combustion step. New techniques are being developed that can "deep clean" up to 90 percent of the total sulfur in high sulfur coal and 95 percent of the mineral matter (or ash), yielding a fuel with environmental characteristics similar to oil. Other, less expensive concepts are being developed for moderate-sulfur coal.

- *Advanced flue gas cleanup* devices which enhance the collection efficiency of post-combustion controls. These include electron beam processes, in which irradiation of flue gases is used to promote removal of SO_2 and NO_x, and the use of metal oxides (such as copper oxide) to capture SO_2 and catalyze the reduction of NO_x by ammonia.

- *Nitrogen oxide controls* which expand available options beyond the current range of combustion modification techniques (such as low excess air, overfire air, and staged combustion which are limited to roughly 30 percent reduction for existing facilities). Development work is proceeding on selective catalytic reduction and related post-combustion techniques with a goal of 90+ percent reduction. *Reburning* is another emerging NO_x control technology in which a portion of the boiler's fuel (or a secondary fuel such as natural gas) is injected into the upper regions of the furnace to create a fuel-rich combustion zone that lowers NO_x emissions.

- *Sorbent injection technologies* involving in-furnace or in-duct injection of alkali chemicals to absorb SO_2. These techniques are often combined with low-NO_x burners to minimize nitrogen oxide formation. An example of this class of technologies is the *limestone injection multistage burner* which is anticipated to be able to reduce SO_2 emissions by 50-60 percent and NO_x emissions by 50-70 percent. Another technique, the slagging combustor is anticipated to reduce SO_2 emissions by 50-90 percent and NO_x by 50-70 percent.

If these technologies fulfill their promise, the U.S. will be able to reduce SO_2 and NO_x emissions more effectively and economically than previously possible. This is the goal of the Clean Coal Technology Program.

The Clean Coal Competitions

Created by Congressional action in 1985, the Clean Coal Technology Program was significantly expanded by President Reagan in 1987. As a result of this dual heritage, the program today consists of two major rounds of competition: Round #1 carried out under Congressional guidance, and Round #2 which reflects President Reagan's endorsement of the Special Envoys' Report on Acid Rain. The President's initiative also envisions subsequent competitive rounds to select additional projects between 1990 and 1992.

Clean Coal Technology Round #1

On December 19, 1985, Public Law 99-190, "An Act Making Appropriations for the Department of the Interior and Related Agencies for the Fiscal Year Ending September 30, 1986," was signed into law. This Act, among other things, provided funds for the federal government to share the costs of the construction and operation of facilities that would demonstrate the feasibility of future commercial applications of innovative, emerging coal technology.

The Act made available $397.6 million for this program over three years ($99.4 million in fiscal 1986, $149.1 million in fiscal 1987, and $149.1 million in fiscal 1988).

Of these funds, $387 million was made available as the federal share of project financing.

By Congressional direction, the first round of competition for government cost-sharing was open to all market applications of clean coal technology. Projects using any segment of the U.S. coal resource base were eligible, and the competition encompassed both new and existing applications.

DOE issued its procurement notice on February 17, 1986, and by the April 18, 1986, deadline, proposers had submitted 51 candidate projects. On July 25, 1986, the department named nine of the projects as its initial choices to negotiate cost-sharing agreements.

Seven of the nine prospective project sponsors successfully concluded negotiations with the government, and their clean coal technology projects have begun. These seven are:

- **The Tidd Pressurized Fluidized Bed Combustion Project.** Sponsored by the American Electric Power Service Corp., Columbus, OH, the Tidd project will convert an idle conventional coal-fired power plant (the Tidd Plant) at Brilliant, OH, into a pressurized fluidized bed combustion combined cycle facility. The repowered plant will consume 660 tons of coal per day and generate 70 megawatts of electricity. Total cost of the project is estimated to be $167.5 million with the government's share being $60.2 million. Groundbreaking took place in April 1988. The project's three-year operating phase is to begin in early 1990;

- **The Advanced Cyclone Combustor Project.** Sponsored by the Coal Tech Corp., Merion, PA, the project replaces a standard oil burner with a newly developed 1-ton-per-hour coal combustor that can be attached to the outside of the boiler. Coal Tech completed installation and began operations of the advanced combustor at an industrial facility in Williamsport, PA, in December 1987. Total cost of the 25-month long project is $786,000 of which 50 percent will be financed by the government;

- **The Limestone Injection Multistage Burner Extension Project.** Sponsored by Babcock & Wilcox Corp., Alliance, OH, the demonstration effort extends previously funded tests of the Limestone Injection Multistage Burner

(LIMB) Process and adds a second pollution control technique known as the Coolside Process which removes sulfur from flue gases in the ductwork outside the boiler. The Coolside tests will begin in October 1988 and run for four months, while the extended LIMB testing will begin in February 1989 and last 14 months. The 105-megawatt demonstration project is being conducted at the Ohio Edison Edgewater Plant in Lorain, Ohio. It is expected to cost $19.4 million with DOE providing $7.6 million.

- **The Gas Reburning/Sorbent Injection Project.** This pollution control technique was proposed by Energy and Environmental Research, Irvine, CA. It combines staged combustion of coal and natural gas with injection of sulfur absorbing chemicals to control SO_2 and NO_x inside the furnace. The technique will be tested on three different utility boiler configurations at sites in Illinois (Bartonville, Hennepin, and Springfield) with operations slated to begin in 1990. The project is being supported by the Gas Research Institute and is expected to cost $30 million with DOE funding half.

- **The Prototype Commercial Coal/Oil Coprocessing Project.** Ohio-Ontario Clean Fuels Inc., Warren, OH, proposed this clean coal technology project which will process a mixture of coal and residual petroleum to produce a low-sulfur, low-nitrogen liquid fuel. The prototype commercial plant is to be built in Warren, OH. When completed in 1991, the plant is projected to produce 12,280 barrels per day of clean distillate fuel from 800 tons of coal and 8,675 barrels of residual oil per day. The 86-month project will cost $225.7 million with DOE providing 20 percent of the funds.

- **The Underground Coal Gasification/Clean Fuels Project.** The project to be pursued by Energy International Inc., Pittsburgh, PA, will convert steeply slanted seams of underground coal into a gas at the rate of 500-1,000 tons of coal per day. The gas is currently planned to be used as a chemical feedstock to produce urea and ammonia for fertilizer. The 36-month project will take place near Rawlins, WY. Its $70.1 million total cost will include $11.8 million of DOE funds. Operations are slated for 1989-90.

- **The Appalachian Project.** Proposed by M.W. Kellogg Co., Houston, TX, the Appalachian Project entails the construction of a coal gasification combined cycle power plant in Somerset County, PA. When it begins operating in mid-1991, the plant will consume 550 tons of coal per day to generate 63.5 megwatts of electricity. Project costs are estimated at $243.8 million with $87.5 million provided by DOE.

DOE has also selected four replacement proposals for the two original projects that could not be negotiated. The four include an advanced steelmaking concept proposed by the State of Minnesota, an atmospheric fluidized bed utility project proposed by the Colorado-Ute Electric Association, an advanced slag-rejecting combustor proposed by TRW Energy Products Group, and a coal gasification combined cycle power plant proposed by the team of Consolidation Coal Co. and Foster Wheeler Power Systems Inc. Negotiations of the four replacement projects are expected to be concluded by the end of September 1988.

Cost-Sharing for Round #1 Negotiated Agreements

Project	Industry	DOE	Total
Tidd PFBC Demonstration Project	$107,300,000	$60,200,000	$167,500,000
LIMB Demonstration Project	$11,807,914	$7,597,026	$19,404,940
Advanced Cyclone Combustion Demonstration Project	$392,992	$392,992	$785,984
Gas Reburning/Sorbent Injection Demonstration Project	$15,000,000	$14,998,253	$29,998,253
Underground Coal Gasification Demonstration Project	$58,323,092	$11,792,362	$70,115,454
The Appalachian IGCC Demonstration Project	$156,309,000	$87,528,000	$242,837,000
Prototype Coal/Oil Coprocessing Project	$180,674,805	$45,000,000	$225,674,805
TOTAL	$529,807,803	$227,508,633	$757,316,436

Clean Coal Technology - Round #2

President Reagan's March 18, 1987, announcement initiated a major expansion of the Clean Coal Technology Program. Immediately following the President's announcement, Secretary of Energy John S. Herrington issued the following statement:

"The President's decision to commit $2.5 billion in federal matching funds over the next five years for innovative clean coal technologies places this nation solidly on a course toward improved energy security in a way that will advance our environmental goals. It will strengthen the common bonds of cooperation with our international neighbors. It will also place the U.S. squarely in the forefront of current worldwide efforts to address the serious and difficult problem of acid rain....

"We will fashion a program that, over the next five years, will entail multiple rounds of competition to elicit the best ideas from the creative minds of American industry....Our intention is to tailor project criteria, as fully as practicable, to those presented last year by the U.S. and Canadian Special Envoys on Acid Rain—namely projects that will demonstrate technologies applicable to existing, high-sulfur coal burning facilities that would reduce sulfur dioxide and nitrogen oxide emissions in the most cost-effective manner possible."

To implement the President's initiative, the Department of Energy, in April 1987, asked Congress to appropriate the full federal share of the Special Envoys' recommended five-year $2.5 billion government funding level in the form of FY 1988 and advanced appropriations. The amount included $150 million already applied to the first round of competition since several of the previously-selected projects met the Special Envoys' objectives. Within the $2.5 billion, the Administration originally envisioned using $850 million for a second solicitation to be carried out in fiscal years 1988-89. The remainder of the funds would be used for a sequence of future competitions in FY 1990-92 to select concepts that are in earlier stages of development today.

In December 1987, Congress approved $575 million for the second solicitation and deferred action on the remaining $1.78 billion. In his fiscal 1989 budget submission, President Reagan renewed his call on Congress to appropriate the full funding level of the Special Envoys' recommended program by increasing the advance budget requests for FY 1990-1992.

Following Congressional approval of funding for a second competition, DOE issued its call for proposals on February 22, 1988, with a deadline for submissions of May 23, 1988. Of the $575 million in appropriated funds, the department has made $536 million available as the federal portion of project financing.

Funding Profile	Fiscal Years ($ in millions) 1986	1987	1988	1989	1990	1991	1992
Clean Coal Technology Round #1	$100	$150	$150				
Clean Coal Technology Round #2			$ 50	$525			
Future Clean Coal Competitions					$575	$600	$600
	$100	$150	$200	$525	$575	$600	$600
			← President's Program →				

In adhering to the Special Envoys' recommendations, the Round #2 solicitation is tailored to attract technologies that:

- are capable of being commercialized in the 1990s,
- are more economical than current technologies, and
- are capable of significantly reducing SO_2 and NO_x emissions from existing coal burning facilities, particularly those that contribute to pollution that is transported across state lines or outside U.S. boundaries.

New facilities are permitted in the competition if the technology they demonstrate is also applicable to existing plants.

As in Round #1, selected project sponsors must fund at least 50 percent of the project's costs, the project must be located in the U.S., and it must use domestic coal. DOE will select candidate projects by October 31, 1988.

Public Input

The President's March 18, 1987, initiative recognized the importance of public input into the creation and implementation of the Clean Coal Technology Program. Accordingly, the President directed the Secretary of Energy to establish a panel of public and private sector representatives to advise DOE on the scope and direction of the demonstration program. The panel is called the Innovative Control Technology Advisory Panel..

The Innovative Control Technology Advisory Panel (ICTAP)

ICTAP was established under provision of the Federal Advisory Committee Act (Pub. L. 92-463) in response to the President's March 18, 1987, directive.

It is comprised of senior representatives from the U.S. government, the Canadian government, several U.S. state governments, the private sector and citizen groups. It is chaired by the Under Secretary of Energy.

The panel provides advice on the funding and selection of clean coal technology projects by:

- Reviewing relevant programs to determine whether they might provide appropriate technology options;
- Reviewing, evaluating and advising on proposed criteria to be used to select projects for U.S. federal cost-sharing; and
- Developing relevant information that can improve federal policies for technology development and deployment or that would otherwise be appropriate for consideration by DOE in more effectively implementing future federal innovative control technology solicitations.

In carrying out these tasks, ICTAP reviews and provides information in the areas of air pollution control, process design, and/or combustion engineering for coal-fired facilities. It also has been assigned topics such as a review of state regulatory policies that influence the commercial demonstration and deployment of clean coal technology projects.

The initial meeting of ICTAP was held on September 30, 1987. In its first year, meetings of the full panel will be held every four months with additional subcommittee meetings for analysis and report preparation. The first report of ICTAP contained recommendations for selection criteria for Round #2 of the Clean Coal Technology Program. Subcommittees of the panel have been formed to assess state regulatory policies and their effect on commercial deployment of clean coal technologies and to review the status of existing domestic and international clean coal R&D projects.

Other Public Activities

DOE has adopted a policy of ensuring that the Clean Coal Technology Program is shaped by the advice of the public, both the technical community that will produce the hardware and consumer who will ultimately purchase its product.

Public Meetings. To prepare for the Round #2 of the Clean Coal competition (the first to be conducted under the President's expanded program), DOE held four public meetings across the country. Each meeting included workshops on various aspects of the Clean Coal Technology Program. DOE published Summary Proceedings of the meetings in November 1987.

Public Comments. DOE has also adopted the policy of issuing a draft of each Clean Coal Technology Program Opportunity Notice (the solicitation document) for public comment prior to its official release. A compilation of the comments is subsequently made available for public inspection.

Public Information. DOE's policy is to make as much information on the Clean Coal Technology Program and projects available to the public within the guidelines of federal procurement practices, including:

- Public comments on draft "Program Opportunity Notices";
- Public abstracts of proposals;
- Questions & answers from pre-proposal conference;
- Selection statements explaining rationale for project selection;
- Reports on negotiated projects, providing facts and circumstances of the project and an analysis of maximum potential changes in air, water and solid waste releases that might be produced regionally and nationally based on projected commercial applications of the generic technology;
- Site specific National Environmental Policy Act documents; and
- Progress reports on each project and the program as a whole.

III. Deploying the Technology — The Regulatory Relief Task Force Report

The true value of the President's Clean Coal Technology initiative will ultimately be measured by the extent to which the new technologies are deployed in the marketplace. Technology demonstration, however, is only one part of a successful commercial equation. The successful commercial deployment of clean coal technologies, in the utility industry especially, will also depend upon the regulatory environment under which electricity is generated and sold.

Policies of state utility commissions for the retail sale of electricity, and of the Federal Energy Regulatory Commission (FERC) for wholesale transactions, will be fundamentally important to the commercial success of these technologies. Likewise, existing environmental regulations can play a major role in the demonstration and deployment of first-of-a-kind clean coal technologies.

