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CAWG
CLEAN AIR WORKING GROUP

EARL W. MALLICK, CHAIRMAN
WILLIAM D. FAY, ADMINISTRATOR

Katie

February 1, 1990

Senator Albert Gore Jr.
393 Russell Senate Office Building
Washington, DC 20510

Dear Senator Gore:

Enclosed for your consideration is a memorandum discussing the reasons why the Southern and Midwestern regions of the nation may find unacceptable the acid rain provisions of S. 1630, and other proposals like it. The Clean Air Working Group believes that, on the whole, provisions of Title IV are scientifically insupportable and economically disastrous. Various regions of the country, however, will confront unique and burdensome problems if S. 1630 is enacted without change. While the regional impacts of acid rain legislation have been widely debated, we hope that the information provided in this memorandum will provide a convenient summary of the impacts on the South and Midwest.

Sincerely,

Bill

William Fay

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WASHINGTON, DC 20006
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SOUTHERN OBJECTIONS TO CLEAN AIR ACT AMENDMENTS

I. General Objections

The South shares in the general objections that have been voiced nationally in opposition to enactment of additional legislation at this time. These objections may be grouped into four basic categories:

1. Additional acid rain legislation should not be considered until NAPAP releases its Final Report. In 1980, Congress established the National Acid Precipitation Assessment Program ("NAPAP") to conduct a comprehensive 10-year research program to determine whether additional emission controls are necessary to address acid rain. NAPAP's Final Report is due in 1990. It is clear that were Congress to act now -- literally months before the Final Report is released -- it would be wasting the almost one-half billion dollars and years of research that have gone into NAPAP. And why? No new information or scientific conclusions have suddenly emerged to dictate such a radical change in Congress' 1980 game plan, and no abrupt deterioration of our environment has occurred in this "eleventh hour." Clearly, common sense should tell us that now is not the time to enact additional acid rain legislation.

2. Additional acid rain legislation is not supported by current scientific knowledge. The Interim Assessment of NAPAP concluded that, 1) contrary to once popular belief, there is no impending acid rain crisis, and 2) the current Clean Air Act is successfully controlling emissions of sulfur dioxide (SO_2) and nitrogen oxides (NOx). Indeed, the Interim Assessment issued in 1988 concluded that there were very few instances of damage to the environment from acid rain and that at present emission rates (and of course these rates will be reduced in the future by the current Clean Air Act) acid rain will have little or no effect on our environment. Proponents of additional acid rain legislation, therefore, must look to some other justification as the basis for their proposals, for current scientific knowledge lends them no support.

3. The cost of implementing additional acid rain legislation is economically unjustifiable at this time. The current acid rain proposals will yield only a short-term acceleration of the SO_2 emission decreases already mandated by the current Clean Air Act. Each of these proposals, however, entails several billions of dollars in yearly compliance costs. Even more, they will have staggering, negative impacts on utility rates, the Consumer Price Index (CPI), inflation, the budget deficit, employment, and U.S. industrial competitiveness -- impacts that have not even been quantified -- and will cause a diversion of funds from clean coal technology research and development. The known compliance costs and unquantified macroeconomic impacts of additional acid rain legislation bear no reasonable relationship to the uncertain and unquantified benefits of a mere acceleration of the rate of

emission decreases. This combination of enormous costs and uncertain benefits demonstrates that the current proposals are economically unwise, especially at a time when our economy is once again teetering on the verge of recession.

4. Science cannot yet provide a clear risk/benefit analysis on which to support additional acid rain legislation. In recent testimony before the Senate Environmental Protection Subcommittee, the Administrator of the EPA could not quantify what the benefits of H.R. 3030 would be nor could he predict when they might arrive. Last year a U.S. Justice Department brief filed in the United States Court of Appeals for the District of Columbia stated as follows: "... important scientific questions remain unresolved concerning acid deposition effects on forests, lakes, crops and building materials. Indeed, science cannot now accurately predict the effects that would result from source-specific emissions reductions of sulfur dioxide and nitrogen oxides on affected areas." These instances indicate exactly how unsettled science is at this time concerning the risks, if any, of proceeding under the current Clean Air Act versus the benefits of enacting additional, costly emission control measures. In light of the absence of any clear risk/benefit analysis, Congress should not be looking to purchase such a colossally expensive insurance policy or, at a minimum, should adopt an approach of flexibility and reasonableness rather than the current one of "command and control."

II. Regional Objections

Aside from the host of reasons demonstrating that additional acid rain legislation is not in our national interest, the current proposals are of particular concern to the South for several reasons:

1. The South is not, and is not likely to be, subject to the serious environmental problems to which these proposals are addressed:

   * NAPAP's Interim Assessment establishes that the South is not experiencing significant environmental problems due to acid precipitation, much less an environmental crisis.

   * NAPAP reports that the acidity of Southern rainfall is less than that of other areas of the country.

   * NAPAP concludes that no significant deterioration of Southern forests, lakes, or crops is likely to occur at present emission levels--levels that will, of course, continue to decrease under the Clean Air Act.

   * NAPAP reports that the acidification of surface waters is significantly more limited than first reported and

that almost all of the affected lakes are in the Northeast. This problem has been found to be strongly influenced by lake bed geology rather than rainfall acidity. Acidic lakes found in Florida are believed to be naturally acidic due to organic acids.

* Several other regional scientific studies confirm NAPAP's findings concerning the South.

2. <u>Implementation of additional emission controls in the Southern states will not affect the acid precipitation situation in the Northeast</u>:

* EPA has concluded that sources of sulfur dioxide and nitrogen oxide emissions can have little, if any, effect on acidic deposition in areas greater than 600 miles away.

* Other scientific studies have placed the range of significant dispersion at even less than 600 miles.

* Most Southern states do not meaningfully contribute to acid precipitation levels in other areas of the country, including sensitive areas of concern such as the Adirondack Mountains of New York.

* Problem areas inventoried by NAPAP seem to be concentrated close to large urban centers in the North, reinforcing the concept that significant emission contributions are from local sources rather than from long-range transport from the South.

3. <u>Current acid rain proposals unfairly burden the South</u>.

* The individual livelihood of Southerners would be unfairly threatened by acid rain legislation, while other regions with already-higher standards of living will enjoy lower compliance requirements and costs. Keep in mind these per capita income figures when considering acid rain legislation:
Mississippi - $9,187;
Alabama - $10,673;
Pennsylvania - $14,437;
Texas - $13,483;
New York - $16,050;
Massachusetts - $16,380.

* The idea of an emissions cap would have a devastatingly chilling effect on economic growth in the South, possibly reversing the positive business climate we have worked so hard to create. The emissions cap would pressure utilities to use yet undeveloped "pristine" technologies, eliminating fossil-fired

generation as an expansion option, expansion necessary to serve the region's growing demand. While "pristine" technologies such as wind and solar power seem prudent in concept, advanced generation alternatives prove to be unattractive when one considers their high installed cost and their technical risk due to lack of development. When Southern utilities chose the coal option in the past, they did not choose to pollute as some have stated; rather, they chose to provide reliable, affordable electricity. That is why electric rates in the South today consistently rank in the lower half of nationwide utility prices. Moreover, Southern coal units are not major acid rain contributors to the areas of concern.

* S. 1630 requires Southern states to make larger emission reductions, at higher costs, than a number of other more pollution-prone states. For example, according to a recent Edison Electric Institute study by Temple, Barker and Sloane, seven of the fifteen states having compliance costs of over $500 million per year are in the South. Three Southern states are among the ten states responsible for making 90 percent of the SO_2 reductions. Yet, if emissions were to be measured for efficiency in terms of SO_2 emitted per customer or SO_2 emitted per kilowatt-hour of delivered electricity, Southern states move way down the list of emission contributors, far enough down to be out of the top 1/4 contributors.

* The trading or selling of emission allowances optimistically predicted by the EPA is an empty hope since most compliance over-performers will choose to keep their own allowances rather than sell them. For regions expecting to grow and thus needing new generation, this is simply self-preservation through allowance self-banking to accommodate their own projected emission growth. Most Public Service Commissions nationwide support this attitude since they are charged with insuring the economic well-being of their state or region. EPA has even implied that the EPA should own and disburse excess credits to ensure trading traffic. Since these credits would be made possible through increases in individual ratepayers' billings, such a solution is inequitable and would penalize those who over control to free up allowances for trading.

4. <u>The "Air Toxics" Title of S. 1630 should not apply to U.S. utilities</u>.

* Title III of S. 1630 seeks to regulate the emission of nearly two hundred so-called "air toxics" or "hazardous air pollutants." Among the air toxics targeted by Title III are a number of metals and chemicals which are present naturally in coal and emitted as trace elements by coal-fired utility plants. Thus, Title III would result in the imposition of additional emission controls on utilities well beyond the emission controls already required by the "Acid Rain" Title of the bill--controls that would double to triple a utility's compliance costs for S. 1630. Given the fact that so little evidence is available, and that which is available reflects a very low risk associated with the trace amounts of elements emitted from utility power plants, mandating EPA to regulate utility emissions under the Title III of S. 1630 is premature at best. Instead, S. 1630 should require, as does S. 1490 and H.R. 3030, that EPA study the health risks associated with utility emissions of air toxics and, before further regulating these sources under Title III, make a positive finding of the necessity for additional controls.

Our current estimates are that Title III will force all coal-fired powerplants to have costly scrubbers; many others, if not all, will also have to have "baghouses."

5. <u>Promising Clean Coal Technologies should be permitted to work</u>.

* A number of southern utilities are sponsoring clean coal demonstration projects to be co-funded by the Department of Energy. For example, some of these projects involve the development of advanced scrubber technologies for SO_2 removal and the control of NO_x emission through innovations in the combustion of coal. These projects will take several years to complete. Unfortunately, these promising technologies that could further the use of Southern coal resources will not be eligible for the compliance extension granted to utilities utilizing clean coal technologies because they are not so-called repowering technologies. Therefore, despite the potential advantages of these clean coal technologies, and despite the funds already spent in perfecting them, S. 1630, as currently drafted, could limit their use by utilities. Provisions can be made for a compliance extension for all clean coal technologies, not just those that involve repowering.

6. <u>Compliance dates should be those provided for in the Administration's proposal</u>.

* S. 1630, as amended in the Environment and Public Works Committee, alters the program timing of the Administration bill by pushing forward twelve months the Phase I and Phase II sulfur dioxide emission control deadlines from December 31, 1995 and December 31, 2001 to January 1, 1995 and January 1, 2001, respectively. It makes little sense at this stage to undo the already stringent timetable developed by the Administration or to place unnecessary time and cost burdens upon Southern industries that will have to comply with the bill.

SUMMARY

The imposition of additional, <u>nationwide</u> emission controls at this time, especially in light of NAPAP's Interim Assessment and its upcoming Final Report in 1990, is environmentally unnecessary. The recent testimony of EPA's Administrator and the Justice Department's legal arguments only confirm this conclusion. But the current proposals are something much worse than scientifically unjustified, they are economically irresponsible, particularly when our global economic position is deteriorating. Additional emission controls will result in a host of potentially debilitating drains on the South's booming economy, negatives that will not be limited to electric rates. As utility rates rise, so will the price of goods and services of industries and businesses that rely on electricity; industries as divergent as metal shops and grocery stores. As these prices rise, the American consumers' standard of living will absorb the double blow of increased electric bills and increased costs of goods and services. In an effort to reduce expenses there is also a significant probability that thousands of jobs will be lost. Also, the South's momentum in areas of international competitiveness, such as textiles, will begin to falter under the weight of increased costs and decreased productivity. Clearly, these are costs the South cannot afford.

Requiring the South to incur these costs in the name of benefits that the EPA Administrator can neither quantify nor forecast will not significantly benefit our country, or any part of it, and the South should not be asked to make such a disproportionate, meaningless sacrifice.

MIDWESTERN OBJECTIONS TO CLEAN AIR ACT AMENDMENTS

I. General Objections

The Midwest shares in the general objections that have been voiced nationally in opposition to enactment of additional legislation at this time. These objections may be grouped into four basic categories:

1. Additional acid rain legislation should not be considered until NAPAP releases its Final Report. In 1980, Congress established the National Acid Precipitation Assessment Program ("NAPAP") to conduct a comprehensive 10-year research program to determine whether additional emission controls are necessary to address acid rain. NAPAP's Final Report is due in 1990. It is clear that were Congress to act now -- literally months before the Final Report is released -- it would be wasting the almost one-half billion dollars and years of research that have gone into NAPAP. And why? No new information or scientific conclusions have suddenly emerged to dictate such a radical change in Congress' 1980 game plan, and no abrupt deterioration of our environment has occurred in this "eleventh hour." Clearly, common sense should tell us that now is not the time to enact additional acid rain legislation.

2. Additional acid rain legislation is not supported by current scientific knowledge. The Interim Assessment of NAPAP issued in 1988 concluded that, 1) contrary to once popular belief, there is no impending acid rain crisis, and 2) the current Clean Air Act is successfully controlling emissions of sulfur dioxide (SO_2) and nitrogen oxides (NOx). Indeed, the Interim Assessment concludes that there are very few instances of damage to the environment from acid rain and that at present emission rates (and of course these rates will be reduced in the future by the current Clean Air Act) acid rain will have little or no effect on our environment. Proponents of additional acid rain legislation, therefore, must look to some other justification as the basis for their proposals, for current scientific knowledge lends them no support.

3. The cost of implementing additional acid rain legislation is economically unjustifiable at this time. The current acid rain proposals will yield only a short-term acceleration of the SO_2 emission decreases already mandated by the current Clean Air Act. Each of these proposals, however, entails several billions of dollars in yearly compliance costs. Even more, they will have staggering, negative impacts on utility rates, the Consumer Price Index (CPI), inflation, the budget deficit, employment, and U.S. industrial competitiveness -- impacts that have not even been quantified -- and will cause a diversion of funds from clean coal technology research and development. The known compliance costs and unquantified macroeconomic impacts of additional acid rain legislation bear no reasonable relationship whatsoever to the meager benefits of a mere acceleration of the rate of emission

decreases and that the current proposals are economically unwise, especially at a time when our economy is once again teetering on the verge of recession.

4. Science cannot yet provide a clear risk/benefit analysis on which to support additional acid rain legislation. In recent testimony before the Senate Environmental Protection Subcommittee, the Administrator of the EPA could not quantify what the benefits of H.R. 3030 would be nor could he predict when they might arrive. Still more recently, in 1989 a U.S. Justice Department brief filed in the United States Court of Appeals for the District of Columbia stated as follows: "... important scientific questions remain unresolved concerning acid deposition effects on forests, lakes, crops and building materials. Indeed, science cannot now accurately predict the effects that would result from source-specific emissions reductions of sulfur dioxide and nitrogen oxides on affected areas." These instances indicate exactly how unsettled science is at this time concerning the risks, if any, of proceeding under the current Clean Air Act versus the benefits of enacting additional, costly emission control measures. In light of the absence of any clear risk/benefit analysis, Congress should not be looking to purchase such a colossally expensive insurance policy or, at a minimum, should adopt an approach of flexibility and reasonableness rather than the current one of "command and control."

II. Regional Objections

Aside from the host of reasons demonstrating that additional acid rain legislation is not in our national interest, the current proposals are of particular concern to the Midwest for several reasons:

* Current legislative proposals do not provide sufficient flexibility for the Midwest. It is clear that if any of the current acid rain legislative proposals are enacted, the Midwest will be forced to use existing technology. And, as we are all aware, scrubbing is an extremely expensive control technology. Indeed, a single scrubber may cost $100 million or more, and capital costs for adding scrubbers to older plants can sometimes equal or even exceed the original plant investment. Even worse, increased dependence on scrubber technology will drain precious resources away from cost-effective, energy-efficient clean coal technologies that offer the nation a more cost effective permanent solution to acid rain.

* If additional controls are enacted, sources closer to the areas of concern should be targeted for Phase I reductions. Common sense and a host of scientific reports say that a ton of emissions reductions close to

the so-called affected areas is more important than a ton of emissions reductions hundreds of miles away.

* Additional acid rain controls will further increase the Midwest's competitive disadvantage. Without question, the largest share of compliance costs for additional acid rain legislation will fall upon the Midwest. This will place the Midwest at a further competitive disadvantage with other regions of the country.

* An emissions "cap" will stifle Midwestern growth. The idea of an emissions cap would have a devastatingly chilling effect on economic growth in the Midwest, possibly reversing the positive business climate it has worked so hard to create. The emissions cap would pressure utilities to use yet undeveloped "pristine" technologies, eliminating fossil-fired generation as an expansion option, expansion necessary to serve the region's growing demand. While "pristine" technologies such as wind and solar power seem prudent in concept, advanced generation alternatives prove to be unattractive when one considers their high installed cost and their technical risk due to lack of development.

* Proposed "allowance" programs are unrealistic and unfair. The trading or selling of emission allowances optimistically predicted by the EPA is an empty hope since most compliance over-performers will choose to keep their own allowances rather than sell them. For regions expecting to grow and thus needing new generation, this is simply self-preservation through allowance self-banking to accommodate their own projected emission growth. Most Public Service Commissions nationwide support this attitude since they are charged with insuring the economic well-being of their state or region. EPA has even implied that the EPA should own and disburse excess credits to ensure trading traffic. Since these credits would be made possible through increases in individual ratepayers' billings, such a solution is inequitable and would penalize those sources who over control to free up allowances for trading.

* The "Air Toxics" Title of S. 1630 should not apply to U.S. utilities. Title III of S. 1630 seeks to regulate the emission of nearly two hundred so-called "air toxics" or "hazardous air pollutants." Among the air toxics targeted by Title III are a number of metals and chemicals which are present naturally in coal and emitted as trace elements by coal-fired utility plants. Our current estimates are that Title III will force all coal-fired powerplants to have scrubbers; many others, if not all, will also have to have "baghouses." Thus,

Title III would result in the imposition of additional emission controls on utilities well beyond the emission controls already required by the "Acid Rain" Title of the bill--controls that would double to triple a utility's compliance costs for S. 1630. Given the fact that so little evidence is available, and that which is available reflects a very low risk associated with the trace amounts of elements emitted from utility power plants, mandating EPA to regulate utility emissions under the Title III of S. 1630 is premature at best. Instead, S. 1630 should require, as does S. 1490 and H.R. 3030, that EPA study the health risks associated with utility emissions of air toxics and, before further regulating these sources under Title III, make a positive finding of the necessity for additional controls.

* Since 1985, Congress has appropriated a total of $2.747 billion for the clean coal program. When that sum is combined with those invested by private entities, DOE estimates that a total of **$6.25 billion** will be spent on clean coal demonstration projects during the life of the program. The government-industry clean coal technology program is yielding promising results, and, in fact, clean coal technologies should be readily available soon that can achieve the same results of flue-gas desulfurization, or scrubbing, at a much lower cost. Supporters of the Clean Coal Technology Program in the Midwest are concerned about the limited role that clean coal technologies play in S. 1630, as amended by the Environment and Public Works Committee. Without changes, S. 1630 could slow or halt development of certain clean coal technologies. It would do this by denying compliance extensions to those companies that wish to retrofit clean coal technologies and whose research will not be complete in time for adequate consideration in so-called Phase I or Phase II of the compliance program established in S. 1630.

* S. 1630, as amended in the Environment and Public Works Committee, alters the program timing of the Administration bill by pushing forward twelve months the Phase I and Phase II sulfur dioxide emission control deadlines from December 31, 1995 and December 31, 2001 to January 1, 1995 and January 1, 2001, respectively. It makes little sense at this stage to undo the already stringent timetable developed by the Administration or to place unnecessary time and cost burdens upon Midwestern industries that will have to comply with the bill.

SUMMARY

The imposition of additional, <u>nationwide</u> emission controls at this time, especially in light of NAPAP's Interim Assessment and its upcoming Final Report in 1990, is environmentally unnecessary. The recent testimony of EPA's Administrator and the Justice Department's legal arguments only confirm this conclusion. But the current proposals are something much worse than scientifically unjustified, they are economically irresponsible, particularly when our global economic position is deteriorating. Additional emission controls will result in a host of potentially debilitating drains on the Midwest's struggling economy, negatives that will not be limited to electric rates. As utility rates rise, so will the price of goods and services of industries and businesses that rely on electricity; industries as divergent as metal shops and grocery stores. As these prices rise, the American consumers' standard of living will absorb the double blow of increased electric bills and increased costs of goods and services. In an effort to reduce expenses there is also a significant probability that thousands of jobs will be lost. Also, the Midwest's momentum in areas of international competitiveness will begin to falter under the weight of increased costs and decreased productivity. Clearly, these are costs the Midwest cannot afford.

Requiring the Midwest to incur these costs in the name of benefits that the EPA Administrator cannot quantify nor forecast will not significantly benefit our country, or any part of it, and the Midwest should not be asked to make such a sacrifice.

ENVIRONMENTAL
DEFENSE
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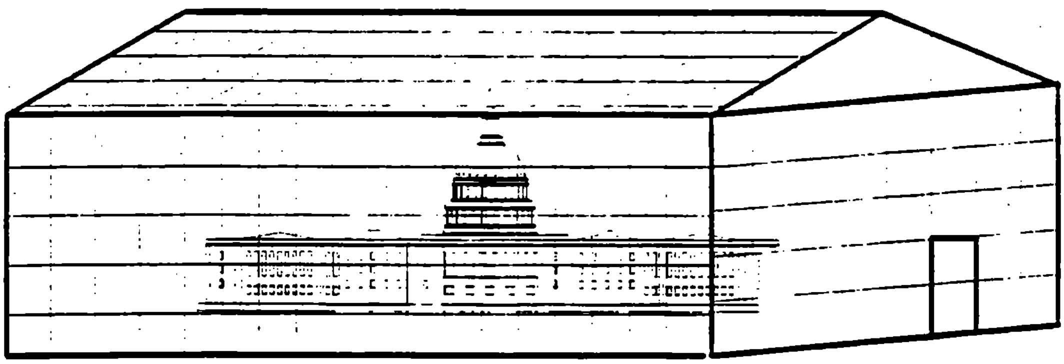
CO_2 and SO_2: Consistent Policy Making in a Greenhouse



ENVIRONMENTAL DEFENSE FUND
New York, New York

CO_2 and SO_2:

Consistent Policy Making in a Greenhouse

by

Daniel J. Dudek,
Alice M. LeBlanc,
and
Peter Miller

ENVIRONMENTAL DEFENSE FUND
New York, New York

January 1990

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EXECUTIVE SUMMARY

Overview

This past year has witnessed a resurgence of interest in problems of atmospheric pollution. Two broad scale atmospheric problems have dominated the news: acid rain and global warming. Each has engendered significant national and international policy debate, but they have not been addressed as linked problems. Instead, the constituencies supporting or opposing various policy initiatives have pursued very narrowly focused objectives. This narrowed vision is a primary source of the complex and conflicting mandates of the current Clean Air Act. The current momentum toward reauthorizing the Act should be viewed as a major opportunity for reform which should begin with the recognition of trade-offs among environmental objectives. Chief among these opportunities are SO_2 control strategies which would also reduce CO_2, the primary greenhouse gas.

This report identifies and estimates the CO_2 implications of alternative acid rain control strategies. The primary competing policy opinions under consideration are regulations requiring the use of specific control technologies such as flue gas desulphurization devices versus allowing each source to determine its least cost solution including overcontrol at a smaller number of plants. While each proposal has its CO_2 effects, the market incentives provided by emissions trading would produce a pattern of pollution control investments which maximizes the reduction of CO_2 discharges. If a proposal to regulate only 20 plants in the first phase, coupled with subsidies is adopted, it is doubtful whether either the allowance market or the attendant CO_2 reductions that it would spur would ever materialize. If the options assessed in this report are adopted and if the integrity of the market and its incentives are maintained, we expect a reduction of between 5.4-6.0% in utility CO_2 emissions otherwise expected to occur over the next 15 years. Each of the options analyzed -- interfuel substitution, cogeneration, demand management, and energy efficiency investments -- are economically and environmentally advantageous under emissions trading for acid rain control. The CO_2 reductions are a bonus.

In addition to this bonus, another important linkage exists, for the problems of global warming and acid rain share a key feature. For each, what matters is the total amount of relevant emissions -- CO_2 for global warming, SO_2 and NO_x for acid rain -- released to the atmosphere. Within broad geographic ranges, it makes little difference precisely where the pollutant reductions occur, as long as they do in fact take place.

This feature of both problems offers an opportunity to design strategies that achieve a "bottom line" of a defined overall reduction in pollutants, without requiring all sources to employ similar methods irrespective of their differing technological circumstances. The resulting flexibility can yield major cost savings for achieving a given environmental goal. By implementing this approach for acid rain now, we can demonstrate its viability in time to provide a proven tool for attacking the even more complex problem of global warming.

As the United States enters the decade of the 90's, will policy makers rise to the challenge of developing tools for a new era of pollution reductions or will regional factionalism continue to shackle the future? The rest of the world is looking to the U.S. for its response to global environmental problems. The Clean Air Act is the first best chance to demonstrate the resolve to reduce our share of greenhouse pollution. We do not need to wait for the development of grand international agreements before progress on reducing greenhouse gases can be made. The market based approach to controlling acid rain leads the way.

<u>Major findings</u>:

Using data from the U.S. Environmental Protection Agency, its contractors, the American Gas Association, and other sources, we estimate that enactment of an unconstrained emissions trading program for acid rain would cause utilites to emit 1.5 to 1.7 billion tons less CO_2 than they would otherwise discharge between 1995 and 2005. The cumulative reductions that would result from these antipated changes in utility behavior are estimated to be as follows:

	Reductions (million tons) CO_2 1995-2005
Switching from residual fuel oil to natural gas..............................	411 - 459
Increased use of cogeneration	424
Decreased use of electricity by consumers in response to minor rate increases	129
Conservation investments by utilities	729
Total projected decreases	1693 - 1741

At the same time, enactment of an emissions trading program would also prompt some individual utilities (or plants) to behave in ways that increase emissions, i.e., by adding scrubbers at some units and/or by burning certain types of low-sulphur coal that has lower energy content (sub-Bituminous coals). These increases are estimated to produce the following cumulative increase in utility CO_2 between 1995-2005:

	(million tons)
Added scrubbing	31 - 125
Sub-Bituminous coal use	10 - 19
Total projected increases	41 - 144

Combining the projected CO_2 decreases and increases provides a net total of CO_2 emission decreases for the decade between 1995 - 2005:

	(million tons)
Projected decreases	1693 - 1741
Projected increases	41 - 144
NET TOTAL DECREASES	1549 - 1700

This total represents a net CO_2 savings of 5.4% to 6% of all CO_2 emissions by utilities over that decade.

Conclusion

Regardless of any other changes influencing future emissions, emissions trading for SO_2 and NO_x will preserve the least cost path for CO_2 management. Emissions trading allows the use of whichever current or future pollution control techniques will reduce discharges most efficiently. As with coal switching versus scrubbing, natural gas substitution for residual fuel oil, and energy efficiency measures, there are ample opportunities to reduce both acid rain precursors and CO_2 simultaneously. Because emissions trading involves a market, it is extremely difficult to forecast actual outcomes. The best that can be done is to indicate what could happen. What new technologies, opportunities, or constraints will emerge over the 15 years assessed in this paper is uncertain at best. Whatever changes those years bring, we can be assured that an emissions market will adjust to the maximum benefit of both the economy and the environment.

1 OVERVIEW

This past year has witnessed a resurgence of interest in problems of atmospheric pollution. Two broad scale atmospheric problems have dominated the news: acid rain and global warming. Each has engendered significant national and international policy debate, but they have not been addressed as linked problems. Instead, the constituencies supporting or opposing various policy initiatives have pursued very narrowly focused objectives. This narrowed vision is a primary source of the complex and conflicting mandates of the current Clean Air Act. The current momentum toward reauthorizing the Act should be viewed as a major opportunity for reform which should begin with the recognition of trade-offs among environmental objectives. Chief among these opportunities are SO_2 control strategies which would also reduce CO_2, the primary greenhouse gas.

This report identifies and estimates the CO_2 implications of alternative acid rain control strategies. The primary competing policy options under consideration are regulations requiring the use of specific control technologies such as flue gas desulphurization devices versus allowing each source to determine its least cost solution including overcontrol at a smaller number of plants. While each proposal has its CO_2 effects, the market incentives provided by emissions trading would produce a pattern of pollution control investments which maximizes the reduction of CO_2 discharges. If a proposal to regulate only 20 plants in the first phase, coupled with subsidies is adopted, it is doubtful whether either the allowance market or the attendant CO_2 reductions that it would spur would ever materialize. If the options assessed in this report are adopted and if the integrity of the market and its incentives are maintained, we expect a reduction of between 5.4-6.0% in utility CO_2 emissions otherwise expected to occur over the next 15 years. Each of the options analyzed--interfuel substitution, cogeneration, demand management, and energy efficiency investments--are economically and environmentally advantageous under emissions trading for acid rain control. The CO_2 reductions are a bonus.

In addition to this bonus, another important linkage exists, for the problems of global warming and acid rain share a key feature. For each, what matters is the total amount of relevant emissions--CO_2 for global warming, SO_2 and NOx for acid rain--released to the atmosphere. Within broad geographic ranges, it makes little difference precisely where the pollutant reductions occur, as long as they do in fact take place.

This feature of both problems offers an opportunity to design strategies that achieve a "bottom line" of a defined overall reduction in pollutants, without requiring all sources to employ similar methods irrespective of their differing technological circumstances. The resulting flexibility can yield major cost savings for achieving a given environmental goal. By implementing this approach for acid rain now, we can demonstrate its viability in time to provide a proven tool for attacking the even more complex problem of global warming.

As the United States enters the decade of the 90's, will policy makers rise to the challenge of developing tools for a new era of pollution reductions or will regional factionalism continue to shackle the future? The rest of the world is looking to the U.S. for its response to global environmental problems. The Clean Air Act is the first best chance to demonstrate the resolve to reduce our share of greenhouse pollution. We do not need to wait for the development of grand international agreements before progress on reducing greenhouse gases can be made. The market based approach to controlling acid rain leads the way.

2 INTRODUCTION[1]

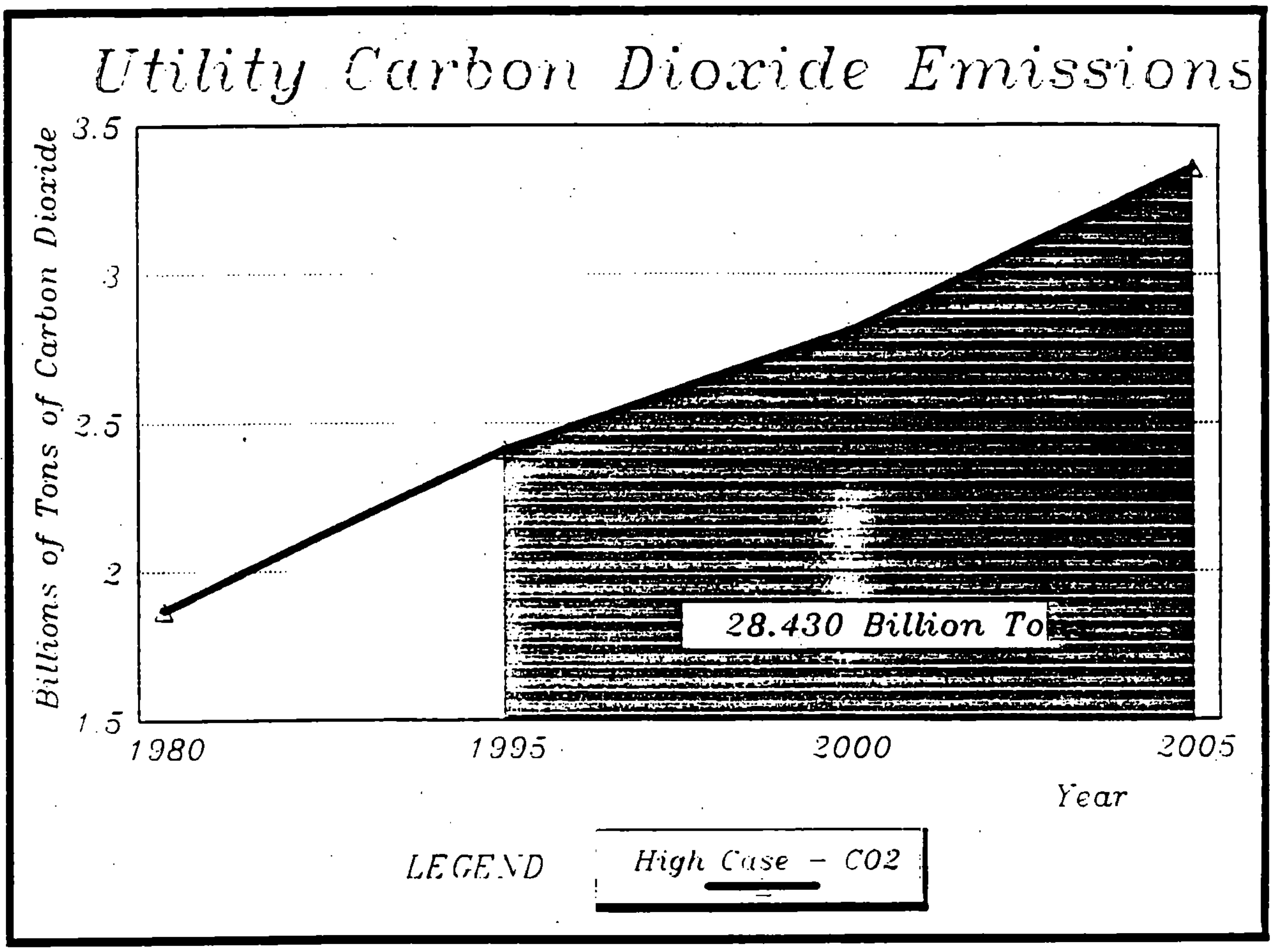
In the absence of a comprehensive U.S. approach, energy policy is actually made by the Environmental Protection Agency under its mandates from the Clean Air Act (CAA). Because the emission of many atmospheric pollutants are the result of energy production decisions, the regulation of sulphur dioxide (SO_2), nitrogen oxides (NO_x), particulates, etc. directly affects those decisions. In the simplest terms, controlling these pollutants changes the relative costs between alternative energy sources increasing the cost of those that produce larger discharges. These differential environmental control costs alter energy purchase and investment patterns changing both quantities of energy consumed and the method of production. Consequently, environmental policy influences energy production and use decisions more than any other factor except relative fuel prices as determined by market forces.

The last twenty years has witnessed a continual evolution of the CAA both in terms of the pollutants that it controls and in the policies used to effect that control. In general, however, management has proceeded on a pollutant by pollutant basis without regard for any cross pollutant effects. Ignoring these cross effects can have serious consequences for both the cost and performance of any environmental policy. This short paper will attempt to explore one particular set of pollutant trade-offs.

In the current debate over reauthorization of the CAA, one of the most hotly contested titles deals with acid rain. The Bush Administration has proposed an innovative emissions trading program to reduce SO_2 and NO_x, the precursors of acid deposition.[2] Many previous proposals relied upon the use of mandated controls such as flue gas desulphurization (FGD) to achieve reductions. The Bush proposal would allow affected sources to achieve reductions in any manner they chose including investment in over-control at other locations. Plants that can achieve reductions at lower cost are encouraged to produce excess reductions for transfer or sale to plants with higher reduction costs. Since the objective is to reduce emissions discharge as expeditiously and inexpensively as possible, it is critical to take advantage of the cost differences among plants and utilities to achieve these aims. Requiring one specific control technology, e.g. scrubbers, would obliterate the cost savings inherent in these plant differences. The current debate in Congress swirls around these two alternative methods of achieving reductions.

Since both of these policy alternatives would affect operations at the nation's fossil fuel fired electric generating stations, the relevant cross pollutant of concern is carbon dioxide (CO_2) emissions. As hotly debated as the acid rain policy is the issue of U.S. commitment to control the emissions of greenhouse gases causing global climate changes. On a global basis, CO_2 emissions are thought to account for roughly 50% of the expected warming. In the U.S. which accounts for 23% of global CO_2 contributions, roughly 30% of total CO_2 emissions originate from electric utilities. Figure 1 shows the growth in utility CO_2 emissions under EPA's base case forecast for high SO_2 emissions. This forecast assumes no national acid rain control program and continued low energy prices.

Figure 1. Utility CO_2 Emissions Under the High Base Case



The conventional wisdom is that action to reduce CO_2 emissions or even to damp their growth will be expensive. The main topic explored in this paper is the nature of the relationship between SO_2 and NO_x control on the one hand and CO_2 emissions on the other. Are there serendipitous gains in CO_2 reductions that could be achieved as a result of choosing one policy over another for acid rain control? If we are to expend resources controlling acid deposition precursors, why not increase the benefits of those expenditures by maximizing the opportunities for CO_2 reductions as well? Many of the options for reducing SO_2 emissions should also produce changes in CO_2 emissions since both gases are the by-products of fossil fuel combustion.

3 REDUCTIONS IN CO_2

Acid rain control expenditures can either increase or decrease CO_2 emissions depending upon the type of policy and the mix of control technologies. The policy choice matters because it may constrain control options available to affected sources. For example, it might limit interfuel substitution which could produce CO_2 savings. Over time these constraints would operate to stifle any incentive for innovation in pollution control technology as markets would have been foreclosed by regulators. Policy also matters because it is a significant determinant of cost which influences electricity demand and therefore atmospheric emissions including CO_2. In fact, this latter effect presents an interesting trade-off. The more expensive the acid rain control program, the greater the impact on utility rates, the greater the electricity demand reduction by customers, and the greater the CO_2 reduction from avoided energy production. However, the more expensive the acid rain program, the less likely it is to be politically feasible due to the more severe impact on the economy. Overall, least cost options tend to be CO_2 reducing. For example, when control technologies are mandated, there is no incentive for conservation by utilities. Not only is the acid rain program more expensive, but any CO_2 reductions are driven solely by electricity consumers' responses. Conservation is not tapped as an emissions reductions tool, even when it is the least cost method.

Since the impacts of SO_2 control have both positive and negative impacts on CO_2, it is important to assess cross-pollutant effects with a systematic accounting framework. The remainder of this paper develops this framework.

3.1 Interfuel Substitution

Some of the most direct CO_2 reductions under a flexible, market based acid rain control program could be produced as a consequence of interfuel substitution. Since fossil fuels differ in their carbon content, they differ in the amount of CO_2 produced during their combustion. Table 1 presents average carbon content for the primary fossil fuels and illustrates the potential for CO_2 reduction. For example, substituting 1,000 Btu from coal combustion with a 1,000 Btu from natural gas reduces CO_2 emissions by over 42%. Similarly, the substitution of natural gas for oil would reduce CO_2 production by over 28%.

TABLE 1. Carbon Dioxide Differences Among Fuels

Fuel	Carbon Content (gC/kBtu)	% CO_2 Reduced	% CO_2 Reduced
Coal	25.109		
Oil	20.256	19.33	
Natural Gas	14.454	42.44	28.65

SOURCE: Edmonds and Reilly, 1985.

While the calculations presented in Table 2 are straightforward, there is some uncertainty that these would be the exact reductions achieved when viewed from the vantage of creating a net reduction in greenhouse gas emissions. For example, as researchers have attempted to refine our understanding of the sources and sinks for methane (natural gas) attention has been focused on potential losses from pipelines and gas fields. If pipelines and gas fields leak, then using additional natural gas may increase fugitive methane discharges to the atmosphere. Since methane is a more potent greenhouse gas, the benefits of reducing CO_2 from interfuel substitution might be offset. Research into the sources of methane increases in the atmosphere is continuing. Theoretical considerations indicate that naturally occurring leakage from a gas field is lessened once the field is developed and tapped (Gold, 1988). Gas that is stolen or erroneously metered could also be confused with leaks in the distribution system (see section 4.3 for a more complete discussion).

Other factors which might alter the actual change in CO_2 produced as a result of interfuel substitution include any additional transportation of substituted fuels. For example, to the extent that nearby coals are replaced with more distant fuels, any CO_2 produced as a result of added transport should be netted out. In practice, such changes may be very difficult to estimate as any increased transport would occur either by rail or water each with very different CO_2 implications.3

3.1.1 Residual Fuel Oil to Natural Gas

The amount of substitution of natural gas for residual fuel oil was estimated based on the American Gas Association's (AGA) and Gas Research Institute's (GRI) forecasts of fuel prices and the estimated value of SO_2 emissions permits assuming the Administration's proposed acid rain legislation is passed. The difference in the forecast prices of residual fuel oil (resid) and natural gas was used to calculate the cost per ton of SO_2

reduction achieved by fuel switching4. This price difference was compared to the value of a permit. No consideration was given to the capital costs involved in switching, which should be relatively low, or to the value of NO_x reductions that would also be produced from the substitution. The asuumption is that most, if not all, of the resid-fired plants are capable of firing natural gas and that they will have access to gas supplies.

Table 3 presents the results of these calculations. The cost effective SO_2 emissions rate is the emissions rate at which the cost per ton of SO_2 reduced by fuel switching equals the expected market value of a permit. At a SO_2 emissions rate above this rate, the utility can switch from resid to natural gas and achieve reductions at a lower cost than by buying permits. This analysis uses the equilibrium market values predicted by the EPA and ICF in their analysis of the Administration's proposal. This ignores any economic incentive to bank emissions over time. Given this opportunity and the time cost of capital, we would expect the equilibrium values of SO_2 permits to be monotonically increasing over time unless a radically new control technology shifts the supply curve and reduces the marginal cost of control. The total mmBtus of heat generated by resid burning utilities with SO_2 emissions rates above the cost effective rate were derived from the NURF85 data base.5 Total mmBtus generated from oil were obtained from the EPA high emissions base case forecast.

If the relative price changes forecast by AGA materialize, then resid will be more expensive than natural gas by 1995. On that basis alone, one would expect natural gas to replace resid. GRI, however, expects gas prices to remain above residual fuel oil prices. Nonetheless, incentives to switch to natural gas are provided under emissions trading. To the extent that excess SO_2 reductions are more valuable than estimated by the EPA analyses of H.R. 3030 (S.1490), cost-effective substitutions of natural gas for resid would be relatively greater not only to meet SO_2 control obligations, but also to produce revenue from allowance sales. Another uncertainty in this analysis is natural gas prices. To the extent that gas substitution becomes aggressively exploited as an emission reduction strategy, natural gas prices could rise as a result of increased demand if supplies do not expand. Natural gas supplies are currently tightest in the Northeast. However, gas storage could overcome capacity restrictions while pipeline capacity is being expanded.

TABLE 3. Substitution of Natural Gas for Residual Fuel Oil

	AGA PRICE FORECASTS			GRI PRICE FORECASTS		
	1995	2000	2005	1995	2000	2005
Total Oil Use (Million mmBtus)	2070	2190	1720	2070	2190	1720
Cost-Effective SO_2 Emissions Rate (lbs/mmBtu)	0.0	0.0	0.0	0.68	0.026	0.46
Affected mmBtus (above cost effective emissions rate) (Millions)	2070	2190	1720	1556.64	2183.43	1419.00
CO_2 Reductions (millions of tons/year)	46.58	49.28	38.70	35.02	49.13	31.93

Cumulative CO_2 Reductions 1995-2005 --
411.44 - 459.60
million tons

Regardless of relative prices, provisions of S.1630 support substitution to natural gas by accommodating any emergency interruptions of gas supplies without any emission penalties if resid is used temporarily. Under these provisions (Section 405(h)), owners of plants using primarily natural gas can receive additional allowances from EPA to cover any SO_2 generated from switching to residual fuel oil during emergency weather conditions. By anticipating the potential operating conditions that this class of plants would face, S.1630 encourages natural gas substitution and the resulting CO_2 reductions.

3.1.2 Natural Gas Penetration Against other Fuels

A number of SO_2 control options which use natural gas have been identified. For example, gas reburn alone and gas reburn combined with sorbent injection would achieve about a 9% CO_2 reduction for a 20% natural gas substitution in existing large coal-fired units (AGA, 1989). Most current studies of the relative economics of alternative SO_2 and NO_x control technologies conclude that natural gas is likely to be too expensive to expect these alternatives to be very widespread (ICF, 1989). Nonetheless, these expectations about natural gas substitution are based upon future relative fuel prices, notoriously difficult quantities to predict. The critical point is that a flexible emissions trading program would not preclude the use of such options if **they became economic at a later date.**

Another indication of the potential for natural gas substitution is presented in a DOE study of fuel substitution without any new capital investment (DOE, 1989). In that study DOE estimated that roughly 6 billion mmBtu of coal could be replaced with natural gas. If indeed no new capital investments would be required, and if gas supplies were not constraining, this substitution would reduce cumulative CO_2 emissions by 2.44 billion tons in the 1995-2005 period. Clearly, gas supplies and prices would be the critical factors in determining how much of this substitution occurred.

Another longer run possibility for natural gas substitution under the acid rain titles of proposed legislation is offered by the repowering provisions. Converting large coal-fired boilers to 100% natural gas is estimated to reduce CO_2 emissions by 43%. Combined cycle conversion would increase this reduction to 64% (AGA, 1989).

3.2 Cogeneration

There are two types of CO_2 reductions that result from the replacement of standard electric utility generation by cogeneration. The first is a result of fuel switching if the fuel used by the electric utility has a higher CO_2 emissions rate than the fuel used by the cogenerator. The second type of reduction is the result of greater efficiency in the cogeneration unit in the production of both electricity and steam.

Estimates of new cogenerated and small power electricity were obtained from a report entitled "Background Documentation for 1989 Base Case Forecasts, Final Report" prepared for the EPA by RCG/Hagler Bailly. The difference between the new cogenerated electric power forecasts in the high and low emissions scenarios was taken as an estimate of additional cogeneration that would occur along with the Administration's proposed acid rain legislation. Because the legislation would cause electricity rates to increase and would require SO_2 emissions permits to be obtained for new electric utility capacity, it would stimulate development of new cogeneration capacity by industrial users who face higher rates and would strengthen a preference in utilities to buy new capacity from outside.6

The differences in forecasted electricity obtained from new cogenerated sources in the two scenarios were multiplied by 90% on the assumption that 10% of these estimates represent new small power sources that are not cogeneration units. The results of this calculation are the numbers listed as "new kwh cogenerated" in Table 5.7

Total CO_2 reductions from cogeneration are calculated by first adding the CO_2 emissions from the production of electricity in coal fired electric utility power plants and the CO_2 emissions from industrial processes using regular industrial boilers to obtain total CO_2 emissions from the energy production that the cogenerated energy is replacing. Subtracting the total CO_2 emissions of the cogeneration facilities produces the estimate of CO_2 reductions attributable to cogeneration.

TABLE 4. CO_2 Reductions due to Cogeneration8

	1995	2000	2005
New KWH Cogenerated (billions)	18.0	74.7	114.3
CO_2 Generated by Electric Utilities from Coal, displaced by Cogeneration (million tons)	18.18	75.45	115.44
CO_2 Generated from Industrial Processes, displaced by Cogeneration (million tons)	21.78	136.01	208.11
Total CO_2 Displaced by Cogeneration (million tons)	39.96	211.46	323.55
CO_2 Generated by Cogeneration from Coal and Gas (million tons)	27.68	166.90	255.37
Annual Net CO_2 Reduction Attributable to Cogeneration (million tons)	12.28	44.56	68.18

Cumulative CO_2 Reduction 1995-2005 -- 423.92 million tons

The offset requirement for new SO_2 sources would increase the relative costs of coal-fired cogenerating plants. Coal-fired capacity is expected to be 30% of expected increases in 1995 and

50% thereafter. After 2000 when offsets would have to be secured to maintain the national SO_2 cap, allowances are expected to cost between $650-$771 per ton. Independent power producers possess a number of significant cost advantages which should allow them to easily absorb these added costs. Of course, some concern has been expressed that independent power producers (IPPs) would be shut out of the market by anti-competitive behavior on the part of utilities, the main allowance holders. To combat these perceived problems, several policy modifications have been either proposed or introduced. S.1630 would withhold 2% of the allowance allocation in an Administrator's reserve which would be sold to sources unable to purchase allowances in the market at a fixed price of $1500 per ton. An alternative which has received wide discussion is to auction annually 5% of allowance allocations. This alternative would also serve a price discovery function and reduce uncertainties about allowance values. In any event, the offset provisions will not pose a barrier to the continued penetration of cogeneration.

3.3 Electricity Demand Response

One of the most easily quantified CO_2 reductions would stem from the reduction in electricity demanded as utility rates rise in response to SO_2 control costs. The strength of this response depends both upon the cost of the control program (and therefore the size of the rate hikes) and the responsiveness of demand (the price elasticity of demand). Another issue in the estimation of this effect is any time lag between the rate hikes and demand response.

Estimates of the long run price elasticity of demand are at best uncertain. A fairly recent survey of elasticity analyses (Bohi and Zimmerman, 1984) published a "consensus" estimate for the residential demand sector, but found that estimates for the industrial and commercial sectors were too few and varied to permit identification of a similar "consensus" estimate. For example, while the survey found 20 studies that estimated the price elasticity of demand for the residential sector, there were only 2 for the commercial sector, and 6 for the industrial sector. The "consensus" estimate for the residential sector was -0.7, i.e. a 1% price increase would produce a 0.7% reduction in the quantity demanded. The estimates for the "commercial" sector ranged from -1.05 to -4.56 while estimates for the industrial sector ranged from -0.12 to -3.55. Despite the uncertainty regarding elasticity estimates for the commercial and industrial sectors, the consensus opinion is that they are more elastic than those for residential demand. In part, the uncertainty in price elasticities is compounded by the need to produce an estimate for the nation as a whole as responsiveness also varies across regions as well as sectors. The long run elasticity used in Table 5 was -0.85 in part to account for greater responsiveness in the commercial and industrial sectors.

The potential for lags in response time also complicate the analysis. Electricity consumption decisions are conditioned, in part, by the efficiency of various capital equipment whether appliances or machinery. In the short run, consumers may have very limited options in response to price increases. This is not to say that they are nonexistent as simply devoting more attention to use decisions and patterns can reduce consumption. However, over the long run, adjustments can also include investment in complementary goods such as more energy efficient appliances.

Table 5 shows the effect of forecast electricity rate increases on demand for electricity and on CO_2 emissions resulting from electricity generation. Price increases were taken from ICF's analysis of the Administration's proposed acid rain legislation. Rate hikes from that report were adjusted upward to reflect the percent change in real terms from rates in 1988. The short-run elasticity of demand for electricity of -0.25 was used to estimate the demand response in order to avoid double-counting with the conservation investment analysis which follows. It was also assumed that the reduction in electricity consumption displaced electricity generated at coal burning facilities. To the extent that reduced demand displaces natural gas fired peaking units first, these estimates are biased upwards by the difference in CO_2 between coal and natural gas.

Although the Wise Bill (H.R. 3211) is substantially more expensive than S.1630 at $3.0 billion in 1995 and $5.8 billion in 2000 due to the emphasis on control technology and subsidies, electricity rate hikes are comparable. ICF forecasted national average utility rate increases of 1.8% in 1995 and 1.7% in 2000. CO_2 reductions are consequently slightly lower although comparable on the basis of demand response (see Section 4.1 for other CO_2 implications).

TABLE 5. Effect of Higher Electricity Prices

	Short	Run	Elasticity	Long	Run	Elasticity
	1995	2000	2005	1995	2000	2005
% Price Increase	0.23	1.70	1.95	0.23	1.70	1.95
Electricity Demand (billions kwh)	3080.7	3524.0	3957.6	3080.7	3524.0	3957.6
Demand Change (billions kwh)	-1.771	-14.977	-19.293	-6.023	-50.922	-65.597
Demand Change (billion mmBtu)	-0.018	-0.150	-0.193	-0.060	-0.509	-0.656
CO_2 Change (million tons/year)	-1.79	-15.13	-19.49	-6.08	-51.43	-66.25

Cumulative CO_2 Reductions 1995-2005 --
128.85 - 438.00 Million Tons

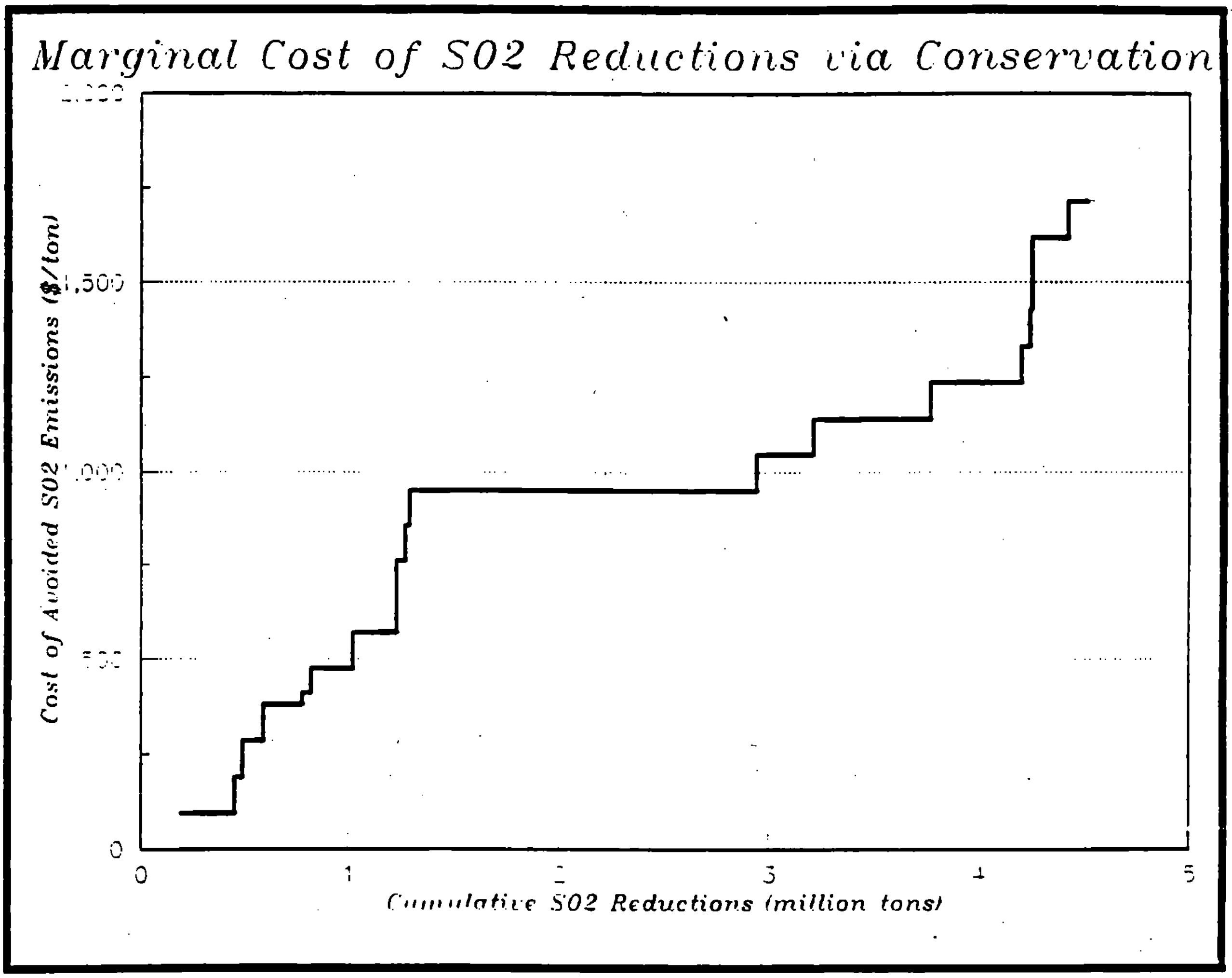
3.4 Energy Conservation Investments

The Administration's proposed acid rain legislation will allow utilities to invest in conservation programs as a cost effective SO_2 emissions control measure. To the extent the programs are successful, they will result in reduced CO_2 emissions as well. Examples of cost-effective conservation measures include increasing the efficiency of residential appliances such as refrigerators and freezers, removing excess fluorescent lighting and reducing air flow rates in commercial spaces, and installing more efficient lighting and motors in the industrial sector.

In order to estimate the amount of conservation that can be induced as cost effective SO_2 emissions control, two cost curves were developed to determine feasible conservation levels. The first is the marginal cost per ton of SO_2 emissions reductions under the Administration's proposal plotted against total amount of reduction below 1980 levels.9 As would be expected, marginal cost increases as more tons of SO_2 emissions are eliminated.

The second curve represents the marginal cost of conservation measures per ton of SO_2 emissions reductions plotted against total amount of reductions below 1980 levels. This curve was derived as a weighted average of regional conservation cost curves from New York state, the Pacific Northwest, and the Mid-west from a set of engineering-economic analyses. Each of these curves represents the maximum kwh saved for a given level of investment per kwh.[10] These curves were translated into total tons of SO_2 reduced and dollars per ton of SO_2 reduced using the assumption of a 2.0 pounds per mmBtu SO_2 emissions rate and a standard electric utility heat rate of 10,000 Btus/kwh. A 2.0 lb/mmBtu SO_2 emissions rate is the average emissions rate for all coal to be burned under the proposed legislation, as estimated by ICF.

Figure 2. The Supply of SO_2 Reductions from Conservation



The two curves were then compared for each of the three years (1995, 2000 and 2005) to find the point at which the following two conditions hold: 1. the marginal cost of conservation measures per ton SO_2 reduced equals the marginal cost of other SO_2 control measures -- i.e. the marginal costs on the two curves are equal and 2. total tons SO_2 reduced from both curves equals the mandated level of SO_2 reductions. This result is equivalent to determining the level at which the conservation programs are cost effective SO_2 control measures.

Once this level was determined, the CO_2 reductions for the kwh saved by conservation were calculated using the standard CO_2 emissions rate for coal and the standard heat rate for the electric utility. It was assumed that the conservation measures displace the use of coal, the dominant fuel consumed by the nation's electric utilities. To the extent that more expensive sources of electricity such as natural gas peaking units are eliminated through conservation first, this analysis overstates the SO_2 and CO_2 reductions.

TABLE 6. Effect of Conservation Investments in Reducing CO_2

	1995	2000	2005	2010
Marginal Cost of SO_2 Emission Reductions ($/ton)	$120	$500	$500	$500
Potential Electricity Savings from Conservation (GWh/year)	32,214	86,283	96,672	108,313
Potential SO_2 Emissions Reductions from Conservation (million tons)	0.35	0.91	1.02	1.15
Potential CO_2 Emissions Reduced from Conservation (million tons)	32.54	87.15	97.64	109.40

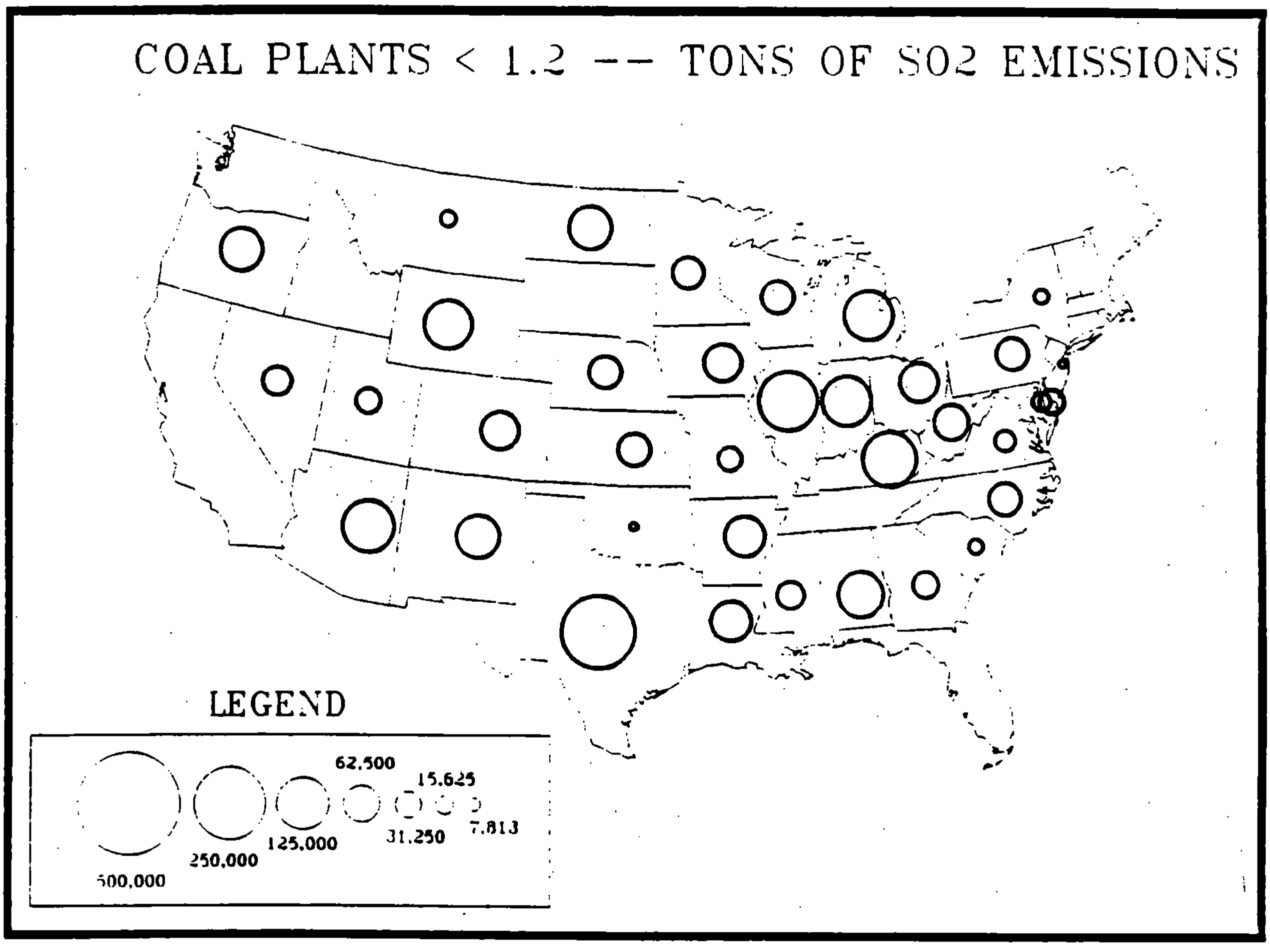
Cumulative CO_2 Reductions 1995-2005 -- 728.62 MILLION TONS

There are two conditions which must be met for these conservation benefits to be realized. The first is the adoption of the emissions trading program for acid rain. Without a system which credits conservation investments with the reductions they produce, conservation remains an opportunity without motivation or incentive. The second condition is the removal of any remaining institutional barriers against conservation investments. This latter condition is more difficult to evaluate. However, one potential remedy may be to increase the incentives created by the Clean Air Act.

One possibility for the creation of new incentives would be to create a pool of bonus allowances which would be available to sources within states that adopted programs designed to encourage conservation investments. Examples of such programs include least cost planning, incentive rate of return, and energy supply bidding. One potential source of the bonus allowances could be the allocations made to the clean plants under S.1630. Under that proposal, each clean plant would receive allowances equal to 120% of its baseline (defined as its average 1985-87 fuel use) times the lesser of its allowable 1985 emissions rate or its actual 1985 emissions rate. Alternatively, 20% of those allowances could be held back to form the bonus pool. As Figure 3 shows such a program would involve nearly every state and thus would not be inherently unfair in redistributing allowances. This bonus pool would serve as a powerful additional incentives to the adoption of programs which would further encourage conservation investments.

Other measures to increase the incentives for energy efficiency investments could be introduced into the CAA. For example, the revenues generated by S.1630's 2% allowance withholding could have redistribution limited to sources in those states in which conservation programs exist. This same stricture could be applied to revenues from any auction of allowances as well. These added incentives could insure that the substantial emissions reductions available through energy efficiency investments are tapped in fact.

Figure 3. Regional Distribution of Emissions from Coal-Fired Plants Below 1.2 lbs SO_2/mmBtu



4 INCREASES IN CO_2

In order to properly estimate the effect of alternative acid rain control policies upon greenhouse gas emissions, any potential source of emission increases must also be assessed. Certainly, relative to no control scenarios, investments to control acid rain precursors will affect CO_2 emissions as energy production and use decisions are altered.

4.1 Scrubbing SO_2

The use of flue gas desulphurization, or scrubbing, as a SO_2 emissions control measure increases CO_2 emissions primarily because extra energy in required to operate the scrubbers. The extra energy is obtained from additional coal burning which results in higher levels of CO_2 emissions for the same amount of electricity generation. In addition, some CO_2 is produced in the reaction of the limestone agent with SO_2. The range of the total increase in CO_2 emissions attributable to scrubbing is from 2% to 6%, with a probable average of 4%. (Source Memo from Bruce Braine, ICF to Rob Brenner, EPA December 1988.)

Assuming a 4% increase in CO_2 emissions as a result of scrubbing, the following table shows the extent of additional CO_2 emissions under the Administration's proposed acid rain legislation. Estimates of new scrubbing capacity come from the "Economic Analysis of Title V of the Administration's proposed Clean Air Act" prepared by ICF for the EPA. The total increase in CO_2 over the period from 1995 to 2005 represents about one tenth of one percent of the total CO_2 emissions from electric utilities forecast in that time period under the high emissions base case.

TABLE 7. Effect of New Scrubber Capacity on CO_2 Emissions under the Administration's Proposal

	1995	2000	2005
Change in Scrubber Capacity (GW)	.5	22.0	22.0
Total New Gwh Scrubbed	2,269	99,829	99,829
Increase in CO_2 Emissions (Million tons)	.09	4.03	4.03

Cumulative CO_2 Increase 1995-2005 -- 30.48 Million tons

In contrast to the estimates presented above, more new scrubbing capacity would come on line as a result of alternative legislation, such as the Wise Bill, that mandates the use of scrubbers as a SO_2 control measure. An examination of the effects of the Wise Bill during the period 1995 to 2005 indicates an addition of almost 125 million tons of CO_2 emissions resulting from increased scrubbing (ICF, 1989). The freedom of choice in SO_2 control strategy allowed under emissions trading would clearly lead to fewer additions to CO_2 emissions from new scrubbing capacity.