Today most utilities are delaying decisions to build new capacity. Many utility commissions are reluctant to approve new coal-fired baseload plants because previous, high projections of electricity demand failed to materialize, resulting in excess generating capacity. In addition, the regulated nature of utilities—profits and financing practices are controlled by regulatory authorities—has made most power companies increasingly adverse to taking financial risks. "Prudence reviews"—retrospective determinations by utility commissions of whether a utility's construction and operational costs have been expended properly—are also a major factor in a utility's investment decisionmaking.

Therefore, recognizing that the path to the marketplace will be dictated, in large part, by the regulatory climate under which clean coal concepts must compete, President Reagan in March 1987 commissioned the Presidential Task Force on Regulatory Relief, chaired by the Vice President, to examine regulatory incentives and disincentives to the demonstration and deployment of new emission control technologies and other cost effective emission reduction measures.

On January 23, 1988, the White House announced the President's acceptance of three general recommendations from the Task Force:

1) the Department of Energy, in its Innovative Clean Coal Technology Program, should consider giving preference in the award of federal funds for demonstration projects,

to projects located in states which offer certain regulatory incentives to encourage such technologies;

2) the Federal Energy Regulatory Commission, in setting rates for electric utilities engaged in wholesale electricity transactions, should implement a five-year demonstration program allowing rate incentives to encourage more rapid deployment of innovative technologies; and

3) the Environmental Protection Agency, in managing the nation's air quality, should encourage greater use of "bubbles" (a form of emission trading) to reduce the cost of pollution control, encourage complementary use of "bubbles" and waivers for innovative technologies, expand commercial demonstration permits for innovative technologies.

To implement these recommendations, several actions have been, or will be, taken. They include:

Department of Energy

The Department of Energy will consider giving preference to innovative projects in states that, for ratemaking purposes, treat innovative clean coal technologies the same as pollution control projects.

Action: In its February 22, 1988 second round proposal solicitation document (termed a "Program Opportunity Notice"), DOE included the following under the heading of "Other Considerations" in the section describing the evaluation criteria and process:

"In the project selection process, DOE will consider giving preference to projects located in states for which the ratemaking bodies of those states treat the innovative clean coal technologies the same as pollution control projects or technologies.

"The inclusion of this project selection consideration is intended to encourage states to utilize their authorities to promote the adoption of innovative clean coal technology projects as a means of improving the management of air quality within their areas and across broader geographical areas. Recognizing the benefits of pollution control to society, some states offer utilities more favorable rate treatment for pollution control equipment than for other utility investments. States which offer such incentives to innovative clean coal technologies may also serve to off-set a portion of the additional risk inherent in demonstrations of new technologies."

DOE subsequently modified this provision to notify prospective proposers that the consideration would be applied only in the event two or more proposed projects received equal technical scores in the evaluation process and only if the application of the provision did not bias regional or technological diversity. DOE also recognized that many states could implement such regulatory treatment only after potentially lengthy legislative reviews, and therefore, the department indicated that *consideration* by a state of such regulatory policies would be sufficient for this provision.

Federal Energy Regulatory Commission

Incentives administered by FERC can serve not only to encourage the use of innovative technologies for the generation of electricity within the wholesale market but also as a model for states to use in considering regulatory practices for the retail sale of electricity.

Action: The Department of Energy has the authority under Section 403 of the DOE Organization Act to propose rulemakings that could provide regulatory incentives for innovative clean coal technologies. FERC would be responsible for completing the rulemaking initiated by DOE. DOE will seek FERC rulemakings in the following areas:

Incentive Rate of Return - The return a utility can receive on an investment in conventional or new technologies is a set amount determined by FERC (for wholesale power generation). By allowing an *incentive* rate of return (a return on investment somewhat greater than normally allowed for conventional technology), FERC would recognize the inherent risk and potential benefits of new technologies. In the rulemaking to be proposed by DOE, incentive rates of return would be sought for innovative emission control technologies (coal and non-coal). FERC already provides similar incentives in certain circumstances.

FERC would be asked to grant a special two-part rate of return for innovative emission control technologies that (a) recognizes the risk of building first generation technologies and (b) prospectively rewards the exceptional performance expected of innovative technologies and, in lieu of retrospective prudence reviews, prospectively penalizes failure to achieve expected performance. The first part of the rate would simply reward risk, while the second part would offer a combination of "carrots and sticks." Performance benchmarks would be set for each innovative technology with respect to air pollution control, capital costs, and availability. Increments above or below the benchmarks would have associated with them additional rewards or penalties, respectively. Incentive rates of return would be available to innovative technologies using fuels other than coal.

DOE's proposed rulemaking would specify the incentive rate of return made available to innovative technologies by FERC and the procedures by which FERC and interested parties would be able to review and determine the applicability of such incentives to such projects.

Allowance for Construction Work in Progress ("Full CWIP") -Permitting a utility to include in its electricity rates the cost of construction projects being built improves the utility's cash flow, reduces risk on invested capital and prevents sudden rises in electricity rates ("rate shock"). Full CWIP is currently provided by FERC for pollution control costs. DOE's proposed rulemaking would expand the applicability of this incentive to innovative technologies that offer improved environmental performance.

DOE would propose a rulemaking under which FERC would include all capital costs for innovative emission control technologies (using either coal or other fuels) in the rate base as incurred (full CWIP), the same as FERC now treats pollution control equipment.

Accelerated Amortization - Being able to depreciate an investment in a shorter timeframe gives utilities more flexibilty in their capital investment decisions, particularly when there is rapid technological change. DOE's proposed rulemaking would allow a 10- to 20-year amortization period to recover the capital costs of innovative technologies (using coal or other fuels) which result in low pollution emission rates. Currently, the typical amortization period is 30 years.

An objective of the proposed FERC incentive program is ultimately to lower costs to ratepayers while fostering cleaner and more efficient technologies. With this objective in mind, the Presidential Task Force recommended that incentives be applied initially with three limitations: (1) utilities should be required to show that the new class of technology, in its ultimate configuration, is reasonably likely to be at least 15 percent less expensive than existing technologies (this cost test is not meant to use the economics of the specific unit being considered for incentives); (2) the program should cover no more than four units in each class of technology; and (3) the incentive program would be established on a temporary basis with a commitment to reexamine the program's merits after five years for the purpose of possibly extending its life.

Environmental Protection Agency

Actions: *"New-New" Bubbles.* EPA will encourage greater use of the recently promulgated policy of allowing emissions trading between two sources subject to certain New Source Performance Standards (NSPS). This action offers possibilities for reducing total compliance costs by applying lower cost technology to one source and making up any shortfall in meeting NSPS by more stringent controls of the other source.

Complementary Use of "New-New" Bubbles and Innovative Technology Waivers. EPA will administer innovative technology waivers and NSPS bubbles to complement each other. This will encourage use of these emission trading options by utilities that are uncertain whether an innovative clean coal technology will actually achieve NSPS levels before a waiver expires. If it appears that after a waiver expires it might be difficult for the source to meet NSPS with the innovative technology, an NSPS "bubble" could be issued relaxing the NSPS for that source in exchange for tightening the NSPS for the other source.

Commercial Demonstration Permits. As new clean coal technologies are developed, EPA would expand the availability and applicability of present commercial demonstration permits that allow innovative control technologies for utility boilers and other source categories to meet less stringent standards than required for other new sources. DOE would recommend to EPA the technologies to be considered and the size of a typical unit eligible for the permit. The permit's emission limits would be set by standard EPA rulemaking procedures in consultation with DOE and would be less stringent than the general NSPS requirement. This permit would be in force for the duration of the unit's operation.

Clean Coal Technology — A Strategy for a Clean, Energy Secure Future

The United States' immense coal reserves could help power this nation well into the 23rd Century. More than one-fourth of the world's total supply of recoverable coal lies in massive deposits beneath 38 of the 50 states.

By using more coal since the early 1970s, the U.S. has made itself less dependent on oil without sacrificing economic growth. Today, coal furnishes nearly one-fourth of all the primary energy used in the U.S.

The U.S. utility sector, in particular, has stepped up its use of coal by more than 70 percent in the past decade. Today, U.S. coal-burning plants consume nearly 700 million tons of coal each year to generate 57 percent of the nation's electricity. Coal is the backbone of the nation's utility power industry.

Yet, despite the abundance of coal and the tightly-knit relationship between economic growth and demand for electricity, many utilities will confront fundamental choices within the next few years.

Demand for electricity is projected to increase, surpassing the nation's existing, committed generation capacity within the next 10 years and continuing steadily upward. As much as 100,000 of additional new capacity beyond what is currently planned—the equivalent of 200 power plants of 500 megawatts each—could be required within the next 12 years to ensure that economic growth is not hindered by power shortages or unstable energy supplies.

Concurrently, the U.S. inventory of fossil fuel power plants is aging rapidly. By 1990, one-fourth of the U.S. fossil fuel power plant capacity will be 30 years old or older, and that percentage will increase sharply after 1990.

The convergence of these two trends—aging power plants and growing demand for electricity—is occurring at the same time environmental requirements have placed increasing demands on new power facilities.

Today's technology will have difficulty responding to the rapidly changing requirements being placed on power plants. New power options must be capable of meeting stringent siting and environmental demands without sacrificing productivity. The importance of new, more economical environmental control technologies is underscored by the fact that approximately 40 percent of the capital investment and 30 percent of the total cost of power for new conventional coal-fired power plants are related to environmental controls.

Future power plants must not only be clean and economical but also capable of being rapidly constructed, preferably in modular fashion, with a high degree of performance efficiency over a range of unit sizes. Future environmental control options must be less sensitive to fuel type and retain acceptable economies over a wide range of boiler sizes and types.

Present-day commercial technology cannot meet these objectives. In fact, conventional commercial technology—both for power production and pollution control—is nearing the end of its development potential. The next 5 to 10 years, therefore, will be critical to the development of new energy options that meet America's energy, economic and environmental goals.

President Reagan's Clean Coal Technology initiative sets into motion a national commitment to meet the demands of a rapidly changing power industry. It also opens new opportunities for coal to penetrate industrial and commercial markets previously dominated by petroleum-based premium fuels.

If the President's Clean Coal Technology Program is successful, a new suite of advanced coal technologies will be brought to the threshold of commercial use.

The successful outcome of the program will give the nation's energy industry new coal-based options potentially including:

- more effective pre-combustion coal cleaning processes,
- new combustion techniques that remove sulfur impurities and minimize nitrogen pollutants inside the coal furnace,
- improved scrubber systems, capable of removing sulfur and/or nitrogen pollutants without producing the wet sludge of today's technology,
- advanced energy concepts that produce clean-burning fuels such as coal-based liquid products or combustible gases from unmineable coal seams and
- highly-efficient, environmentally clean, coal-based combined cycle power plants that can be easily and quickly fabricated in a wide range of modular sizes.

A common thread running through each of these advanced coal concepts is the ability to use domestic coal more efficiently while reducing acid rain-causing pollutants. Several of these concepts have the added advantage of boosting an existing power plant's electrical output, possibly forestalling expensive investments in new power generating capacity. Many of the technologies will be suitable for both existing and new power facilities.

Together, they can bring the nation to the threshold of technological opportunities that could significantly reduce, or perhaps eliminate, the threat of acid rain damage in the future.

Virtually all of the innovative Clean Coal Technology concepts have sufficient environmental or economic advantages to find their way into the marketplace if their commercial feasibility can be demonstrated and if the regulatory environment in which they will compete is fair. Many of the technologies could also be in demand overseas, and by linking their availability with the sale of U.S. coal, the domestic coal industry's standing in international trade could be greatly enhanced.

President Reagan's Clean Coal Technology initiative was forged from a commitment to Canadian Prime Minister Mulroney. But in addition to addressing the pressing domestic and international concerns over acid rain, the President's initiative will also return significant benefits to this nation not only in terms of cleaner air but by ensuring that the U.S. enters the 21st Century with a broad array of highly efficient, more economical energy options based on our most abundant and secure fossil fuel – coal.

Glossary of Clean Coal Technology Terms

Atmospheric Fluidized Bed Combustion -- a fluidized bed combustion system that operates at or near atmospheric pressure; see *Fluidized Bed Combustion*.

Coal Cleaning -- a category of technologies that separate ash and sulfur from coal prior to combustion. Physical coal cleaning relies on physical differences between coal and the discrete particles of pyritic sulfur trapped within it, while chemical and microbial cleaning involve the introduction of chemical or biological agents to react with both pyritic and organic (chemically-bound) sulfur in coal.

Combined Cycle -- an electric power generating configuration that employs both combustion turbines and steam turbines. This dual turbine configuration increases power plant efficiency.

Co-Processing -- a technique in which clean liquid fuels are produced by processing a mixture of coal and residual petroleum through a refining-like process.

Flue Gas Scrubber -- a pollution control technology that involves the removal of SO_2 from the combustion flue gases by chemical reaction with alkaline sorbents.

Fluidized Bed Combustion -- an advanced technique for burning coal in which a bed of solid particles is suspended in a stream of upward-flowing air. The distinctive aspect of a fluidized bed combustor is that when coal and a sorbent--such as limestone--are injected into the bed, sulfur dioxide is absorbed by the sorbent inside the furnace to produce a dry and benign solid. No additional sulfur capture is required. Fluidized bed combustors can remove 90% to 95% of the sulfur pollutants in coal. The formation of nitrogen oxide is minimized because fluidized bed combustors operate at relatively low combustion temperatures compared to conventional combustors.

Gas Reburning -- a pollution control technique that uses a small amount of natural gas injected above the normal heat release zone of the furnace to form an oxygen deficient zone. The NOx produced in the primary heat release zone is "reburned" in the oxygen deficient zone and partially converted to molecular nitrogen.

Gasification Combined Cycle -- a power generating technology in which coal is first converted to a combustible gas which is then cleaned and burned in a gas turbine to generate one source of electricity. Hot gases from the gas turbine are then directed to a conventional steam turbine-generator to produce a second source of electricity. Gasification combined cycle systems can remove more than 99% of the sulfur in coal.

Limestone Injection Multistage Burner -- a pollution control technique in which sulfur-absorbing limestone is injected into the reducing zone of a conventional pulverized coal burner. The technology also achieves low-NO_x emissions by burning coal in multiple stages. LIMB technology can remove 55% to 75% of the sulfur emissions released from coal combustion.

Pressurized Fluidized Bed Combustion -- a variation of the fluidized bed combustion technology in which the combustor is pressurized to between six and 16 times atmospheric pressure; see *Fluidized Bed Combustion.*

Slagging Combustion -- an advanced combustion device in which coal is injected radially from a central injector while combustion air is fed tangentially around the periphery. The interaction of fuel and air provides rapid and efficient combustion of coal while the cyclone action removes objectionable sulfur and particulate matter from the coal-derived fuel before it is injected into retrofitted boilers or heaters. Slagging combustors can reduce SO_2 emissions by 50% to 90%.

Sorbent Injection -- a pollution control technique that typically involves spraying calcium based sorbents into the ductwork leading from the coal boiler. Sulfur dioxide is converted to dry calcium sulfate particles and removed in downstream particulate collection equipment. Sorbent injection can reduce SO_2 emissions by 55% to 75%.

W.N.

THE WHITE HOUSE

Office of the Press Secretary

For Immediate Release January 23, 1988

STATEMENT BY MARLIN FITZWATER
ASSISTANT TO THE PRESIDENT FOR PRESS RELATIONS

The President has instructed his advisors to continue discussions with their Canadian counterparts toward completion of a bilateral air quality accord. He reiterated his commitment to implement the recommendations of the 1986 Special Envoys' report, committing fully to proceeding with the Innovative Control Technologies Program.

The Innovative Control Technologies Program is a five-year, joint Federal and industry $5 billion effort to encourage the development and deployment of innovative technologies designed to reduce power plant emissions that are thought to cause acid rain. The President will request the full amount of the Federal government's share in this program.

Additionally, the President has accepted the recommendations of his Task Force on Regulatory Relief, chaired by the Vice President. These recommendations are designed to eliminate regulatory barriers to the deployment of innovative emissions control technologies and to other cost effective emissions reductions measures. The specific recommendations of the Task Force are:

o Preferential treatment, under the Innovative Control Technologies Program, for projects in States that, for rate making purposes, treat innovative technologies the same as pollution control projects. This treatment would recognize the additional risk inherent in demonstration of innovative technologies.

o A Federal Energy Regulatory Commission (FERC) five-year demonstration program allowing rate incentives for innovative technologies. This would also recognize the risk inherent in demonstration of innovative technologies. FERC already provides this type of incentive in certain circumstances.

o The Environmental Protection Agency (1) encourages the states to consider achieving greater ozone reduction through inter-pollutant trading and other measures that substitute less expensive nitrogen oxide emissions reductions for more expensive volatile organic compound emissions reductions; (2) encourage the use of "bubbles" between recently built emissions sources; (3) expand commercial demonstration permits for innovative control technologies; and (4) encourage complementary use of emissions "bubbles" and waivers for innovative technology applications.

# # #

THE WHITE HOUSE

WASHINGTON

June 29, 1988

MEMORANDUM FOR THE WORKING GROUP ON ENERGY, NATURAL RESOURCES AND ENVIRONMENT

FROM: RALPH C. BLEDSOE Ralph Bledsoe
Chairman

SUBJECT: July 5 Meeting

The Working Group on Energy, Natural Resources and Environment is scheduled to meet on Tuesday, July 5, 1988 at 2:00 p.m. in Room 208 of the Old Executive Office Building. We will discuss the enclosed paper on the NOx Protocol.

Please inform Mary Beth Riordan (456-6640) of your attendance by Friday, July 1.

Enclosure

DRAFT

June 29, 1988

MEMORANDUM FOR THE DOMESTIC POLICY COUNCIL

FROM: THE WORKING GROUP ON ENERGY, NATURAL RESOURCES AND ENVIRONMENT

SUBJECT: Nitrogen Oxides (NOx) Protocol

ISSUE: Should the U.S. sign the NOx protocol negotiated among parties to the Economic Commission for Europe's Long Range Transboundary Air Pollution (LRTAP) Convention?

BACKGROUND: A NOx protocol has been negotiated among parties the LRTAP Convention. This protocol is the second emissions control agreement to be negotiated under LRTAP. A sulfur dioxide (SO_2) protocol was concluded in 1985 and signed by 21 countries, but not by the U.S. The U.S. did not sign because the SO_2 protocol did not recognize prior U.S. actions, and because the U.S. did not agree that additional measures are needed to control SO_2 emissions.

The development of a NOx protocol began in 1985 and was concluded in May 1988. The original U.S. position, as laid out in the Circular 175 authorizing U.S. representatives to negotiate a protocol, incorporated four elements:

- o Technology-based standards for stationary and mobile sources;
- o Research on a longer term strategy that might establish an environmental effects (critical loads) approach for setting control levels;
- o Credit for prior unilateral actions by the U.S. if a percentage reduction of (or freeze on) emissions was part of the basic obligations of the protocol; and
- o Consistency with current U.S. domestic statutory and regulatory provisions.

The final protocol achieves these objectives, although the credit is contained in bracketed language (a compromise between the U.S. and Canada) that will only remain in the final text if the U.S. informs the other LRTAP parties by July 1, 1988 that it accepts the language. Implicit in U.S. acceptance of this language would be a decision to sign the protocol at an October 1988 meeting in Sophia, Bulgaria. The State Department considers that a one-month delay past July 1, would be acceptable.

The NOx protocol places several obligations on parties who sign the agreement:

- o Implement three steps to control NOx emissions and its effects:

  - A freeze on NOx emissions at 1987 levels [or any previous year] by December 31, 1995. [Any party that chooses a previous year at signing will ensure that its national average annual transboundary fluxes of NOx from January 1, 1987 to January 1, 1996 do not exceed its transboundary fluxes for the calender year 1987.] The U.S. has consistently maintained that transboundary fluxes cannot be calculated accurately. To be consistent with this position, the U.S. should call for a language change from "transboundary fluxes" to "transboundary fluxes or national emissions." The protocol reflects the U.S. position on this issue in all other sections.

  - Application of best available technologies that are economically feasible to new stationary and mobile sources, and introducing pollution control measures for existing sources, taking into account such factors as plant age and rate of utilization and the need to avoid undue operational disruption. These requirements are fully consistent with the U.S. Clean Air Act.

  - A commitment by the parties to endeavor to develop ecological/health-based ambient air and/or deposition standards for implementation in 1996.

- o Make unleaded gas available "as a minimum along main transit routes" by 1990. This would be a major new step for most European countries, the U.S. already meets this obligation.

- o Facilitate, consistent with national laws, regulations and practices, the exchange among other parties of technologies to reduce NOx emissions.

- o Annually report levels of NOx emissions or transboundary fluxes, as well as current and proposed national NOx control programs.

DISCUSSION: NOx emissions adversely affect health and welfare, are a precursor to both acid rain and ozone, and contribute to excess nutrient nitrogen in watersheds and coastal water systems. The U.S. currently controls NOx emissions on the basis of direct health and welfare hazards, although existing law allows NOx to be controlled as a precursor to ozone and other secondary pollutants.

The attached chart illustrates the NOx emissions trend over recent years and projects a trend through 2010. The chart represents a conservative (high) estimate of future NOx emissions. The projections, however, are subject to change due to assumptions about the future (i.e., economic growth and vehicle usage) that could vary substantially.

Assuming the U.S. signs the protocol, the bracketed language would 1) obligate the U.S. to limit average annual NOx emmissions between 1987 and 1996 to or below the 1987 level; and 2) beginning in 1996, permit the U.S. to limit average annual emissions to a peak year level (1978).

Concerning the period from 1987 to 1995, as the attached chart indicates, the U.S. should be able to comply without additional controls. However, given that the projections through 1995 are close to the 1987 level, there is only a small margin for error. Concerning the period after 1995, if projections are accurate, the U.S. would begin to exceed 1978 levels after the year 2000. In such a case, if the parties fail to incorporate a health/ecological standard into the protocol by 1996, the U.S. would have to consider additional NOx control regulations. If the parties do succeed in incorporating such a standard into the protocol, depending on the standard, the U.S. may or may not need additional regulations. If the projections overestimate future NOx emissions, then compliance with the protocol would not require added controls.

If the NOx protocol creates a need for increased U.S. regulatory stringency, an emissions reduction of ten percent (two million tons annually) could be achieved at an average annual cost of $75-100 per ton reduced. This would cost $150-200 million annually. Much of this reduction may occur for domestic reasons, even if the U.S. does not sign the protocol.

The protocol requires Canada and European nations to adopt regulatory features currently in U.S. law. These features include the use of economically feasible, best available controls on new stationary and mobile sources. The protocol also serves to limit Canadian flexibility in relaxing mobile and stationary source NOx emissions controls.

In the absence of specific implementing legislation, there appears to be a very low risk that a U.S. court would entertain a direct challenge to EPA implemention of the protocol. There is a possibility that a court might consider the protocol indirectly as a factor in its review of NOx-related decision making under the Clean Air Act. If EPA can show that it has taken the protocol into consideration when making future NOx-related decisions, this possibility would be minimized.

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<u>OPTIONS</u>: The following optoins appear to represent the range of actions available to the U.S.

<u>Option #1</u>. <u>Sign the protocol, and ratify as an executive agreement</u>.

<u>Pros</u>: o Substantially attains U.S. negotiating objectives.

o No additional control actions are anticipated until the mid-1990's, and, even then, the need for additional controls may not materialize.

o Adds to U.S. credibility as a world leader in environmental action, and is consistent with U.S. participation in LRTAP.

o Will be accepted in Canada as at least a step towards reducing acid rain concerns.

o Concluding the protocol as an executive agreement will enable this Administration to take full credit for the protocol.

<u>Cons</u>: o Risk that the U.S. will need to take additional NOx emission control actions on a basis other than domestic interpretation of the science, technology, and economic implications of NOx emissions and effects.

o Some Members of Congress may object to a decision not to submit the protocol to the Senate for advice and consent.

<u>Option #2</u>. <u>Sign the protocol, and ratify as a treaty</u>.

<u>Pros</u>: o Same as pros of Option #1, except this Administration will not receive full credit for the protocol.

o A treaty should appeal to those in the Congress who would like an opportunity to advise and consent.

<u>Cons</u>: o Same as cons of Option #1, except there would be a risk of the Senate not agreeing to ratification, or adding unacceptable requirements to the protocol.

<u>Option #3</u>. <u>Sign the protocol with a qualification to continue an indefinite freeze beyond 2000 should an ecological/ health-based standard acceptable to the U.S. not be incorporated into the protocol</u>.

<u>Pros</u>: o Reduces the risk of having to place additional NOx emissions controls on U.S. sources solely due to the protocol's obligations.

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- o Places greater pressure on other parties to incorporate ecological/health-based standards acceptable to the U.S. into the protocol by 1996.

Cons: o Other parties, including Canada, could reject the qualification as contrary to the fundamental intent of the protocol, as well as contrary to the U.S.-Canadian agreement concerning the compromise language.

Option #4. Do not sign the protocol, and remain a party to LRTAP.

Pros: o Eliminates risk that the U.S. would have to place additional NOx emissions controls on sources based on other than domestic interpretation of the science, technology, and economic implications.

- o Allows the U.S. to continue to participate in discussions and exercise leadership on environmental issues in this forum.

Cons: o Risk that not signing the protocol will result in reduced U.S. credibility as a world leader in effectively addressing international environmental questions.

- o Loss of the opportunity, if the U.S. decides to sign the protocol later, to obtain a NOx emissions freeze at other than 1987 levels.

- o Continued differences with other parties of LRTAP over credit for prior actions are likely.

Option #5. Do not sign the protocol, and withdraw from LRTAP.

Pros: o Eliminates the risk that the U.S. would have to place additional NOx emissions controls on sources based on other than domestic interpretation of the science, technology, and economic implications.

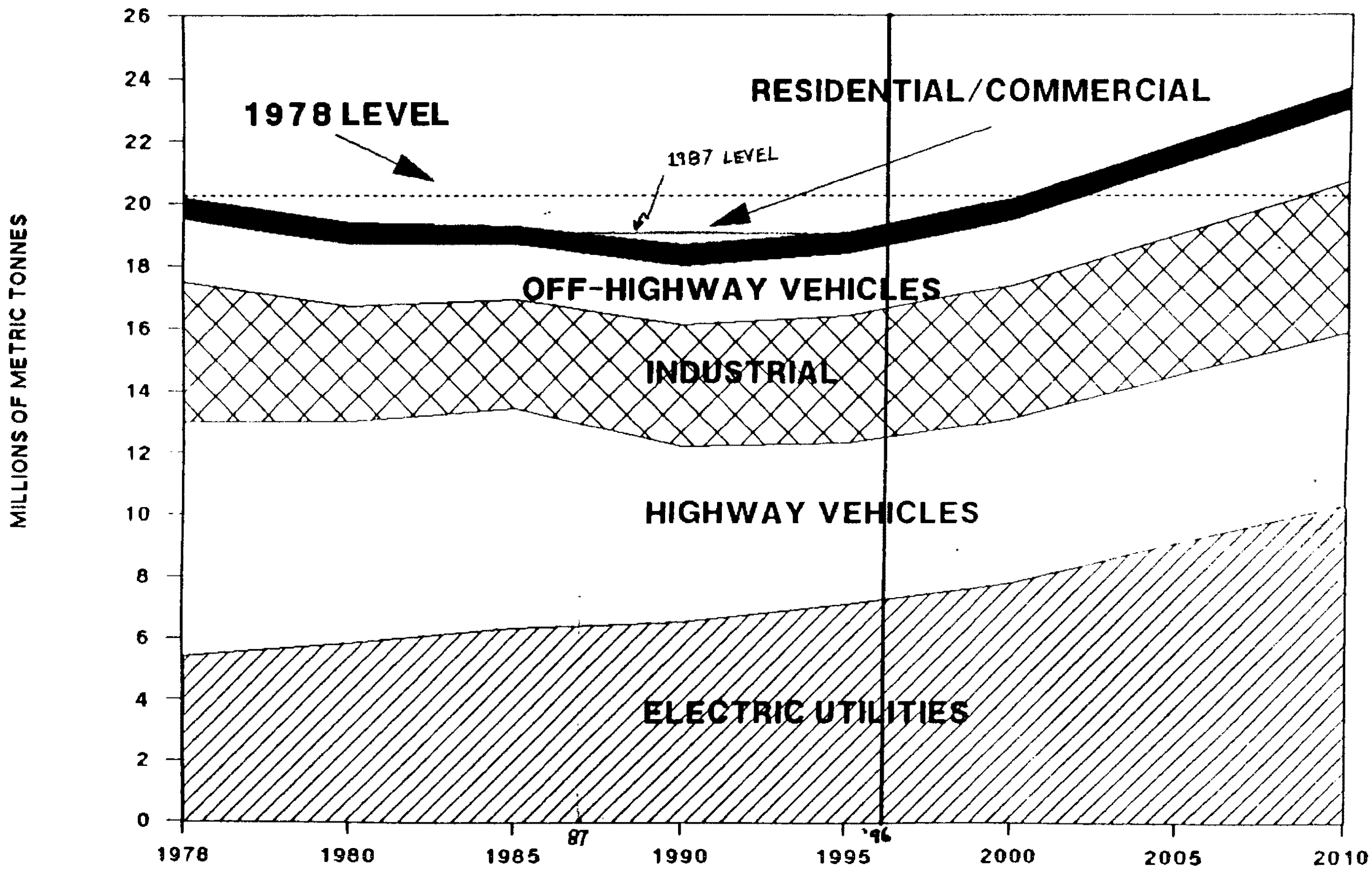
- o Would end discussions with the Europeans and Canadians over credit for prior environmental actions in this forum.