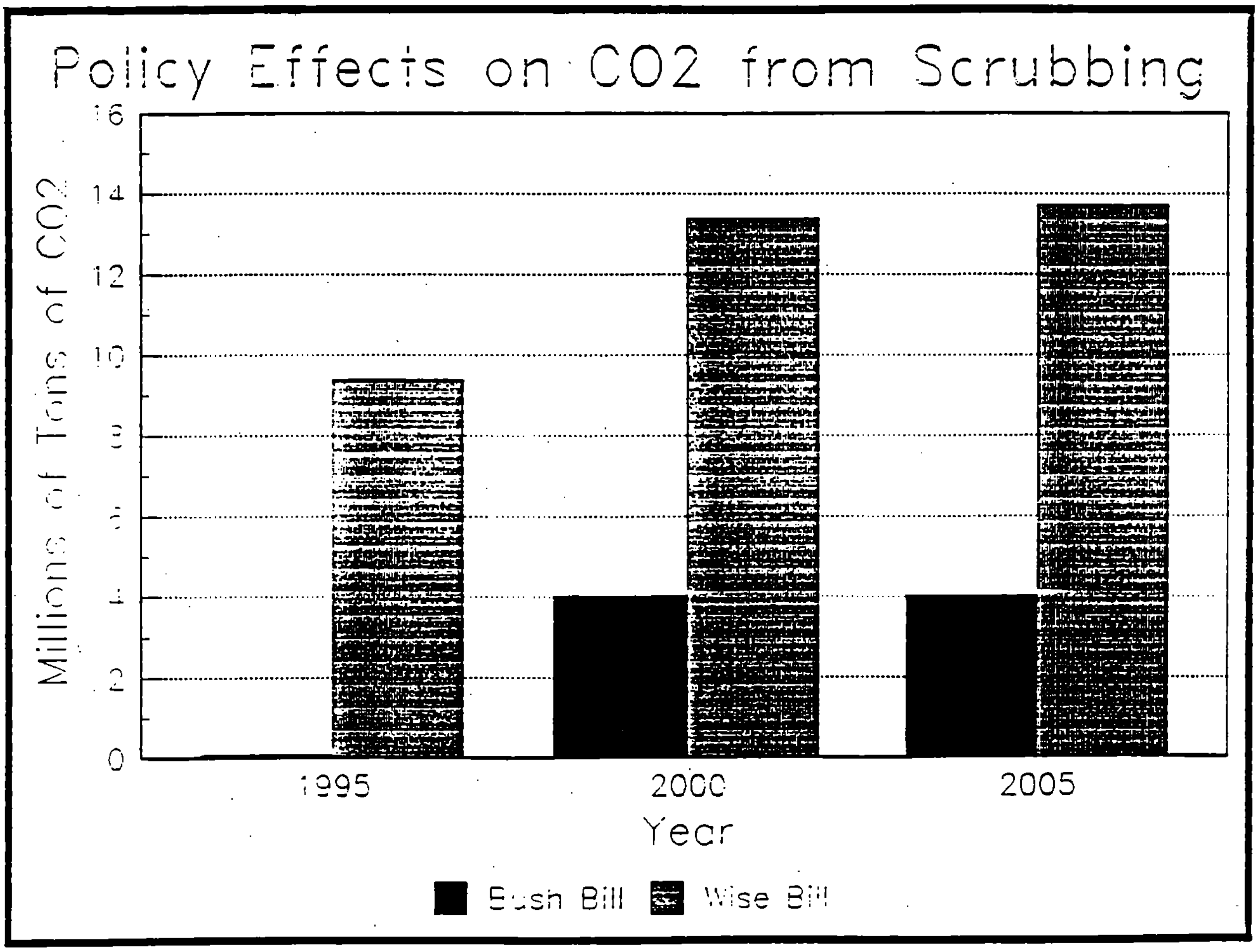
TABLE 8. Effect of Scrubbing on CO_2 Emissions Wise Bill

	1995	2000	2005
Change in Scrubber Capacity (GW)	51.2	73.0	74.9
Total new Gwh Scrubbed	232,319	331,251	339,872
Increase in CO_2 Emissions (Million tons)	9.39	13.38	13.73

Cumulative CO_2 Increase 1995-2005 -- 124.7 Million Tons

The Wise Bill (H.R. 3211) would require the top 20 SO_2 emitting powerplants in 1985 to reduce SO_2 emissions by 90% through the use of flue gas desulphurization devices. These Phase I reduction requirements would be augmented by a second phase during which all sources above 75 megawatts capacity would have to meet a 1.2 lb SO_2/mmBtu requirement. In each phase, subsidies would be provided to utilities employing scrubbers to meet their control obligations. As Figure 4 illustrates, these provisions would lead to a dramatic increase in scrubbing and CO_2. Furthermore, the actual increase in CO_2 is likely understated since the Wise Bill provisions would probably prevent the emergence of an allowance market. Other proposals that target 20 plants in Phase one and legislate a subsidy are under discussion in the Senate. They are likely to produce a CO_2 result similar to the Wise Bill.

Figure 4. CO_2 from Scrubbing Under Alternative Acid Rain Proposals



4.2 Switching to Fuels with Lower Energy Content

With the enactment of acid rain legislation that allows flexibility in choice of control methods, it is expected that some utilities will switch to the use of coal with a lower sulphur content. Some of the switching will occur between high sulphur and low sulphur bituminous coals from Appalachia. This substitution will have little effect on CO_2 emissions as there is little variation among bituminous coals. However, some Mid- Western utilities will switch from high sulphur bituminous coal mined in Appalachia to low sulphur sub-bituminous coal from more distant Western areas. Because sub-bituminous coal has on average a higher moisture content than bituminous coal, it can cause a utility's heat rate to rise and result in more coal burned per unit of electricity generated. The estimated increase in CO_2 emissions resulting from a switch from bituminous to sub-bituminous coal is 2%.

ICF's analysis of acid rain control technologies assumes that no sub-bituminous coal can be used in boilers designed for bituminous coal, although their assessment of the Administration's acid rain proposal notes that 40 to 50 million tons per year of sub-bituminous coal could penetrate the bituminous market. Data Resources Inc. (DRI), on the other hand, estimates that 29 million tons a year in Phase 1 and 25 million tons per year in Phase 2 will represent a switch from high sulphur bituminous coal to low sulphur sub-bituminous coal. Based on these forecasts Table 9 displays estimates of additional CO_2 emissions. The high end of the range of cumulative CO_2 increases assumes the high end of ICF's estimates of sub-bituminous market penetration for this entire decade.

TABLE 9. Effect of Coal Switching on CO2 Emissions

	DRI FORECAST 11			ICF FORECAST
	1995	2000	2005	2005
Switch to Sub-bituminous Coal (Million tons)	29	25	25	40-50
Efficiency Loss (Million tons of Coal)	0.58	0.50	0.50	0.8-1.0
Increase in CO_2 Emissions (Million tons)	1.12	0.96	0.96	1.54-1.92

Cumulative CO_2 Increase 1995-2005 -- 10.01 - 19.20 Million Tons

4.3 Potential Effects on Other Greenhouse Gas Emissions

Leakage of methane (natural gas) in the production, transmission and distribution processes is an issue that should be addressed because methane is a far more potent greenhouse gas than CO_2. Leakage occurs naturally in gas fields as a result of pressure exerted by the gas. Production, by removing some of the gas, reduces the pressure and the naturally occurring leakage. However, production equipment is another source of leakage. Unfortunately, little research has been conducted to measure the overall effect of production on leakage.

Leakage also occurs in the transmission of gas through pipelines and its distribution in individual customer grids. The magnitude of this leakage appears to be related to the age and material composition of the transmission and distribution systems. While the leakage is difficult to measure, it is clear that the amount of "unaccounted for " gas in the United States also includes theft, measurement inaccuracies caused in part by meter sensitivity to temperature and variations in gas purchase and sale billing dates.

Several studies and surveys have recently been conducted to estimate the extent of methane leakage worldwide and in the U.S. An "Engineering Technical Note" by the American Gas Association dated November 1989 estimates, based on a survey of members, that 0.06% is emitted in transmission and 0.28% in distribution. In addition, the AGA estimates 0.2% is lost in production. The Interstate Natural Gas Association of the U.S. estimates that transmission pipelines account for emissions of 0.13%.

"Methane Leakage from Natural Gas Operations" reports the results of an investigation by the Alphatania Group of Sweden in August 1989. The report presents information on gas leakage in the U.S., Canada, Japan and 10 European countries. It concludes that there is no justification for estimating methane leakages from the gas industry worldwide at more than 1% of supply and that even this figure is regarded by many as too high. It also states that there is strong evidence that the only significant methane leakage occurs in older distribution systems found in some countries. Based on the countries surveyed, the following estimates are made for methane leakage: Production 0 to 0.2%; Transmission 0 to 0.13%; New distribution systems 0.03 to 0.3%; and Old distribution systems up to 1%.

The Netherlands Energy Research Foundation presented a study in Paris in June 1989 entitled "CH4/CO Emissions from Fossil Fuels Global Warming Potential." The study addresses whether fuel switching strategies to mitigate the green house effect would be affected by methane leakages. It concludes that global warming differences in the burning of oil and coal as opposed to gas would be offset by methane leakages if they occurred at the high levels of 9 to 13%.

It is difficult to compare the potency of methane and CO_2 as greenhouse gases because of complexities involved in modeling and forecasting their effective lifetimes in the atmosphere. However, it is possible to compare methane leakage from additional natural gas use brought about by acid rain legislation to coal bed methane leaked in the coal mining process. If we assume that methane leakage from the production, transmission, and distribution of natural gas is 0.5% and that on average 19 cubic meters of methane is leaked per ton of mined coal, the methane leakage from coal mining is approximately 7 times that from natural gas use on an energy equivalent basis. Of course, nothing in this comparison accounts for the fact that emissions from both sources could be controlled.

5 CONCLUSIONS

This report has identified major interrelationships between SO_2 management decisions and CO_2 consequences. Table 10 summarizes the estimates for CO_2 reductions and increases. **The** cumulative totals indicate that acid **rain control provides a serendipitous opportunity to eliminate between 5.4-6.0% of all utility CO2 emissions over the decade 1995-2005.** However, not all acid rain programs are equal in their incentives to simultaneously reduce both SO_2 and CO_2 emissions. Only the market-based approach embodied in emissions trading will give affected sources the flexibility to choose among the emission control options assessed in this report. Programs which force the adoption of one technology over another, particularly those proposals which would require the use of scrubbers, would forego major CO_2 reduction opportunities and cause increased CO_2 emissions. **The major unspoken policy question surrounding the acid rain debate is whether the U.S. should capture these CO_2 benefits.** When set against the backdrop of ongoing international discussions concerning climate change policy and the criticism that the U.S. has received on this issue, it is difficult to understand why the relationship between SO_2 and CO_2 has been ignored. The U.S. should strive to adopt an acid rain program that incorporates incentives to reduce SO_2 emissions most efficiently. Further, given increasing concerns about global climate change, that program should be designed to maximize opportunities for CO_2 reductions as well. Is the U.S. so wealthy that we can choose the most expensive approach to solving the acid rain problem, and, at the same time, increase the cost of any ultimate policy action on CO_2?

TABLE 10. The CO_2 Balance Sheet

SOURCE of REDUCTIONS	CUMULATIVE AMOUNT (mm tons)	SOURCE of INCREASES	CUMULATIVE AMOUNT (mm tons)
Resid to Natural Gas	411.440-459.600	Added Scrubbing	30.480-124.700
Cogeneration	423.920	Sub-Bituminous Coal	10.010-19.200
Demand Response	128.850		
Conservation	728.620		
TOTAL	1,692.78-1,740.99		40.580-143.900

Cumulative CO_2 Reductions 1995-2005 --
1,548.88 - 1,700.41 Million Tons

Another way to understand the potential magnitude of these CO_2 effects is to compare them with the CO_2 implications of the energy and emission futures that EPA has developed as baselines from which alternative policies can be evaluated (EPA, 1989). The base case analysis produced by EPA this year differs sharply from prior practice in that two alternatives are presented; one scenario with high SO_2 emissions and an alternative with lower emissions. Table 11 presents the differences in critical assumptions underlying the alternative SO_2 emissions forecasts.

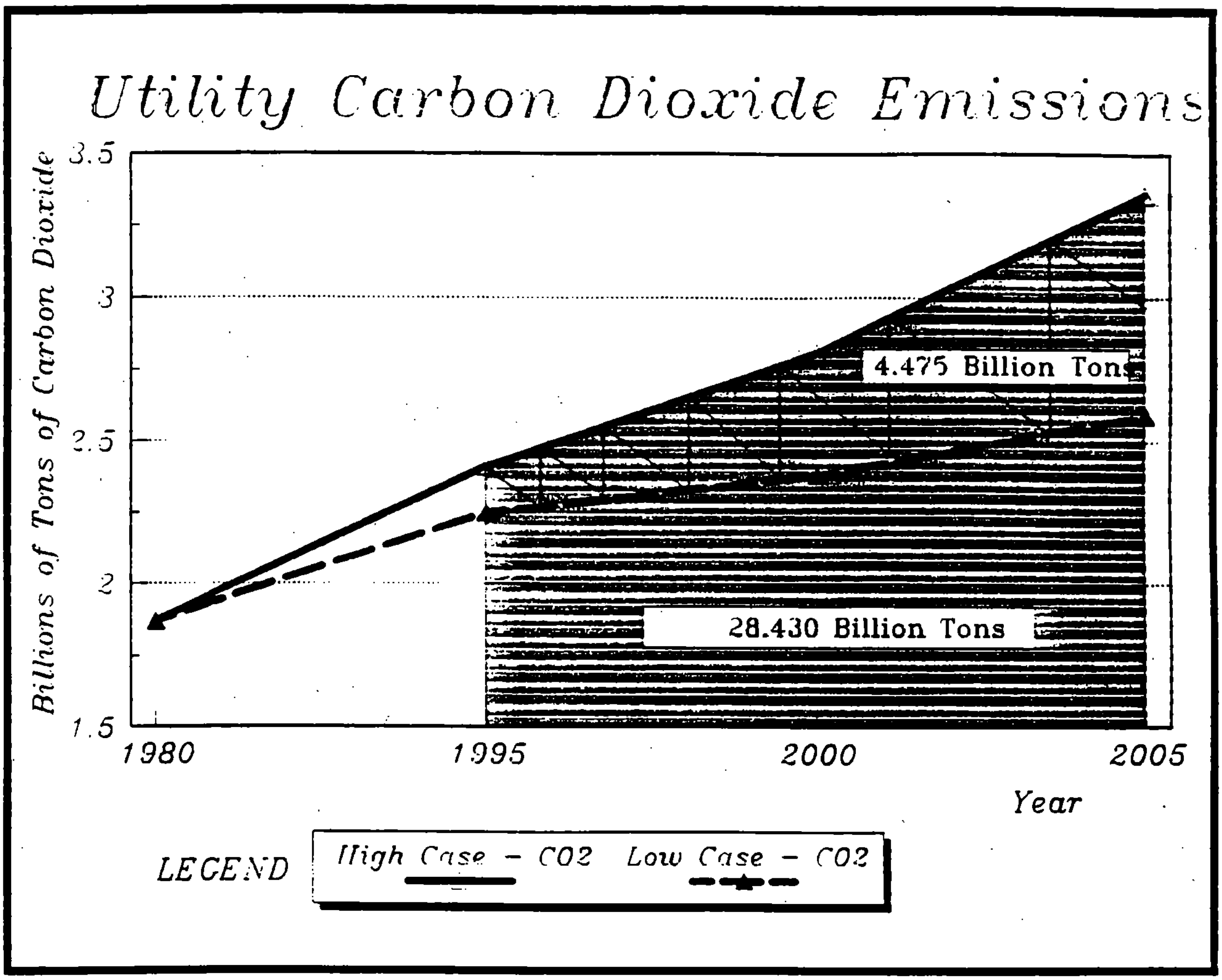
Table 11. Differences Between High and Low Emissions Scenarios

ASSUMPTION	HIGH CASE	LOW CASE
oil and gas prices	lower	higher
electricity demand	higher	lower
repowered capacity	lower	higher
unplanned coal capacity	sooner	later
unplanned non-fossil fuel capacity	lower	higher
cogeneration	lower	higher
fossil fuel plant lifetime	longer	shorter
nuclear power plant lifetime	shorter	longer

Source: ICF Resources, EPA, April, 1989.

The standard approach in analyzing SO_2 policies has been to compare the policy results against alternative future emissions scenarios as depicted in Figure 5. Each of these alternative futures represents the status quo since neither presumes any acid rain control. Unfortunately, there is no way to know which alternative future will materialize. Consequently, as in the case with SO_2, potential CO_2 emission changes should be gauged against both the high and low emissions alternatives. To the extent that the low emissions future occurs independent of any acid rain program, some of CO_2 reduction benefits outlined in this paper would be eliminated. For example, one of the major differences between the high and low tracks in CO_2 terms is the amount of new cogeneration. Both base cases forecast large additions to cogeneration capacity. Will the larger amount of new cogeneration in the low emissions base case occur independent of acid rain legislation? Perhaps, but factors related to that legislation such as higher electricity rates and SO_2 control costs should spur more new investments in independently produced cogenerated power.

Figure 5. ALTERNATIVE FUTURE UTILITY CO_2 EMISSIONS



Source: ICF Memo Report, Analysis of EDF Acid Rain Proposal, May 1989.

Figure 5 presents the high and low SO_2 base case forecasts translated into CO_2 terms. The figure presents CO_2 emissions forecasts only to the year 2005 and concentrates on the decade 1995-2005 when acid rain policies are expected to have the most impact. Cumulative CO_2 emissions from utilities over the decade are expected to be 28.43 billion tons under the high scenario and 23.76 billion tons for the low track. The 4.48 billion ton difference between the two scenarios represents roughly a 16% CO_2 reduction from the high track. Clearly, this is not a trivial difference. Nonetheless, it begs the question of whether in fact the U.S. economy will actually be on the high or low emissions track.

Throughout this report the potential for CO_2 savings from acid rain legislation have been emphasized. Table 11 presents the key factors presumed to account for the differences in emissions between the high and low scenarios. After investigating a number of CO_2 reduction opportunities and utility reactions under acid rain policies, one can examine the assumptions of Table 11 and inquire which scenario is more likely to occur under emissions trading. Certainly, to the extent that natural gas substitution is encouraged and natural gas supplies do not expand, gas prices will be higher. Electricity prices are likely to rise under any acid rain control program. In response, the quantity of electricity demanded is likely to fall. Cogeneration and unplanned non-fossil fueled capacity are also likely to be greater with any acid rain legislation that emphasizes emissions trading. In sum, the assumptions of the low emissions scenario match closely the expected effects of the administration's acid rain proposal.

Regardless of any other changes influencing future emissions, emissions trading for SO_2 and NO_x will preserve the least cost path for CO_2 management. Emissions trading allows the use of whichever current or future pollution control techniques will reduce discharges most efficiently. As with coal switching versus scrubbing, natural gas substitution for residual fuel oil, and energy efficiency measures, there are ample opportunities to reduce both acid rain precursors and CO_2 simultaneously. Because emissions trading involves a market, it is extremely difficult to forecast actual outcomes. The best that can be done is to indicate what could happen. What new technologies, opportunities, or constraints will emerge over the 15 years assessed in this paper is uncertain at best. Whatever changes those years bring, we can be assured that an emissions market will adjust to the maximum benefit of both the economy and the environment.

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NOTES

1 This paper has benefited from the comments of Karen Florini, Bob Hahn, Elizabeth Nixon, Michael Oppenheimer, Tim Searchinger and Jim Tripp. Others including Lori Trayweek, Michael Gibbs, Thad Huetteman, Bill Liss, John Palmisano, Paul Wilkinson, and Jim Williams have assisted this research by contributing valuable information and suggestions. The contents of this report are the responsibility of the authors however.

2 For a technical analysis of the implications of the Bush Administration's acid rain legislation see ICF Resources (1989). For a more complete discussion of the emissions trading policy see Dudek (1989).

3 A recent report from Shearson Lehman concerning the implications of acid rain legislation for coal markets concludes that barge transport of coal should increase if legislation is passed (Shearson Lehman, p. 37-39).

4 The natural gas prices used in this analysis are for interruptible supplies and represent the prices normally charged to utilities. Both the AGA and the Gas Research Institute (GRI), among others, forecast natural gas and residual fuel oil prices. Their forecasts for interruptible supplies to utilities are shown below in Table 2.

Table 2. Fuel Price Forecasts

Fuel	1995	2000	2010
AGA		1989 $/mmBtu	
natural gas	$2.69	$3.43	$5.63
resid (No. 6)	$3.40	$4.20	$7.76
GRI		1988 $/mmBtu	
natural gas	$3.20	$3.59	$5.64
resid (No. 6)	$3.05	$3.58	$5.23

5 The NURF data base identifies the primary fuels used by individual units. To the extent that resid-fired units are already using some natural gas, the estimates of CO_2 savings presented are overstated. The extent of this bias is unknown.

6 The status of cogeneration units under the several acid rain proposals is not unambiguous. Cogenerating units are likely to be subject to the offset requirements for new sources. However, due to the large proportion of cogeneration units that will be gas fired and the greater efficiency of the cogeneration process, offsets required by cogenerators should be substantially less than those required for added utility capacity.

7 Assumptions made to calculate the CO_2 savings include the following. New cogenerated electric power replaces power previously produced from coal fired facilities. In 1995, the new cogeneration sources are 30% coal fired, 47% gas fired combined cycle and 23% gas fired combustion turbine. In 2000 and beyond, the mix is 50% coal fired, and 25% each combined cycle and combustion turbine. Boiler efficiency of industrial boilers is 80%. Efficiency for coal fired cogeneration is 80%, for gas combined cycle is 78% and for combustion turbine is 70%. The average heat rate for a coal fired electric utility is 10,000 Btu/kwh. The ratio of electric to thermal energy (e/t) is 0.13 for coal fired cogeneration facilities; 0.9 for combined cycle and 0.65 for combustion turbine. It was also assumed that new coal fired cogenerated thermal energy would replace energy produced from coal in industrial processes and likewise for natural gas.

8 The CO_2 generated by electric utilities from coal is calculated by converting the kwh in column 1 (new kwh cogenerated) to mmBtus using the average electric utility heat rate and multiplying by the CO_2 emission rate for coal (202 lbs/mmBtu). The CO_2 generated by cogeneration is calculated separately for coal and gas fired cogeneration units and summed in row 3. To do this, an estimate of the fuel input to cogeneration is obtained and translated into CO_2 emissions. For example, for coal fired units, the percent cogeneration that is coal fired according to the assumptions is multiplied by the kwh in row 1 and converted to mmBtus using the conversion 3413 Btus/kwh. An estimate of mmBtus of thermal energy produced is obtained by solving for t in the appropriate equation for coal fired steam turbines, e/t=0.13. The total mmBtus is divided by the efficiency of the cogeneration system, in this case 80% to obtain fuel input which is converted to tons of CO_2 emissions based on the emissions rate for coal. A similar process is carried out for gas fired combined cycle and

combustion turbine cogeneration units. The CO_2 generated by industrial processes is estimated by taking the thermal energy calculated as the value of t above and dividing by the efficiency of the industrial boiler and estimating the level of CO_2 emissions for the appropriate fuel type, coal or gas.

9 The marginal costs of SO_2 control were taken from ICF's analysis of the economic implications of the Administration's acid rain proposal (ICF, 1989). Control measures considered were scrubbing and switching to lower sulphur coal.

10 Each of these curves expresses the relationship between the cost of conservation measures in $/kwh saved and the total number of kwh saved. The cost of conservation measures consists of conservation program costs and does not account for the cost of lost revenues or the savings from avoided fuel costs. Total kwh saved in the three curves were converted to percent kwh saved. A weighted average was taken to produce a "national" curve. The percentages for kwh saved in the national curve were applied to total projected U.S. electricity use forecast by ICF for the EPA's base case emissions. This procedure was repeated for 1995, 2000 and 2005 to obtain a nationwide conservation cost curve in terms of kwh saved and $/kwh.

11 DRI believes that most plants would comply with Phase I requirements by blending sub-bituminous coals with other higher sulphur coals. In Phase II, however, DRI believes that utilities will switch to bituminous compliance coals to avoid de-rating plants as required if all sub-bituminous coals were used. Consequently, DRI estimates sub-bituminous coal use to fall over time.

CARE

COALITION FOR ACID RAIN EQUITY

CLEAN AIR PROPOSAL NEEDS EQUITY

The **Coalition for Acid Rain Equity** supports the goal of cleaner air for all Americans. CARE, a coalition comprised of business, labor and state government representatives, also believes a national commitment to eliminate the causes of acid rain demands a national solution - one that does not place a disportionate burden on one region of the country.

President Bush has proposed and the 101st Congress is expected to pass legislation that will significantly reduce sulfur dioxide and nitrogen oxide emissions over the next decade. Unfortunately, the President's plan contains a flaw - an economic inequity - that threatens to cause undue hardship on millions of consumers of electric power and thousands of coal miners.

All Americans will enjoy cleaner air but some will have to pay more for it than others.

The President's bill asks 13 unlucky states to bear more than their fair share of reducing the emissions that cause acid rain. Those states (Florida, Georgia, Illinois, Indiana, ~~Iowa,~~ Kansas, Kentucky, Maryland, Missouri, Ohio, Pennsylvania, Tennessee and West Virginia), collectively emit **60 percent** of the national total of sulfur dioxide but, under the Bush proposal, are required to make **86.5 percent** of the SO2 reductions. The cost to rate payers in these 13 unlucky states is $16 billion <u>more</u> than their fair share of the national clean up. Utility rate impacts in many of these states would top 20 percent, overburdening not just the residential electric consumer but the thousands of businesses and industries that employ these rate payers.

Other states, some of which emit more sulfur dioxide than those in the Unlucky 13, are required to reduce only a fraction of their fair allotment of the 10 million tons President Bush seeks to eliminate. The Coalition for Acid Rain Equity believes this is fundamentally unfair.

In the days ahead, you will be receiving additional information from CARE - facts we hope you'll use to help craft a bill that is both environmentally sound and economically even-handed.

We are not asking for a free ride. We believe the national goal of cleaner air can be achieved. We will pay our share for that cleaner air. We ask only that Congress recognize the inequities that exist and act to remedy them.

P.O. BOX 33924 • WASHINGTON, D.C. 20006-0924 • (202) 887-0497

COALITION FOR ACID RAIN EQUITY

COST SHARING DOESN'T PENALIZE ANYONE... BUT THE PRESIDENT'S BILL DOES

Many critics of those seeking fair and equitable acid rain legislation try to paint us simply as "the dirty states trying to make the clean states pay twice." You will probably hear this "us versus them" argument often in the weeks ahead. But, to accept it, is to ignore the commitment the Midwest already has made to emission control as well as the substantial expenditures the region will have to make under any new clean air law, with or without cost sharing.

It is actually the President's bill that makes the Unlucky 13 targeted states pay twice while allowing several high-emitting states to pay less than their share. This inequity occurs because the Administration's bill requires only that utilities reduce emissions while thousands of industrial boilers, many in the so-called "clean states", are not affected.

Texas, for example, is the third highest source of sulfur dioxide, emitting 1.48 million tons or 6.4 percent of the national total. Pennsylvania is the fourth highest emitter at 1.43 million tons or 6.2 percent of the national total. If the emission reductions were fairly allocated, Texas would be expected to to reduce its SO2 emissions by 508,000 tons while Pennsylvania's contribution to the 10 million tons reduction bill would be 492,000 tons.

But, under the Bush proposal, look what happens: Texas' "share" is a mere 82,000 tons while Pennsylvania's allotment jumps up to 547,000 tons. Texas is only required to reduce 16 percent of its fair share while Pennsylvania pays to reduce 12 percent more than its fair share. Ohio is required to reduce 67 percent more; Georgia 77 percent more; Missouri 86 percent more.

Even among the states that "get a break" there's an inequity. Industrial New Jersey, an emitter of 184,000 tons of SO2, is required to reduce emissions by 16,000 tons. That's 1,000 tons less that agricultural Nebraska which emits only 65,000 tons. Nebraska's share is still 29 percent below what it would owe in a fair allocation, but New Jersey's "break" is a whopping 75 percent.

Cost sharing does not mean a state - any state - will be asked to pay twice. It means only that all states will

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be asked to pay their fair share of a cleanup that will benefit the entire nation. For the Midwest, that will still mean much more than other states whose emission levels are lower.

It's wrong to portray the Midwest as having intentionally avoided its responsibility to the environment. Nearly 40 percent of all funds spent nationwide for pollution control have been spent in the Midwest under the current Clean Air Act. Ohio's utilities lead the nation, spending more than $2.1 billion since 1987. Pennsylvania has spent $2 billion; Indiana nearly $1.4 billion.

It's important to remember that all 50 states are in compliance with the existing Clean Air Act. Indiana, Ohio and Illinois are no more "dirty" than Idaho, Utah and New Mexico are "clean" if "dirty is meant to imply guilt and "clean" innocence. Under the proposed new Clean Air Act, we all start from ground zero, in compliance with current law but with new emission requirements to be met in the future.

Doesn't fairness suggest those reductions be made equitably by all and not by only one region of the country?

Proposed Changes in Title IV of S. 1630

The amendments listed below are offered as amendments to Title IV of S. 1630. It is intended that those provisions of Title IV of S. 1630 not directly addressed by these proposed amendments, such as Section 406 and the repeal of percent reduction, shall remain unchanged.

The amendments listed below are designed and intended to conform with the purpose of Title IV, which is to achieve a 10 million ton reduction in annual emissions of sulfur dioxide from 1980 levels, and to "cap" sulfur dioxide emissions in the year 2000, so as to preserve any emissions reductions achieved prior to that year.

PROPOSED AMENDMENTS

1) Section 404: Amend language so as to make the annual emission limitation for affected units in Phase I equal to the product of each unit's baseline multiplied by an emission rate of 1.1 lbs/mmBtu.

2) Section 404: Amend language so as to list only the top 18 SO_2 emitters in Table A. (See Table A in original Mitchell-Baucus draft, deleting the Clifty Creek and Kyger Creek facilities.)

3) Section 404: Add subsection requiring all DOE facilities (Clifty Creek, Kyger Creek and Joppa) to install and begin operation of a technological system of continuous emission reduction, achieving 90% emissions reduction, by January 1, 1995.

4) Section 404: Add subsection providing a two-year delay in the Phase I deadline for listed units that elect to install a technological system of continuous emission reduction for the purpose of meeting the emissions limitations of the bill.

5) Section 403: Add subsection(s):

-- establishing an EPA-administered allowance trading system;

5) -- providing that for each "base" allowance placed in the EPA-administered trading pool during Phase I by a listed unit employing a technological system of continuous emission reduction for the purpose of meeting the emissions limitations requirements of the bill, the EPA shall award the owner or operator of the unit one "incentive" allowance;

-- providing that allowances, once deposited in the EPA-administered trading pool, can only be withdrawn or removed from the pool through an open auction, or other means approved by the EPA Administrator;

-- prohibiting the use of allowances obtained through the EPA-administered trading pool by a unit depositing allowances in the EPA-administered trading pool during Phase I for the purpose of complying with the Phase I emissions limitations requirements of the bill; and

-- providing that all proceeds from the sale of allowances from the EPA-administered pool shall be distributed to the owners of allowances in the pool, in proportion to the distribution of ownership at the time of a sale.

6) Section 402 (1) and 409 (a): Amend language so as to require the publication of a list, not later than December 31, 1992, of eligible clean coal technologies, and provide for the possibility of subsequent additions of other technologies to that list. Further amend language so as to include retrofit and replacement, in addition to repowering, technologies among the list of eligible clean coal technologies.

7) Section 409 (b): Add section providing that any affected unit granted an extension under Section 409 shall not forfeit that extension as a result of its inability to install and operate a clean coal technology which the EPA Administrator finds to be economically and/or technologically infeasible.

8) Section : Add section providing WEPCO "fix" for clean coal demonstration projects.

<u>ITEMS FOR FURTHER DISCUSSION</u>

9) Section 403 (b): Amend language so as to remove geographic limitations on trading of emissions allowances.

10) Section 403: Amend language so as to prohibit the EPA Administrator from revoking, suspending, or terminating emissions allowances already awarded.

11) Section 405: Amend language so as to make the annual emission limitation for affected units in Phase II equal to the product of each unit's baseline multiplied by an emission rate of 1.2 lbs/mmBtu or the product of each unit's average annual fuel consumption in 1980-1982 multiplied by an emission rate of 1.1 lbs/mmBtu. Any owner or operator selecting the latter tonnage limitation shall be required to apply such limitation system-wide.

12) Section 409 (c): Add subsection providing an exemption for retrofitted clean coal units from section 111.

13) Section 409 (c): Add subsection providing an exemption for retrofitted clean coal units, with post-retrofit emissions levels below their pre-retrofit emissions levels, from the SO2 requirements of parts C and D of title I.

THE NEW YORK TIMES **NATIONAL** THURSDAY, JANUARY 11, 1990

Cost-Sharing on Acid Rain by States Assailed

By PHILIP SHABECOFF
Special to The New York Times

WASHINGTON, Jan. 10 — Several Midwestern governors whose states have already cut the air pollution causing acid rain today denounced a plan that would have them help pay for reducing the problem in other parts of the country.

At a news conference here, the Alliance for Acid Rain Control, a coalition of governors, environmentalists and business leaders from states that have made a substantial investment to reduce the smokestack emissions that lead to acid rain, said the plan was unfair.

"It's hard to see why consumers in states that have already done their part should be paying a second time for those who have dragged their feet on environmental protection," said Gov. Rudy Perpich of Minnesota, co-chairman of the alliance. He was joined by Gov. Tommy G. Thompson of Wisconsin and Gov. Mike Sullivan of Wyoming.

Study on Utility Rates

The alliance issued a study indicating that utilities in lower Midwestern states like Ohio, Indiana and Illinois that were responsible for a large amount of the pollution charged substantially lower electric rates than power companies in states that have already acted to clean up their emissions.

But government officials and utility spokesmen in that band of states disputed the rate survey findings. They also said that, under pending Federal legislation, their states would be required to bear too heavy a share of the economic burden of reducing acid rain.

Pending Legislation

Legislation proposed by President Bush to strengthen the Clean Air Act, awaiting action in somewhat revised form in Congress, would require, among other things, that coal-fired power plants reduce their smokestack emissions of sulfur dioxide, a major contributor to acid rain, by 50 percent, or 10 million tons, by the year 2000.

Acid rain is created when sulfur and nitrogen oxides flow up into the atmosphere and fall back to earth as acidic rain, snow, fog and dust. Much of this pollution originates in the industrial states of the Midwest but is deposited in the Northeast and Canada, where, according to scientific studies, it destroys aquatic life, damages buildings and may play a role in damaging forests.

Support for Cost-Sharing

Utilities from the lower Midwestern states, supported by their state governments, contend that acid rain is a national problem and that the cost of dealing with it should be shared by the entire nation. Several members of Congress from the Midwest have called for the addition of a cost-sharing provision to the pending legislation.

Representative Philip R. Sharp, Democrat of Indiana who is chairman of the House Energy and Commerce Committee's Energy and Power Subcommittee, said the pending legislation "is fundamentally unfair and flawed because it asks 13 states to make emissions reductions not only for themselves but for others as well."

The President opposes the cost-sharing proposal on the ground that it would be tantamount to a tax on the states with lower sulfur emissions and a subsidy for the heavily polluting states.

"Asking other states to pick up the tab for their cleanup is like asking a middle class family to help a rich family absorb the financial shock of losing a tax loophole," Governor Thompson said.

But John L. Stowell, chairman of the Coalition for Acid Rain Equity, a group of utilities and companies that is pressing for cost-sharing legislation, said that the study released by the alliance was misleading and that there was actually little difference in electric rate structures.

Mr. Stowell said the study lumped industrial rates, which are lower because they are offered at a discount to heavy users, together with residential rates. Because the Midwest is more heavily industrialized than other areas, the combined rates are lower, he said. But he added that residential consumers pay in the Midwestern states pay just as much as in other parts of the country.

COALITION FOR ACID RAIN EQUITY

PHOTOCOPY PRESERVATION

To: Katie 224-0580

FROM: Randi Thompson

Subj: Proposed changes to Byrd's 2-for-1 on 20 Plants proposal.

we need these changes in order to support 2-for-1

2-for-1 without these changes is worse for utility companies than the President's bill.

2-for-1 also brings in Uranium enrichment plants and makes them reduce, which is real tough.

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Changes to 2-for-1

Item #

1. Change emission rate from 1.1 to 1.2.

2. §404: Amend language so as to list only a sufficient number of units (from Table A) to achieve 4.5 million tons, but listing only one unit from each utility company. "Company" is defined as each operating company within a holding company, not as the holding company itself. [By spreading risk widely, no price support for allowances would be required if market fails to evolve].

3. Clarify that DOE/Secretary of Energy is responsible for full costs of compliance for these units.

8. Fix WEPCO for all units, not only clean coal projects.

11. §405: [Insert before last sentence in paragraph] "or the product of 60% of each unit's maximum capacity, the unit heat rate, 1000, and an emission rate of 1.1 lbs./mmBtu."

New Items

Delete "Credits For Clean States", §406 within §401 of Title IV, p. 469 of S 1630.

Delete §407, p. 493.

Delete 120% factor in §405(d) within §401, Title IV, p. 467.

In addition to points 9 and 10, include further language from Dingell staff proposal strengthening allowance system and smoothing trading requirements.

Add language clarifying that excess reductions made during Phase I may be "banked" by the source for its own use, or sale, in Phase II, or to offset future additions to capacity. Credits for such excess reductions in Phase I should equal one-for-one if achieved by other than technological system of continuous emission reduction, and two-for-one if technological system is employed.

Add language permitting sources named in Phase I list to include one additional unit (up to the equivalent MW capacity of the listed unit) for early reductions resulting in two-for-one credits if reductions are achieved through technological system of continuous emission reduction.

Add language providing for capital projects related to Clean Air Act (all titles):

1. tax free bond financing;
2. accelerated depreciation; and
3. investment tax credits.

Add language limiting the total percentage of SO^2 reductions achieved or required to be achieved by each source in both Phases to the proportion of SO^2 emissions which each source's base line emissions bear to the total tons of SO^2 emitted during 1980.

Add language exempting cyclone boilers and wet bottom boilers used for such units from requirements for NOx emission rates.

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Christian Rice (202) 382-3324

EPA RELEASES STUDY OF FUTURE ACID RAIN DAMAGE

The U.S. Environmental Protection Agency's acid rain researchers today offered evidence that if sulfur emissions are not reduced in the future, aquatic systems in the South will suffer damage from acid rain. Evidence also indicates that reductions in sulfur emissions could improve the health of damaged lakes in the Northeast.

"This study makes a compelling statement about the future effects of acid rain on water quality in the Northeast and the Southern Blue Ridge Province," said F. Henry Habicht, EPA Deputy Administrator. "The scientific data reinforce President Bush's proposal to reduce annual sulfur dioxide emissions by 10 million tons. We encourage the Congress, upon its return, to take prompt action on the Clean Air Act," he said.

The study, "Future Effects of Long-Term Sulfur Deposition on Surface Water Chemistry: The Direct/Delayed Response Project", developed 50-year projections of watershed quality under three plausible acidic deposition, or acid rain, scenarios. Three areas were studied--the Northeast, comprising all of New England and parts of N.Y. and Pa.; the Mid-Appalachian Region, covering much of Pa., Md., Va. and W. Va.; and the Southern Blue Ridge Province, an area covering parts of N.C., Tenn., S.C. and Ga. The study is a key element in the closing months of the 10-year National Acid Precipitation Assessment Program.

Results of the study were made available today for the Northeast and the Southern Blue Ridge Province. Preliminary results for the Mid-Appalachian Region are presented but the final results will not be available until next year.

In the study, EPA examined scenarios of decreased, constant, and increased deposition. It is generally accepted that acidic deposition is related to emissions of sulfur dioxide. Thus, changes in emissions of sulfur dioxide will lead to changes in levels of acidic deposition on watersheds.

EPA measured surface-water chemistry in dilute lakes and streams in units of micro-equivalents per liter (ueq/l)--a measure of concentration related directly to the ability of a chemical compound to contribute or neutralize acidity.

The Northeast

In the current study, EPA researchers sampled 145 lakes and watersheds representing 3,200 lakes in the Northeast. Of these lakes studied, an estimated 5 percent are acidic and 27 percent have very low levels (less than 50 ueq/l of Acid Neutralizing Capacity (ANC) and, thus, are potentially susceptible to becoming temporarily acidic on an episodic basis during snowmelt or very heavy rainstorms.

In this region, EPA projected future watershed quality under two separate scenarios. The first assumed that acidic deposition would remain constant over the next 50 years, and the second assumed that acidic deposition is reduced by 30 percent, beginning in 10 years and lasting over a 15-year period. Deposition was then assumed to be constant at the reduced level for another 25 years.

Under the constant-deposition scenario, researchers found that median sulfate concentrations would decrease only very slightly (about 10 ueq/l) and that median ANC of the surface waters would experience very slight decreases of only a few ueq/l. In essence, under this scenario, water quality would change very little over the 50 years for which the projections were made.

Under the decreased-deposition scenario (30-percent decrease), however, median lake sulfate concentrations would decrease relatively rapidly (within 10-20 years following the decrease in deposition) up to a total of about 40 ueq/l in 50 years and the median surface water ANC would increase by 9 ueq/l (from 126 to 135 ueq/l) with concomitant improvement in surface water quality. The number of acidic lakes (ANC less than 0 ueq/l) is projected to decrease by about one-half (from 162 to 87, out of the target population of 3,200) and the number of lakes with ANC less than 50 ueq/l (and thus susceptible to episodic acidification) would also decrease (from 880 to 586, representing a decrease of nine percent of the target population of 3,200). From the standpoint of aquatic life, such changes could lead to improvements in surface water quality in the region.

The Southern Blue Ridge Province

In the Southern Blue Ridge Province, EPA studied 35 streams and watersheds representing approximately 1,300 streams in that region.

In this region, EPA researchers examined the same constant-deposition scenario. They then added a new scenario of increased sulfur deposition of 20 percent beginning in 10 years and lasting for 15 years with deposition then constant at the increased level for another 25 years.

Under the constant deposition scenario, median sulfate concentrations of the Southern Blue Ridge waters would double (from 37 ueq/l to 75 ueq/l) and median ANC values would decrease by about 10 percent (from 124 to 112 ueq/l) over the next 50 years. Currently, EPA estimates that none of the target population of streams (1300) is acidic. The number is projected to increase to 129 streams. (At the 95-percent-confidence level, the margin of uncertainty is roughly equal to the magnitude of the estimate itself, i.e., the lower boundary is zero streams, the high is 324). The number of streams projected to be less than 50 ueq/l (and, thus, potentially susceptible to episodic acidification) is 203 (similarly, the range of uncertainty is from 0 to 439) under the constant-deposition scenario. Currently, only three streams of the target population are estimated to be less than 50 ueq/l.

For the increased-deposition scenario in the Southern Blue Ridge Province, (i.e., a scenario assuming a 20-percent increase in deposition), median sulfate concentrations would more than double (from 37 to 92 ueq/l), about 17 ueq/l greater than under the constant-deposition scenario for the same 50-year period. The increases would be accompanied by decreases in stream ANC and deterioration of surface water quality. The projected change in median ANC value for the stream reach target population is a decrease of 16 percent (from 124 to 104 ueq/l).

Currently, no streams are estimated to be acidic and only three are estimated to have an ANC less than 50 ueq/l. Under the increased-deposition scenario, an estimated 159 streams (uncertainty range: 0 to 372) would be projected to become acidic, and 340 streams (uncertainty range: 54 to 626) would be projected to become potentially susceptible to episodic acidification.

EPA researchers have not yet examined a decreased-deposition scenario for the Southern Blue Ridge Province. However, due to the nature of soils in this region, adverse effects of acid rain on stream chemistry could occur even under a decreased-deposition scenario. Also, only a part of the adverse effects would be realized at 50 years. Continued decreases in stream quality are projected to occur for up to 200 years.

The Mid-Appalachian Region

As part of the project, EPA researchers examined the current retention of atmospherically-deposited sulfur in watersheds of the Mid-Appalachian Region. This retention is a key factor in determining whether future effects of acid rain are relatively fast (i.e., "direct"--as in the Northeast) or relatively slow (i.e., "delayed"--as in the Southern Blue Ridge Province).

From the studies performed, EPA concludes that the Mid-Appalachian Region is between the Northeast and the Southern Blue Ridge Province. Although the National Stream Survey of 1988 estimated that 323 stream reaches are acidic (ANC less than 0 ueq/l) in the region, and 2,192 stream reaches have ANC less than 50 ueq/l already, the preliminary results of the Direct/Delayed Research Project indicate that it is likely that these numbers of low ANC and acidic stream reaches will increase in the future, and likely at a faster pace than in the Southern Blue Ridge Province. Complete analyses and model projections for the Mid-Appalachian Region will be available next year.

Overview

Although the exact quantitative levels of changes in surface water chemistry are subject to a variety of uncertainties, the results of analyses and models of surface water acid-base chemistry used in this work are consistent internally, consistent with prevalent theory on surface water acidification, and qualitatively consistent with observations of changes in lake chemistry in Sudbury, Ontario, where deposition has decreased dramatically in the last decade.

The study is a project of EPA's Environmental Research Laboratory in Corvallis, Oregon and has been extensively peer-reviewed. The Laboratory director is Dr. Thomas A. Murphy, phone (503) 757-4601; Dr. M. Robbins Church is the Technical director of the project, phone (503) 757-4666.

On June 12, President Bush announced the Administration's plan to amend the Clean Air Act. The proposal was sent to Congress in July and was introduced in the House of Representatives as HR. 3030 with 147 co-sponsors. The Senate bill was introduced as S. 1490 with 24 co-sponsors. Title 5 of the bills is the section dealing with acid rain and calls for an annual 10-million-ton reduction of sulfur dioxide emissions by the end of the year 2000.

Copies of the 24-page Executive Summary of the report are available from the EPA Press Office.

# # #

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Cost Sharing

1/18/90

AEP CRITIQUE OF BYRD/MITCHELL PROPOSED CHANGES TO S. 1630

The proposed changes to S. 1630, billed as the "Byrd/Mitchell Compromise," is a good faith effort to craft a reasonable bill on a very controversial and divisive issue. The flaws in the proposed changes, from AEP's perspective, are unfortunately numerous:

(1) Phase I affected plants are treated in a clearly discriminatory manner. They are subject to emission limitations based on a 1.1 pounds sulfur dioxide emission rate while Phase II affected sources are subject to SO_2 emission limitations based on a less restrictive SO_2 emission rate (1.2 pounds).

(2) Unlike H. R. 3030 and S. 1630 (as approved by the Senate Environment and Public Works Committee last fall), the Byrd/Mitchell proposal makes no pretense at spreading the burden of Phase I control throughout the eastern half of the United States. Without any genuine cost-sharing mechanism, it concentrates the burden of Phase I emission controls upon a comparative handful of companies in a comparative handful of states with only the merest gesture toward cost-sharing. (This gesture is termed "incentive allowances.") This is plainly inequitable.

(3) There is no effort to select Phase I affected plants scientifically, i.e., in a manner calculated to reduce acid deposition problems in ecologically sensitive areas. If a small group of Midwestern plants are singled out, it would be equitable only if Phase I costs were spread out more evenly through a device such as a nongraduated generation tax. (A comparatively small number of plants are selected for control in Phase I; as a logical matter, these plants are a surrogate for other plants that might just as rationally have been selected from the perspective of environmental protection. If the Byrd/Mitchell Compromise's "surrogate" approach is to be adopted, true cost-sharing should be incorporated.)

(4) The selection of plants, coupled with the incentive of a Phase I compliance deadline extension until December 31, 1996 for affected plants which choose to retrofit scrubbers, evidences a clear design to preserve high sulfur coal-mining jobs. As in any scrubber-mandate or scrubber-inducement plan that does not also include *bona fide* cost-sharing, the "protection" afforded to

high sulfur coal mining is more illusory than real. The mining of high sulfur coal will continue only as long as there exist manufacturing concerns that rely upon electricity generated through use of high sulfur coal. Scrubber retrofits will merely cause electric rates of electric-intensive industries in the Midwest to skyrocket, forcing industry to close or relocate. If industry leaves, electric generation will decline, leaving little reason for utilities to continue the purchase of high sulfur coal.

(5) Two large aluminum smelters, comprising 11% of the nation's primary aluminum manufacturing capacity, are directly linked by contract to two of the plants identified in the Byrd/Mitchell Compromise list of Phase I affected plants (Kammer, Muskingum River). These smelters compete in a cost-conscious world commodity market and will almost certainly have to go out of business if the two named powerplants are forced to scrub. This would mean the direct loss of 2,300 jobs and a $203-million payroll in the Ohio Valley. This result is senseless from both a national and a regional perspective.

(6) The offer of an "incentive allowance" in Phase II in exchange for Phase I scrubbing does nothing to undo the economic harm that would be visited upon specific utilities (and these utilities' customers) in Phase I. Likewise, the payment of the proceeds of an allowance auction to Phase I affected sources will occur too late to meaningfully ameliorate the harsh impact of the arbitrarily imposed Phase I requirements on targeted utilities. Distribution of auction proceeds is no substitute for up-front <u>bona fide</u> cost-sharing.

(7) The Byrd/Mitchell Compromise selection of Phase I affected plants is unfortunate. Instead of selecting larger, newer units at affected plants, at which scrubber retrofit might make engineering and economic sense from the standpoint of age, unit condition and economy of scale, the compromise merely selects entire plants. The list of Phase I affected plants includes a minimum of seven units that are smaller than 250 MW and older than 30 years; scrubber retrofits (the Compromise's clearly preferred compliance option) are not a rational compliance option at these units. Whether or not substitute units can be selected for control in place of these seven small, old units, their inclusion within the Phase I affected source category will only hasten their retirement, or use of an alternative fuel supply, most likely natural gas.

(8) Further concern over the selection of a Phase I affected source is the jeopardy which it casts over the successful operation of AEP's Tidd Plant pressurized fluidized bed combustion (PFBC) commercial demonstration. In order to retrofit scrubbers at the adjacent Cardinal Plant, it will be necessary to dismantle the already constructed Tidd PFBC facility. It is unfortunate that an acid rain bill would jeopardize a project like Tidd PFBC since it shares the same goal as the legislation, namely reduced emissions. It will also likely lead to the termination of the Sporn PFBC Repowering Project, since the needed experience from Tidd which will permit final engineering and design decisions on Sporn, will not be fully realized before the plant is torn down.

(9) The Compromise seems determined to impose the bulk of Phase I emission reduction requirements upon only a few electric systems; for example, the Southern Company System has Phase I reduction responsibility for more than 7000 MW while AEP is burdened with Phase I reduction requirements for nearly 6000 MW of total coal-fired capacity of about 20,000 MW.

(10) One of the objectives of the Compromise is to preserve high sulfur coal mining jobs. The legislation attempts to do that by mandating a very low emission rate, 1.1 lbs/mmBtu, at the 18 selected plants. The least-cost response to meeting the Phase I requirement is likely to be fuel switching to low sulfur coal, not scrubbing. By the use of fuel switching and a slight capacity factor adjustment, compliance with the Phase I requirements could be met with a 1.2 lbs/mmBtu coal. The marginal cost difference between a fuel switch approach and scrubbing, even with the auction proceeds, is so great that utilities interested in minimizing Phase I customer rate increases will find fuel switching attractive. A means to thwart the lower-cost solution of coal switching is to further lower the target emission rate below 1.1 lbs/mmBtu. However, this then would reduce the number of excess allowances that would be generated and available for auction, thus further minimizing the "cost-sharing" provision.

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SUMMARY OF NAPAP FINDINGS

Congress created the National Acid Precipitation Assessment Program (NAPAP) in 1980 (P.L. 96-294) as a ten-year research and assessment program with the statutory responsibility to prepare comprehensive scientific, technological and economic information to assist the President and Congress in developing policies for control of acidic deposition effects. Approximately $500 million has been appropriated to date for this program. NAPAP will publish its complete integrated assessment on the causes and effects of acidic deposition, combined with analyses of the costs and effectiveness of various emission reduction strategies, in September, 1990. However, almost all of the data has been collected and 28 "State of the Science and Technology" papers have been drafted and are being circulated for peer review. NAPAP will host an International Conference in February as part of the peer review process to gain final input from scientists around the world before preparing its integrated assessment.

While there continue to exist some scientific uncertainties, the direction of the NAPAP research effort is becoming clear. Based on NAPAP's Congressional testimony and intra-Administration memoranda, the following broad conclusions can be drawn:

1) the effects of acid deposition are relatively small;

2) given current deposition rates, there will be no catastrophic ecological changes and other identified effects will be minor;

3) SO_2 emissions have fallen 23% since 1973 and remain constant (most of the reduction occurred in the Ohio River Valley and midwestern states);

4) NOx emissions have decreased 14% since a 1978 peak;

5) the primary benefits expected from acid rain controls will be small improvements in acidic and sensitive lakes and streams;

6) at present, only 5% of the lakes in the Northeast U.S. are acidic (from all causes) and, at current deposition levels, the extent of acidification is unlikely to change for decades;

7) a 30% reduction in acidic deposition in the Northeast may result in approximately half of those lakes which are currently acidic becoming non-acidic within 50 years, although the level of uncertainty with this projection suggests the possibility of even fewer lakes improving;

8) although the changes projected to occur in the chemistry of a small number of acidic lakes will be enough to classify them as nonacidic, the projected improvements are so small they will have little or no biological significance;

9) lake liming, at a cost of approximately $50,000 per lake, is the most cost-effective method for neutralizing acidic lakes, allowing them to support a healthy fish population almost immediately;

10) at present, a few thousand acres of high elevation red spruce forests show damage due to a collection of stresses that may include acid deposition, the extent of damage is not likely to increase at current deposition levels, and reduction in SO_2 emissions alone is insufficient to reduce the damaging stresses;

11) other tree species and crops do not show any evidence of acid deposition damage at current deposition levels;

12) acid deposition contributes to the deterioration of carbonate stone, galvanized steel, paint, etc., however, there are several reasons why materials maintenance and reconstruction activities are undertaken which are unrelated to acidic deposition;

13) controls on sources of SO_2 emissions in the eastern U.S. may result in a small improvement in visibility, but the improvement is just on the threshold of human perception;

14) a control strategy focused on the Ohio Valley and other midwestern power plants is not optimal;

15) the time scale for either further acidification or recovery of lakes and streams is believed to be long (e.g., decades), thus a control strategy based on the use of clean coal technologies is preferred (compared to retrofit scrubbers).

CAWG
CLEAN AIR WORKING GROUP

EARL W. MALLICK, CHAIRMAN
WILLIAM D. FAY, ADMINISTRATOR

February 1, 1990

Senator Albert Gore Jr.
393 Russell Senate Office Building
Washington, DC 20510

Dear Senator Gore:

Enclosed for your consideration is a memorandum discussing the reasons why the Southern and Midwestern regions of the nation may find unacceptable the acid rain provisions of S. 1630, and other proposals like it. The Clean Air Working Group believes that, on the whole, provisions of Title IV are scientifically insupportable and economically disastrous. Various regions of the country, however, will confront unique and burdensome problems if S. 1630 is enacted without change. While the regional impacts of acid rain legislation have been widely debated, we hope that the information provided in this memorandum will provide a convenient summary of the impacts on the South and Midwest.

Sincerely,

Bill

William Fay

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SOUTHERN OBJECTIONS TO CLEAN AIR ACT AMENDMENTS

I. General Objections

The South shares in the general objections that have been voiced nationally in opposition to enactment of additional legislation at this time. These objections may be grouped into four basic categories:

1. Additional acid rain legislation should not be considered until NAPAP releases its Final Report. In 1980, Congress established the National Acid Precipitation Assessment Program ("NAPAP") to conduct a comprehensive 10-year research program to determine whether additional emission controls are necessary to address acid rain. NAPAP's Final Report is due in 1990. It is clear that were Congress to act now -- literally months before the Final Report is released -- it would be wasting the almost one-half billion dollars and years of research that have gone into NAPAP. And why? No new information or scientific conclusions have suddenly emerged to dictate such a radical change in Congress' 1980 game plan, and no abrupt deterioration of our environment has occurred in this "eleventh hour." Clearly, common sense should tell us that now is not the time to enact additional acid rain legislation.

2. Additional acid rain legislation is not supported by current scientific knowledge. The Interim Assessment of NAPAP concluded that, 1) contrary to once popular belief, there is no impending acid rain crisis, and 2) the current Clean Air Act is successfully controlling emissions of sulfur dioxide (SO_2) and nitrogen oxides (NOx). Indeed, the Interim Assessment issued in 1988 concluded that there were very few instances of damage to the environment from acid rain and that at present emission rates (and of course these rates will be reduced in the future by the current Clean Air Act) acid rain will have little or no effect on our environment. Proponents of additional acid rain legislation, therefore, must look to some other justification as the basis for their proposals, for current scientific knowledge lends them no support.

3. The cost of implementing additional acid rain legislation is economically unjustifiable at this time. The current acid rain proposals will yield only a short-term acceleration of the SO_2 emission decreases already mandated by the current Clean Air Act. Each of these proposals, however, entails several billions of dollars in yearly compliance costs. Even more, they will have staggering, negative impacts on utility rates, the Consumer Price Index (CPI), inflation, the budget deficit, employment, and U.S. industrial competitiveness -- impacts that have not even been quantified -- and will cause a diversion of funds from clean coal technology research and development. The known compliance costs and unquantified macroeconomic impacts of additional acid rain legislation bear no reasonable relationship to the uncertain and unquantified benefits of a mere acceleration of the rate of

emission decreases. This combination of enormous costs and uncertain benefits demonstrates that the current proposals are economically unwise, especially at a time when our economy is once again teetering on the verge of recession.

4. Science cannot yet provide a clear risk/benefit analysis on which to support additional acid rain legislation. In recent testimony before the Senate Environmental Protection Subcommittee, the Administrator of the EPA could not quantify what the benefits of H.R. 3030 would be nor could he predict when they might arrive. Last year a U.S. Justice Department brief filed in the United States Court of Appeals for the District of Columbia stated as follows: "... important scientific questions remain unresolved concerning acid deposition effects on forests, lakes, crops and building materials. Indeed, science cannot now accurately predict the effects that would result from source-specific emissions reductions of sulfur dioxide and nitrogen oxides on affected areas." These instances indicate exactly how unsettled science is at this time concerning the risks, if any, of proceeding under the current Clean Air Act versus the benefits of enacting additional, costly emission control measures. In light of the absence of any clear risk/benefit analysis, Congress should not be looking to purchase such a colossally expensive insurance policy or, at a minimum, should adopt an approach of flexibility and reasonableness rather than the current one of "command and control."

II. Regional Objections

Aside from the host of reasons demonstrating that additional acid rain legislation is not in our national interest, the current proposals are of particular concern to the South for several reasons:

1. The South is not, and is not likely to be, subject to the serious environmental problems to which these proposals are addressed:

   * NAPAP's Interim Assessment establishes that the South is not experiencing significant environmental problems due to acid precipitation, much less an environmental crisis.

   * NAPAP reports that the acidity of Southern rainfall is less than that of other areas of the country.

   * NAPAP concludes that no significant deterioration of Southern forests, lakes, or crops is likely to occur at present emission levels--levels that will, of course, continue to decrease under the Clean Air Act.

   * NAPAP reports that the acidification of surface waters is significantly more limited than first reported and

that almost all of the affected lakes are in the Northeast. This problem has been found to be strongly influenced by lake bed geology rather than rainfall acidity. Acidic lakes found in Florida are believed to be naturally acidic due to organic acids.

* Several other regional scientific studies confirm NAPAP's findings concerning the South.

2. <u>Implementation of additional emission controls in the Southern states will not affect the acid precipitation situation in the Northeast</u>:

* EPA has concluded that sources of sulfur dioxide and nitrogen oxide emissions can have little, if any, effect on acidic deposition in areas greater than 600 miles away.

* Other scientific studies have placed the range of significant dispersion at even less than 600 miles.

* Most Southern states do not meaningfully contribute to acid precipitation levels in other areas of the country, including sensitive areas of concern such as the Adirondack Mountains of New York.

* Problem areas inventoried by NAPAP seem to be concentrated close to large urban centers in the North, reinforcing the concept that significant emission contributions are from local sources rather than from long-range transport from the South.

3. <u>Current acid rain proposals unfairly burden the South</u>.

* The individual livelihood of Southerners would be unfairly threatened by acid rain legislation, while other regions with already-higher standards of living will enjoy lower compliance requirements and costs. Keep in mind these per capita income figures when considering acid rain legislation:
Mississippi - $9,187;
Alabama - $10,673;
Pennsylvania - $14,437;
Texas - $13,483;
New York - $16,050;
Massachusetts - $16,380.

* The idea of an emissions cap would have a devastatingly chilling effect on economic growth in the South, possibly reversing the positive business climate we have worked so hard to create. The emissions cap would pressure utilities to use yet undeveloped "pristine" technologies, eliminating fossil-fired

generation as an expansion option, expansion necessary to serve the region's growing demand. While "pristine" technologies such as wind and solar power seem prudent in concept, advanced generation alternatives prove to be unattractive when one considers their high installed cost and their technical risk due to lack of development. When Southern utilities chose the coal option in the past, they did not choose to pollute as some have stated; rather, they chose to provide reliable, affordable electricity. That is why electric rates in the South today consistently rank in the lower half of nationwide utility prices. Moreover, Southern coal units are not major acid rain contributors to the areas of concern.

* S. 1630 requires Southern states to make larger emission reductions, at higher costs, than a number of other more pollution-prone states. For example, according to a recent Edison Electric Institute study by Temple, Barker and Sloane, seven of the fifteen states having compliance costs of over $500 million per year are in the South. Three Southern states are among the ten states responsible for making 90 percent of the SO_2 reductions. Yet, if emissions were to be measured for efficiency in terms of SO_2 emitted per customer or SO_2 emitted per kilowatt-hour of delivered electricity, Southern states move way down the list of emission contributors, far enough down to be out of the top 1/4 contributors.

* The trading or selling of emission allowances optimistically predicted by the EPA is an empty hope since most compliance over-performers will choose to keep their own allowances rather than sell them. For regions expecting to grow and thus needing new generation, this is simply self-preservation through allowance self-banking to accommodate their own projected emission growth. Most Public Service Commissions nationwide support this attitude since they are charged with insuring the economic well-being of their state or region. EPA has even implied that the EPA should own and disburse excess credits to ensure trading traffic. Since these credits would be made possible through increases in individual ratepayers' billings, such a solution is inequitable and would penalize those who over control to free up allowances for trading.

4. <u>The "Air Toxics" Title of S. 1630 should not apply to U.S. utilities</u>.

* Title III of S. 1630 seeks to regulate the emission of nearly two hundred so-called "air toxics" or "hazardous air pollutants." Among the air toxics targeted by Title III are a number of metals and chemicals which are present naturally in coal and emitted as trace elements by coal-fired utility plants. Thus, Title III would result in the imposition of additional emission controls on utilities well beyond the emission controls already required by the "Acid Rain" Title of the bill--controls that would double to triple a utility's compliance costs for S. 1630. Given the fact that so little evidence is available, and that which is available reflects a very low risk associated with the trace amounts of elements emitted from utility power plants, mandating EPA to regulate utility emissions under the Title III of S. 1630 is premature at best. Instead, S. 1630 should require, as does S. 1490 and H.R. 3030, that EPA study the health risks associated with utility emissions of air toxics and, before further regulating these sources under Title III, make a positive finding of the necessity for additional controls.

Our current estimates are that Title III will force all coal-fired powerplants to have costly scrubbers; many others, if not all, will also have to have "baghouses."

5. <u>Promising Clean Coal Technologies should be permitted to work</u>.

* A number of southern utilities are sponsoring clean coal demonstration projects to be co-funded by the Department of Energy. For example, some of these projects involve the development of advanced scrubber technologies for SO_2 removal and the control of NO_x emission through innovations in the combustion of coal. These projects will take several years to complete. Unfortunately, these promising technologies that could further the use of Southern coal resources will not be eligible for the compliance extension granted to utilities utilizing clean coal technologies because they are not so-called repowering technologies. Therefore, despite the potential advantages of these clean coal technologies, and despite the funds already spent in perfecting them, S. 1630, as currently drafted, could limit their use by utilities. Provisions can be made for a compliance extension for all clean coal technologies, not just those that involve repowering.

6. Compliance dates should be those provided for in the Administration's proposal.

* S. 1630, as amended in the Environment and Public Works Committee, alters the program timing of the Administration bill by pushing forward twelve months the Phase I and Phase II sulfur dioxide emission control deadlines from December 31, 1995 and December 31, 2001 to January 1, 1995 and January 1, 2001, respectively. It makes little sense at this stage to undo the already stringent timetable developed by the Administration or to place unnecessary time and cost burdens upon Southern industries that will have to comply with the bill.