Cons: o Risk of political fallout from charges of the U.S. withdrawing from a leadership role on environmental issues in this important international forum.

Attachment

FIGURE 1

TOTAL NOX EMISSIONS



CONFIDENTIAL ATTACHMENT

THE WHITE HOUSE
WASHINGTON

CABINET AFFAIRS STAFFING MEMORANDUM

Date: 7/29/88 **Number:** 490,769 **Due By:** ------

Subject: Domestic Policy Council Meeting -- Monday, August 1, 1988 -- 2:00 p.m. -- Cabinet Room

	Action	FYI
ALL CABINET MEMBERS	☐	☐
Vice President	☑	☐
State	☑	☐
Treasury	☑	☐
Defense	☑	☐
Justice	☑	☐
Interior	☑	☐
Agriculture	☑	☐
Commerce	☑	☐
Labor	☐	☐
HHS	☑	☐
HUD	☑	☐
Transportation	☐	☐
Energy	☑	☐
Education	☑	☐
Chief of Staff	☑	☐
OMB	☑	☐
UN	☐	☐
USTR	☐	☐
CEA	☑	☐
CIA	☐	☐
EPA	☑	☐
GSA	☐	☐
NASA	☐	☐
OPM	☐	☐
SBA	☐	☐
VA	☐	☐

	Action	FYI
CEQ	☑	☐
OSTP	☑	☐
____	☐	☐
____	☐	☐
____	☐	☐
____	☐	☐
Powell	☑	☐
Cribb	☑	☐
Bauer	☑	☐
Dawson *(For WH Staffing)*	☑	☐
____	☐	☐
____	☐	☐
____	☐	☐
____	☐	☐
____	☐	☐
Executive Secretary for:		
DPC	☑	☐
EPC	☐	☑
____	☐	☐
____	☐	☐
____	☐	☐
____	☐	☐
____	☐	☐

REMARKS:

The Domestic Policy Council will meet on Monday, August 1, 1988 at 2:00 p.m. in the Cabinet Room. The agenda and background materials are attached for your review.

RETURN TO:

☑ Nancy J. Risque
Cabinet Secretary
456-2823
(Ground Floor, West Wing)

☐ Associate Director
Office of Cabinet Affairs
456-2800
(Room 235, OEOB)

THE WHITE HOUSE

WASHINGTON

July 29, 1988

MEMORANDUM FOR THE DOMESTIC POLICY COUNCIL

FROM: RALPH C. BLEDSOE Ralph Bledsoe
Executive Secretary

SUBJECT: Domestic Policy Council Meeting on August 1, 1988

Enclosed are an agenda and materials for the Domestic Policy Council meeting with the President scheduled for Monday, August 1, 1988 at 2:00 p.m. in the Cabinet Room. The issue to be discussed is the NOx protocol. The enclosed paper is based on the July 19 Council discussion of this issue.

Enclosures

THE WHITE HOUSE

WASHINGTON

DOMESTIC POLICY COUNCIL

Monday, August 1, 1988

2:00 p.m.

Cabinet Room

AGENDA

1. NOx Protocol -- Lee M. Thomas
Administrator
Environmental Protection Agency

John C. Whitehead
Deputy Secretary
Department of State

CONFIDENTIAL

THE WHITE HOUSE

WASHINGTON

July 29, 1988

MEMORANDUM FOR THE PRESIDENT

FROM: THE DOMESTIC POLICY COUNCIL

SUBJECT: Nitrogen Oxides (NOx) Protocol

ISSUE: Whether the United States should sign the NOx protocol negotiated by parties to the Economic Commission for Europe's (ECE) Convention on Long Range Transboundary Air Pollution (LRTAP).

BACKGROUND: The United States participates in an increasing number of negotiations and agreements to promote improved air quality, often involving our European allies, Warsaw Pact countries, Canada, Mexico, China, the Soviet Union, and others. The vast majority of the agreements focus on understanding the science related to air pollution. Discussions cover such issues as acid rain, ozone, and global climate change, and involve emissions of sulfur dioxide (SO_2), NOx, volatile organic compounds, and carbon dioxide. The United States has signed only one agreement that explicitly sets targets and timetables -- the Montreal Protocol on limiting the production and consumption of chlorofluorocarbons and halons that deplete the stratospheric ozone layer.

The LRTAP, which set up a framework for general cooperation but did not establish specific targets or timetables for controlling emissions that cross national boundaries, was signed in 1981 by the United States, Canada, and European countries. A protocol addressing SO_2 was negotiated by LRTAP parties in 1985, but was not signed by the United States and twelve other ECE nations. The United States helped negotiate the protocol, but abstained because we considered the thirty percent reduction in emissions to be unjustified based upon our knowledge of the science and because the United States was not given credit for its existing expensive domestic control programs.

The June 1988 Toronto economic summit declaration stated that the NOx protocol should be "energetically pursued." The NOx protocol, also negotiated by LRTAP parties, is scheduled to be signed at a late-October meeting in Sofia, Bulgaria. During negotiations, a compromise was reached that would allow the United States to receive a 25 percent credit for past NOx emissions controls. This credit is to be included in the final protocol only if the United States and Canadian delegations inform the LRTAP Secretariat of their governments' agreement to the protocol by early August. Other provisions of the protocol include:

- o Applying economically feasible, technology-based standards for stationary and mobile NOx emissions sources (which the United States already does);

- o A commitment to endeavor to develop a follow-on protocol for NOx to set environmental effects control standards (instead of emissions control standards) for implementation in 1996; and,

- o A requirement for parties to submit annual reports, to exchange information on control technologies, and to increase the availability of unleaded gasoline.

NOx is an air pollutant that adversely affects the health of individuals and quality of the environment, and is subject to control under U.S. law. Only southern California currently does not meet U.S. NOx standards. Existing U.S. law also allows NOx to be controlled as a precursor to ground level ozone, but only California presently limits NOx emissions to control ozone levels. However, non attainment of federally-mandated ozone standards remains a problem in over sixty U.S. cities, and each is being asked to determine whether NOx controls would be appropriate. NOx is also a pollutant being studied in the acid rain research program.

DISCUSSION: If the United States signs the NOx protocol, we would be obligated to 1) keep average annual NOx emissions at or below the 1987 level from 1988 through 1995; and 2) limit annual emissions to no higher than 1978 levels, the peak U.S. level, beginning in 1996. Canada and the other LRTAP parties are likely to join the protocol independently of a U.S. decision. The protocol would require them to adopt regulatory features similar to the United States' generally higher environmental standards. If current U.S. NOx emissions projections are accurate:

- o For the period 1988 through 1995, the United States should be able to comply with the protocol without additional controls.

- o The United States would have to plan adoption, by the early to mid-1990's, additional NOx regulations, or we could begin to exceed the 1978 NOx emissions level after the year 2000.

The United States, however, may not need to adopt additional regulations if 1) the LRTAP parties agree to a follow-on protocol that allows for higher levels of emissions, 2) the NOx emissions projections are overestimated, 3) mandated reviews of current regulations result in stricter NOx standards, or 4) market forces reduce NOx through measures such as the success of the Administration's clean coal technology program.

While some Administration officials argue that the NOx protocol would provide additional incentive for industry to invest in clean coal technolgies, others maintain that the NOx protocol would create investment disincentives. Those who claim that the protocol will promote investment in clean coal technologies feel that the NOx emissions freeze will cause industry to step up their search for new, cleaner technologies. Those who disagree with this argument point out that the NOx emissions freeze will limit the projected growth of emissions prior to the expected deployment of clean coal technologies. This, they maintain, will create a riskier investment environment for clean coal technologies, and therefore become a disincentive for investment.

OPTIONS: The Council's deliberations have resulted in the following two options for your consideration. A decision memorandum will be forwarded to you for action after the Council meeting on August 1.

Option #1. Sign the Protocol as an Executive Agreement with qualifications. The qualifications are that: (1) the United States will consider withdrawal if by 1996 an acceptable follow-on protocol is not adopted that establishes a control obligation based on scientific, technical and economic factors; and, (2) nations will have the flexibility to meet the requirements of the protocol through the most cost-effective means.

Pros:

- o Signing the protocol maintains U.S. credibility as a world leader in environmental action, and is consistent with U.S. participation in LRTAP.
- o Signing the protocol establishes a precedent for at least partial credit for prior emissions controls.

Cons:

- o The United States may be required to take additional NOx emissions control actions by the mid-1990's.
- o Some believe that signing the protocol establishes a precedent for not receiving full credit for past actions, which is not acceptable to several domestic agencies.

Option #2. Do not sign the Protocol.

Pros:

- o Abstaining from the protocol eliminates any risk that the United States would have to adopt stricter NOx standards based on other than domestic interpretation of the science, technology, and economic implications.

Cons:

- o There is a risk that this will result in reducing deserved U.S. credibility as a world leader in addressing international environmental questions.
- o Failure to sign the protocol eliminates international recognition of the principle that the United States is entitled to some credit for past emissions control actions.

Ralph C Bledsoe

Ralph C. Bledsoe
Executive Secretary

THE WHITE HOUSE

WASHINGTON

May 18, 1987

MEMORANDUM FOR THE DOMESTIC POLICY COUNCIL

FROM: THE ENERGY, NATURAL RESOURCES & ENVIRONMENT WORKING GROUP

SUBJECT: Stratospheric Ozone Protocol Negotiations

Issue - What should the U.S. negotiating position be for elements of the protocol to protect the stratospheric ozone layer by controlling emissions of ozone-depleting substances [chlorofluorocarbons (CFC) and halons]?

Background - The Environmental Protection Agency, under terms of a court order resulting from a lawsuit by the National Resources Defense Council against the EPA Administrator, must publish in the Federal Register by December 1, 1987, a proposed decision on whether there is a need need for further domestic regulations, under the Clean Air Act, of chemicals which deplete the stratospheric ozone layer. These chemicals [certain chlorofluorocarbons (CFCs) and halons] are used for solvents, refrigerants, foam blowing, fire extinguising agents, sterilants, aerosol propellants, and other miscellaneous uses.

Compared to other environmental laws, the Act sets a low threshhold for required action by EPA. Because of the global nature of the problem of ozone depletion, however, unilateral U.S. regulatory action would not be effective in protecting the ozone layer. An important U.S. objective in attaining an early and effective international agreement on ozone is also to avoid disadvantages to U.S. industry resulting from unilateral U.S. action required by the Clean Air Act.

The U.S. has been participating in international negotiations since 1983 on this subject, leading to the 1985 Vienna Convention on Protection of the Ozone Layer. Negotiations on a protocol to this Convention resumed in December, 1986, following intensive international scientific and economic assessments. Since December, there have been two further sessions, in February and April, 1987, and the protocol is scheduled for signing in September, 1987 in Montreal.

The objectives for the U.S. Government are in State Department Circular 175 of November 28, 1986. These objectives include:

(a) a near-term freeze on the combined emissions of the most ozone-depleting CFC and halon substances;

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

(c) periodic review of the protocol provisions based upon regular assessment of science, technology, environmental and economic (STEE) elements, which could remove or add chemicals, or change the schedule or the emission reduction target.

The Working Group on Energy, Natural Resources and the Environment has considered the issue of stratospheric ozone depletion over the past several months. Attached is a paper prepared by OMB that summarizes the available scientific, environmental, economic, and international data.

Discussion - Since the negotiations are now reaching a stage where final positions are being proposed, and due to the broad economic impact of these positions, several Cabinet agencies have asked that the Domestic Policy Council review the U.S. position and give guidance to the U.S. negotiating team on several elements of our position prior to the next negotiations.

Representatives of key countries, including the U.S., will meet on June 29 and at subsequent sessions to discuss a suggested text (attached) for a control schedule prepared by the Chairman of the April negotiation sessions (referred to as the Chairman's text). At that time they will address the chemicals to be covered, the timing and stringency of the controls, and the relationship of scientific assessments to this process. Following these meetings, the Council will be informed, and asked for further guidance on the U.S. final position prior to the formal negotiating meeting on September 8, 1987, and a ministerial endorsement meeting September 16-20, 1987.

DPC Guidance - General DPC guidance is sought on the following issues:

1. Chemical Coverage

-- The U.S. objective is to achieve the broadest coverage of major ozone depleters on a weighted basis, including fully halogenated CFCs and halons.

-- The European Community, Japan, and the USSR wanted only CFC 11 and 12 covered; but now may agree that CFC 113, 114, 115 and halons could be included if UNEP, in its June meeting, agrees that the Convention can include them.

-- Options include seeking differential coverage, i.e. reducing some and only freezing others. There is support for freezing but not reducing halons, given its defense uses.

-- There is general interagency agreement on chemical coverage. The negotiating team will press for the broadest attainable coverage in the freeze, subject to DPC guidance.

2. Stringency and Timing of Controls; Relationship to Periodic Assessments

-- Key issues are:

o Stringency: Should there be an initial freeze and subsequent reductions? What should the reduction levels be, and in what timing and increments? What would be the probable effect on the ozone layer?

o Timing: There are environmental benefits for early action to reduce CFC's; further, it would encourage industry to develop CFC substitutes. Given that a required reduction is likely, there is a need to provide time for industrial product development adjustment. Some in industry prefer a definite decision and advance notice. This conflicts with those who prefer to delay positive action as long as possible.

o Relationship to periodic reassessments of scientific, technological, environmental and economic (STEE) factors scheduled in the protocol: Should we go for (1) planned reductions subject to reversal by vote of parties after reassessment, or (2) target levels to be implemented only by positive vote after reassessment, or (3) no targeted reductions?

-- The Chairman's text, released after the last negotiating session in April 1987, represents a possible emerging international consensus and is a convenient vehicle for review. It includes:

o Freeze at 1986 levels of production/consumption of CFC 11, 12, 113, [114, 115] within two years after entry into force (EIF) of the protocol. This could happen in 1988, but the most likely EIF date is 1990.

o An automatic 20% reduction 4 years after EIF. Likely date 1994.

o Additional 30% reduction, to be implemented after scheduled STEE reassessment, with two options:

(1) 6 years after EIF (likely date 1996), if positively confirmed by majority vote of parties, or

(2) 8 years after EIF (likely date 1998), unless reversed by two-thirds vote of parties.

o Additional steps down to possible eventual elimination of these chemicals for all but limited uses would be decided subsequently by parties based on periodic reassessments.