SUMMARY

The imposition of additional, nationwide emission controls at this time, especially in light of NAPAP's Interim Assessment and its upcoming Final Report in 1990, is environmentally unnecessary. The recent testimony of EPA's Administrator and the Justice Department's legal arguments only confirm this conclusion. But the current proposals are something much worse than scientifically unjustified, they are economically irresponsible, particularly when our global economic position is deteriorating. Additional emission controls will result in a host of potentially debilitating drains on the South's booming economy, negatives that will not be limited to electric rates. As utility rates rise, so will the price of goods and services of industries and businesses that rely on electricity; industries as divergent as metal shops and grocery stores. As these prices rise, the American consumers' standard of living will absorb the double blow of increased electric bills and increased costs of goods and services. In an effort to reduce expenses there is also a significant probability that thousands of jobs will be lost. Also, the South's momentum in areas of international competitiveness, such as textiles, will begin to falter under the weight of increased costs and decreased productivity. Clearly, these are costs the South cannot afford.

Requiring the South to incur these costs in the name of benefits that the EPA Administrator can neither quantify nor forecast will not significantly benefit our country, or any part of it, and the South should not be asked to make such a disproportionate, meaningless sacrifice.

MIDWESTERN OBJECTIONS TO CLEAN AIR ACT AMENDMENTS

I. General Objections

The Midwest shares in the general objections that have been voiced nationally in opposition to enactment of additional legislation at this time. These objections may be grouped into four basic categories:

1. Additional acid rain legislation should not be considered until NAPAP releases its Final Report. In 1980, Congress established the National Acid Precipitation Assessment Program ("NAPAP") to conduct a comprehensive 10-year research program to determine whether additional emission controls are necessary to address acid rain. NAPAP's Final Report is due in 1990. It is clear that were Congress to act now -- literally months before the Final Report is released -- it would be wasting the almost one-half billion dollars and years of research that have gone into NAPAP. And why? No new information or scientific conclusions have suddenly emerged to dictate such a radical change in Congress' 1980 game plan, and no abrupt deterioration of our environment has occurred in this "eleventh hour." Clearly, common sense should tell us that now is not the time to enact additional acid rain legislation.

2. Additional acid rain legislation is not supported by current scientific knowledge. The Interim Assessment of NAPAP issued in 1988 concluded that, 1) contrary to once popular belief, there is no impending acid rain crisis, and 2) the current Clean Air Act is successfully controlling emissions of sulfur dioxide (SO_2) and nitrogen oxides (NOx). Indeed, the Interim Assessment concludes that there are very few instances of damage to the environment from acid rain and that at present emission rates (and of course these rates will be reduced in the future by the current Clean Air Act) acid rain will have little or no effect on our environment. Proponents of additional acid rain legislation, therefore, must look to some other justification as the basis for their proposals, for current scientific knowledge lends them no support.

3. The cost of implementing additional acid rain legislation is economically unjustifiable at this time. The current acid rain proposals will yield only a short-term acceleration of the SO_2 emission decreases already mandated by the current Clean Air Act. Each of these proposals, however, entails several billions of dollars in yearly compliance costs. Even more, they will have staggering, negative impacts on utility rates, the Consumer Price Index (CPI), inflation, the budget deficit, employment, and U.S. industrial competitiveness -- impacts that have not even been quantified -- and will cause a diversion of funds from clean coal technology research and development. The known compliance costs and unquantified macroeconomic impacts of additional acid rain legislation bear no reasonable relationship whatsoever to the meager benefits of a mere acceleration of the rate of emission

decreases and that the current proposals are economically unwise, especially at a time when our economy is once again teetering on the verge of recession.

4. Science cannot yet provide a clear risk/benefit analysis on which to support additional acid rain legislation. In recent testimony before the Senate Environmental Protection Subcommittee, the Administrator of the EPA could not quantify what the benefits of H.R. 3030 would be nor could he predict when they might arrive. Still more recently, in 1989 a U.S. Justice Department brief filed in the United States Court of Appeals for the District of Columbia stated as follows: "... important scientific questions remain unresolved concerning acid deposition effects on forests, lakes, crops and building materials. Indeed, science cannot now accurately predict the effects that would result from source-specific emissions reductions of sulfur dioxide and nitrogen oxides on affected areas." These instances indicate exactly how unsettled science is at this time concerning the risks, if any, of proceeding under the current Clean Air Act versus the benefits of enacting additional, costly emission control measures. In light of the absence of any clear risk/benefit analysis, Congress should not be looking to purchase such a colossally expensive insurance policy or, at a minimum, should adopt an approach of flexibility and reasonableness rather than the current one of "command and control."

II. Regional Objections

Aside from the host of reasons demonstrating that additional acid rain legislation is not in our national interest, the current proposals are of particular concern to the Midwest for several reasons:

* Current legislative proposals do not provide sufficient flexibility for the Midwest. It is clear that if any of the current acid rain legislative proposals are enacted, the Midwest will be forced to use existing technology. And, as we are all aware, scrubbing is an extremely expensive control technology. Indeed, a single scrubber may cost $100 million or more, and capital costs for adding scrubbers to older plants can sometimes equal or even exceed the original plant investment. Even worse, increased dependence on scrubber technology will drain precious resources away from cost-effective, energy-efficient clean coal technologies that offer the nation a more cost effective permanent solution to acid rain.

* If additional controls are enacted, sources closer to the areas of concern should be targeted for Phase I reductions. Common sense and a host of scientific reports say that a ton of emissions reductions close to

the so-called affected areas is more important than a ton of emissions reductions hundreds of miles away.

* <u>Additional acid rain controls will further increase the Midwest's competitive disadvantage</u>. Without question, the largest share of compliance costs for additional acid rain legislation will fall upon the Midwest. This will place the Midwest at a further competitive disadvantage with other regions of the country.

* <u>An emissions "cap" will stifle Midwestern growth</u>. The idea of an emissions cap would have a devastatingly chilling effect on economic growth in the Midwest, possibly reversing the positive business climate it has worked so hard to create. The emissions cap would pressure utilities to use yet undeveloped "pristine" technologies, eliminating fossil-fired generation as an expansion option, expansion necessary to serve the region's growing demand. While "pristine" technologies such as wind and solar power seem prudent in concept, advanced generation alternatives prove to be unattractive when one considers their high installed cost and their technical risk due to lack of development.

* <u>Proposed "allowance" programs are unrealistic and unfair</u>. The trading or selling of emission allowances optimistically predicted by the EPA is an empty hope since most compliance over-performers will choose to keep their own allowances rather than sell them. For regions expecting to grow and thus needing new generation, this is simply self-preservation through allowance self-banking to accommodate their own projected emission growth. Most Public Service Commissions nationwide support this attitude since they are charged with insuring the economic well-being of their state or region. EPA has even implied that the EPA should own and disburse excess credits to ensure trading traffic. Since these credits would be made possible through increases in individual ratepayers' billings, such a solution is inequitable and would penalize those sources who over control to free up allowances for trading.

* <u>The "Air Toxics" Title of S. 1630 should not apply to U.S. utilities</u>. Title III of S. 1630 seeks to regulate the emission of nearly two hundred so-called "air toxics" or "hazardous air pollutants." Among the air toxics targeted by Title III are a number of metals and chemicals which are present naturally in coal and emitted as trace elements by coal-fired utility plants. Our current estimates are that Title III will force all coal-fired powerplants to have scrubbers; many others, if not all, will also have to have "baghouses." Thus,

Title III would result in the imposition of additional emission controls on utilities well beyond the emission controls already required by the "Acid Rain" Title of the bill--controls that would double to triple a utility's compliance costs for S. 1630. Given the fact that so little evidence is available, and that which is available reflects a very low risk associated with the trace amounts of elements emitted from utility power plants, mandating EPA to regulate utility emissions under the Title III of S. 1630 is premature at best. Instead, S. 1630 should require, as does S. 1490 and H.R. 3030, that EPA study the health risks associated with utility emissions of air toxics and, before further regulating these sources under Title III, make a positive finding of the necessity for additional controls.

* Since 1985, Congress has appropriated a total of $2.747 billion for the clean coal program. When that sum is combined with those invested by private entities, DOE estimates that a total of **$6.25 billion** will be spent on clean coal demonstration projects during the life of the program. The government-industry clean coal technology program is yielding promising results, and, in fact, clean coal technologies should be readily available soon that can achieve the same results of flue-gas desulfurization, or scrubbing, at a much lower cost. Supporters of the Clean Coal Technology Program in the Midwest are concerned about the limited role that clean coal technologies play in S. 1630, as amended by the Environment and Public Works Committee. Without changes, S. 1630 could slow or halt development of certain clean coal technologies. It would do this by denying compliance extensions to those companies that wish to retrofit clean coal technologies and whose research will not be complete in time for adequate consideration in so-called Phase I or Phase II of the compliance program established in S. 1630.

* S. 1630, as amended in the Environment and Public Works Committee, alters the program timing of the Administration bill by pushing forward twelve months the Phase I and Phase II sulfur dioxide emission control deadlines from December 31, 1995 and December 31, 2001 to January 1, 1995 and January 1, 2001, respectively. It makes little sense at this stage to undo the already stringent timetable developed by the Administration or to place unnecessary time and cost burdens upon Midwestern industries that will have to comply with the bill.

SUMMARY

The imposition of additional, nationwide emission controls at this time, especially in light of NAPAP's Interim Assessment and its upcoming Final Report in 1990, is environmentally unnecessary. The recent testimony of EPA's Administrator and the Justice Department's legal arguments only confirm this conclusion. But the current proposals are something much worse than scientifically unjustified, they are economically irresponsible, particularly when our global economic position is deteriorating. Additional emission controls will result in a host of potentially debilitating drains on the Midwest's struggling economy, negatives that will not be limited to electric rates. As utility rates rise, so will the price of goods and services of industries and businesses that rely on electricity; industries as divergent as metal shops and grocery stores. As these prices rise, the American consumers' standard of living will absorb the double blow of increased electric bills and increased costs of goods and services. In an effort to reduce expenses there is also a significant probability that thousands of jobs will be lost. Also, the Midwest's momentum in areas of international competitiveness will begin to falter under the weight of increased costs and decreased productivity. Clearly, these are costs the Midwest cannot afford.

Requiring the Midwest to incur these costs in the name of benefits that the EPA Administrator cannot quantify nor forecast will not significantly benefit our country, or any part of it, and the Midwest should not be asked to make such a sacrifice.

Katie, he will call later
Mrg

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W. R. Timken, Jr.
Chairman - Board of Directors

January 24, 1990

The Honorable Albert Gore, Jr.
United States Senate
393 Senate Russell Office Building
Washington, DC 20510-4202

Dear Senator Gore:

You are about to begin debate on a bill which will severely impact the competitiveness of our business and the lives of our employees. The danger extends to all those employed in similar industries in the impacted areas as well as their neighbors. I urge you to consider the following points as you deliberate S1630, the Mitchell-Baucus amendments to the Clear Air Act.

If enacted in its present form, this bill would have serious effects on the competitiveness of business and industry throughout the Midwest. The result can be lost jobs and a halt to the as yet incomplete recovery from the economic restructuring in the early 1980's.

Here in northeast Ohio, sulfur dioxide (SO2) emissions reductions imposed on our utility would increase our electric rates by more than 25%. Our total manufacturing costs would increase by more than $10 million annually. In view of the preliminary information coming out of the NAPAP study, enactment of federal legislation with such staggering economic consequences may be environmental overkill.

We believe some level of SO2 reduction is justified in view of the NAPAP findings. However, something less than the current arbitrary 10 ton figure may be appropriate. It will be a serious error to force application of outdated scrubber technology, with its enormous cost, because of restrictive emissions levels or arbitrary dates.

If in the final bill a disproportionate share of SO2 emissions reduction costs are placed on the Midwest states, a mechanism must be developed to protect all electric consumers from drastic rate increases. Protection from an increase above a "reasonable amount" will help insure that the industrial Midwest can continue to compete in world markets while contributing to cleaner air for all Americans.

I also believe that the legislative framework for improving our nation's air should permit wide flexibility in achieving emission reductions. Compliance deadlines and emission reduction requirements should not be structured to require immediate mandatory scrubbing. We need to preserve maximum flexibility to insure cost minimization and to protect the viability of clean coal technology.

The enclosed article highlights some of our concerns about the acid rain issue and the pending legislation.

Thank you for your consideration.

Sincerely,

W. R. Timken, Jr.

Enclosure

The Washington Times

THURSDAY, OCTOBER 26, 1989

On gold-plated ponds

At a hearing on Oct. 5, members of the Senate Subcommittee on Environmental Protection discovered that the Bush administration acid rain program is expensively futile.

A preview of the 1990 final report by the National Acid Precipitation Assessment Project shows the Bush proposal to spend up to $4 billion to $6 billion a year to cut sulphur dioxide emissions will deacidify only 26 lakes in the Northeast after 20 years — and only 75 lakes after 50 years. (See table.)

This means a 20-year cumulative cost of almost $5 billion per deacidified lake and after 50 years about $4 billion per lake. (By contrast, the 20-year cost of liming the average lake is less than $50,000.)

In his report to the Senate, James Mahoney, NAPAP director, admitted that even this scandalously small projection of benefits from the proposed Clean Air Program was iffy because: "There are significant uncertainties about the role that watershed mineral processes, organic acids and nitrates (in the soils) may play in the acidification and recovery process."

This is "science-ese" for admitting that, despite protestations, NAPAP knows there is very little correlation between acid-rain levels and acid lakes. For example, Mr. Mahoney acknowledged that the highest acid lake concentration in any U.S. state is in Florida. Yet Florida gets hardly any acid-rain deposition, and, as Mr. Mahoney noted, its acid lakes were the result of natural causes.

Also contrary to spurious "new (but unreleased) research" by the Environmental Protection Agency, published geological core studies show that more than 80 percent of the acidic Northeast lakes were acidic in pre-industrial times.

Dr. Mahoney had to tell the Senate that "determining the precise percentage of acidic waters due wholly or in part to acidic deposition carries with it scientific and statistical uncertainties." This statement directly counteracted the propaganda with which EPA Director William Reilly had practically insisted that Mr. Mahoney lead his statement.

Mr. Mahoney granted that "the effects of constant, increased and decreased acid-rain deposition are not always statistically significant." Indeed they are not, either here or abroad.

In fact, the EPA's own data shows that land use and soil composition are at least three times as statistically significant "causes" of acidic lakes as acid rain.

The NAPAP analysis shows that acid rain is not a serious problem, and the costs of SO_2 reduction are ludicrously out of line with the benefits.

This is why NAPAP was forced to project that even if we do nothing, the number of acidic lakes in the Northeast will actually *decline* by one in the next 20 years, to a total of 161 and will only rise to 186 by the end of the next 50 years. Mr. Mahoney admitted, "What that really means, statistically, is no change at all."

Worse, even if we do as the Bush proposal suggests and cut SO_2 emissions by 10 million tons a year, raising electric bills in the Midwest by as much as $900 a year in Ohio, $630 in Indiana and Pennsylvania, $520 in Missouri, and more than $400 a year in Tennessee, West Virginia and Illinois, little will change.

When Democratic Sen. Daniel Patrick Moynihan of New York, a cosponsor of the Bush Clean Air Program, heard this, he began to raise some carefully soft-spoken hell: "No matter what legislation we pass, about 10 percent of the lakes are going to be acidic beyond the lifetime of anybody in this room? We have to ask ourselves, is that the best way to spend $4 billion a year?"

It is especially questionable when *all* of the lakes in North America could *definitely* be deacidified immediately by boat-liming, at a cost of less than $400,000 a year total!

But what about other effects of acid rain on forests and crops? NAPAP Director Mahoney admitted: "Research has established that there is no measurable and consistent adverse crop-yield response from the direct effects of acidic rain at ambient levels in North America."

On the contrary, "an evaluation of the nutritional enrichment of some agricultural soils through the input of sulfur and nitrogen from acidic deposition indicates indirect benefits associated with decreased fertilizer requirements."

But what about trees? NAPAP said that "other than for red spruce, extensive surveys of forest condition have indicated no evidence of widespread forest decline in North America related to acidic deposition."

Even on red spruce, NAPAP said the effects were limited to about 6 percent of the forests, all at high elevations (above 2,600 feet), and added, "Several natural stresses are related to these declines (droughts, freezes, diseases, etc.); and acid rain *may* intensify the effects of the natural stresses." (Emphasis added.)

In short, the NAPAP analysis shows now what it did in 1987: Acid rain is *not* a serious environmental problem (Mr. Moynihan concluded, "The sky is not falling"), and the costs of SO_2 reduction are ludicrously out of line with the benefits.

It's a scandal waiting to be legislated.

Warren T. Brookes is a nationally syndicated economics columnist.

THE HIGH COSTS OF REDUCING ACID RAIN

	Number of acidic NE lakes	Cumulative costs of SO_2 reduction	Cumulative costs to lime all NE acidic lakes
This year	162	$4-6 bill./yr.	$400,000/yr.
20 Years From Now			
■ No Program	161	—	—
■ Liming	0		$8 million
■ Bush Program	136	$120 billion	—
50 Years From Now			
■ No program	186	—	—
■ Liming	0		$20 million
■ Bush Program	87	$300 billion	—
20-year Cost per Lake Changed From Present			
■ Liming			$50,000
■ Bush Program		$5 billion	

Source: Based on NAPAP Oct. 5, 1989. Report. Senate Subcommittee on Environmental Protection.

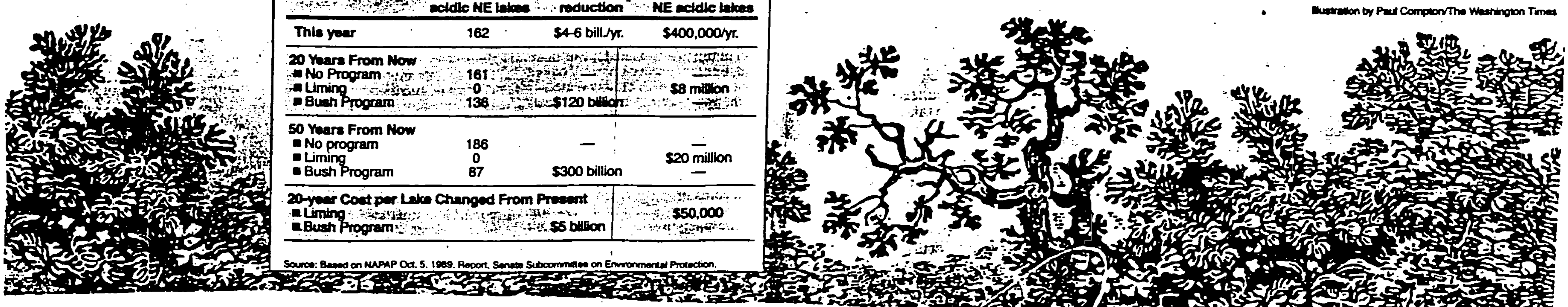

Illustration by Paul Compton/The Washington Times

REVIEW & OUTLOOK

No Pap From NAPAP

The following editorial contains the results of scientific research and so may be inappropriate or offensive to those who conduct environmental policy in Washington, D.C. Reader discretion is advised.

The results of the National Acid Precipitation Assessment Program are trickling into public view. Science now knows more about acid rain than it used to. NAPAP is a 10-year-long, government-sponsored study involving hundreds of scientists and costing more than $500 million. It is the definitive statement on the acid-rain problem. Its report is not final and has not been released but some of its conclusions are circulating through the press and scientific community.

It appears, for instance, that except for red spruces high in Northeastern mountains, acid rain does not directly harm trees or other vegetation. Acid rain does impose indirect stress on trees, but that stress is minor compared with that caused by other factors, such as temperature, insects, root diseases and ozone. Nor does acid rain reduce crop yields.

Acid rain does affect lakes, though exactly how much is not completely understood. Many lakes have been naturally acidic since prehistoric times. In Florida, for example, 22% of the lakes are acidic, but Florida has little or no acid rainfall.

Nevertheless, in many areas where soils are naturally acidic, the organic sulfates that are produced by burning fossil fuels do further reduce the pH level, sometimes significantly. A separate section of the report, still under review, indicates that putting lime into lakes is the most effective way to neutralize the acid. It is certainly the cheapest.

Senator Daniel Moynihan, who wrote the bill creating the NAPAP study in 1979, summarized the study's results this way: "To me, it's reassuring, because it shows that the sky is not falling."

The NAPAP results expose the irresponsible hysteria fomented by environmental groups, and encouraged in hyperventilating media reports. A lot of people have a lot of explaining to do about their statements on the severity of the problem, not least EPA head William Reilly and other authors of the Bush Clean Air Bill who produced their legislation before the NAPAP results were released.

The Bush acid-rain provisions would cost the U.S. at least $4 billion a year, according to the EPA. Can this spending be justified in light of the NAPAP findings? For millions, not billions, it would be possible to lime all the artificially acidified lakes in the country. Wouldn't this be the more financially prudent course, until the NAPAP folks have nailed down the full acid-rain story? Assuming, of course, that anyone in Washington can still think in terms of financial prudence on environmental issues.

Voters outside the Beltway should certainly hope so. Under the acid-rain provision of the House bill, which is substantially the same as the Bush bill, Ohioans will have to pay an extra $898 million in their utility bills. Georgians will have to pay an extra $396 million, West Virginians will pay $417 million. These figures come from the Edison Electric Institute and, even allowing for the fact that they may be high-end estimates, the costs are surely staggering.

In addition, the acid-rain provision would add $5 a ton to the price of domestically made steel, and 4 cents a pound to domestically made aluminum, thus damaging the competitive posture about which such men as Rep. Gephardt and Sen. Mitchell profess concern. Immediate capital costs required by the legislation would also divert investment from efforts to modernize industrial plants.

The kicker is that the bill will have only a slight effect on acidified lakes. NAPAP Director James Mahoney recently testified that the Bush bill emissions cap would mean that after 20 years, 25 lakes in the Northeast would be deacidified—a cost of more than $3 billion to deacidify each lake. Sen. Mitchell and the environmental acolytes who staff the Senate environmental committee have written an even more expensive acid-rain provision. The Senate bill would move up compliance dates, demand stricter nitrogen-oxide reductions and reduce allowances for new power plants.

The White House could achieve any immediate pay-back on the public's investment in the environment by announcing an immediate program to begin liming the lakes, based on the NAPAP results. It would constitute a rational, interim acid-rain policy, spare Congress a tumultuous debate over costs, save the American people billions of dollars a year in needlessly higher utility costs, and, though this may seem trivial in Washington, the lakes actually would be enhanced.

United States Senate

WASHINGTON, D.C. 20510

February 1, 1990

The Honorable Max Baucus
Chairman
Subcommittee on Environmental Protection
U.S. Senate
Washington D.C. 20510

Dear Max:

Now that the Senate has turned to consideration of the Clean Air Act Amendments of 1989, we would like to express our concerns regarding this bill's impact on clean burning plants that were operating at low capacity during the baseline years outlined in the legislation. We would like to find a fair solution that does not break the emissions cap but would also allow these facilities to generate at normal capacity factors.

Section 405 (d) of S. 1630 limits "clean" coal-fired units, that is below 1.20 lbs/mmBTU, to an annual sulfur dioxide tonnage emission limitation that is the product of the unit's baseline (as defined in Sec. 402 (d) (1)) multiplied by a factor of 120 per centum and its actual 1985 emission rate, divided by 2,000.

For these "clean" plants that operated at low capacity during the baseline years, the capacity factor increase of 20 per centum to the 1985-87 "baseline" only further exacerbates the capacity problems experienced by these plants in our states. This provision discourages the use of existing capacity to meet future energy needs, and contrasts with the provision for all new plants at section 405 (g) of the bill that imputes a normal capacity factor of 65 per centum.

We are not opposed to legislation that would address the acid rain problem. However, S. 1630 does not provide sufficient flexibility for utilities in those "clean" states that have already invested significant efforts to achieve exceptionally low SO2 emissions. Granting these "clean" plants which operated at low capacity an imputed 65 per centum capacity factor adjustment would make S. 1630 a far more equitable bill.

J. Robert Kerrey

J. James Exon

United States Senate

WASHINGTON, D.C. 20510

January 25, 1990

Dear Colleague:

We are writing to alert you to serious capacity factor restrictions facing "clean" utilities in your State under S. 1630, the Clean Air Act Amendments of 1989.

Over one-hundred existing "clean" units will be locked in at below normal capacity levels. This contrasts with the bill's provision "imputing" a normal capacity factory of 65 percent for "new" plants that begin operation between 1985 and the date of enactment. In fairness, the same standard should be provided to existing "clean" plants.

We support legislation to reduce sulfur dioxide emissions permanently by 10 million tons. However, we believe that the bill pending before the Senate must be amended to allow "clean" utilities to operate at a normal 65 percent capacity. Currently, S. 1630 will limit the ability of "clean" utilities to meet near-term and future energy needs with existing capacity.

new or existing

It is our understanding that this change can be accomplished without leading to an increase in emissions, thereby preserving the bill's goal of a 10 million ton reduction. We would like to work with the Committee to see that this change is incorporated in the bill.

We urge you to carefully review the impact of S. 1630 on the capacity factor of "clean" utilities in your State. These units emitting less than 1.2 lbs/mmBTU of SO2 should not be penalized with below normal restrictions.

Please contact Graham Chisholm (Sen. Kerrey) at 4-6551 and Phil Karsting (Sen. Exon) at 4-4224 if you interested in joining us in signing this "Dear Colleague" letter.

J. Robert Kerrey

J. James Exon

Q -, This in lieu of 120% baseline? yes

Boren, Levin → definite

Bingaman, Kohl, Lugar, Kasten, Kastenbaum, Harkin, Ford. } interested

United States Senate

WASHINGTON, D.C. 20510

January 24, 1990

The Honorable Max Baucus
Chairman
Subcommittee on Environmental Protection
U.S. Senate
Washington D.C. 20510

Dear Max:

Now that the Senate has turned to consideration of the Clean Air Act Amendments of 1989, we would like to express our concerns regarding this bill's impact on clean burning plants that were operating at low capacity during the baseline years outlined in the legislation. We would like to find a fair solution that does not break the emissions cap but would also allow these facilities to generate at normal capacity factors.

Section 405 (d) of S. 1630 limits "clean" coal-fired units, that is below 1.20 lbs/mmBTU, to an annual sulfur dioxide tonnage emission limitation that is the product of the unit's baseline (as defined in Sec. 402 (d) (1)) multiplied by a factor of 120 per centum and its actual 1985 emission rate, divided by 2,000.

For these "clean" plants that operated at low capacity during the baseline years, the capacity factor increase of 20 per centum to the 1985-87 "baseline" only further exacerbates the capacity problems experienced by these plants in our states. This provision discourages the use of existing capacity to meet future energy needs, and contrasts with the provision for all new plants at section 405 (g) of the bill that imputes a normal capacity factor of 65 per centum.

We are not opposed to legislation that would address the acid rain problem. However, S. 1630 does not provide sufficient flexibility for utilities in those "clean" states that have already invested significant efforts to achieve exceptionally low SO2 emissions. Granting these "clean" plants which operated at low capacity an imputed 65 per centum capacity factor adjustment would make S. 1630 a far more equitable bill.

J. Robert Kerrey

J. James Exon

Kearley/Exon

H.R. 3030 and S. 1630 Amendment
Provide A Capacity-Factor Baseline

In general, coal-fired utility units are required to meet an annual emission limitation equivalent to either 2.5 or 1.2 lbs. $SO_2/10^6$ Btu (for Phase I or II respectively) multiplied by the unit's generation baseline under the proposed legislation. (For some categories of units, S. 1630 proposes a different reduction or rate formula.) For units in operation before CY 1985, the baseline has been arbitrarily set as the annual average quantity of fuel consumed during CY 1985-1987. A 3-year average was chosen in an attempt to compensate for generation anomalies which might occur in a single year and CY 1985-1987 was chosen as the averaging period to avoid the assumed effects of the early 1980s recession on power demand. Arbitrarily limiting utilities to the CY 1985-1987 baseline is certain to result in unrepresentative low generation for some utilities in the future. It does for TVA.

TVA's annual average generation during CY 1985-1987 was 80.6 billion Kwh from all of TVA's coal-fired units. In CY 1980, the benchmark year of the legislation, coal-fired system generation was 83.4 billion Kwh. The 1988 generation from TVA's coal-fired system was 84.1 billion Kwh which is probably more representative of future generation. This level can increase further as demand continues to grow despite the return to service of TVA nuclear units.

Q = whether clean or not.

One means of avoiding or lessening the extent of this potential problem would be to assume a maximum realistic capacity factor for each unit or to use the 3-year average baseline, whichever is greater. Assuming operation at a capacity factor of 65 percent is representative of a well-run unit, TVA's compliance costs would be reduced under H.R. 3030 by approximately $25 million annually and under S. 1630 by approximately $60 million annually. A capacity-factor formula has, in fact, been proposed in S. 1630 for units commencing operation between 1985 and the date of enactment. Such an approach is equally appropriate for existing units commencing operation before 1985.

H.R. 3030

Amend Section 504(4)(A) (page 258; lines 8-24):

"(4) The term 'baseline' means the annual quantity of fossil fuel consumed, measured in millions of British thermal units ('mmBtus'), by an affected unit, calculated as follows:

(A) For each steam-electric unit in operation prior to January 1, 1985, the baseline shall be the annual average quantity of mmBtu consumed in fuel during calendar years 1985, 1986, and 1987, ad recorded pursuant to Department of Energy Form 767 [~~For any unit for which these forms were not filed, the baseline shall be the level specified for that unit in the 1985 National Acid Precipitation Assessment Program (NAPAP) Emissions Inventory, Version 2. The Administrator may exclude periods during which a unit is shutdown for a continuous period of four months or longer.~~] or the annual average quantity of mmBtu consumed in fuel assuming a 65-percent capacity factor, whichever is greater.

S. 1630

Amend Section 402(d)(1) (pages 448-449; lines 17-26, 1-6):

(d)The term 'baseline' means the annual quantity of fossil fuel consumed, measured in millions of British Tehrmal Units ('mmBtus'), by an affected unit, calculated as follows:

"(1) For each steam-electric generating utility unit that was in commercial operation prior to January 1, 1988, the baseline shall be the annual average quantity of mmBtus consumed in fuel during calendar years 1985, 1986, and 1987, as reocrded by the Department of Energy pursuant to Form 767[~~For any unit for which such form was not filed, the baseline shall be the level specified for such unit in the 1985 National Acid Precipitation Assessment Program (NAPAP) Emissions Inventory, Version 2, National Utility Reference File (NURF). The Administrator may exclude periods during which a unit is shutdown for a continuous period of four months or longer.~~] or the annual average quantity of mmBtu consumed in fuel assuming a 65-percent capacity factor, whichever is greater.

H.R. 3030 and S. 1630 Amendment
1.2 Pound Cap for Lower Emitting Coal-fired Units

Utility units with actual CY 1985 emission rates less than 1.2 lbs. $SO_2/10^6$ Btu are capped at those rates in Phase II under H.R. 3030. Under S. 1630, coal-fired units with CY 1985 emission rates less than 1.2 lbs. $SO_2/10^6$ Btu would be held to an annual tonnage limitation based on their 1985 emission rate and 120% of their baseline (generally annual average generation during CY 85-87). TVA operates 13 units which would be affected by these provisions. There are two problems with this kind of requirement.

First, it establishes regulatory limitations based on what could be atypical operating conditions. A generating unit emitting below 1.2 pounds in 1985 could have done so for several reasons. (e.g., the control equipment may have been new and at peak performance). For instance, TVA's Widows Creek unit 8, which has a scrubber, has an existing emission limitation of 0.9 lb. per million Btu, but its actual 1985 emission rate is recorded as only 0.31 pounds. Widows Creek unit 8 could be required to meet a 0.31-pound standard after the year 2000 regardless of how uneconomical or technically infeasible it would be to sustain that level of compliance over a long period of time under H.R. 3030. (The 120% multiplying factor and the use of annual tonnage limitations under S. 1630 would alleviate this problem slightly.)

Second, any conservatively run generating unit will be managed so that its actual emissions are lower than its legal emission limitation in order to provide a margin of safety to avoid violations. In other words, to ensure that a unit actually meets the 1.2-pound standard, a utility may have to aim at meeting a 0.9- to 1.0-pound standard. Under H.R. 3030, such concern for compliance would be penalized by setting a post-2000 emission limitation at a level that includes that margin of safety, but which must then be met in the future with its own margin of safety. In the Widows Creek unit 8 example, TVA would have to plan operationally to meet something like a 0.25- to 0.28-pound standard to ensure compliance. Such a low emission limitation would require both the burning of lower sulfur coal and the operation of the existing scrubber at peak performance. Assuming this margin of safety does not have to be used (e.g. that control equipment functions as designed, that a load of noncomplying coal is not burned by mistake), extra allowances would be produced which may be marketable under S. 1630. Whether these allowances could be sold for the cost of this over compliance is unknown.

To avoid these potential problems, such low-emitting coal-fired units should be capped at the floor specified in the legislation for coal-fired units in general, 1.2 lbs. $SO_2/10^6$ Btu, or the applicable limitation in the State implementation plan, whichever is lower. This would reduce TVA's compliance costs in Phase II annually by approximately $10 million to $30 million under H.R. 3030 and S. 1630.