Questions for Decision: Should U.S. delegation seek agreement along lines of chairman's text, work for greater stringency/earlier impact, or propose some relaxation in terms?

(a) Freeze. Interagency accord, within 1-2 years of EIF. Some prefer an earlier freeze.

(b) 20% reduction. Some agencies feel implementation should require positive vote of parties following a STEE reassessment in 1990.

(c) Additional 30% reduction. There is interagency disagreement here on several elements.

-- Should a set level of reduction beyond the first 20% be scheduled; if so, at what level?

-- Should a second reduction be 6 years after EIF and be subject to a positive vote, or be 8 years after EIF and be subject to a reversal vote, or some other variant?

(d) Additional reduction steps. Should the delegation press for further reductions as contained in the Chairman's text and Circular 175? If so, at what levels and time frame? Should they require a positive vote or be implemented unless there is a vote for reversal? Alternatively, should the process for setting reductions and timing be specified? Anything beyond the Chairman's text may not be achievable.

3. Control Formula and Trade Provisions:

(A) Trade Among Parties.

Significant differences remain among governments over a formula for regulating controlled chemicals.

o Options include national ceilings on: (a) production; (b) production plus imports, combined or separately; (c) consumption; or, (d) production plus imports, less exports to parties, less amounts destroyed.

o There is general interagency agreement favoring a ceiling on consumption, or "adjusted production," but compromise may be needed.

o U.S. objectives include effective control of emissions with accountability, fewest restriction on the flow of trade and captial among parties, and most favorable formula for U.S. industry. Verification remains an issue.

o Subject to DPC guidance, the delegation will pursue these objectives and seek DPC approval of specific recommendations at a later time.

(B) Trade With Non-Parties.

-- Key elements:

- o General international consensus on:
  - -- Ban on imports of controlled chemicals in bulk from non-parties.
- o No international consensus on:
  - -- Restrictions on exports of bulk chemicals.
  - -- Restrictions on imports of products containing controlled chemicals.
  - -- Consideration of restrictions on products made with controlled chemicals.
  - -- Consideration of restrictions on export of technology and equipment.

-- U.S. objectives: to regulate trade in order to encourage adherence to protocol and avoid benefits to non-parties at expense of parties. Proposals consistent with GATT.

-- Interagency consensus in favor of strong trade article, including trade in bulk chemicals and products that could be uniformly enforced. Transfer of technology and equipment remains an issue.

-- Subject to DPC guidance, delegation will pursue these objectives and seek DPC approval of specific recommendations at a later time.

4. Participation.

-- U.S. objective: To encourage effective global control through widest possible participation by other countries.

-- **Problem:** The less developed countries (LDCs) need concessions for essential domestic uses to encourage adherence; but exemptions must remain limited to avoid undercutting global control levels. Concessions being considered in the Chairman's text could double global production ceiling if fully used within the period allowed.

-- One option entails exemption from controls for a limited period for LDCs followed by adherence to the protocol. Controls will be needed to restrict production in the LDCs by existing producers.

-- Related problem: Majority LDC membership could control protocol voting to U.S. disadvantage. Should U.S. press for weighted voting based on historic use and production levels? Should elements be put into the protocol?

-- This issue needs more work. Subject to DPC guidance, we will refine our objectives for subsequent negotiations and later seek DPC approval of specific recommendations.

CHAIRMAN'S TEXT

Distr.
RESTRICTED

UNEP/WG.172/CRP.8/Rev.1
30 April 1987

Original: ENGLISH

Ad Hoc Working Group of Legal and Technical Experts for the Preparation of a Protocol on Chlorofluorocarbons to the Vienna Convention for the Protection of the Ozone Layer (Vienna Group)

Third Session
Geneva, 27-30 April 1987

TEXT PREPARED BY A SMALL SUB-WORKING GROUP OF HEAD OF DELEGATIONS

ARTICLE II: CONTROL MEASURES

1. Each party, under the jurisdiction of which CFC 11, CFC 12, CFC 113, (CFC 114, CFC 115) are produced shall ensure that within (2) years after the entry into force of this Protocol the (combined annual production and imports) (combined adjusted annual production) of these substances do not exceed their 1986 level.

2. Each party, under the jurisdiction of which substances referred to in paragraph 1 are not produced at the time of the entry into force of this Protocol, shall ensure that within (2) years from the entry into force of this Protocol (its combined annual production and imports) (its combined adjusted annual production) do not exceed the levels of imports in 1986.

3. Each party shall ensure, that within (4) years after the entry into force of this Protocol levels of substances referred to in paragraph 1 attained in accordance with paragraphs 1 and 2 will be reduced by 20 per cent.

4. Each party shall ensure that within (6) (a), (8) (b) years after the entry into force of this Protocol, the 1986 levels of substances referred to in paragraphs 1 and 2 will be further reduced (by 30 per cent), (a) (if the majority of the parties so decide, (b) (unless parties by a two-third majority otherwise decide), in the light of assessments referred to in Article III, such decision should be taken not later than (2) (4) years after entry into force.

5. Parties shall decide by (two-third majority) (a majority vote)

- whether substances should be added to or removed from the reduction schedule
- whether further reductions of 1986 levels should be undertaken (with the objective of eventual elimination of these substances).

These decisions shall be based on the assessments referred to in Article III.

Note: A second paragraph reading as follows has to be added to Article III. Beginning 1990, and every four years thereafter, the parties shall review the control measures provided for in Article II. At least one year before each of these reviews, the parties shall convene a panel of scientific experts, with composition and terms of reference determined by the parties, to review advances in scientific understanding of modification of the ozone layer, and the potential health, environmental and climatic effects of such modification.

BACKGROUND FACTS OZONE ISSUE

THE DEPLETION MECHANISM

Man-made chlorofluorocarbons (CFC´s) and halons are compounds widely used in industrial economies. Their lifetimes in the atmosphere are expected to be 75 - 100 years. Eventually, they are transported into the stratosphere and broken apart, by ultraviolet light (UV), into oxides of chlorine and bromine. These act as catalysts, each molecule breaking apart thousands of ozone molecules. The reduction of ozone transmits more UV to the surface.

NUMERICAL PREDICTIONS OF DEPLETION

Chart 1 shows projected depletions for a range of CFC emissions.

Even when predicted changes in total ozone in the column are small and little change occurs in UV reaching the surface, major changes in the vertical distribution of the ozone are still predicted with a potential net warming effect on the climate.

HOW GOOD ARE THE NUMERICAL MODELS

The models are in some conflict with empirical measurements. Measured ozone abundances above 35 km. exceed modeled abundances by as much as 30-50 percent. There are also errors in predicted temperatures, in distributions of odd nitrogen species and other atmospheric chemicals and in model sensitivity to chlorine.

On the other hand, all of the models predicted, within acceptable limits, similar ozone depletions for given CFC scenarios.

ACTUAL TRENDS IN OZONE

Monitoring efforts to measure actual trends in global ozone have produced inconsistent and inconclusive results. Ground-based "Dobson" instruments, in use since 1960 at dozens of stations, show no trend in ozone abundance. A much smaller number of "Umkehr" stations, in use since 1970, and satellite data taken since 1978 show significant decreasing trends in the total ozone column, largely since 1981. Whether the apparent trends are due to satellite sensor-drift, the El Chichon eruption, the 1982 El Nino, changes in solar radiation, or manmade CFC´s is not certain. A detailed re-evaluation of these sources of data will be available in late fall, 1987.

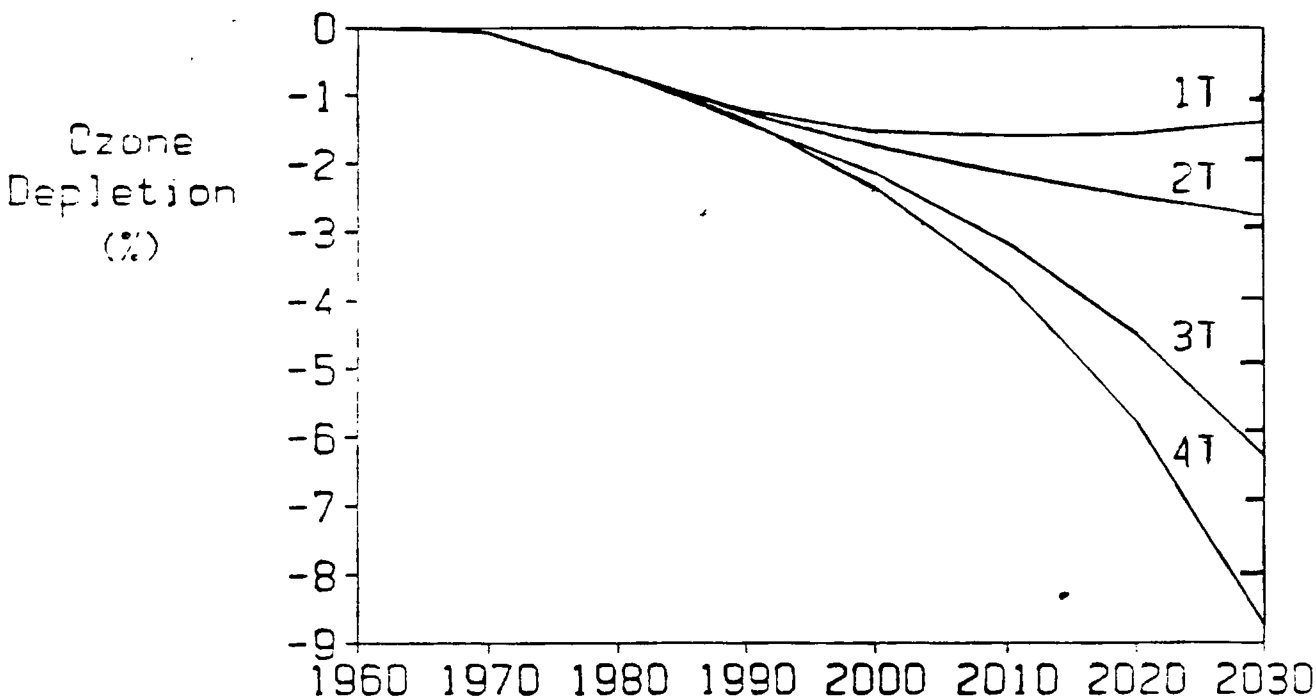
In short, interpretations of the existing satellite and ground-based data on ozone trends range from:

-- No obvious human-caused trends, to

-- Marked downward trends, 2-3X larger than predicted by theory.

Chart 1

Time Dependent Globablly and Seasonally Averaged Changes in Ozone for Coupled Perturbations (IS 2-D Model)



Results show for four scenarios of trace gas growth:

Scenario	CFC-11 and CFC-12
1T	1980 levels
2T	1.2% growth
3T	3.0% growth
4T	3.8% growth

Assumptions for other trace gases are the same in each scenario: constant emissions of CFC-113, CCl4, and CH3CCl3, zero emissions of halons, one percent growth per year in CH4, and 0.25 percent growth per year in N2O. CO2 concentrations grow at 0.5 percent.

Source: Stordal and Isaksen, (1986).

THE ANTARCTIC OZONE "HOLE"

It was discovered in 1985 that, since about 1965, in the Antarctic spring, and only in the spring, overhead ozone has increased in a ring around, and decreased directly above Antarctica. This seasonally temporary depletion has been more and more each year and now amounts to 40-50 percent of the ozone, approximately offset by the build-up in the ring. It was totally unanticipated by the existing science and models.

The global implications, if any, of the "hole" are currently unknown since the cause is not established. The existing observations could be consistent with but are not proof of the man-made chlorine hypothesis.

EFFECTS OF OZONE DEPLETION

Ozone depletion has a number of potential adverse impacts as follows. Except possibly for skin cancer, the level of depletion needed to cause significant adverse effects is unknown.

Skin Cancer Effects. Prolonged sun exposure is considered to be the dominant risk factor for non-melanoma skin tumors. However, uncertainty exists in the actual doses received by populations and in the changes in response which would result from changes in dose. Changes in behavior have tended to increase skin cancer incidence and mortality, which, therefore, could be reduced by changes in behavior.

In the U.S. there are more than 400,000 non-melanoma skin cancer cases each year with about 4000 deaths. Table 1 shows the range of estimates of increase from a 2 percent depletion for San Francisco. Worldwide growth of CFC emission of 1 percent annually is estimated to cause a 2 percent depletion by about the year 2010.

Table 1.

Type	Current Cases, %	Current Deaths, %	Increase in Incidence, % Male	Female
Basal Cell	71	20-25	2.1 - 7.2	0.7 - 5.0
Squamous Cell	29	75-80	3.2 - 11.7	3.1 - 13.3

The non-melanoma skin cancer effects of ozone depletion are not likely to be given great weight in developing countries wishing to use CFC's -- skin pigmentation is a protective barrier that reduces the incidence of such tumors.

Much circumstantial evidence implicates solar radiation as one of the causes of cutaneous malignant melanoma (CMM), with 25,000 cases and 5,000 deaths in the U. S. in 1985. On the other hand, some studies find no correlation between incidence and latitude, and outdoor workers have lower CMM rates than indoor workers.

EPA´s estimate is that each 1 percent ozone depletion would increase incidence by 1-2 percent and deaths by 0.8-1.5 percent.

Immune System Effects. Solar radiation has been found to have a detrimental effect on the immune system of both humans and animals. Although the mechanisms are not fully understood, it is clear that the UV part of the spectrum, which is screened out by ozone, is responsible.

Plant Life Effects. Existing knowledge of the risks to crops and terrestrial ecosystems from ozone depletion is extremely limited.

Data for crop species, although incomplete and often not from field studies, suggest that large variations exist within species for response to UV. For example, in 3/4 of soybean cultivars tested, levels of UV simulating 16-25 percent ozone depletion reduced yields by up to 25 percent with quality reductions.

Little or no data exists for trees, woody shrubs, vines, or lower vascular plants. Increased UV could alter competition in natural ecosystems unpredictably.

Aquatic Life Effects. Experiments show that UV causes damage to fish larvae and juveniles, shrimp and crab larvae, and to plants essential to the aquatic food web. Enhanced UV would probably change the composition of marine plant communities and could cause unpredictable changes to aquatic ecosystems.

Current data is very incomplete and limited. Understanding of aquatic organism lifecycles and of aquatic ecosystems is very limited. Great uncertainty exists about effects because UV attenuation in the water column is variable and organism behavior can affect dosage.

Climate Changing Effects. CFC´s, like CO_2, are greenhouse gases, but more powerful by a factor of 10,000. Increasing concentrations contribute to global warming.