H.R. 3030

Amend Section 505(c) (pages 272–273; lines 18–19, 1–8):

"(c) UNITS BELOW 75 MWe OR 1.20LBS/MMBTU.—After December 31, 2000, each steam-electric existing unit with nameplate capacity of less than 75 MWe [~~or an actual 1985 emission rate less than 1.20lbs/mmBtu~~] shall not exceed an annual emission rate requirement equal to its actual 1985 emission rate. After December 31, 2000, each steam-electric 1985 emission rate less than 1.20 lbs/mmBtu shall not exceed 1.2 lbs/mmBtu or the SO2 emission limitation established under an applicable implementation plan, whichever is lower. The emission rate requirement for an existing unit that was not in operation during calendar year 1985 shall be the emission rate for a calendar year after 1985, as determined by the Administrator consistent with the preceeding sentence. Such a unit shall not be an affected unit for purposes of this title, except as provided under section 509.

S. 1630

Delete Section 405(a) (page 467; lines 4–18) and substitute the following:

"(d) COAL-FIRED UNITS BELOW 1.20 LBS/MMBTU.—After January 1, 2000, each steam-electric existing unit with a nameplate capacity of 75MWe or more and an actual 1985 emission rate less than 1.2 LBS/mmBtu shall not exceed 1.2 lbs/mmBtu or the SO2 emission limitation established under an applicable implementation plan, whichever is lower. The emission rate requirement for an existing unit that was not in operation during calendar year 1985 shall be the emission rate for a calendar year after 1985, as determined by the Administrator consistent with the preceeding sentence. Such a unit shall not be an affected unit for purposes of this title, except as provided under section 410.

All over 75 MW + under 1.2

ESTIMATED 1985 LOWEST EMITTING UNITS WITHOUT SCRUBBERS

RK	ST	UTILITY	UNIT/NUMBER	NAMEPLATE CAPACITY (MW)	1985 COAL CONSUMPTION TONS (1000)	1985 HEAT VALUE (BTU/LB)	1985 SULFUR CONTENT (%)	1985 ESTIMATED EMISSIONS W/ASH RET (# SO2/MMBTU)	EST BASELINE AVG 85-87 (10^12 BTU)	EST BASELINE CAP FACTOR	EST 120% BASELINE CAP FACTOR
1	AR	ARKANSAS POWER & LIGHT	INDEPENDENCE 2*	800	2,647	8,605	0.20	0.407	49.7	67.5%	81.1%
2	AR	ARKANSAS POWER & LIGHT	INDEPENDENCE 1*	800	3,249	8,590	0.20	0.407	46.6	63.3%	76.0%
3	CO	P S CO OF COLORADO	VALMONT5	166	308	10,585	0.23	0.424	7.9	51.6%	62.0%
4	IA	INTERSTATE POWER CO	LANSING 4	275	693	8,299	0.23	0.485	11.9	47.1%	56.6%
5	OK	OKLAHOMA G & E	SOONER 1	569	1,376	8,934	0.30	0.588	23.3	44.5%	53.4%
6	TX	SOUTHWESTERN PUB SERV	HARRINGTON STATION 2	360	1,273	8,929	0.30	0.588	22.2	67.0%	80.5%
7	TX	SOUTHWESTERN PUB SERV	HARRINGTON STATION 3	360	1,298	8,928	0.30	0.588	23.7	71.6%	85.9%
8	TX	SOUTHWESTERN PUB SERV	HARRINGTON STATION 1	360	1,314	8,927	0.30	0.588	20.9	63.1%	75.7%
9	OK	OKLAHOMA G & E	SOONER 2	569	1,340	8,926	0.30	0.588	25.3	48.4%	58.0%
10	OK	OKLAHOMA G & E	MUSKOGEE 5	572	1,242	8,813	0.30	0.596	20.3	38.6%	46.3%
11	OK	OKLAHOMA G & E	MUSKOGEE 4	572	1,195	8,786	0.30	0.598	23.0	43.7%	52.4%
12	NE	NEBRASKA PUB PWR DIS	GERALD GENTLEMAN STA 1	681	1,290	8,785	0.30	0.598	23.7	37.8%	45.4%
13	WI	WISCONSIN PUB SERV	WESTON 3	322	1,087	9,032	0.31	0.601	21.1	71.3%	85.6%
14	TX	SOUTHWESTERN PUB SERV	TOLK STATION 1	561	1,793	8,712	0.30	0.603	30.7	59.5%	71.4%
15	NE	NEBRASKA PUB PWR DIS	GERALD GENTLEMAN STA 2	628	1,907	8,699	0.30	0.604	29.0	50.2%	60.2%
16	WI	WISCONSIN P & L	COLUMBIA 2*	512	1,287	8,981	0.31	0.604	24.2	51.4%	61.7%
17	TX	SOUTHWESTERN PUB SERV	TOLK STATION 2	561	1,314	8,667	0.30	0.606	26.7	51.7%	62.1%
18	OK	OKLAHOMA G & E	MUSKOGEE 6	572	1,344	8,856	0.31	0.613	21.2	40.3%	48.3%
19	OR	PORTLAND GENERAL ELEC	BOARDMAN 1*	561	417	8,227	0.30	0.638	6.9	13.4%	16.1%
20	KS	KANSAS CITY CITY OF	NEARMAN CREEK 1	262	919	8,227	0.30	0.638	14.9	61.8%	74.2%
21	TX	CENTRAL POWER & LT	COLETO CREEK 1	600	1,712	10,982	0.36	0.639	40.7	73.7%	88.4%
22	IA	IOWA-ILLINOIS G&E	LOUISA 1*	738	1,152	8,181	0.30	0.642	27.9	41.1%	49.3%
23	CO	CO SPRINGS CITY OF	RAY D NIXON 1	207	533	10,483	0.35	0.651	13.4	70.4%	84.5%
24	TX	L COLORADO RV AUTH	FAYETTE POWER PROJ 2*	615	2,503	8,714	0.33	0.663	39.5	69.8%	83.8%
25	OK	GRAND RIVER DAM AUTH	GRDA 1	490	1,924	8,238	0.32	0.680	24.2	53.7%	64.4%
26	IA	IOWA POWER & LIGHT CO	COUNCIL BLUFFS 3*	726	2,168	8,228	0.32	0.681	35.7	53.5%	64.2%
27	WI	WISCONSIN ELEC POWER	PLEASANT PRAIRIE 2	617	839	8,845	0.31	0.683	30.3	53.4%	64.1%
28	IA	IOWA POWER & LIGHT CO	COUNCIL BLUFFS 2	82	137	8,191	0.32	0.684	2.1	28.0%	33.6%
29	WI	WISCONSIN ELEC POWER	PLEASANT PRAIRIE 1	617	1,725	8,818	0.31	0.686	35.6	62.8%	75.3%
30	CO	P S CO OF COLORADO	ARAPAHOE 4	109	233	10,794	0.38	0.686	5.1	55.4%	66.5%
31	NV	SIERRA PACIFIC POWER	NORTH VALMY 1*	254	565	11,276	0.40	0.692	13.6	58.1%	69.8%
32	MO	KANSAS CITY P&L	IATAN 1*	726	2,383	8,815	0.35	0.695	40.2	60.2%	72.2%
33	TX	HOUSTON LIGHTING & PWR	W A PARISH 7	615	2,083	8,526	0.34	0.698	35.2	62.3%	74.7%
34	TX	L COLORADO RV AUTH	FAYETTE POWER PROJ 1*	615	2,081	8,760	0.35	0.699	36.7	64.8%	77.8%
35	UT	UTAH POWER & LT	HUNTINGTON 2	446	1,174	11,856	0.43	0.707	25.7	62.6%	75.1%
36	CO	P S CO OF COLORADO	PAWNEE 1	500	1,913	8,359	0.34	0.712	33.1	72.0%	86.4%
37	MI	DETROIT EDISON CO	BELLE RIVERST2*	698	1,558	9,255	0.38	0.719	39.0	60.8%	72.9%
38	CT	UNITED ILLUM	BRIDGEPORT HAR 3	400	774	13,229	0.50	0.737	20.8	56.6%	67.9%
39	CO	P S CO OF COLORADO	COMANCHE 1	350	940	8,479	0.36	0.743	18.8	58.4%	70.1%
40	IA	IOWA PUBLIC SERVICE CO	GEORGE NEAL 4*	640	2,463	8,203	0.35	0.747	29.7	50.5%	60.6%
41	WI	DAIRYLAND POWER COOP	J. P. MADGETT 1	387	945	8,346	0.36	0.755	17.0	47.8%	57.3%
42	NE	HASTINGS CITY OF	HASTINGS ENG 1	76	NA	8,103	0.35	0.756	0.0	0.0%	0.0%
43	IA	IOWA SOUTHERN UTIL	OTTUMWA 1*	726	1,792	8,314	0.36	0.758	33.5	50.2%	60.2%
44	MI	DETROIT EDISON CO	BELLE RIVERST1*	698	1,389	9,179	0.40	0.763	35.8	55.8%	67.0%
45	CO	P S CO OF COLORADO	COMANCHE 2	350	1,187	8,488	0.37	0.763	16.1	50.0%	60.0%
46	IN	INDIANA & MICHIGAN ELE	ROCKPORT 1	1,300	3,130	7,797	0.34	0.763	53.9	45.1%	54.1%
47	CO	CO SPRINGS CITY OF	MARTIN DRAKE 6	75	278	10,610	0.42	0.772	5.3	76.8%	92.2%
48	CO	CO SPRINGS CITY OF	MARTIN DRAKE 7	132	391	10,607	0.42	0.772	8.5	70.0%	84.0%
49	AZ	SALT RIVER PROJ	NAVAJONAV2	803	1,874	11,065	0.44	0.775	50.1	67.8%	81.4%
50	AZ	SALT RIVER PROJ	NAVAJONAV3	803	2,704	11,052	0.44	0.776	50.7	68.6%	82.4%
51	NE	GRAND ISLAND UTIL	PLATTE 1	113	197	8,099	0.36	0.778	3.3	32.7%	39.2%
52	MI	DETROIT EDISON CO	ST CLAIR 4	169	300	9,307	0.42	0.790	8.2	52.8%	63.4%
53	TX	HOUSTON LIGHTING & PWR	W A PARISH 6	734	2,673	8,385	0.38	0.793	39.7	58.8%	70.6%

54	WI	WISCONSIN P & L	EDGEWATER 5*	380	1,067	8,152	0.37	0.794	19.6	56.1%	67.3%
55	AZ	SALT RIVER PROJ	NAVAJONAV1	803	2,581	11,047	0.45	0.794	53.4	72.3%	86.7%
56	CO	CO UTE ELECTRIC ASSN	HAYDEN 1	190	628	10,302	0.43	0.798	13.6	77.8%	93.4%
57	MI	DETROIT EDISON CO	ST CLAIR 3	156	399	9,356	0.43	0.804	8.3	57.7%	69.3%
58	MI	DETROIT EDISON CO	ST CLAIR 2	156	307	9,468	0.44	0.813	8.3	57.7%	69.3%
59	TX	SAN ANTONIO CITY OF	J T DEELY 1	418	1,624	8,310	0.39	0.821	25.0	65.0%	78.0%
60	TX	SAN ANTONIO CITY OF	J T DEELY 2	418	1,712	8,304	0.39	0.822	23.0	59.8%	71.8%
61	MI	DETROIT EDISON CO	ST CLAIR 1	169	364	9,341	0.44	0.824	8.5	54.7%	65.7%
62	IN	COMMONWEALTH EDISON	STATE LINE 3	225	432	9,516	0.45	0.828	7.8	37.7%	45.2%
63	TX	HOUSTON LIGHTING & PWR	W A PARISH 5	734	2,800	8,402	0.40	0.833	43.9	65.0%	78.0%
64	CO	CO UTE ELECTRIC ASSN	HAYDEN 2*	275	904	10,482	0.45	0.837	19.4	76.7%	92.0%
65	TX	SOUTHWESTERN ELEC PWR	WELSH 2	558	1,436	8,322	0.40	0.841	24.5	47.7%	57.3%
66	TX	SOUTHWESTERN ELEC PWR	WELSH 3	558	1,887	8,319	0.40	0.841	27.9	54.4%	65.2%
67	TX	SOUTHWESTERN ELEC PWR	WELSH 1	558	1,536	8,315	0.40	0.842	25.3	49.3%	59.2%
68	NE	FREMONT CITY OF	FREMONT NO 2 8	91	125	11,087	0.48	0.844	2.6	31.1%	37.3%
69	AR	SOUTHWESTERN ELEC PWR	FLINT CREEK 1*	511	1,810	8,289	0.40	0.844	28.7	61.1%	73.3%
70	UT	UTAH POWER & LT	CARBON 2	114	109	11,752	0.51	0.846	5.0	47.9%	57.4%
71	OK	W FARMERS ELEC COOP	HUGO 1	400	1,151	8,250	0.40	0.848	16.4	44.6%	53.5%
72	KS	KANSAS CITY P&L	LA CYGNE 2*	685	1,635	8,348	0.41	0.859	30.4	48.2%	57.9%
73	IN	COMMONWEALTH EDISON	STATE LINE 4	389	751	9,511	0.47	0.865	13.3	37.2%	44.6%
74	IL	ILLINOIS POWER CO	HAVANA 6	489	449	11,877	0.53	0.870	14.8	32.9%	39.5%
75	NV	S CALIFORNIA EDISON	MOHAVE 1*	818	2,238	12,275	0.55	0.874	57.6	76.5%	91.9%
76	IN	NORTHERN INDIANA P S	R M SCHAHFER 15	556	713	11,066	0.50	0.881	9.4	18.4%	22.0%
77	IN	NORTHERN INDIANA P S	R M SCHAHFER 14	540	519	10,857	0.50	0.898	9.5	19.1%	23.0%
78	IN	NORTHERN INDIANA P S	DEAN H MITCHELL 11	115	174	10,846	0.50	0.899	2.4	22.7%	27.2%
79	IN	NORTHERN INDIANA P S	DEAN H MITCHELL 6	138	196	10,844	0.50	0.899	3.2	25.2%	30.2%
80	IN	NORTHERN INDIANA P S	DEAN H MITCHELL 4	138	120	10,827	0.50	0.901	2.8	22.0%	26.5%
81	CO	P S CO OF COLORADO	CHEROKEE 1	100	237	10,981	0.51	0.906	5.5	59.8%	71.8%
82	CO	P S CO OF COLORADO	CHEROKEE 3	150	421	10,969	0.51	0.907	7.5	54.4%	65.2%
83	CO	P S CO OF COLORADO	CHEROKEE 2	110	261	10,968	0.51	0.907	5.8	57.3%	68.8%
84	CO	P S CO OF COLORADO	CHEROKEE 4	350	869	10,955	0.51	0.908	18.6	57.8%	69.3%
85	LA	CENTRAL LA LT	RODEMACHER 2*	558	1,949	8,480	0.44	0.908	29.7	57.9%	69.4%
86	MS	MS POWER	VICTOR DANIEL 2	500	919	11,885	0.56	0.919	21.9	47.6%	57.1%
87	IN	INDIANA & MICHIGAN ELE	TANNERS CREEK 3	215	186	11,833	0.56	0.923	4.7	23.7%	28.5%
88	WV	APPALA PWR	MOUNTAINEER 1	1,300	2,647	12,549	0.60	0.932	73.1	61.1%	73.4%
89	AR	ARKANSAS POWER & LIGHT	WHITE BLUFF 1*	800	2,301	8,632	0.46	0.933	40.6	55.2%	66.2%
90	AL	ALABAMA PWR CO	MILLER JR 1	706	1,118	12,451	0.60	0.940	24.7	38.1%	45.7%
91	AL	ALABAMA PWR CO	MILLER JR 2	706	767	12,442	0.60	0.940	23.0	35.4%	42.5%
92	OH	DAYTON PWR & LT	KILLEN STA 2	666	512	12,323	0.60	0.949	31.0	50.6%	60.7%
93	MI	DETROIT EDISON CO	ST CLAIR 6	353	649	9,572	0.52	0.951	14.4	44.4%	53.3%
94	MI	DETROIT EDISON CO	ST CLAIR 7	545	649	9,572	0.52	0.951	25.6	51.1%	61.3%
95	MS	MS POWER	VICTOR DANIEL 1	500	662	11,890	0.58	0.951	21.0	45.7%	54.8%
96	IN	INDIANA & MICHIGAN ELE	TANNERS CREEK 2	153	209	11,887	0.58	0.951	4.4	31.4%	37.6%
97	UT	UTAH POWER & LT	CARBON 1	75	135	11,785	0.58	0.960	3.8	55.1%	66.1%
98	UT	UTAH POWER & LT	GADSBY 3	114	162	11,758	0.58	0.962	3.3	31.6%	37.9%
99	OK	P S CO OF OKLAHOMA	NORTHEASTERN 3	473	1,578	8,163	0.45	0.965	23.6	54.3%	65.2%
00	OK	P S CO OF OKLAHOMA	NORTHEASTERN 4	473	1,494	8,161	0.45	0.965	25.5	58.7%	70.4%
01	AR	ARKANSAS POWER & LIGHT	WHITE BLUFF 2*	800	2,292	8,495	0.47	0.968	43.2	58.7%	70.5%
02	LA	GULF STATES UTIL	R S NELSON 6*	615	2,440	8,429	0.47	0.976	37.5	66.3%	79.6%
03	IL	COMMONWEALTH EDISON	WAUKEGAN 8	355	501	9,462	0.53	0.980	9.7	29.7%	35.6%
04	MI	UPPER PENINSULA PWR	PRESQUE ISLE 8	90	263	8,871	0.50	0.986	4.0	48.3%	58.0%
05	MI	UPPER PENINSULA PWR	PRESQUE ISLE 9	90	170	8,871	0.50	0.986	2.5	30.2%	36.2%
06	MI	UPPER PENINSULA PWR	PRESQUE ISLE 7	90	152	8,862	0.50	0.987	3.7	44.7%	53.6%
07	KS	KANSAS POWER & LIGHT	TECUMSEH 8	150	131	10,860	0.55	0.988	2.3	16.7%	20.1%
08	IL	COMMONWEALTH EDISON	FISK 19	374	200	9,338	0.53	0.993	6.7	19.5%	23.4%
09	IL	COMMONWEALTH EDISON	WILL COUNTY 4	598	541	9,318	0.53	0.995	17.0	30.9%	37.1%
10	IN	INDIANA & MICHIGAN ELE	TANNERS CREEK 1	153	171	11,895	0.61	1.000	4.2	29.9%	35.9%
11	NE	NEBRASKA PUB PWR DIS	SHELDON STATION 1	109	78	11,661	0.60	1.003	1.3	13.0%	15.6%
12	KY	TN VAL AUTH	SHAWNEE 9	175	233	12,437	0.64	1.003	6.9	42.9%	51.4%
13	IL	COMMONWEALTH EDISON	WILL COUNTY 3	299	479	9,371	0.54	1.008	9.6	34.9%	41.9%
14	IL	CENTRAL ILLINOIS LT	NEWTON 2	617	685	11,141	0.58	1.015	14.0	24.7%	29.6%
15	KY	TN VAL AUTH	SHAWNEE 4	175	241	12,482	0.65	1.015	5.7	35.4%	42.5%
16	IL	COMMONWEALTH EDISON	WAUKEGAN 7	326	649	9,478	0.55	1.016	11.9	39.6%	47.6%
17	KY	TN VAL AUTH	SHAWNEE 2	175	213	12,456	0.65	1.018	5.0	31.1%	37.3%
118	KY	TN VAL AUTH	SHAWNEE 8	175	242	12,446	0.65	1.018	6.4	39.8%	47.7%

9 NE	NEBRASKA PUB PWR DIS	SHELDON STATION 2	120	69	11,677	0.61	1.019	1.6	14.5%	17.4%
30 AZ	ARIZONA PUBLIC SERVICE	CHOLLA 3	302	690	9,838	0.52	1.031	13.0	46.9%	56.3%
1 DE	DELMARVA P & L	INDIAN RV 4	442	988	13,243	0.70	1.031	24.8	60.9%	73.1%
2 IL	COMMONWEALTH EDISON	JOLIET 29 7	660	885	9,504	0.56	1.031	17.2	28.3%	34.0%
3 WY	PACIFIC P & L	DAVE JOHNSTON 4	330	1,343	7,616	0.45	1.034	16.6	54.6%	65.6%
4 KY	TN VAL AUTH	SHAWNEE 3	175	221	12,435	0.66	1.035	5.6	34.8%	41.7%
5 IL	COMMONWEALTH EDISON	POWERTON 6	893	1,914	9,462	0.56	1.036	36.8	44.8%	53.8%
6 KY	KY UTIL	GHENT 3	557	531	13,149	0.70	1.038	15.8	30.9%	37.0%
7 KY	KY UTIL	GHENT 2	556	501	13,140	0.70	1.039	17.9	35.0%	42.0%
8 OH	TOLEDO EDISON	ACME 6	113	154	12,574	0.67	1.039	3.1	30.0%	35.9%
9 IL	COMMONWEALTH EDISON	POWERTON 5	893	1,711	9,429	0.56	1.039	35.4	43.1%	51.7%
30 KY	KY UTIL	GHENT 4	556	622	13,116	0.70	1.041	19.8	38.7%	46.4%
1 OH	CLEV ELEC ILLUM	LK SHORE 18	256	345	13,108	0.70	1.041	0.2	0.8%	1.0%
2 KY	TN VAL AUTH	SHAWNEE 7	175	259	12,544	0.67	1.042	6.5	40.4%	48.5%
3 KS	KANSAS POWER & LIGHT	TECUMSEH 7	82	74	10,845	0.58	1.043	0.9	12.0%	14.4%
4 IL	COMMONWEALTH EDISON	CRAWFORD 7	239	231	9,370	0.56	1.046	4.3	28.6%	34.3%
5 IL	COMMONWEALTH EDISON	CRAWFORD 8	358	445	9,310	0.56	1.053	10.1	30.7%	36.8%
6 IL	COMMONWEALTH EDISON	WILL COUNTY 1	188	308	9,309	0.56	1.053	4.5	26.1%	31.3%
7 WY	PACIFIC P & L	JIM BRIDGER 1*	509	1,930	9,471	0.57	1.053	33.1	70.8%	84.9%
8 WY	PACIFIC P & L	D JOHNSON 1	100	632	4,623	0.46	1.056	8.6	93.5%	112.2%
9 WY	PACIFIC P & L	D JOHNSON 2	100	593	7,625	0.46	1.056	8.3	90.2%	108.3%
40 WY	PACIFIC P & L	D JOHNSON 3	220	1,071	7,626	0.46	1.056	15.2	75.1%	90.1%
41 NE	OMAHA PUB PWR DIST	NEBRASKA CITY 1	616	102	8,253	0.50	1.060	27.3	48.2%	57.8%
42 GA	GA PWR	SCHERER 2	891	1,260	12,674	0.69	1.062	26.6	32.5%	38.9%
43 GA	GA PWR	SCHERER 1	891	1,168	12,603	0.69	1.068	21.9	26.7%	32.1%
44 KY	TN VAL AUTH	SHAWNEE 6	175	178	12,559	0.69	1.071	5.9	36.7%	44.0%
45 IL	COMMONWEALTH EDISON	JOLIET 29 8	660	919	9,452	0.58	1.074	13.7	22.6%	27.1%
46 IL	COMMONWEALTH EDISON	WAUKEGAN 6	121	144	9,277	0.57	1.075	2.6	23.4%	28.0%
47 IL	COMMONWEALTH EDISON	WILL COUNTY 2	184	323	9,277	0.57	1.075	4.4	26.0%	31.2%
48 KY	TN VAL AUTH	SHAWNEE 5	175	143	12,510	0.69	1.076	5.3	32.9%	39.5%
49 NC	CAROLINA PWR & LT	ROXBORO 4	745	1,573	12,299	0.68	1.078	37.1	54.1%	65.0%
50 DE	DELMARVA P & L	EDGE MOOR 4	177	369	13,200	0.73	1.078	11.2	68.9%	82.6%
51 NE	OMAHA PUB PWR DIST	NORTH OMAHA 4	136	293	8,247	0.51	1.082	4.3	34.4%	41.2%
52 IL	COMMONWEALTH EDISON	JOLIET 9 6	360	429	9,374	0.58	1.083	8.3	25.0%	30.0%
53 MD	BALTIMORE G & ELEC	BRANDON SHORES 1	685	1,021	12,699	0.71	1.090	33.0	52.4%	62.8%
54 MI	CONSUMERS POWER CO	J H CAMPBELL 3*	770	1,816	12,519	0.70	1.090	49.0	69.2%	83.0%
55 TX	TEXAS UTIL ELEC	B BROWN 2	593	2,050	7,177	0.49	1.092	36.7	67.3%	80.7%
56 FL	FL PWR CORP	CRYSTAL RVST4	739	1,384	12,504	0.70	1.092	41.2	60.6%	72.7%
57 FL	FL PWR CORP	CRYSTAL RV 5	739	1,773	12,470	0.70	1.095	44.3	65.1%	78.2%
58 OH	CIN G & ELEC	MIAMI FT 8	558	1,041	12,283	0.69	1.095	30.8	60.0%	72.1%
59 LA	CAJUN ELEC	B CAJUN 2 1	560	1,542	7,971	0.50	1.098	23.3	45.2%	54.3%
60 LA	CAJUN ELEC	B CAJUN 2 2	560	1,447	7,954	0.45	1.100	22.5	43.7%	52.4%
61 LA	CAJUN ELEC	B CAJUN 2 3	560	1,592	7,955	0.51	1.100	21.3	41.4%	49.6%
62 NE	OMAHA PUB PWR DIST	NORTH OMAHA 3	109	173	8,262	0.52	1.101	3.2	32.0%	38.4%
63 PA	PA PWR & LT	SUNBURY 1	75	169	9,167	0.58	1.107	5.2	75.4%	90.5%
64 PA	PA PWR & LT	SUNBURY 2	75	169	9,167	0.58	1.107	5.2	75.4%	90.5%
65 VA	APPAL PWR	CLINCH RV 1	238	369	12,987	0.74	1.111	9.2	42.1%	50.5%
66 NC	CAROLINA PWR & LT	MAYO 1	736	1,938	12,270	0.70	1.112	45.6	67.4%	80.9%
67 VA	APPAL PWR	CLINCH RV 3	238	531	12,950	0.74	1.114	9.8	44.9%	53.8%
68 FL	GULF PWR	SMITH 1	150	420	11,705	0.67	1.116	11.0	79.9%	95.9%
69 NE	OMAHA PUB PWR DIST	NORTH OMAHA 2	109	174	8,256	0.53	1.123	2.6	26.0%	31.2%
70 VA	APPAL PWR	CLINCH RV 2	238	415	12,950	0.75	1.129	10.6	48.5%	58.2%
71 MI	LANSING CITY OF	ERICKSON 1	155	404	12,984	0.76	1.141	11.0	77.2%	92.6%
172 MI	LANSING CITY OF	ECKERT STATION 4	80	61	12,964	0.76	1.143	3.1	42.1%	50.6%
73 AL	ALABAMA PWR CO	BARRY 5	789	1,510	12,070	0.71	1.147	41.9	57.8%	69.3%
174 FL	GULF PWR	SMITH 2	190	426	11,705	0.69	1.150	12.6	71.9%	86.3%
75 MI	LANSING CITY OF	ECKERT STATION 5	80	158	13,029	0.78	1.167	4.3	58.4%	70.1%
176 MI	LANSING CITY OF	ECKERT STATION 6	80	136	13,004	0.79	1.185	3.8	51.6%	62.0%
77 MI	DETROIT EDISON CO	TRENTON CHANNEL 7	120	103	12,976	0.79	1.187	4.6	41.7%	50.0%
178 MI	DETROIT EDISON CO	TRENTON CHANNEL 8	120	88	12,976	0.79	1.187	4.8	43.5%	52.2%
179 WV	APPALA PWR	AMOS 2	816	1,805	12,317	0.75	1.187	41.6	55.4%	66.5%

Southern Co

**BACKGROUND MEMORANDUM CONCERNING
THE TREATMENT OF "CLASS OF 1985" COAL-FIRED UNITS
UNDER THE ACID RAIN PROVISIONS
OF S. 1630**

Background

In complying with various acid rain proposals, electric utilities have favored "freedom of choice" because it gives them the flexibility to choose the most cost-efficient compliance method for any particular coal burning plant. In some instances, cost-effective sulfur dioxide emission reductions can be obtained simply through the use of lower sulfur coal. In fact, most utilities would rely, in part, upon "fuel switching" to lower sulfur coal at some units. The latest Senate version of proposed acid rain legislation, however, could make it nearly impossible for utilities to rely on lower sulfur coal to fire plants that are a part of the so-called Class of `85.

The "Class of `85" Problem

The Class of `85 consists of fossil-fired utility ~~boilers~~ that emitted at rates less than 1.20 lbs/mmBtu of sulfur dioxide (SO_2) in 1985. There ~~are approximately 179 coal-fired~~ units that burn low sulfur coal. Under the provisions of most acid rain bills, ~~the~~ utilities ~~that~~ operate these plants would continue using low sulfur coal to fire these plants. Under Phase II of the Environment & Public Works Committee bill (S. 1630), however, the Class of `85 units will be subject to the tonnage cap requirement of subsection 405(d).

Under subsection of 405(d), each of these units will be awarded allowances equal to the ~~product of~~ 120 percent of the unit's baseline energy inputs multiplied by its actual 1985 emission rate. In many instances, because these relatively new units were expensive to run and the last to be dispatched on an economic basis, they were run at low capacity factors in the baseline years of 1985 through 1987. Thus, for instance, the baseline capacity factor -- even calculated at 120 percent of the actual average -- would be below 65 percent at approximately 99 plants and, thus, below future capacity utilization projected for most of these units. The emission rates for approximately 55 of these plants in 1985 were also low -- at or below 1.0 lbs SO_2/mmBtu. Together, these low capacity factors and emission rates would produce SO_2 emission caps that would essentially eliminate the possibility of switching to the use of lower sulfur coal as a compliance option and, perhaps, lead to the installation of scrubbers at these NSPS plants. The imposition of low emission rates makes these already clean units likely candidates for expensive scrubber technology that would burn higher sulfur coal.

In order to remedy the problem outlined above, the bill should be changed to grant an adequate number of allowances to these Class of `85 units. Utilities should be given the flexibility to use realistic capacity factors and emission rates to calculate the allowances necessary to utilize the potential of these power plants without being required to install scrubbers on them.

1/24/90

Chelkem Co.

01/09/90
(No. 4)

Amendment

to S. 1630 as reported by the Senate
Committee on Environment and Public Works
(Report No. 101-228, December 20,1989)

Subject: Correct inequitable treatment of Class of '85 NSPS plants.

Explanation:

1. What the Bill Requires.

The bill creates an inequity for clean coal-fired NSPS units in operation as of 1985 which emitted sulfur dioxide at a rate below 1.20 lbs/mmBtu in 1985. Such units are subject in phase II to tonnage caps arbitrarily tied to those units' actual 1985 emission rates. Many of these units, because of their recent vintage, were operated at capacity factors substantially below their optimal economic levels. The bill therefore penalizes, without any reason, our newest lowest polluting units.

2. What the Amendment Does.

The amendment fairly treats clean (below 1.20 lbs/mmBtu) coal-fired NSPS units in operation as of 1985 the same as it treats NSPS units commencing operation between 1985 and the date of enactment. These units are all among the most efficient and lowest emitting units. It would be unfair to penalize any such units simply for having emitted at an unusually low rate in 1985. The amendment removes the possibility of such unfair penalty.

Amendment:

Amend the first sentence of subsection 405(d) (page 467, lines 4-13),to read as follows:

"(d) Coal-fired Units below 1.20 lbs/mmBtu. -- After January 1, 2000, it shall be unlawful for any coal-fired unit with an actual 1985 emission rate less than 1.20 lbs/mmBtu to exceed an annual sulfur dioxide tonnage emission limitation equal to the product of the unit's ~~baseline~~ annual fuel consumption on a Btu basis, at a 65 per centum capacity factor multiplied by ~~a factor of 120 per centum and its actual 1985~~ the emission rate specified in its permit or other federally enforceable emission limitation, divided by 2000 unless the owner or operator of such unit has obtained allowances equal to the emissions in excess of those permitted under this subsection."

United States Senate

WASHINGTON, D.C. 20510

February 1, 1990

The Honorable Max Baucus
Chairman
Subcommittee on Environmental Protection
U.S. Senate
Washington D.C. 20510

Dear Max:

Now that the Senate has turned to consideration of the Clean Air Act Amendments of 1989, we would like to express our concerns regarding this bill's impact on clean burning plants that were operating at low capacity during the baseline years outlined in the legislation. We would like to find a fair solution that does not break the emissions cap but would also allow these facilities to generate at normal capacity factors.