CFC´s IN U. S. INDUSTRY

Use of CFC´s in the U. S. is spread among seven use categories and a large number of applications.

Table 2

Use Category	1985 Use (Metric Tons)	Percentage of Ozone Depleting Potential
Solvents	41,369	14
Refrigeration	78,987	28
Foam Blowing	70,430	28
Fire Extinguishing	6,250	20
Sterilization	12,133	4
Aerosol Propellants	8,000	3
Other Miscellaneous	7,083	3

COSTS OF EMISSION REDUCTION

EPA has done a preliminary analysis of possible actions to reduce CFC compound use in the short (shown below), medium, and long term:

Table 3

Cost/Kilogram Reduced	Percent Reduction in Use (Weighted by Ozone Depleting Potential)
Short-term:	
<$0.15	30
$0.15 to <$2.30	5
$2.30 and more	16
Short-term total	61

CHEMICAL SUBSTITUTES FOR CURRENTLY USED CFC´s

The industry is looking at several possible compounds which could be sustituted for current CFC´s. The minimum time frame to introduce such susbstitute products into commercial use would be 5-10 years. For the following reasons, it is likely to be closer to 10:

-- Publicly known production processes are low in yield with large waste streams that are partly toxic and partly recyclable. Long-term (3-4 years) toxicology tests will probably not be done until the process that will be used is defined and optimized.

-- Potential producers may not commit to a process until they are reasonably sure that better ones don´t exist.

-- Commercial users may insist upon completion of toxicology testing before adopting new compounds.

-- Users would also need a period for product compatibility/performance testing and for any product and process redesign.

-- Producers would need time to design and build full scale plants.

Dupont has published estimates that substitutes are likely to have a cost that is 2-5 times that of current CFC´s. However, for most uses, the cost of CFC´s is a very small part of the total cost of the final product. Dupont estimates that 5-6 years would be needed to bring substitute compounds to the commercial market place, not including time for customers to shift to the new products.

One industry estimate of future U. S. CFC consumption estimates that a freeze would cause a real price increase of 2-3 times within the first 3 years and 4 times beyond 7 years. EPA and others argue that a freeze would not bring in substitute compounds in the short-term, because alternatives would prevent a sufficient price increase unless a 50 percent or greater reduction in use were imposed.

CFR CONTROL MUST BE GLOBAL

U. S. use of CFC's is 27 percent or world use and is not large enough that U. S. action alone can significantly affect long term emissions. Under the Clean Air Act, EPA must consider unilateral action even though it would not be as effective as global action.

CONTROL IN U.S. IS MORE DIFFICULT - AEROSOLS ALREADY BANNED

Patterns of use in the U.S. and in other non-communist reporting countries are significantly different. Other country use is 2 times U.S., Canada, and Sweden banned non-essential aerosol use in 1975, using available substitutes.

Some observers have argued that the U. S. position should be for equal percentage reductions in use after the elimination of non-essential aerosol use. Others argue that approach is very unlikely to be acceptable to countries with unrestricted aerosol use.

COSTS AND BENEFITS

CEA believes that given the projections of ozone depletion and estimates of the health consequences assuming no behavioral changes, it is possible to asess the economic benefits of the CFC control protocol presently under discussion. EPA's risk assessment indicates that the freeze + 20 percent cutback will avoid approximately 992,900 deaths in the U.S. from skin cancer among people alive today and those born through 2075. An additional 30 percent cutback will save an additional 78,700 lives. The economic benefit of saving these lives, under standard assumptions for valuation of statistical lives saved and discounting of future values, is very large, on the order of hundreds of billions.

These benefits, which do <u>not</u> include non-health benefits or benefits from avoidance of non-fatal skin cancers and cataracts, are much larger than the costs of control estimated by industry or EPA. Industry has estimated that the cost of a freeze to the U.S. would be about $1 billion cumulatively between now and the year 2000. EPA has estimated that the cost of a 30 percent reduction in the controlled substances would be about $3-$4 billion cumulatively between now and the year 2000.

United States
Environmental Protection
Agency

Office of
Public Affairs (A-107)
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EPA Environmental News

FOR RELEASE: MONDAY, AUGUST 1, 1988

Christian Rice (202) 382-3324

EPA SETS FINAL RULES FOR CUTS IN CFC PRODUCTION TO PROTECT OZONE LAYER

The U.S. Environmental Protection Agency today announced new domestic regulations limiting the production and consumption of certain stratospheric-ozone-depleting chemicals called chlorofluorocarbons (CFCs) and halons. The rules fulfill the U.S. commitment under the Montreal Protocol, which has now been signed by 37 nations and ratified by six.

The rule, under the authority of the Clean Air Act, allocates quotas to each of the firms engaged in production and consumption of CFCs and halons in 1986.

"This regulation provides a low-cost means of achieving our goal of reducing CFC and halon damage to stratospheric ozone," said EPA Administrator Lee M. Thomas. "It also spurs technological innovation, which is critical to the eventual elimination of these chemicals from our environment."

In addition to the final rule, EPA also seeks public comment on adding a regulatory fee to its use of quotas to capture the multi-billion-dollar windfall profits to CFC and halon producers which might be an unintended result of the allocated quota system. The agency is concerned that the existence of such windfalls would create a potential economic incentive for the producers to delay the introduction of chemical substitutes. The agency also seeks comment on shifting to auctions or further supplementing its quota system with specific-use controls or bans.

The final rules require a freeze at 1986 production and consumption levels of CFC-11, -12, -113, -114 and -115 on the basis of their relative ozone-depletion weights. This freeze will be followed in mid-1993 by a

(more)

20-percent reduction from the 1986 levels and in mid-1998 by a 50-percent reduction from the 1986 levels.

The rules also prohibit production and consumption of Halon 1211, 1301 and 2402 from exceeding 1986 levels on a weighted basis beginning in approximately 1992.

The agency received almost 500 comments in response to its proposed rule last December. Today's final rule contains only minor changes from that proposal. A public hearing on the proposal was held in Washington in February.

U.S. producers of CFCs are E.I. du Pont de Nemours & Co Inc, Allied-Signa Inc., Pennwalt Corp., Kaiser Chemicals and Racon Inc. In addition to Dupont, Great Lakes Chemical Corp. and ICI Americas Inc. are U.S. producers of halons

The Advance Notice of Proposed Rulemaking which accompanies the final rule provides the rationale and EPA's intention to develop possible regulations to remedy the potential windfall-profit consequences of the final rule. Such windfalls would accrue to the CFC and halon producers because of future price increases in their chemicals due to EPA's limits on their supply. The agency is seeking comment on the appropriate structure and legal issues related to a regulatory fee to address this concern. EPA's regulatory-impact analysis estimates windfall profits of between $1.8 to $7.2 billion through the end of the century depending on the rate at which firms employed low-cost technologies to replace CFCs.

EPA is also seeking public comment on the use of auctions as an alternative to its rule which allocates rights to past producers and importers. An auction system would also shift windfalls from producers to the U.S. Treasury

Second, EPA is concerned that some industries, particularly those in which CFCs and halons are a small part of the price of the final goods, e.g., a refrigerator or computer, may be slow to respond to market-driven price increases and may delay their shift away from these chemicals. The agency is considering requiring certain user groups to increase recycling or to switch to alternative chemicals or processes to decrease their use of these chemicals to prevent unexpected price increases.

Finally, recent new scientific evidence contained in the summary of the Ozone Trends Panel Report issued this spring suggests that EPA may have underestimated the risks of depletion. The notice describes the findings contained in the summary and states that EPA will make the full report of the Ozone Trends Panel available to the public upon its release and seek public comment.

The control requirements in today's rule are scheduled to take effect at the same time they are required under the Montreal Protocol. Article 16 of the Protocol provides that the Protocol will enter into force on Jan. 1, 1989, provided that 11 nations or regional economic-integration organizations representing two-thirds of 1986 global consumption have ratified the Protocol by that date and that the Vienna Convention for the Protection of the Ozone Layer has entered into force. Otherwise, the Protocol will enter into force 90 days after that condition has been satisfied. As of July 30, six nations

(more)

(Mexico, the United States, Norway, Sweden, Canada and New Zealand) had ratified the Protocol. The Vienna Convention has been ratified by the requisite number of nations and enters into force on Sept. 22, 1988.

Concern about possible depletion of the ozone layer from CFCs was first raised in 1974 with publication of research which theorized that chlorine released from CFCs could migrate to the stratosphere and reduce the amount of ozone which shields the planet from harmful ultraviolet radiation. Because some of the CFCs have an atmospheric lifetime of over 120 years and do not break down in the lower atmosphere, they migrate slowly to the stratosphere where higher energy radiation strikes them, releasing chlorine. Once freed, the chlorine acts as a catalyst repeatedly combining with and breaking apart ozone molecules. If ozone depletion occurs, because of the long atmospheric lifetimes of CFCs, it will take from many decades to over a century for the ozone layer to return to past concentrations.

In 1978, EPA and the Food and Drug Administration banned the use of CFCs as aerosol propellents in all but essential applications. During the early 1970s, CFCs used as aerosol propellents constituted over 50 percent of total CFC consumption in the United States. This particular use of CFCs now has been reduced by approximately 95 percent of the amount consumed in aerosols in 1974. Today's proposal does not affect the 1978 regulations. Since 1978, CFC use has continued to expand in other applications (e.g., as a foam-blowing agent, refrigerant and solvent). Total production in the United States now has surpassed pre-1974 levels. Since 1983, worldwide production of CFCs has grown at an average annual rate of five percent.

EPA has conducted environmental- and economic-impact analyses of the regulation. Approximately 3.7 million deaths will be avoided in the United States for the population alive today or born by the year 2075. These deaths would have occurred due to increases in various skin cancers. Other health effects, such as cataracts and suppression of the immune system, will also be reduced. Stratospheric-ozone depletion and increased incidence of damaging ultraviolet radiation have been linked to such ecological and welfare effects as crop loss, aquatic damage and materials damage. CFCs also contribute to climate change (CFCs are a greenhouse gas) and associated impacts on health and the environment.

EPA estimates that the total social cost of this regulation through 2075 is approximately $20-40 billion, depending on the rate at which firms adopt low-cost reductions, while the estimated benefits under a wide range of assumptions would far outstrip the costs.

Today's rule and notice will appear in the Federal Register within the next several days.

\# \# \#

Fact sheets are attached.

R-136

July 30, 1988

NATIONS THAT HAVE RATIFIED THE VIENNA CONVENTION FOR THE PROTECTION OF THE OZONE LAYER (ENTERS INTO FORCE ON SEPTEMBER 22, 1988)

Australia	Guatemala	Switzerland
Austria	Hungary	Uganda
Byelorussian SSR	Maldives	Ukrainian SSR
Canada	Mexico	USSR
Egypt	New Zealand	USA
Finland	Norway	United Kingdom
France	Sweden	

NATIONS THAT HAVE SIGNED THE MONTREAL PROTOCOL ON SUBSTANCES THAT DEPLETE THE OZONE LAYER **

Argentina	Greece	Panama
Australia	Indonesia	Portugal
Belgium	Israel	Senegal
Byelorussian SSR	Italy	Spain
Canada *	Japan	Sweden *
Chile	Kenya	Switzerland
Denmark	Luxembourg	Togo
Egypt	Maldives	Ukrainian SSR
European Economic Community	Mexico *	USSR
Federal Republic of Germany	Morocco	United Kingdom
Finland	Netherlands	USA *
France	New Zealand *	Venezuela
Ghana	Norway *	

* Ratified

** Ratification is expected by sufficient countries to allow the Protocol to enter into force on January 1, 1989.

STATUS OF RATIFICATION AND IMPLEMENTATION *

RATIFICATION COMPLETED

Country	Comment
Canada	Promulgating final regulations for phase one, in accordance with the Protocol, January 1989. Phase two (6-18 months) will facilitate early reductions in emissions of the most harmful ozone-depleting chemicals. Environment Canada is reviewing possible restrictions on lesser essential uses of CFCs and halons, labelling, and prohibiting new uses.
Mexico	
Norway	Proposing regulations on CFCs and Halons stipulating 50% reduction by 1991 and 90% reduction by 1995.
Sweden	Adopted a program reducing the use of CFCs by 50% by 1991 and an almost total ban by 1995.
USA	Promulgating final regulations in accordance with the Protocol, August 1988, specifying reductions through allocated production and consumption quotas.

RATIFICATION IN PROCESS

Country	Comment
European Economic Community (EEC)	Council of Ministers voted unanimous approval of regulations implementing Protocol. Adopted resolution calling for limits on individual members' production and imports of ozone-depleting substances, and that increased reduction, beyond the Protocol, by one country could not be offset by increased use in other Community countries. Final action expected in October.

* This information is based on formal and informal contacts and is subject to change.

EUROPE

Denmark	Industry voluntarily phasing out CFC use in aerosols. Likely to adopt EEC regulations.
Federal Republic of Germany	Industry voluntarily phasing out CFC use in aerosols. Likely to adopt EEC regulations.
France	Ratification expected in early 1989, after presidential election. Likely to adopt EEC regulations.
Greece	Likely to adopt EEC regulations.
Italy	Likely to adopt EEC regulations.
Luxembourg	Expected to ratify by end of 1988.
Netherlands	Industry voluntarily reducing 95% of CFC use in aerosols by 1990. Expected to ratify by end of 1988. Likely to adopt EEC regulations. Called for the complete ban on use of CFCs by 2000, and urged European Community members to terminate the use of CFCs.
Portugal	Expected to ratify by end of 1988. Likely to adopt EEC regulations.
Switzerland	Expected to ratify by end of 1988. Preparing regulations to ban CFC use as an aerosol propellent by 1990. Industry voluntarily reducing use of CFCs and phasing out aerosol use of CFCs by 1990.
United Kingdom	Industry voluntarily reducing aerosol use of CFCs. Likely to adopt EEC regulations.

OTHER NATIONS

Israel	Proposed ban of aerosol use of CFCs. Preparing regulations limiting imports of CFCs.
Japan	Legislation passed by both houses. Expected to ratify by end of 1988. Tax incentives for alternatives. Reductions achieved through allocated production quotas.
New Zealand	Called for international restrictions on the use of ozone-depleting substances that would be tougher than those in the Montreal Protocol.

UNITED STATES NO_x CONTROL:

PROGRAMS AND TRENDS

ENVIRONMENTAL PROTECTION AGENCY

OFFICE OF AIR AND RADIATION

JUNE 10, 1988

I. INTRODUCTION

The Clean Air Act was enacted in 1970, and substantially amended in 1977, to protect and enhance the quality of U.S. air resources in order to "promote the public health and welfare and the productive capacity of its population." As the Act has been implemented over the past 15 years, the control of nitrogen dioxide (NO_2) has been one of its most important elements. Emissions of NO_2 are regulated under three major provisions of the Act. One sets health based standards that can lead to controls on new and existing stationary and mobile sources (NAAQS), one directly controls new stationary sources (NSPS), and one directly controls new mobile sources (FMVCP).