Section 405 (d) of S. 1630 limits "clean" coal-fired units, that is below 1.20 lbs/mmBTU, to an annual sulfur dioxide tonnage emission limitation that is the product of the unit's baseline (as defined in Sec. 402 (d) (1)) multiplied by a factor of 120 per centum and its actual 1985 emission rate, divided by 2,000.

For these "clean" plants that operated at low capacity during the baseline years, the capacity factor increase of 20 per centum to the 1985-87 "baseline" only further exacerbates the capacity problems experienced by these plants in our states. This provision discourages the use of existing capacity to meet future energy needs, and contrasts with the provision for all new plants at section 405 (g) of the bill that imputes a normal capacity factor of 65 per centum.

We are not opposed to legislation that would address the acid rain problem. However, S. 1630 does not provide sufficient flexibility for utilities in those "clean" states that have already invested significant efforts to achieve exceptionally low SO2 emissions. Granting these "clean" plants which operated at low capacity an imputed 65 per centum capacity factor adjustment would make S. 1630 a far more equitable bill.

J. Robert Kerrey

J. James Exon

SIERRA CLUB

408 C Street, N.E. Washington, D.C. 20002 202·547·1141

January 29, 1990

S. 1630'S ACID RAIN PROGRAM CLEANS UP THE EAST BUT DIRTIES THE WEST

Dear Senator:

We urge you to support the acid rain title of S. 1630, and to support amendments to remove loopholes and exemptions which would allow acid rain to increase in the western part of the United States. S. 1630 does a good job of reducing the sulfur emissions which cause acid rain in the east, midwest and south, but would allow emissions to increase in the west's fragile ecosystem.

THE VOTES ON THE ACID RAIN CONTROL PROGRAM ARE CRITICAL TO PUBLIC HEALTH AND THE ENVIRONMENT. A strong clean air bill is the Sierra Club's number one priority.

S. 1630: A SOLID ACID RAIN PROGRAM FOR THE EAST

S. 1630 requires a 10-million-ton annual reduction of the sulfur dioxide which causes acid rain by the year 2000. The "emissions trading" system proposed by President Bush allows utilities to sell excess emissions reductions to other existing or new coal-fired power plants to offset emissions increases from these plants. S. 1630 allows utilities to decide on their cleanup strategy, with state approval. In addition, S. 1630 requires a 2.7-million-ton annual decrease in nitrogen oxide emissions by the year 2000.

EMISSIONS CAP IS ESSENTIAL TO ENDING THE ACID RAIN CRISIS ONCE AND FOR ALL

Sulfur emissions from power plants are expected to increase by 20% to 30% over the next 25 years. To offset this emissions growth, S. 1630 includes President Bush's proposal to make emissions reductions permanent by establishing a cap on emissions from new sources after the year 2000. The emissions cap also creates an incentive to use energy conservation to meet increased demands for power. In addition to conservation, plants can meet increased demands for power by purchasing emissions allowances from plants which reduce their emissions below the minimum standard. For instance, a 90% reduction in five of the dirtiest power plants in Florida would yield a savings of over 34,000 tons annually. This savings would be equivalent to the emissions from three new 500-megawatt units.

The emissions cap is an absolutely essential environmental protection program because it will prevent the erosion of emissions reductions required by S. 1630. Without a strong cap, the acid rain crisis will be postponed, not ended. THE SIERRA CLUB OPPOSES AMENDMENTS TO S. 1630 WHICH WOULD REDUCE THE TOTAL TONNAGE REDUCTION OR WEAKEN THE EMISSIONS CAP.

S. 1630 ALLOWS ACID RAIN TO INCREASE IN THE WEST

S. 1630 allows increases in western sulfur emissions between now and the year 2000 because of three key loopholes. Unless these loopholes are removed, S. 1630 will provide little protection for the west. Sierra Club supports amendments to eliminate or remedy these loopholes.

* "Clean Plants" growth provision could lead to a significant increase in western emissions. S. 1630 allows power plants emitting less than 1.2 lbs. of sulfur per million BTU's (mBTU) of energy to increase their generation and emissions by 20% from 1985 levels until the year 2000 without having to obtain emissions offsets. The Senate Committee Report predicts that this will lead to a net increase of sulfur emissions of 650,000 tons annually nationwide. A large part of this increase is likely to occur in the west.

* "Seven State Exemption" could lead to a significant increase in western emissions. The bill exempts existing power plants in states with less than 150,000 tons of annual emissions and 50% of their coal-fired capacity equipped with emissions control technology from the program until the year 2000. Kansas, Minnesota, Montana, North Dakota, New Mexico, Utah and Wyoming would qualify for this exemption. Beginning in 2001, plants in these states must limit their annual emissions to the average emissions from 1996-98. This provision creates an incentive for plants to expand their capacity rather than use energy conservation. The Environmental Defense Fund estimates that this would increase emissions from these states by 450,000 tons annually.

* Nationwide trading would allow transfer of emissions from the midwest to the west. The bill allows new western plants to obtain offsets from any source nationwide, rather than within the west. This means that a new power plant in Utah could seek a needed emissions reduction from an existing source in Kentucky, allowing pollution levels to increase in the west.

WESTERN EMISSIONS EXPECTED TO SIGNIFICANTLY INCREASE

The Environmental Defense Fund estimates that total utility emissions of sulfur and nitrogen oxides are expected to increase by approximately 80% between 1985 and 2010. These emissions increases are expected from existing plants that increase their electric generation and from new power plants.

WESTERN PARKS, ENVIRONMENT THREATENED BY ACID RAIN

Acid rain damage is most documented in the eastern and southeastern regions of the United States. However, the west -- particularly the Rocky Mountains -- is also very vulnerable to acid rain damage. According to the U.S. Park Service, there are fourteen power plants with large sulfur emissions within 150 kilometers of national parks. This pollution shrouds the parks' scenic vistas in a blanket of pollution. For instance, air pollution in the Grand Canyon impairs visibility approximately 100 days per year. Sulfur emissions are the major contributor to the manmade pollution that obscures nature's most glorious canyon.

Many western lakes are very vulnerable to acidification because they have little ability to neutralize (or "buffer") acid precipitation. EPA estimates that at least 16.8% of western lakes have a poor buffering capacity. This estimate is low because EPA conducted the tests in the fall when pH levels are most stable.

OUR NATIONAL PARKS AND WESTERN HERITAGE MUST BE PROTECTED FROM ACID RAIN.

ACID RAIN COST BILLIONS OF DOLLARS IN EXTRA HEALTH CARE

Acid rain's devastating impact on lakes, forests, streams, fish and wildlife has been well documented. Sulfur dioxide (SO_2) also harms human health by impairing lung function. Senior citizens, children and asthmatics are particularly vulnerable to harm from SO_2. In fact, a recent survey of physicians determined that air pollution is the number one cause of the recent increase in the frequency and severity of asthma. EPA estimates that health care costs related to acid rain are at least $2.7 billion-$10 billion annually. The American Lung Association reported that sulfur oxides caused up to $40 billion in increased health care costs and lost productivity.

We strongly urge you to support amendments to remove these provisions which would allow an increase of acid rain in western national parks. Thank you.

Sincerely,

Richard Cellarius

Richard Cellarius
President

DONALD F. SANTA, JR.
COUNSEL

UNITED STATES SENATE
COMMITTEE ON ENERGY
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September __, 1990

Dear Senator Baucus:

We are writing to request your support for revisions in Title IV of the Clean Air Act Amendments of 1990 to address more comprehensively the so-called WEPCo issue. Without a broader legislative resolution of this issue, we believe that the cost-effective emissions reduction program that is the centerpiece of the clean air bill will be undermined and that a reliable supply of electricity in certain regions of the country could be jeopardized.

As you may recall, during the Senate floor debate on S. 1630, you agreed that in conference you would try to find a way to accomplish the objectives of a comprehensive legislative solution to the issues raised by EPA's WEPCo policy consistent with the overall thrust of both S. 1630 and the underlying Clean Air Act. In particular, you expressed concern that any legislative solution must continue to protect local air quality to the extent achieved by the current Clean Air Act and must not undermine the SO2 emissions reduction requirements of the bill.

On July 23, 1990, the Administration transmitted to the Senate Energy Committee a comprehensive proposal for a legislative resolution of the WEPCo issue. We believe that a simplified version of the Administration proposal could address both our concerns as to the adverse effects of EPA's WEPCo policy and your valid concerns about local air quality and SO2 emissions reductions.

We wish to emphasize that the legislative provision we suggest will not in any way authorize SO2 emissions in excess of the 8.9 million ton cap. Furthermore, this provision will not authorize emissions that exceed local air quality objectives established under the ambient air quality standards, prevention of significant deterioration, or visibility provisions of the current Clean Air Act.

In particular, we urge your support for revisions to S. 1630 that would accomplish the following:

1. Allow utilities to undertake projects that reduce emissions (i.e., installation of control equipment, natural gas cofiring) without first meeting new source permitting requirements;

[illegible] Henderson

2. Ensure that an existing unit would not trigger new source review where there is no causal link between a change at the unit and an increase in the unit's annual emissions; and

actual or capacity ??

3. Allow utilities to undertake needed repairs at an existing unit without triggering an obligation to meet stringent new source performance standards.

Two additional issues raised by EPA's WEPCo policy should be addressed by the conference report. First, the provisions in the Senate bill that specifically address "temporary" and "permanent" clean coal technology demonstration projects should be preserved. Second, the provision in the Administration proposal which equates low-NOx burners with BACT should be part of the final bill.

what other types ?

Draft language that would accomplish the aforementioned goals ~~has been~~ included for your consideration. We greatly appreciate your taking the time to find a solution to this complex problem and are willing to work with you and your staff in this effort.

Very truly yours,

Katie,

This is the explanation of the modification rule, its evolution and implications for efficient operations of electric generating facilities. Don Santa will deliver a clean (i.e. unfaxed) copy of the Johnston letter. He also can tell you who has signed the letter.

If you have any questions call me.

Bill

August 16, 1990

EPA'S WEPCO POLICY AND ITS IMPLICATIONS FOR IMPLEMENTATION OF THE CLEAN AIR ACT

I. STATUTORY BASIS FOR APPLICABILITY OF THE MODIFICATION RULE TO EXISTING UNITS

One of the fundamental concepts introduced in the 1970 Clean Air Act (CAA) was that newly constructed sources must install best demonstrated emissions control technology pursuant to EPA-established new source performance standards (NSPS). CAA § 111. The rationale for this requirement was that new sources could be designed to incorporate the best technology at the least possible cost. The CAA applied this requirement only prospectively, however, because Congress recognized that retrofit of existing sources with such control technology would be technically and economically burdensome, and therefore Congress mandated emissions controls for existing sources only as needed to attain and maintain the health and welfare-protective ambient standards. CAA §§ 109, 110.

Congress realized, however, that existing sources might become so substantially changed that, in essence, they would become "new" sources. In such situations, Congress sought to prohibit units from being perpetually rebuilt to avoid new source controls. Congress provided that such sources would be deemed "modified," and would be subject to the same technology-based NSPS as newly constructed sources. "Modification" is defined in § 111(a)(4) as "any physical change in, or change in the method of operation of, a stationary source which increases the amount of any air pollutant emitted by such source or which results in the emission of any air pollutant not previously emitted."

In the 1977 Amendments, Congress extended the § 111 "modification" concept to the newly created prevention of significant deterioration (PSD) program. CAA § 169(2)(c). Thus, new or "modified" sources would be required to undergo PSD review and install "best available control technology" (BACT) for regulated pollutants. Again, the purpose for extending new source review for PSD to existing sources is because the CAA otherwise did not impose stringent new source limitations on existing sources.

II. EPA'S INTERPRETATION OF THE APPLICABILITY OF THE MODIFICATION PROVISIONS

EPA's NSPS modification rule was developed pursuant to the CAA in 1971 and was refined in 1975. The rule was a restatement of the § 111 definition, except that EPA defined the emissions increase test in terms of an emissions rate (kilograms/hour). 40 C.F.R. § 60.14. Thus, if a physical or operational change results in an increase in the hourly emission rate, the source is "modified" and subject to NSPS. EPA also made clear in the modification rule that certain activities that might be perceived to increase emissions are not covered by the rule, such as increases in production rates and switching to higher-emitting fuels that the source was designed to accommodate.

A similar PSD modification definition was developed in 1978, following the 1977 Amendments. EPA established the emissions increase test for PSD based on "tons per year," rather than kilograms/hour for NSPS. 40 C.F.R. § 52.21(b)(2). The rules provide that the "tons per year" comparison before and after the change is to be based on "actual" emissions, and that EPA may assume that "actual" emissions equal "allowable" emissions. However, for emission units that have not begun "normal operations" (i.e., new units constructed at existing sources), emissions after the change are to be based on "potential to emit." 40 C.F.R. § 52.21(b)(21).

From the initial implementation of the NSPS and PSD modification rules through the mid-1980s, EPA recognized that the circumstances in which an existing source would be deemed "modified" were limited. See ASARCO v. EPA, 578 F.2d 319, 327 n.24 (D.C. Cir. 1978) (EPA "candidly admits" that its modification rule was written to minimize the impact on existing sources); 44 Fed. Reg. 33591, col. 3 (1979) ("few, if any, existing electric utility steam generating units will become subject to these [Subpart Da] standards"). See also June 24, 1981 letter from the EPA to Amasjit S. Gill, attached, which sets forth EPA's prior policy for existing units.

Thus, in 1973, 1976, and 1980 Agency memoranda, EPA indicated that physical changes needed to return a plant to its former operating condition (i.e., original design capacity) do not constitute a modification of the plant.[1/] Throughout the 1970s and 1980s, owners and operators of plants were free to, and did, replace deteriorated equipment, engage in efficiency improvements, switch fuels, and undertake other projects without triggering application of NSPS and without PSD review, provided the total cost did not exceed 50% of the costs of an entirely new facility (50% reconstruction rule). 40 C.F.R. 60.15.[2/]

III. EPA'S CURRENT INTERPRETATION OF THE APPLICABILITY OF THE MODIFICATION RULE

In 1986, EPA departed from the then existing interpretation of the modification rule for existing units. In the 1988-89 case involving Wisconsin Electric Power Company (WEPCo), EPA, for the first time, narrowly interpreted its modification rules and found that a project to make like-kind replacement of some deteriorated equipment at a power plant in order to restore lost generating capacity would constitute a modification.

Under the new policy, the EPA required the emission rate comparison to be done by using the maximum hourly emissions rate

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1/ This assumption, that utilities would refurbish units at least once to return the unit to design capacity and ensure longer life, was incorporated in all of EPA's emissions assumptions used in analyzing the pending clean air legislation. See letter from ICF Resources to Robert Beck, attached. EPA also did not assume in developing the emissions data that its new WEPCo policy would affect the emissions of any units.

2/ The 50% rule is a regulatory construct that limits physical changes at a unit to 50% of the costs of an entirely new facility. Changes costing more than 50% are treated as new units.

"immediately" before the change (even though the rate was much lower than achievable at design capacity due to the equipment deterioration) with the rate after the change (after deteriorated equipment was replaced). This was in contrast to the prior policy of basing emissions before the change on representative operations, or on the design capacity of the unit.

Perhaps more importantly, in the PSD context, EPA stated that its rules always require a comparison of actual annual emissions before the changes with the "potential to emit," in the absence of post change, federally enforceable operating limits (reduced hours of operation). Because "potential to emit" assumes that the source will operate year-round at full capacity, with no scheduled down time, something which utility plants rarely (if ever) do, this comparison virtually always shows an emissions increase. Thus, any change in a facility -- even installing pollution control projects -- may be considered a "modification," which subjects the facility to new source review and the requirements of PSD.

Because EPA's policy in WEPCo was a change from past implementation of the rules, WEPCo challenged the Agency's decisions in the U.S. Court of Appeals for the Seventh Circuit. The court upheld EPA's narrow interpretation of its NSPS rules. The court ruled, however, that EPA could not, under its PSD modification rule, use "potential to emit" to estimate post-change emissions, without undertaking a full rulemaking proceeding. 893 F.2d 901 (7th Cir. 1990).

On June 8, 1990, EPA issued its final determination in response to the Seventh Circuit decision. Instead of following the court's instructions, EPA created a new PSD emissions increase test based on an "actual before-actual after" test which leaves the Agency with considerable discretion to find an emissions increase. Moreover, EPA limited this new test exclusively to projects involving like-kind replacement of equipment. Thus, for other projects, EPA will continue the use of "potential to emit" for estimating post-change emissions.

IV. PROBLEMS CREATED BY EPA'S NEW POLICY

In light of the pending legislation, which for the first time requires emissions reductions at all existing sources regardless of their effect on local air quality, the EPA's new source review policy will result in greatly increased costs but produce only marginal, at best, environmental benefits. Even EPA has come to realize the implications of its new narrow interpretations of the NSPS and PSD modification rules go far beyond WEPCo-type projects.

There are many examples why, twenty years after the first Clean Air Act and in light of the pending legislation, it makes no environmental or economic sense to apply NSPS or require PSD review for existing units.

EPA's new interpretation means that Detroit Edison's proposed conversion of its Greenwood plant from oil to cleaner natural gas fuel cannot proceed without a lengthy PSD review and, possibly, more stringent, technology based emissions requirements. This is because, for a non-like-kind replacement project, EPA believes its rules call for a comparison of pre-change actual emissions and post-change potential to emit. Thus, although the NOX and SO_2 emissions from natural gas are substantially less for the same amount of electricity generated, comparing actual emissions (based on normal capacity factor) with potential emissions (based on 100% capacity factor) could result in higher annual NOX emissions.

The policy also would apply to units that already are very clean units. For example, Duquesne Light has a 300 MW unit that has scrubbers to remove 90% of the SO_2, precipitators and other equipment to remove 99% of all particulates, and Duquesne plans to install low NOX burners prior to bringing the unit back on line. Because the Pittsburgh region has been depressed, the unit has been in cold storage. To bring the unit back on line, Duquesne wants to make certain efficiency changes to ensure safe operation at just under the design capacity. This unit would be subject to PSD limitations under EPA's current policy, which means Duquesne would have to meet BACT requirements for NOX (probably selective catalytic reduction), and install new particulate removal equipment to increase removal from 99% to something greater. This simply makes no sense.

Similarly, companies participating in CCT projects also face risks under EPA's new narrow interpretations. These companies have sought "no action assurance" letters from EPA, which are letters that promise no civil enforcement actions by the Agency for projects that the Agency believes constitute modifications. To obtain such a letter, however, companies have had to supply EPA with reams of information and wait months for a response. Moreover, such letters do not preclude citizen suits or even Department of Justice criminal actions.

Other beneficial projects are also caught up in EPA's new modification interpretations. For example, projects to improve efficiency (i.e., maintain output while burning less fuel, or increase output without burning additional fuel), which reduce emissions for a given amount of electricity produced, will trigger PSD review under EPA's interpretation.

More importantly, implementation of the proposed acid deposition allowance program will be significantly impeded by the Agency's new interpretations of the modification rules. Companies will be discouraged from over controlling one source under the program and using allowances for another source that is more expensive to control. Indeed, controlling any source may itself trigger a PSD review given EPA's "actual to potential" comparisons for determining emissions increases. Other projects, such as gas cofiring, to create allowances for use by other plants in the same system or for sale to other systems will also be discouraged by the new modification interpretations.

V. ENVIRONMENTAL BENEFITS AND LACK OF IMPACT ON LOCAL AIR SHEDS

It is important to recognize that limiting new source review will not have a negative impact on the environment and, indeed, could produce greater reductions more quickly under the pending legislation. First, the pending bill imposes a nation-wide limit on SO_2 which applies to existing, as well as, future units. The purpose of the 8.9 million ton cap is to allow least cost compliance with the bill through use of the market in allowances. Second, it is likely that many units will simply avoid the impact of the EPA WEPCo policy by postponing needed changes and operating the units inefficiently at high capacity factors and emissions rates to establish a high baseline for actual emissions.

Finally, altering the WEPCo policy will not affect local air quality or preempt local authority. In non-attainment areas, the local air quality authority does not need new source review to impose more stringent emissions limitations. In PSD areas, the emissions from the unit are already in the local PSD inventory for emissions based on design capacity. Consequently, operating a unit at its designed capacity under any circumstances would not contribute to a worsening of the air quality in local air sheds.

VI. CONCLUSION

It is critically important to the utility industry that EPA's new modification interpretations be administratively or legislatively changed. Failure to resolve the WEPCo issues will greatly increase the costs currently estimated for complying with the pending clean air legislation and will seriously impede the efficiency and liquidity of the market for allowances. Resolving the problems will not threaten local air quality, because existing (and new) sources will always be regulated to ensure attainment and maintenance of ambient standards, PSD increments, and any other limitations such as those to protect visibility.

Crisis or not, acid rain persists

THERE is both good news and a cause for concern in the recent results of a report ordered by Congress on acid rain.

The encouraging part is that acid rain should not be viewed as the crisis some environmental advocates have suggested it is. Instead, the decade-long study, coming at a cost of $537 million, said acid rain should be "viewed as a long-term problem."

Therein lies reason for concern.

Just because the immediacy of the problem has been toned down by the report, it by no means should be construed as a reason to relax on addressing it. The fact is, the report still portrays acid rain difficulties as "long-term" and a "problem."

Acid rain is pollution carried by rain. It is caused by the burning of fossil fuels — from industrial plants and automobiles — producing sulfur dioxide and nitrogen oxides. These pollutants combine with water vapor in clouds and when precipitation occurs it can be highly acidic, endangering forests, wildlife and lakes and streams and damage buildings.

While the recent report, by the National Acid Precipitation Assessment Program, said acid rain is not the environmental crisis some thought, it also reiterated that pollution control measures are needed.

A previous estimate by the Congressional Budget Office predicted that if no steps are taken to curb acid rain, U.S. electric utilities will emit 18.5 million tons of sulfur dioxide in 1995. That is almost three million tons more than in 1985.

Acid rain has been recognized as a danger to the environment for more than a decade. The latest study, begun in 1980, was established to improve understanding about the problem. It seems to have done that.

But while the most recent report can provide some comfort and reassurance, all is not sunny about acid rain. The clouds of concern have not gone away. And they shouldn't, until that "long-term problem" is corrected. ■

Results per WP, Sat. 9/15
10% of all lakes & streams affected; ↓ visibility in all Eastern & (?) Western areas; corrosion; ↓ tolerance of red spruce in high altitude for cold temps.

New justices are distinctive

TENNESSEANS have ushered in a new state Supreme Court, already marked by one distinction and showing signs of distinguishing itself in many ways.

Justice Martha Craig Daughtrey, who was appointed to the court in April, was sworn in for a full eight-year term as the first woman to sit on the Tennessee Supreme Court. She joined Justices Frank Drowota and Charles O'Brien, along with new Justices Lyle Reid and Riley Anderson.

Together, the court promises to be as active and engaged a group of justices as the state has seen. Without any Republican opposition, the justices spent their summer "campaign" touring the state, listening at courthouses to clerks as well as judges about Tennessee's court system.

Though properly reticent about their opinions on legal cases, the justices have very definite ideas about making the courts work more smoothly. They all have extensive backgrounds as hard-working professionals, active in legal and judicial circles for most of their careers. They promise a bolder, more visible presence for the least understood branch of government.

New Chief Justice Lyle Reid struck a note of uniqueness in his remarks on the opening day of court during the swearing-in ceremonies.

"The uniqueness and sanctity of individuals recognized in our Constitution must be protected against expediency and public clamor," the chief justice said. "The education of our children is a mockery unless the law ensures freedom of thought and expression, the right and opportunity to be creative, to be different, to be controversial."

It was a fitting beginning for a court that may not be controversial, but certainly gives every indication of being distinctive and productive for the next eight years. ■

ENVIRONMENTAL AND ENERGY STUDY CONFERENCE

SPECIAL REPORT

July 12, 1989

Acid rain: science and control issues

by Jim Ketcham-Colwill

The 101st Congress is widely expected to pass clean air legislation that includes acid rain controls, after a decade of debate over whether the threat of acid rain is great enough to justify the economic costs of controlling it.

A key reason is that after eight years of Reagan administration opposition, a new president is calling for acid rain control legislation as part of a comprehensive revision of the Clean Air Act. President Bush announced the outline of his clean air proposal June 12 and is expected to submit legislation to Congress this month. The administration acid rain proposal will compete with the leading acid rain proposals in the House and Senate.

Many believe the question now is what kind of control legislation will be passed, not whether it will be passed. Much of the debate will center on economic and regional equity issues. But scientific understanding of the causes and effects of acid rain will continue to be important as Congress debates how to fashion a control program. The issues include how much to reduce emissions, how fast to reduce emissions, and who should bear the burden of control costs.

Science: Environmental groups for years have argued that acid rain and its precursor pollutants cause or exacerbate human illnesses, kill aquatic life in lakes and streams, may damage forests, and decrease visibility. They say studies of acid rain's effects justify immediate action to reduce emissions, which they predict will increase dramatically without legislation.

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Opponents of acid rain control legislation — notably the coal and utility industries — contend that there is no environmental crisis requiring immediate action, and that emissions of sulfur dioxide are on a downward trend. They say that more research is needed before an acid rain control program can be designed that will be effective and will not impose unnecessary economic costs.

Some of the key issues Congress is considering in fashioning acid rain legislation are in part scientific questions. For example:

- How much should emissions of sulfur dioxide and nitrogen oxides, which cause acid deposition, be reduced to protect most sensitive lakes and streams from acidification?

Interest groups advocate reducing annual sulfur dioxide emissions in the United States by anywhere from 8- to 12-million tons. The administration proposal and bills introduced so far in the 101st Congress call for reductions in the range of 10 million tons, but vary on the starting point for calculating the reduction.

- How much damage to lakes and stream ecosystems, human health, forests and materials will occur if the deadline for emissions reductions is postponed by several years? If the deadline is later, will it take longer for aquatic ecosystems to recover?

There is much controversy over how much damage acid rain and its precursor pollutants have caused, and over how much damage would occur in the future without acid rain controls. One issue is how fast additional acidification of surface waters will occur. Another is whether emissions of sulfur dioxide will rise substantially in the absence of acid rain legislation.

A bill introduced by Rep. Gerry Sikorski (D-Minn.) (HR 1470) sets a January 1998 deadline for accomplishing emissions reductions. The administration proposal sets a 2000 deadline with a three-year extension available to plants using new technologies to repower old plants and reduce emissions. A bill (HR 144) introduced by Rep. Jim Cooper (D-Tenn.) calls for reductions by the end of 2003, with the possibility of a two-year extension for sources using clean coal technology.

- What kinds of emissions sources should be controlled?

Although utility power plants are the largest source of acid rain-causing pollutants in the East, other sources also emit sulfur dioxide and nitrogen oxides. Some recent proposals would control only utility emissions; others would control industrial boilers and industrial process emissions of sulfur dioxide.

- Which areas of the country should pay for acid rain controls? Although the question is political, the debate is based partly on scientific considerations — where the pollutants that cause acid rain are emitted, and which areas of the country would benefit most from acid rain controls.

Some proposals would provide no subsidies for installation of control technologies. Others would ease the impact on electricity rates in states with high utility emissions by providing subsidies, financed by national fees on electricity or emissions.

Primer: The long-running and contentious debate over acid rain control has featured a bewildering array of conflicting claims and charges. Hundreds of acid rain studies, and many major reports, have been published.

This EESC primer on causes and effects of acid rain attempts to sort out the points on which there is general agreement and the points of uncertainty or controversy. It highlights scientific issues that are relevant to acid rain legislation — for example, how fast additional acidification of surface water will occur, how long it will take for acidified lakes to recover, what level of deposition will protect most sensitive watersheds, and whether a reduction in emissions will result in an equal reduction in deposition.

Legislative outlook: Action on acid rain legislation is about to begin in earnest.

Rep. Henry A. Waxman (D-Calif.), chairman of the House Energy health subcommittee, has said that he plans to begin markup of clean air legislation soon. Staff say the markup vehicle is likely to include the Sikorski acid rain bill, which is co-sponsored by about 140 members including Waxman. Sponsors say the bill, similar to Sikorski bills in the past two Congresses, would require a 10-million-ton reduction in annual sulfur dioxide emissions and a 4-million-ton reduction in nitrogen oxides by 1998.

Senate Majority Leader George Mitchell (D-Maine) and other Senate Environment members plan to introduce acid rain legislation after the August recess, a staffer said. That bill is to be marked up as part of a comprehensive clean air package.

The administration bill is expected to receive serious attention from Congress and could have a major impact on the debate.

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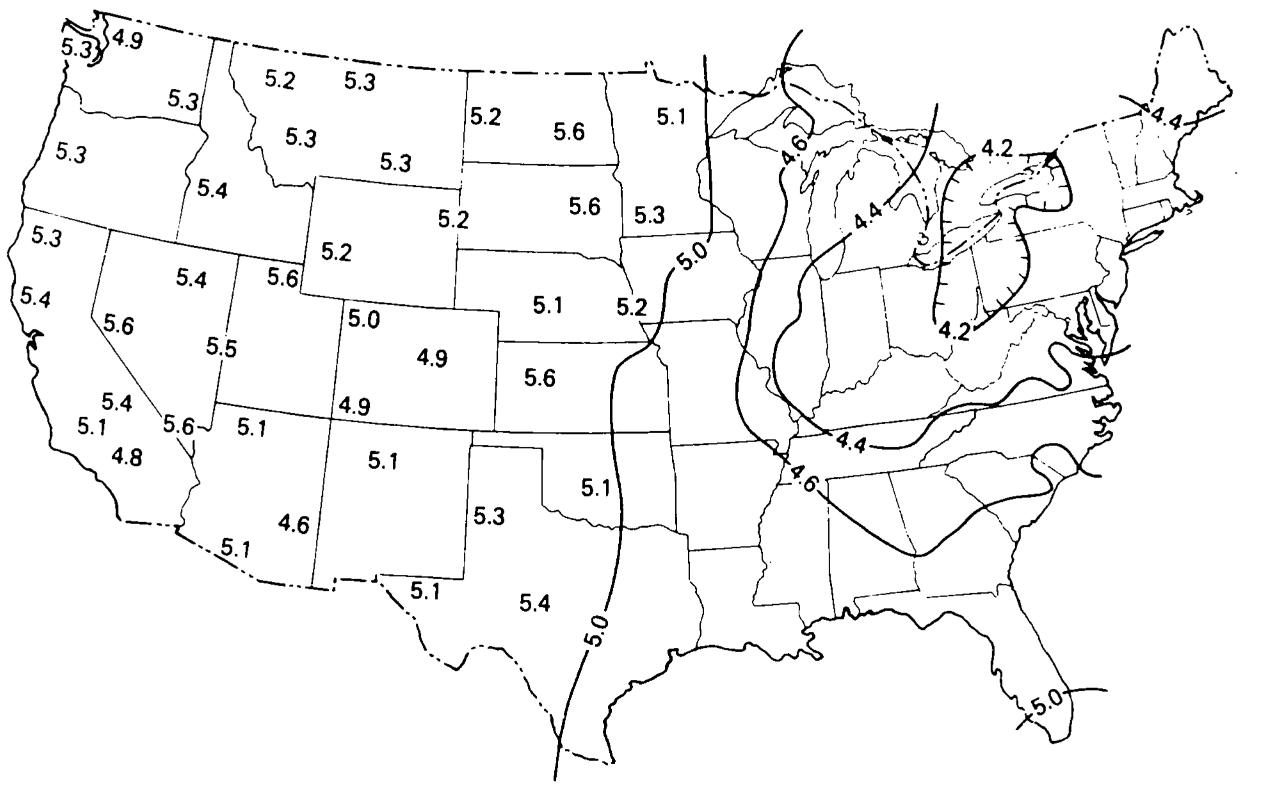

Figure 1: pH of wet deposition in 1985 (precipitation-weighted annual average). Numbers standing alone indicate pH at a sample site; numbers along a line indicate a line of equal pH value. Source: NAPAP 1985 annual report, p. 54.

The acid rain phenomenon

Acid rain is the popular term for "acid deposition," the fallout of acids from the atmosphere in wet or dry form. The total acidity (hydrogen ion) deposited comes from acidic rain, acidic snow, acidic fog, fine acidic particles in the air known as acid aerosols, and acidic gases such as nitric acid vapor and sulfur dioxide.

Acid deposition in the United States is primarily caused by pollutants. Sulfuric acid is formed when sulfur dioxide (SO2) reacts with other substances in the atmosphere or in water films on surfaces. Nitric acid is formed largely by the reaction of nitrogen dioxide (NO2) in the atmosphere.

Most of the other substances that react with SO2 and NOx — including hydrogen peroxide, ozone and hydroxyl radicals — are formed in reactions involving volatile organic compounds (VOCs). VOCs come from natural sources and from pollution.

What it is: The measure of acidity is pH, the hydrogen ion concentration of a liquid. The lower the pH, the more acid is the liquid. A change of 1 in pH means a tenfold change in acidity, and a change of 2 means a hundredfold change. Neutral is pH 7.