The implementation of these three major provisions of the Clean Air Act has had a substantial impact on total national emissions of NO_x. Between 1940 and 1970, national NO_x emissions increased steadily -- from 6.7 to 18.1 million metric tonnes per year -- because of steadily increasing fossil fuel combustion. Since the passage of the Clean Air Act in 1970, however, total NO_x emissions have leveled off, despite continued increases in fossil fuel combustion. After almost tripling in the three decades prior to 1970, total national NO_x emissions increased by only seven percent -- to 19.3 million tonnes per year -- between 1970 and 1985. In fact, from 1978 to 1985 total national emissions decreased by five percent.

Figure 1 illustrates the NO_x emissions trends over recent years and projects a trend out through 2010. Assuming current regulations and projections of economic and electricity demand growth, and without introduction of innovative clean coal technologies, nor switches in fuel utilization, NO_x emissions will decrease to 1990 and then increase at an accelerating rate. The prior annual emissions maximum (1978 level) would be achieved in year 2001.

II. NO_x EMISSIONS ESTIMATES AND FORECASTS

- Total NOx emissions decline from 20.3 to 18.7 million tonnes between 1978 and 1990 due to a significant decline (1.9 million tonnes) in highway vehicle NOx emissions, and a 0.6 million tonne decline from industrial sources. This is offset partially by growth in electric utility emissions of 1.1 million tonnes.

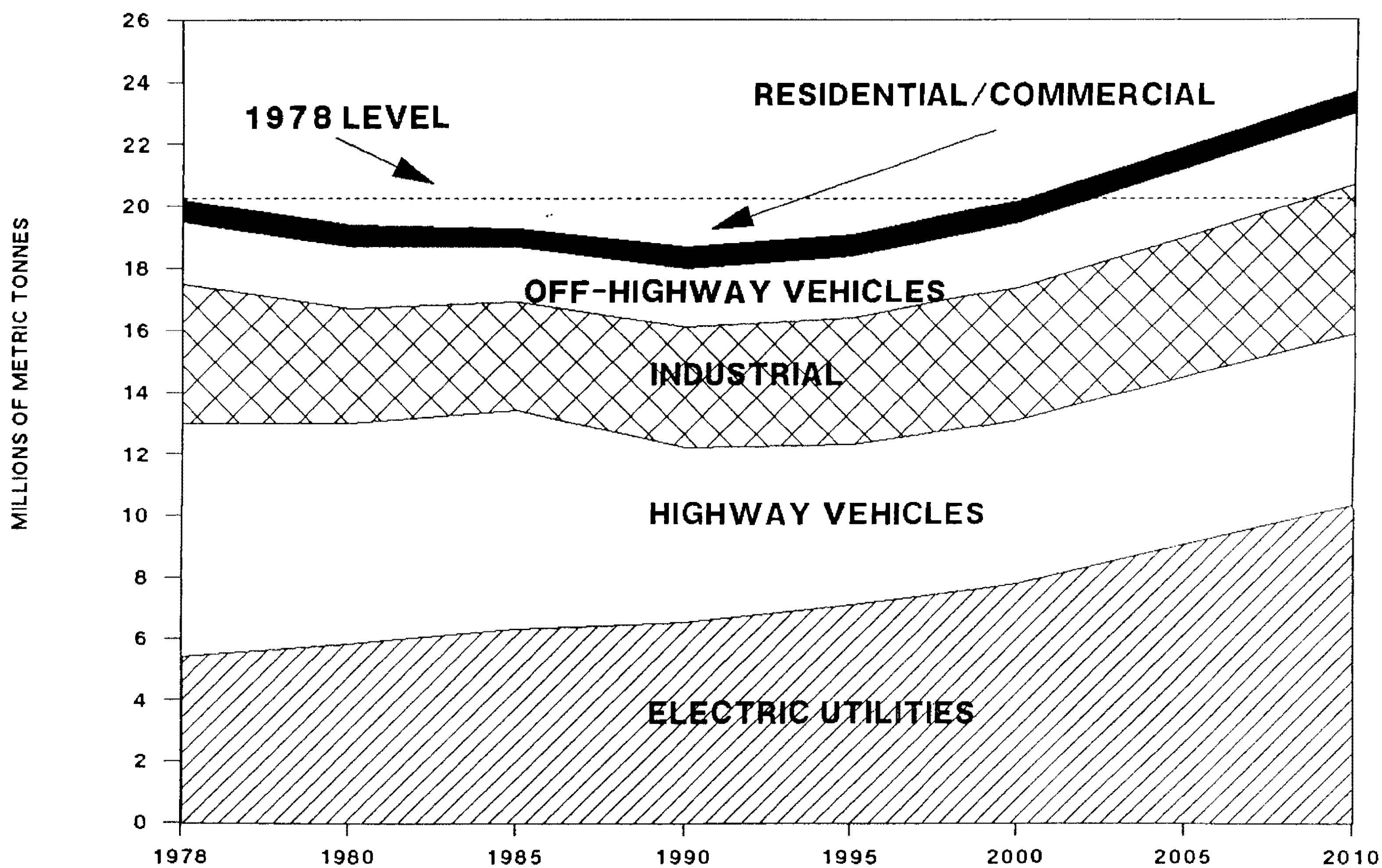
- Between 1990 and 1995 highway NOx is projected to continue to decline but the declining trend in total NO_x is reversed by growth in the electric utility sector; industrial NOx begins to increase also.

- Thereafter, if the projections, which reflect only past economic and energy use trends and presently promulgated regulations, continues, NOx emissions for all categories would increase.

- Emissions projections could change due to a number of factors not included in this projection; some factors are aggregates of private choices while others could be regulated or legislated.

FIGURE 1

TOTAL NOX EMISSIONS



III. NO_x CONTROL PROGRAMS

NO_x emissions are regulated under three major provisions of the Clean Air Act (CAA). First, Section 109 requires EPA to set national ambient air quality standards (NAAQS) for pollutants which may reasonably be anticipated to endanger public health (primary) and welfare (secondary). To date, NAAQS have been set for six pollutants, including NO_2 and ozone. The current NAAQS are listed in Table 1. Under Section 109, EPA can set standards that can lead to controls on new and existing stationary and mobile sources. The primary ambient standard for NO_2 is set at 0.053 ppm (100 ug/m^3 measured as an annual arithmetic mean. The secondary NO_2 NAAQS is the same as the primary standard, because welfare values are believed to be protected by the health standard. The primary ozone NAAQS is set at 0.12 ppm (235 ug/m^3) The secondary standard for ozone is also the same as the primary.

The CAA requires that NAAQS be reviewed every five years and revised as appropriate in light of the most recent scientific information. The NO_2 NAAQS were reviewed and the existing standards were retained in 1985. However, a possible short-term (1-3 hour) NO_2 standard is still under consideration because acute health effects related to short-term exposures may be associated with existing NO_2 concentrations. The ozone standard is currently under review.

Section 111 requires EPA to limit the air emissions from major new stationary sources that cause, or contribute substantially to, air pollution that may reasonably be anticipated to endanger public health or welfare. To date, standards for NO_x have been set for six source categories. New Source Performance Standards (NSPS) are based on the level of control achieved by "best demonstrated technology." They were included in the Clean Air Act to prevent new air pollution problems in the short term and to cause a gradual improvement in air quality over the long term as existing plants are replaced by new, cleaner facilities. The CAA requires that all NSPS be reviewed at least every four years and revised as appropriate in light of improved pollution control technologies. However, these statutory deadlines have been sometimes been missed and, for example, the utility boiler NSPS was last reviewed in 1979. Table 2 lists the six stationary source categories regulated for NO_x.

Section 202 requires EPA to limit emissions of air pollution from new motor vehicles if that air pollution may reasonably be anticipated to endanger public health or welfare. To date, six classes of new motor vehicles have been regulated; of these six, four are subject to NOx controls (the four highway vehicle categories are controlled for NO_x; aircraft and motorcycles are not.) Table 3 lists the mobile source categories and allowable limits for NO_x emissions.

IV. WHY WE REGULATE NO_x EMISSIONS

There are eight oxides of nitrogen (NO_x) which can be found in the air we breathe. Only three, nitrous oxide (N_2O), nitric oxide (NO), and nitrogen dioxide (NO_2) are common in the atmosphere.

NATIONAL AMBIENT AIR QUALITY STANDARDS

Pollutant	Primary Standards	Averaging Time	Secondary Standards
Carbon Monoxide	10 mg/m^3 (9 ppm) 40 mg/m^3 (35 ppm)	8-hour[a] 1-hour[a]	same as primary
Lead	1.5 ug/m^3	Quarterly average	same as primary
Nitrogen oxides	100 ug/m^3 (.053 ppm)	Annual (arithmetic mean)	same as primary
Particulate Matter (PM-10)	50 ug/m^3 150 ug/m^3	Annual (geometric mean) 24-hour[a]	
Particulate Matter (TSP)	75 ug/m3 150 ug/m^3	Annual (geometric mean) 24-hour[a]	
Ozone	235 ug/m^3 (.12 ppm)	1-hour[c]	same as primary
Sulfur oxides	80 ug/m^3 (.03 ppm) 365 ug/m^3 (.14 ppm)	Annual (arithmetic mean) 24-hour[a] 3-hour[a]	--- --- 1300 ug/m^3 (0.5 ppm)

[a]Not to be exceeded more than once per year.
[b]Guide to achieving the 24-hour standard.
[c]The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 235 ug/m^3 is equal to or less than 1

Table 1

EXISTING NOx NSPS

SOURCE	EMISSIONS LIMIT	ESTIMATED PERCENTAGE REDUCTION
Fossil fuel fired steam generator >250 million BTU/hr commencing construction between August 17, 1971 and Sept. 18, 1978		25%
- firing coal, coal/wood residue	0.70 lb/10^6 BTU (300 ng/J)	
- firing oil, oil/wood residue	0.30 lb/10^6 BTU (130 ng/J)	
- firing gas, gas/wood residue	0.20 lb/10^6 BTU (86 ng/J)	
- firing lignite, lignite/wood residue	0.60 lb/10^6 BTU (260 ng/J) 0.80 lb/10^6 BTU (340 ng/J) for ND, SD, MT lignite burned in cyclone-fired units	
- firing mixed fossil fuels (except lignite or 25% coal refuse)	Prorated by fuel mixture	
Electric utility steam generators >250 million BTU/hr commencing contstruction after September 18, 1978		
- firing solid and solid derived fuels	0.50 lb/10^6 BTU (210 ng/J) for coal derived fuels, subbituminous coal, shale oil	30-40%
	0.80 lb/10^6 BTU (340 ng/J) for >25% ND, SD, MT lignite burned in slag tap furnance	30-40%
	0.60 lb/10^6 BTU (260 ng/J) for lignite, bituminous coal, anthracite, and other fuels	30-40%
- firing liquid fuel	0.30 lb/10^6 BTU (130 ng/J)	30%
- firing gaseous fuel	0.20 lb/10^6 BTU (86 ng/J)	25%
- firing mixed fossil fuels	Prorated by fuel mixture	
Nitric Acid Plants.	3.0 lb/ton	93%
Stationary Gas Turbines		70-80%
- between 10 and 100 x 10^6 BTU/ng (>10.7 and ≤107.2 GJ/hr)	0.015% (150 ppm)	
- greater than 100 x 10^6 BTU/ng (>107.2 GJ/hr)	0.0075% (75 ppm)	
- greater than 100 x 10^6 BTU/ng (>107.2 GJ/hr) used in oil/gas production and transportation	0.015% (150 ppm)	

Existing NOx NSPS

SOURCE	EMISSIONS LIMIT	ESTIMATED PERCENT REDUCTION
Industrial-commercial-institutional steam generators >100 x 10^6 BTU/hr commencing construction after June 19, 1984		30-40%
- firing pulverized coal	0.70 lb/10^6 BTU (300 ng/J)	
- spreader stoker firing coal	0.60 lb/10^6 BTU (258 ng/J)	
- mass-feed stoker firing coal	0.50 lb/10^6 BTU (215 ng/J)	
- firing lignite	0.60 lb/10^6 BTU (260 ng/J)	
- firing ND, SD, or MT lignite in a slag tap furnance	0.80 lb/10^6 BTU (340 ng/J)	
- firing natural gas or distaillate oil	0.10 lb/10^6 BTU (43 ng/J)	
- firing mixtures including more than 5 percent natural gas or distillate oil iwht either wood or minicipal-type solid waste	0.30 lb/10^6 BTU (130 ng/J)	
- firing residual oil with a fuel nitrogen content of 0.35 weight percent or less	0.30 lb/10^6 BTU (130 ng/J)	
- firing residual oil with a fuel nitrogen content greater than 0.35 weight percent	0.40 lb/10^6 BTU (172 ng/J)	

KEY
BTU - British thermal units
ng/J - programs per Joule
ND, SD, MT, - N. Dakota, S. Dakota, Montana
ppm - parts per million

Table 2
(Cont'd)

TABLE 3

MOBILE SOURCE NO_x STANDARDS

YEAR	PASSENGER CARS[1]	LIGHT-DUTY TRUCKS[1]	HEAVY-DUTY GASOLINE ENGINES AND VEHICLES	HEAVY-DUTY DIESEL ENGINES
Prior to control	1000 ppm[2] 4 gpm[2] 3.6 gpm[3]	1000 ppm[2] 4 gpm[2] 3.6 gpm[3]	*6.86 g/bhp-hr[6] 6.71 g/bhp-hr[7]	---
1970-72	---	---	---	---
1973	3.0 gpm	3.0 gpm	---	---
1974	3.0 gpm	3.0 gpm	---	---
1975	3.1 gpm	3.1 gpm	---	---
1976	3.1 gpm	3.1 gpm	---	---
1977	2.0 gpm	3.1 gpm	---	---
1978	2.0 gpm	3.1 gpm	---	---
1979	2.0 gpm	2.3 gpm	---	---
1980	2.0 gpm	2.3 gpm	---	---
1981	1.0 gpm[4]	2.3 gpm	---	---
1982	1.0 gpm[4]	2.3 gpm	---	---
1983	1.0 gpm[4]	2.3 gpm	---	---
1984	1.0 gpm[4]	2.3 gpm	*10.7 g/bhp-hr[8]	10.7 g/bhp-hr[1] 9.0 g/bhp-hr[1]
1985	1.0 gpm	2.3 gpm	10.6 g/bhp-hr[9] 10.7 g/bhp-hr[9]	10.7 g/bhp-hr
1986	1.0 gpm	2.3 gpm	10.6 g/bhp-hr[9] 10.7 g/bhp-hr[9]	10.7 g/bhp-hr
1987	1.0 gpm	2.3 gpm	10.6 g/bhp-hr	10.7 g/bhp-hr
1988 & later	1.0 gpm	1.2 gpm[5,10] 1.7 gpm[5,10]	6.0 g/bhp-hr	6.0 g/bhp-hr
1991 & later			5.0 b/bhp-hr[10]	5.0 g/bhp-hr[10]

*Controlled emissions of NO_x initially are higher than uncontrolled levels, because the controls on other pollutants cause NO_x emissions to increase.

TABLE 3 (CONT'D)

FOOTNOTES

1. Standards do not apply to vehicles with engines less than 50 CID from 1968 through 1974.

2. 137 second driving cycle test procedure.

3. Constant volume sample test which includes cold and hot starts.

4. Oxides of nitrogen standard can be waived to 1.5 gpm for innovative technology or diesel.

5. Standards of 1.2 gpm apply to LDTs up to and including 3,750 lbs. loaded vehicle weight; 1.7 gpm standard applies to LDTs equal to and over 3,751 lbs. loaded vehicle weight.

6. Uncontrolled emissions as measured on the EPA transient test.

7. Uncontrolled emissions as measured on the MVMA transient test.

8. This standard was derived from the HC+NOx standard when the transient test was adopted. It does not represent any significant level of control, although control of HC emissions has exerted an upward influence on NOx emissions over baseline levels.

9. Different standards apply depending on different test procedures.

10. Emissions averaging may be used to meet this standard under certain circumstances.

KEY

CID - cubic inch displacement

gpm - grams per mile

LTD - light duty truck

MVMA - Motor Vehicle Manufacturers Assoc.

ppm - parts per million

g/bhp-hr - grams per brake horsepower/hour

Nitrous oxide is a common by-product of natural biological process. It figures prominently in the upper atmosphere reactions which control the stratospheric ozone layer but N_2O is not considered an air pollutant. Both NO and NO_2 are present in the lower troposphere in significant concentrations. Both are viewed as pollutants but NO is much more reactive than NO_2 and quickly forms NO_2 or other compounds. Thus, the NO_x compound of most concern in environmental regulation is NO_2.

Nitrogen dioxide is a mildly reactive oxidant with slightly acidic properties. It is a brownish gas commonly produced when NO, resulting from fossil fuel combustion, reacts with oxygen. It is NO which is largely responsible for the brown cast of smog in urban areas. NO_x also contributes to regional haze, especially in the west, after it is transformed to nitrate particles in the atmosphere. In the east, the majority of the haze degradation is due to sulfate and carbon particles.

Average annual NO_2 concentrations are increasing (as of late 1985). The following table provides a description of typical ambient levels of NO_2 today, in parts per million (ppm). Although more than 95% of the 186 urban areas monitored are in compliance with the annual standard for NO_2, the NO_2 concentration in several areas is beginning to approach the standard.

NO_2 CONCENTRATIONS IN PPM

	TYPICAL RURAL	TYPICAL SUBURBAN	TYPICAL URBAN	HIGHEST URBAN	NAAQS
ANNUAL AVERAGE	0.001	0.01	0.029	0.05 6 LA	0.053
ONE-HOUR AVERAGES	0.06		0.3	0.5	---

TABLE 4

At elevated concentrations NO_2 can adversely affect human health, vegetation, materials, and visibility. Nitrogen oxide compounds also contribute to increased rates of acid deposition and to the formation of tropospheric ozone.

A variety of respiratory system effects are associated with exposure to NO_2 concentrations less than 2.0 ppm in humans and animals. The most frequent and significant NO_2-induced respiratory effects reported in the scientific literature include: (1) altered lung function and symptomatic effects observed in controlled human exposure studies and in community epidemiologic studies; (2) increased prevalence of acute respiratory illness and symptoms observed in outdoor community epidemiological studies and in indoor community epidemiological studies comparing residents using gas and electric stoves; and (3) lung tissue damage and increased susceptibility to infection observed in animal toxicology studies. Results from these several kinds of studies indicate that certain human health effects may occur as a result of exposures to NO_2 concentrations at or approaching some recorded NO_2 levels.

In addition to its negative health effects, NO_2 can adversely affect vegetation, materials, and visibility. Two additional welfare impacts of NO_x are not presently considered under the NAAQS. First is the NO_x contribution to increased rates of acid deposition as nitric acid or dry particle deposition. Second is the NO_x contribution of excess nutrient nitrogen to watersheds and coastal water systems. More analysis is needed on both these subjects.

NO_x, along with volatile organic compounds (VOCs), is a precursor to photochemical oxidants - secondary pollutants which affect lung function. Currently, ozone is the most well known, most severe, and prevalent air pollution problem in urban areas. Ozone and other photochemical oxidants are formed in the atmosphere from their precursors by processes that are a complex function of precursor emissions and meteorological factors. Nitrogen oxide emissions both promote and inhibit the ozone formation process. What the net effect of NOx in a given area would be depends on the relative concentrations of NO, NO2, and hydrocarbons. The mix of these pollutants in turn, depends on many factors such as types and quantities of emissions, meteorology, topography, and carry over of pollutants from the previous day and from up wind areas.

Ozone has been shown to cause breathing difficulties in human subjects at rest and during light exercise. During heavy exercise, concentrations of 0.18 ppm ozone can cause difficulties such as coughing and shortness of breath. In animal studies, exposure of 0.30 ppm ozone while the animal was exercising was demonstrated to cause lung damage. This and other evidence suggests that the same type of structural damage to the lung may occur in humans exposed to this and lower concentrations of ozone.

OZONE CONCENTRATIONS IN PPM

	TYPICAL RURAL	TYPICAL SUBURBAN	TYPICAL URBAN	HIGHEST URBAN	NAAQS
ANNUAL AVERAGE	0.03-0.05	----	----	----	----
ONE-HOUR MAXIMUM DAILY	0.03-0.05	0.110	0.131	0.370	0.12
MAX 3-MONTH MEAN for 8 HOUR DAILY	0.03-0.05	0.054	0.057	0.086	

TABLE 5

Ozone causes damage to tires, textiles, paints, and art work. Ozone causes crop loss damage, and is the leading pollutant suspected to stress forests causing foliar damage and reducing growth in trees.

The Agency is currently expending considerable effort studying and modeling ozone formation processes. While there is generally a good understanding of the relationship between NOx, HC, and ozone formation and degradation, quantitative estimates of the effects of specific controls applied to specific sources and source areas require consideration of detailed meteorological and environmental factors.

To that end the Agency has developed the Regional Oxidant Model (ROM) which simulates conditions over periods up to a month over spatial areas of roughly 1000 squared km. The model contains detailed descriptions of meterological and chemical processes and it utilizes comprehensive inventories of emissions. The model is designed to analyze multi-day, regional scale transport and source impacts. Because of its relatively large spatial scale, ROM will be used in conjunction with an urban scale transport and chemistry model to predict resulting ozone concentrations from hypothetical HC and NOx emissions reductions. Through the use of the two models discussed above, the relative mix of NOx and HC controls necessary for attaining the ozone standard will be determined on an area specific basis.

Preliminary applications of the ROM include two NO_x-only control strategies and a VOC-only strategy. The first NO_x control strategy simulated the affect of new emissions limits on utility boilers in the eastern U.S. Most of these facilities are located west of the Northeast Corridor where non-attainment of the ozone NAAQS is a serious problem. In effect this strategy reduced utility emissions by 39% and total NO_x emissions in the region by 11%. The results of NO_x strategy 1 were small reductions in peak ozone concentrations in isolated rural areas and moderate increases in peaks near urban areas. No impact on Northeast Corridor peak ozone was indicated and large areas continued to exceed the NAAQS.

NO_x strategy 2 simulated the affect of a 22% reduction of total NO_x in the NE Corridor, a 27% reduction in NO_x in Detroit and a 10% reduction of region-wide NO_x emissions. The results were small reductions of peaks downwind of Corridor urban areas and moderate increases in peaks near urban areas. Again, large areas continues to exceed the NAAQS.

Finally, the VOC-only strategy simulated the affect of widespread VOC reductions in the Corridor (275 to 70%) and 30% reductions in attainment areas. The results were large reductions of peaks near and downwind of cities and no increases in peak ozone anywhere. However, large areas remained in exceedance of the NAAQS.

The preliminary nature of these results cannot be stressed too strongly. In particular, the results are very sensitive to the accuracy of base emissions. For these applications the 1980 emissions inventory was used; future applications will be made using the 1985 emissions inventory which is considered to be substantially better especially with respect to VOCs. Also, the combined VOC and NO_x control runs are not yet complete, and any ozone attainment plan is likely to at least consider reductions in both pollutants.

APPENDIX

PROJECTED IMPACTS OF NOX PROTOCOL ON US PROGRAMS

- o From now until 1996, we would be bound by the requirement of the third provision of the compromise to keep average annual emissions[1] to the 1987 level.

- o Between 1987 and 1996 average U.S. annual national emissions could not exceed 1987 levels. As indicated by the Table 1, according to our current forecasts this should not be a problem. Average annual NOx emissions between 1985 and 1995 would be 19.0 million tonnes under existing legislative and regulatory programs.

Total NO_x Emissions by Sector
(Millions of Metric Tonnes)

	1978	1980	1985	1990	1995	2000
Electric Utilities	5.4	5.8	6.3	6.5	7.1	7.8
Highway Vehicles	7.6	7.2	7.1	5.7	5.2	5.3
Industrial	4.5	3.7	3.5	3.9	4.1	4.3
Off-Highway	2.0	2.0	1.8	1.9	2.0	2.1
Res/Com	0.7	0.7	0.6	0.7	0.7	0.7
	---	---	---	---	---	---
Total	20.3	19.3	19.3	18.7	19.1	20.2

TABLE 1

- o Beginning in 1996, when under Article 2, paragraph 3 parties shall commence measures and a timetable for achieving reductions based on the critical loads study and other factors, the temporary freeze is off and we would be bound by the 1978 cap.

- o The U.S., in the early 1990's, will need to periodically review anticipated NOx emission projections to determine if economic,

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[1]The text actually says transboundary flux must be kept constant, but as discussed above, the U.S. intends to interpret this requirement by substituting average annual emissions for average annual transboundary flux. The Canadian and other delegations are aware of our intended interpretation and could object. For now we should assume no one will object.

technological and regulatory patterns appear sufficient to maintaining national NOx emissions below 20.3 million tonnes.

- Emissions projections could change due to a number of factors not included in this projection; some factors are aggregates of private choices while others could be regulated or legislated.

  - Among the private choices are:

    - impacts of economic and /or electricity demand growth rates that could increase or decrease the emissions,
    - changing oil prices could increase or decrease vehicle miles traveled,
    - fuel switching from coal and oil to natural gas could decrease emissions by up to 2 million tons per year, according to association projections,
    - accelerated deployment of clean coal technologies, both due to improved controls and, for repowering, due to increased efficiency could decrease emissions by up to 4 million tons in the year 2010.

  - The regulatory options include:

    - for utility boilers,

      tightening the NSPS (regulatory),
      requiring NOx controls on non-NSPS boilers (statutory),
      nuclear plant life extension (regulatory),
      demand management and energy conservation programs,
      acceleration of introduction of clean coal technologies,
      greater substitution of natural gas or other low emitting fuels for oil and coal.

    - For mobile sources options to consider include,

      tighter NOx standards on all LDGV (regulatory),
      lower NOx emission rates on other vehicle categories,
      lower deterioration and tampering rates,
      reductions in VMT growth;

    - For industrial boilers and processes reductions could be achieved through

      new and tighter NOx standards for process emissions,
      tighter NOx standards for boilers (regulatory).

- The reduction potential of the options listed above are not additive, but in composite they could achieve emission decreases on the order of 3 to 5 million tonnes per year.

technologies.

Consideration of preferential treatment, under the Clean Coal Technology Program, for projects in States that treat innovative technologies the same as pollution control projects for ratemaking purposes.

Regulatory innovations by the Environmental Protection Agency (EPA) to reduce acid rain precursors and spur technological innovation.

United States Environmental Protection Agency

Office of Public Affairs (A-107) Washington DC 20460

EPA

Environmental News

FOR RELEASE: MONDAY, SEPTEMBER 26, 1988

Christian Rice (202) 382-3324

THOMAS CALLS FOR CFC AND HALON PHASEOUT

U.S. Environmental Protection Agency Administrator Lee M. Thomas today called for even greater efforts in halting the depletion of stratospheric ozone by asking all nations to ratify the Montreal Protocol and then move toward a complete phaseout of ozone-depleting chlorofluorocarbons (CFCs) and halons.

"The Ozone Trends Panel's report and the new analysis we are releasing today paint an alarming picture of present and future global ozone levels," Thomas said. "The depletion that has already occurred calls into question our earlier projections of future damage. Regretfully, our new analysis predicts an even worse scenario than anticipated. We must go further than a 50-percent reduction in these chemicals in order to stabilize ozone levels."

Thomas called on all nations to join in the ratification of the Montreal Protocol, a landmark environmental pact made in September of last year. The Protocol has been signed by 45 nations, but still needs ratification by several major CFC producers (Japan, the European Economic Community and the Soviet Union) in order to enter into force next January.

"It is increasingly clear that we as a global environmental community must use the Protocol to go even further to eliminate these chemicals which damage the stratospheric-ozone layer and threaten our future," Thomas said.

"The Montreal Protocol contains a provision that requires us to take into consideration emerging scientific evidence. It is a wise provision and it must be used to make the Protocol an even more environmentally protective pact," Thomas said.

(more)

The Ozone Trends Panel, which released a summary of its findings last March, is an international group of scientists from federal agencies, research institutions, private industry and universities. Using ground-based instruments, the panel found greater stratospheric-ozone depletion than models had predicted.

EPA's latest analysis, "Future Concentrations of Stratospheric Chlorine and Bromine," being released today, concludes that under the Montreal Protocol there will still be growing chlorine and bromine levels in the stratosphere and it will take a complete phaseout of damaging CFCs and halons to stabilize future stratospheric-ozone levels. In addition, for the first time, it finds that in order to stabilize chlorine levels, there would also need to be a worldwide freeze of the chemical methyl chloroform.

# # #

(Copies of the summary of the EPA analysis are attached, and full copies of the analysis are available from the EPA Press Office.)

R-173

PROLOGUE

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

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

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

FINDINGS

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

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

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

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

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

3. Future chlorine growth has several sources.

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

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

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

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

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

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

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

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

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

5. Bromine levels will grow under the Montreal Protocol.

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

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

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

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

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

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