Rainfall is naturally acidic, but pollution makes it more so. A 1987 report by the federal National Acid Precipitation Assessment Program— *Interim Assessment: The Causes and Effects of Acid Deposition* — defines acid rain as having an annual average pH of less than 5.0. NAPAP says that the natural background level is 5.0 in the eastern United States, and that the average annual pH of rain in the West is 5.2.

The natural acidity of rain varies in different regions and in the same place at different times. The level for pure water in equilibrium with carbon dioxide in the atmosphere is pH 5.6, but natural substances in unpolluted rainfall can significantly lower the pH of rainfall.

Scientists are concerned about the biological effects of sulfur and nitrogen that are part of acid deposition, not just the acidity of rainfall.

Where it falls: Rainfall in much of the eastern United States and Canada is substantially more acidic than normal. (See 1985 NAPAP map.) The average annual rainfall east of the Mississippi is 4.5, the NAPAP report says.

The most acid rainfall on an annual average basis — as acid as 4.11, according to 1986 NAPAP data — falls mostly in eastern Pennsylvania and neighboring parts of Ohio, West Virginia, Maryland, New York, and Ontario. Sites in Maryland, Virginia, New Jersey and Tennessee also were among the top 20.

In the West, the most acidic rainfall on an average annual basis is approximately pH 4.7, in an area straddling the California-Arizona border.

Single rainfalls can be much more acidic. The most acidic rainfall samples in 1985 and 1986 were between pH 3.1 and 3.6, and came from a variety of states in the Midwest, South, Mid-Atlantic, and Northeast, and from California.

Clouds and fogs are generally more acid than rain at the same area and time. The NAPAP report said mountain clouds along the Appalachian chain have an average pH of about 3.6. The most acid cloud measured in 1986 on Whiteface Mountain, N.Y., had a pH of 2.5. The report said the most acid fog on record occurred in the Los Angeles basin and measured 1.7 — more acid than lemon juice.

Dry and wet deposition are believed to be approximately equal in the eastern United States as a whole. Dry deposition occurs when particles containing acidic compounds come to earth, and when acid gases react with water on surfaces to form acids.

Soils, lakes and streams vary in their vulnerability to acid deposition. Many soils and watersheds have enough buffering capacity that at current levels, acid deposition would not lower surface water pH for decades or centuries, if ever. However, waters in many parts of the East and the mountainous West are sensitive to acid deposition, and many scientists believe that regional acidification has occurred in the Northeast.

The causes of acid rain

Pollution sources: the potential targets for control

Power plants — particularly older, coal-burning plants in the middle and northern parts of the eastern United States — are the primary source of sulfur dioxide emissions. Power plants also are a leading source of nitrogen oxides.

More than two-thirds of SO2 emissions come from electric utilities. About 13 percent comes from industrial processes, and about 11 percent from industrial combustion, according to the 1985 NAPAP emissions inventory.

The leading source of NOx emissions is motor vehicle and other transportation sources, which account for more than 40 percent of emissions. Electric utilities are close behind with 33 percent. Another 15 percent comes from industrial fuel combustion. *See table, p. 5.*

Acid rain control bills focus on reducing emissions of SO2 and NOx, with much greater reductions of SO2. SO2 emissions are responsible for about two-thirds of precipitation acidity in the East, but the contribution of NOx has been rising. In the West, nitrogen oxides play a bigger role than in the East, potentially accounting for a third or more of precipitation acidity — much more in some locations.

Although VOCs play a role in reactions that form acids, VOC controls are proposed primarily in bills designed to reduce ozone levels to the Clean Air Act health standard, not acid rain control bills. The 1987 NAPAP report says it is unclear what effect reducing VOC emissions would have on acid deposition.

Trends: Before the 1970 Clean Air Act, SO2 and NOx emissions were increasing dramatically. Annual SO2 emissions increased 55 percent between 1940 and 1970. NOx emissions increased 250 percent during the same time period.

The Clean Air Act helped curb the growth in emissions. Despite growth in the economy and increased fossil fuel combustion, annual SO2 emissions dropped 25 percent from 1973 — the peak year for SO2 emissions — to 1985, NAPAP says. The reductions resulted largely from Clean Air Act controls on power plants. Other factors were competitive prices for low-sulfur coal, decreased use of some power plants with high emissions rates, and reductions from non-ferrous smelters in the West.

Nitrogen oxide emissions have fluctuated since 1975. Levels in recent years (1985 through 1987) are 7 percent to 10 percent higher than they were in 1983, when NOx emissions were the lowest since 1975. Estimates show that increases in power plant NOx emissions have been largely offset by reductions from gasoline-powered vehicles and industrial combustion of oil and natural gas, the 1987 NAPAP report says.

SO2 sources: Acid rain control legislation would reduce SO2 primarily by reducing emissions from older power plants, the main cause of the acid rain problem in the East.

EPA in 1971 issued the first federal regulation limiting SO2 from new utility plants. The regulation, called a new source performance standard (NSPS), was tightened in 1979, virtually mandating scrubbers by imposing percentage emissions reduction requirements.

More than 90 percent of utility SO2 comes from plants built before 1971. Power plants built before the first NSPS are subject to other Clean Air Act requirements implemented by states, but their emission limits are generally less stringent than the NSPS.

Because it is more economical, utilities have extended the life of many older plants rather than build new plants, which would be cleaner because they would have to meet the NSPS.

Both coal- and oil-fired plants produce SO2, but coal predominates. Coal-fired plants were responsible for more than 95 percent of utility SO2 in 1985, according to NAPAP's recent emissions inventory.

Some acid rain bills would reduce SO2 solely from utilities. Others would require controls on industrial process emissions and industrial boilers as well.

Copper smelters and other non-ferrous smelters, located primarily in the West, caused between 4- and 5-percent of SO2 emissions in 1980, the 1987 NAPAP report says. However, smelter emissions have dropped significantly since then, primarily because of plant closures.

Other industrial processes accounted for 9 to 10 percent of SO2 emissions in 1980. They included petroleum refining, cement plants, pulp and paper manufacturing, iron and steel production, sulfur manufacturers, and sulfuric acid producers.

Another significant source of SO2 emissions is industrial combustion. A wide variety of industries and businesses use coal- or oil-fired boilers for space heating, process steam and electricity generation. They emit both SO2 and NOx. Important examples include the food processing, pulp and paper, chemicals, textiles, petroleum refining, iron and steel, and non-ferrous metal smelting industries.

Residential and commercial fuel use, and motor vehicles and other transportation sources, each contributed less than 5 percent of 1980 SO2 emissions.

1985 U.S. man-made emissions of SO2 and NOx
(1,000 short tons*, % of total)

Category	SO2	%	NOx	%
Utility combustion	16,177.9	70.3	6,769.6	32.9
Industrial combustion				
Small sources	662.4		1,404.1	
Large sources**	1,783.2		1,705.7	
Subtotal	2,445.6	10.6	3,109.8	15.1
Other combustion				
Small sources	408.1		618.2	
Large sources**	171.7		95.1	
Subtotal	579.8	2.5	713.2	3.4
Industrial process				
Small sources	0.0		0.0	
Large sources**	2,906.9		923.0	
Subtotal	2,906.9	12.6	923.0	4.5
Transportation	863.6	3.7	8,834.4	42.9
Other				
Small sources	18.9		198.6	
Large sources**	20.1		18.3	
Subtotal	38.9	0.2	216.8	1.1
Grand total	23,012.7		20,566.9	

*1 short ton = 2,000 pounds
**"Large" sources include those that emit more than 100 short tons per year.
Source: EPA 1985 NAPAP Inventory (November 1988)

Regional differences: One of the main reasons that an acid rain compromise has been so elusive is that utility emissions are much higher in some parts of the country than others. Some states would bear the brunt of control costs and electricity rate increases, unless Congress spread out the burden through pollution control subsidies.

Emissions are high in a corridor stretching from Missouri and Tennessee through New York. Total sulfur dioxide emissions in 1984 were highest in the Ohio Valley states of Ohio, Indiana, Pennsylvania and Illinois. Those four states, along with Missouri, West Virginia and Tennessee, produced 44 percent of total U.S. SO2 emissions in 1984, a 1986 special acid rain edition of the *EPA Journal* said.

The Ohio Valley is a major source of NOx as well as SO2. The top six NOx emitting states in 1984 included four Ohio Valley states — Ohio, Illinois, Pennsylvania, and Indiana. Texas, fifth in total SO2 emissions, was far and away the top NOx emitter. California was second. *See tables, p. 6.*

Another source of regional controversy is variation in the sulfur content of coal, which determines how much SO2 is produced during combustion. States that produce large amounts of high-sulfur coal — including portions of Indiana, Illinois, Ohio, West Virginia and Pennsylvania — fear legislation that would encourage utilities to switch to low-sulfur coal, causing massive job losses in high-sulfur coal mining. But low-sulfur coal-producing areas of the West and Central Appalachia want acid rain legislation that does not prevent or discourage coal switching.

Most coal in the East and Midwest is high in sulfur content (average sulfur content by state is between 0.9 and 5.0 pounds per million Btu). Most Western coal is low in sulfur (averaging 0.5-1.0 lbs./MMBtu). A few states, notably Kentucky and West Virginia, have both high and low-sulfur coal.

SO2 emissions are high in the Midwest because the region has many coal-fired plants built before the advent of new source performance standards. Some state implementation plans allow high-sulfur coal to be burned in older power plants that are remotely located and use tall stacks to disperse the pollution, a 1986 Congressional Budget Office report says. The use of tall stacks to meet emissions limits was curtailed by the 1977 Clean Air Act amendments, but some plants fall under a "grandfather clause," an EPA official said.

Many parts of the Northeast already have strict controls. The CBO report says that in the Northeast, emission sources are concentrated near urban centers. The resulting high atmospheric levels of SO2 prompted strict SO2 requirements on nearby combustion sources, including many coal- and oil-fired utilities, the report says.

Another factor is that the Northeast has many oil-fired and nuclear plants and relatively few coal-fired plants, a DOE official said.

In the West, many of the coal-fired plants were built after 1971 and were required to install scrubbers. Even at plants without scrubbers, emissions generally are lower because coal supplies in the West tend to be low in sulfur.

Transport and deposition

In debating acid rain legislation, politicians long have argued over who is to blame for the acid rain that falls in areas most susceptible to damage. Some members from high-emitting states have argued that there is no proof that their states' emissions are the problem.

There is broad agreement that pollutant emissions can cause acid deposition near the source or thousands of miles away. Although air masses move predominantly from west to east, weather patterns carry emissions in all directions.

Scientists believe that the high-emitting Ohio Valley region contributes significantly to rainfall acidity in New York and New England. A 1983 National Academy of Sciences report notes that the region of highest rainfall acidity corresponds to the regions of heavy industrialization and urbanization along the Ohio Valley and Eastern seaboard, where man-caused emissions of sulfur dioxide, nitrogen oxides and hydrocarbons are high. The report also said that evidence from air-parcel trajectory studies suggests that a major source of acid deposition at remote parts of the Northeast is the industrial region to the southwest.

Still in question is how much acid deposition is caused by distant emissions sources as opposed to local sources.

A 1983 National Academy of Sciences report said that on the basis of current data, "we cannot in general determine the relative importance for the net deposition of acids in specific locations of long-range transport from distant sources or more

State-level estimates of SO2 emissions from power plants and all man-made sources in 1985***

(million metric tons/year)

State	Power plants	Total
Alabama	0.52	0.74
Arizona	0.10	0.59
Arkansas	0.07	0.12
California	0.0*	0.30
Colorado	0.08	0.13
Connecticut	0.05	0.07
Delaware	0.06	0.12
D.C.	0.00	0.01
Florida	0.41	0.61
Georgia	0.89	0.96
Idaho	0.00	0.05
Illinois	0.98	1.27
Indiana	1.35	1.67
Iowa	0.18	0.26
Kansas	0.15	0.21
Kentucky	0.78	0.90
Louisiana	0.07	0.35
Maine	0.01	0.07
Maryland	0.20	0.25
Massachusetts	0.21	0.26
Michigan	0.37	0.60
Minnesota	0.11	0.16
Mississippi	0.10	0.21
Missouri	0.85	1.00
Montana	0.02	0.12
Nebraska	0.05	0.07
Nevada	0.04	0.11
New Hampshire	0.07	0.08
New Jersey	0.09	0.20
New Mexico	0.09	0.27
New York	0.43	0.69
North Carolina	0.31	0.42
North Dakota	0.11	0.13
Ohio	2.01	2.43
Oklahoma	0.07	0.13
Oregon	0*	0.04
Pennsylvania	1.14	1.50
Rhode Island	0*	0.01
South Carolina	0.14	0.23
South Dakota	0.03	0.04
Tennessee	0.73	0.89
Texas	0.39	1.01
Utah	0.03	0.08
Vermont	0*	0.01
Virginia	0.12	0.27
Washington	0.09	0.25
West Virginia	0.86	0.99
Wisconsin	0.27	0.44
Wyoming	0.13	0.21
Total U.S.**	14.7	21.5

*Approximate

**Not including Hawaii & Alaska

***Source: Knudsen, 1986, cited in 1987 NAPAP Interim Assessment, Vol. II, p. 1-35. Power plant values are from 1985; values for other sources reflected in totals are for 1984.

State-level estimates of man-made NOx emissions from vehicles, power plants and all sources in 1985*** (million metric tons/year of NO2)

State	Highway vehicles	Power plants	Total
Alabama	0.13	0.17	0.42
Arizona	0.09	0.11	0.25
Arkansas	0.09	0.09	0.24
California	0.68	0.07	1.11
Colorado	0.08	0.11	0.28
Connecticut	0.08	0.02	0.12
Delaware	0.02	0.03	0.06
D.C.	0.01	0	0.02
Florida	0.27	0.25	0.66
Georgia	0.19	0.28	0.58
Idaho	0.03	0	0.08
Illinois	0.30	0.29	0.81
Indiana	0.19	0.36	0.71
Iowa	0.11	0.11	0.28
Kansas	0.10	0.10	0.40
Kentucky	0.13	0.27	0.58
Louisiana	0.13	0.14	0.60
Maine	0.03	0*	0.05
Maryland	0.11	0.07	0.19
Massachusetts	0.13	0.08	0.26
Michigan	0.24	0.24	0.62
Minnesota	0.14	0.09	0.30
Mississippi	0.09	0.05	0.23
Missouri	0.17	0.20	0.45
Montana	0.04	0.03	0.13
Nebraska	0.07	0.04	0.15
Nevada	0.03	0.05	0.10
New Hampshire	0.02	0.02	0.05
New Jersey	0.19	0.06	0.41
New Mexico	0.05	0.09	0.22
New York	0.30	0.14	0.65
North Carolina	0.18	0.17	0.42
North Dakota	0.03	0.09	0.15
Ohio	0.32	0.46	1.02
Oklahoma	0.12	0.13	0.37
Oregon	0.10	0*	0.21
Pennsylvania	0.30	0.34	0.86
Rhode Island	0.02	0*	0.03
South Carolina	0.10	0.07	0.24
South Dakota	0.03	0.02	0.07
Tennessee	0.16	0.18	0.45
Texas	0.55	0.61	2.47
Utah	0.04	0.04	0.13
Vermont	0.03	0*	0.03
Virginia	0.16	0.06	0.32
Washington	0.13	0.04	0.25
West Virginia	0.06	0.29	0.42
Wisconsin	0.15	0.14	0.38
Wyoming	0.03	0.13	0.25
Total U.S.**	6.79	6.34	19.1

*Approximate

**Not including Hawaii & Alaska

***Source: Knudsen, 1986, cited in 1987 NAPAP Interim Assessment, Vol. II, p. 1-52. Power plant values are from 1985; values for motor vehicles and other sources reflected in totals are for 1984.

direct influences of local sources."

An EPA report — the August 1985 critical assessment document on acid deposition — said most sensitive lakes, streams and forests are in remote areas, so local sources less than 50 kilometers away are not significant except in isolated cases.

The EPA assessment said that the Adirondack and New England mountains receive roughly equal amounts of acid deposition from distant (greater than 500 kilometers) sources and intermediate-range (50-500 kilometers) sources. The southern Appalachians receive most deposition from intermediate-range sources. Maine and eastern Canada receive most deposition from distant sources, the assessment said.

The distances the pollutants travel are affected by different air chemistry and weather conditions. The distances also arerelated to whether the acid deposition is wet or dry. In areas remote from pollution sources, such as the Adirondacks, wet deposition may account for up to 80 percent of the sulfur deposited, a 1984 Office of Technology Assessment report said. In urban areas near many sources of pollution the situation is reversed, OTA said. A third of Eastern sulfur emissions exit over the Atlantic.

Environmental and industry groups have disputed whether Congress should wait for more research on the relationship between emissions and deposition before enacting acid rain controls. *See control issues section, p. 16.*

Transboundary pollution: The Canadian factor

Since air pollution knows no boundaries, emissions in the United States cause acid rain in Canada and vice versa. Although power plants are the largest source of SO2 in the United States, smelters are the main source in Canada.

Both countries have substantially reduced emissions of SO2 since 1970. The 1987 NAPAP report found that SO2 emissions in the 11 states that border Canada and the Great Lakes decreased 20 percent between 1975 and 1985. Canada's total emissions of SO2 and NOx are much less than the U.S. totals.

A brochure distributed by the Canadian embassy said studies by Canadian scientists show that U.S. SO2 emissions "cause, on average, 50 percent of the acid deposition that falls on Canada. In some particularly vulnerable areas of Canada, up to 75 percent of the acid deposition originates in the United States. Canadian emissions are responsible, on average, for 15 percent of the acid rain falling on the northeastern United States."

An EPA staffer said that the Canadian estimates are quite uncertain, and apply only to the East.

Canada has been pushing the United States to reduce its emissions since 1980, when the two nations signed a memorandum of intent to develop a bilateral agreement on transboundary air quality. The Reagan administration, however, contended that acid rain controls were premature and that further research on the problem was needed. The issue has been one of the main points of tension between the two countries.

Acid rain effects: How severe?

There is much dispute over how much harm acid rain has caused to date, and over how much harm acid rain will cause in the future if pollution controls are not tightened.

Environmental groups say that acid deposition has caused biological damage in thousands of lakes and streams, and will cause significant additional damage unless controls are enacted. They say that acid rain or its precursor pollutants cause or exacerbate serious human illnesses, cause billions of dollars of damage each year to building materials and paints, reduce visibility, and may damage forests and crops.

In recent years, industry groups — such as the Utility Air Regulatory Group and the Clean Air Working Group — have said that relatively few lakes are acidic and that the number affected by acid rain is uncertain. They have argued that Clean Air Act standards are sufficient to protect human health from acid-rain forming pollutants. They have said that damage to materials has at most a negligible economic consequence, and that effects of current levels of acid deposition on crops and forests have not been demonstrated.

Lakes and streams: How much damage to date?

Studies during the 1980s have confirmed that hundreds of lakes and streams in surveyed regions of the East have a pH of 5 or less — too acidic for most fish species. However, dispute continues over the number of lakes acidified by acid rain and the number in danger of future acidification.

Many watersheds have the ability to prevent or slow acidification of lakes and streams. Acids deposited from the sky may be retained in the soil, or neutralized by alkaline substances in the soil or water body. Many other water bodies are in watersheds with little buffering capacity, and can be quickly acidified by acid deposition.

Acid rain researcher D.W. Schindler, in a January 1988 article in *Science*, says that "it is now clear that acid rain has already caused widespread acidification [reduction of alkalinity] of many aquatic ecosystems in the northeastern United States, Canada, Norway, Sweden, and the United Kingdom. Evidence comes from four sources: geochemical theory, analysis of long-term trends, comparison of older with more recent chemical records, and paleoecological analyses [analyses of diatom remains in lake sediments]."

The Environmental Defense Fund says that acid rain has caused about 1,000 acidified (pH below 5.3) lakes and 3,000 chemically altered (pH below 6.0) lakes in the United States.

But George Hidy, a scientist with the Electric Power Research Institute, the research arm of the utility industry, told a House Energy subcommittee in 1988, "If one applies rigorous scientific standards to the assessment of recent acidity developing in (sensitive U.S.) lakes, we find that historic information can only identify — out of a large number of waters surveyed — a very few that have recent acidity that can be explained only by acid deposition."

Acidic waters in some cases are caused by natural factors, such as vegetative decay, or by acid mine drainage.

Schindler says that although reliable historical data are limited, geochemical theory shows that acidification (reduction in alkalinity) has taken place on a regional scale. "Studies show that the alkalinity (acid neutralizing capacity) of lakes has been replaced with sulfate over broad areas of Scandinavia, the northeastern United States, and eastern Canada," he said. He said this causes lakes to have low ratios of alkalinity to calcium and magnesium ions, which are leached from soils by acid deposition, and high ratios of sulfate to calcium and magnesium ions, relative to lakes in pristine areas.

Thousands of lakes and streams are vulnerable to continued acid deposition over some time scale. However, there is much uncertainty and controversy over how quick, how extensive, and how serious changes in the acidity of lakes and streams would be. (See discussion below under "Science and control issues."

What is an acidic lake: Because of natural variation in lake acidity and sparse historical data to document trends in lake acidity, the definition of acidic lake can be controversial.

Waters with acid neutralizing capacity (ANC) less than zero are acidic. The corresponding pH level varies regionally, so scientists prefer to use ANC to compare lake-water chemistry. But biological damage is much more closely tied to pH levels than ANC.

For that reason, the 1987 NAPAP report used three pH values — 5.0, 5.5, and 6.0 — to compare the acidity of lakes in different regions. Species of fish and other aquatic life vary in their ability to withstand acidity.

The report's executive summary prompted controversy by referring to acidic lakes as those with pH less than or equal to pH 5. The Natural Resources Defense Council and some U.S. and Canadian scientists charged NAPAP's director with trying to downplay the acid rain problem, noting that biological damage from acidity begins around pH 6 and occurs in many sport fish species below pH 5.5.

In a reply, NAPAP stressed that data on lake pH levels only describes the status of a water body and cannot define the extent of damage from acid rain.

Lakes survey: The most comprehensive survey of the acidity and sensitivity of U.S. lakes and streams is the National Surface Water Survey conducted by EPA beginning in 1984. The survey, which used statistical techniques to estimate the number of acidic lakes, sampled water quality of lakes in four regions selected for their probable high sensitivity to acid deposition:

- the Northeast (including New England and parts of New York, Pennsylvania and New Jersey);
- the Upper Midwest (including parts of northern Michigan, Wisconsin and Minnesota);
- the Southeast (including much of Florida and a southern Blue Ridge subregion stretching from Georgia to Virginia); and
- the mountainous West (including much of the Pacific mountain chain and segments of the Rocky Mountain chain from the Canadian border to New Mexico).

Not all lakes were included in the survey. Very large and very small lakes were excluded, and lakes had to meet other certain criteria for inclusion.

In total, the three Eastern regions had 629 lakes with pH 5.0 or less and 1,355 lakes with pH 5.5 or less. In the Northeast region, where acid rain has prompted the most concern, 3.4 percent of the lakes (240) had a pH of 5.0 or less, and 8.6 percent (613 lakes) had a pH of 5.5 or less.

Much higher percentages of low-acidity lakes were found in several subregions. Twenty percent of the lakes in the Adirondack Mountains and Florida have a pH of 5.5 or less.

Acid rain is believed to be the main cause of low-acidity lakes in the Adirondack Mountains and Upper Peninsula of Michigan, and an important contributing factor in southern New England. In Florida, the NAPAP report said, natural causes are responsible for the acidity of many of the lakes; other possible factors include acid deposition, mining, industry, forestry and agriculture.

Low-acidity Eastern lakes by region

(percentage and estimated number of low-acidity lakes for selected subregions)

Region	ph5 or less	pH 5.5 or less
Adirondacks	10% (128)	20% (256)
Upper Michigan	9.4% (99)	13.6% (143)
Southern New England	5% (66)	10% (132)
Florida	12.4% (259)	20.6% (433)

The survey found essentially no lakes or reservoirs with pH less than 5 and very few with pH less than 5.5 in the mountainous West and the northeastern Minnesota, Upper Great Lakes, and the southern Blue Ridge subregions.

The lakes survey did not include lakes in Canada. The Canadian government says that 14,000 lakes have been acidified (that is, have pH 5.0 or less), and that 150,000 eastern Canadian lakes — one in every seven — have already suffered biological damage from acid rain.

NAPAP, responding to a Canadian critique of its 1987 report, said that the 14,000-lake estimate comes from distillations of multiple surveys conducted over a period of years. "Thus the uncertainty of the estimates is undefined, but larger than those for the (U.S. lakes survey)," NAPAP said. The percentage of lakes with pH less than 5 is in the same range (1-10 percent) in subregions of the Northeastern U.S. and eastern Canada, NAPAP said, with an average of about 2 percent in eastern Canada.

The Adirondacks: In the Adirondacks, 10 percent of the lakes were pH 5 or less and 20 percent were pH 5.5 or less.

The NAPAP report said high levels of acid deposition and high runoff through shallow, extremely acidic soils are the significant causes of acidity in most Adirondack lakes. Most of the acid lakes are in the southwestern sector of Adirondack Park.

Environmentalists and NAPAP agree that the Adirondack figures would be higher if lakes smaller than 4 hectares (10 acres) were included in the survey. In the Adirondacks, small lakes are more likely to be acidic, and are important sport fisheries, the NAPAP report says.

A survey by the Adirondack Lake Survey Corp., a cooperative effort of New York state and utilities, found a much larger number of acidic lakes in the Adirondacks. Some 352 — 24 percent of the 1,469 surveyed between 1984 and 1987 — had a pH of 5 or less.

Walter Kretser, a research scientist with the New York Department of Conservation, said the higher percentage of low-pH lakes in the corporation survey is largely due to the fact that it included lakes as small as one acre. He said that some of the sampled lakes are naturally acidic; 46 are true bogs.

Streams: The initial results of EPA's National Stream Survey, released in 1988, showed "a broader geographical extent of environmental effects from acid rain than we previously realized," said Courtney Riordan, director of the agency's Office of Environmental Processes and Effects Research.

The survey, which examined 500 streams in the mid-Atlantic and southeastern United States, found that 2.7 percent — 5,429 kilometers — of the combined stream length was acidic (ANC of zero or less during spring baseflow). For most of the acidic segments — 4,455 km — "the major source of acidity is most likely to be acid deposition," the report said.

This conclusion is based on the fact that other major sources of acidity such as acid mine drainage and organic acids were excluded by site visits and examination of stream chemical data. Also, stream water sulfate concentrations within subregions were highly correlated with wet sulfate deposition rates.

Of the stream segments suspected to be acidified by acid rain, slightly more than half were located in small upland forested watersheds in the interior mid-Atlantic region — the Poconos and Catskills region in New York, New Jersey and Pennsylvania; the Valley and Ridge subregion in Pennsylvania, Maryland, West Virginia and Virginia; and the Northern Appalachians subregion in Pennsylvania, Maryland and West Virginia.

Most of the rest are in lowland drainages of the mid-Atlantic coastal plain, primarily in the New Jersey Pine Barrens. However, most of the streams in the Pine Barrens are also influenced by organic acidity and many are likely to have been acidic at least since the early 1900s, the report said.

The survey, based on statistical sampling of targeted stream segments, examined small and middle-size streams with widths between one and six meters and depths less than one-half meter. Streams of this size can support fish but are small enough to be susceptible to acid rain effects.

Damage to fish and aquatic life: Acid deposition has eliminated many species of fish and other aquatic organisms in hundreds of lakes in the Northeast and Upper Midwest, according to a major new study published in the May 1989 edition of *Environmental Science & Technology*.

The authors, led by David W. Schindler, say data is unavailable to directly establish the degree of damage to North American waters from acid deposition. Instead, they use indirect means to estimate declines in lake-water pH and the likely degree of biological damage. The estimates are based on models that use current information on lake chemistry, relationships between chemical variables, and relationships between pH and aquatic life.

The study estimates that 17 percent of low-calcium (poorly buffered) lakes in the Northeast region that once had pH values suitable for a variety of sport fish species are now too acidic for any game fish except largemouth bass. In the Adirondacks and the Catskills and Poconos, 30 percent of low-calcium lakes fall into that category. Estimated losses of organisms lower in the food web were much higher than for sport fish.

"A high proportion (34-42 percent) of the low-calcium lakes in the Adirondack, Catskill/Poconos, and South New England subregions appear to have suffered severe losses of species," the study says. "They are no longer able to support many of the species of small fishes, leeches, molluscs, benthic crustaceans, and sensitive insects that are typical food organisms for sport fish.

"A smaller, but significant number of lakes in central New England, Upper Michigan, and north central Wisconsin also have apparently suffered some decreases in species numbers. Effects in Maine, northeastern Minnesota and the upper Great Lakes states are still estimated to be minimal."

When sensitive species are lost from a lake, acid-resistant species typically multiply. However, the new species "may not be suitable replacements for the food web supporting valuable fisheries," the study says. "While most of the species eliminated from northeastern lakes by acid precipitation are not valued directly by man, they maintain the integrity of vital food chains and biogeochemical cycles."

The study notes that the findings are subject to a variety of uncertainties and shortcomings in data, but says that the estimates are conservative. The authors say that the number of species originally present in a given lake cannot be determined without detailed pre-acidification surveys, which are not available. However, they say most of the species of primary concern are widely distributed in the Midwest and Northeast. The numbers show regional average declines, and cannot be used to ascertain the number of species lost for a particular lake.

How damage occurs: Fish species and other types of aquatic organisms vary in their tolerance for acidity.

Most fish species tolerate pH levels above 5.5, although some species have reported effects slightly above pH 6. Some species begin to have significant difficulty at pH 5.5, and only a few species can sustain populations in water below pH 5.0, the NAPAP report says.

Fish are sensitive both to the acidity of the water and to toxic metals — primarily aluminum — that can be released from the watershed under acid conditions.

The new Schindler study says "we now know that the number of aquatic taxa (taxonomic groups of plants and animals) in an ecosystem usually declines continuously with increasing acidity below pH values of 6.5 to 7. Many of the forage fishes and invertebrates that are key elements in the food chains of north temperate lakes are lost at pH values near 6.0. Some impoverishment of the biotic community may therefore occur with any decline in pH. Such impoverishment can have detrimental effects on the food chains supporting sport fishes, well before direct toxicity to adult fish is evident."

Fishless lakes: The 1986 National Academy of Sciences report said that available data indicate that fish populations decline as lakes are acidified, but that high-quality data are sparse. The strongest evidence, from some Adirondack Mountain lakes, is that populations of acid-sensitive fish species declined or disappeared over the past 20 to 40 years in lakes thought to have been acidified over the same time period.

Large numbers of fishless lakes have been found, but the number that are fishless because of acid rain is uncertain. A 1976 survey of 214 high-elevation lakes in the Adirondacks found that 50 percent had pH less than 5.0 and that 84 percent of those were fishless, according to the NAPAP interim assessment. The Adirondack Lake Survey Corporation found no fish in 346 of the 1,469 surveyed.

Smaller numbers of fishless waters, or the lack of acid-sensitive species, have been found in northern New England, Massachusetts, and Pennsylvania, the NAPAP report said.

Ann Powers of the Chesapeake Bay Foundation told the House Energy health subcommittee in April 1989 that acidification of streams and tributaries may be taking a toll on some Chesapeake Bay fish species that spawn in fresh water.

A **Ducks:** The Izaak Walton League of America, in a 1987 report, said that acid rain may be a significant factor in the dramatic decline of the black duck and other waterfowl in the Atlantic flyway over the past 30 years. The report cited data showing poorer performance and duckling survival on acidic wetlands, as compared to more neutral wetlands, and noted a correlation between rising emissions and the decline in waterfowl populations in northeastern North America.

In the Atlantic flyway since 1955, there have been declines of 60 percent for the black duck, 31 percent for the mallard, 79 percent for the ring-necked duck or 52 percent for the goldeneye duck, the league's Paul W. Hansen said in a 1988 statement.

U.S. Fish and Wildlife Service Director Frank Dunkle testified at an Oct. 2, 1987, House hearing that "there are no scientific data that clearly point to acid precipitation as a primary factor in the decline of black ducks or other waterfowl." He said land use, overharvest and hybridization with mallards may have contributed to the declines. In a subsequent statement inserted in the hearing record, the wildlife service said, "It is most likely that several interacting factors, including indirect effects of acid precipitation, are involved in the decline of black ducks."

In a rebuttal, Hansen said waterfowl biologists have sought to explain the waterfowl declines for almost three decades. He said the declines could not be explained by theories such as hybridization with mallards, overharvest, poisoning from lead shot ingestion and habitat loss due to agriculture.

Eutrophication of coastal waters

A 1988 study by the Environmental Defense Fund concludes that acid rain is a major source of a key nutrient — nitrogen — that stimulates excessive algae growth in waters along the East Coast. The resulting loss of oxygen in the water sometimes causes mass killings of aquatic life, and often is cited as contributing to the long-term decline in fish and other aquatic animals and plants in the Chesapeake Bay and other estuaries.

The EDF study concluded that "25 percent of all nitrogen contributed by human activity to the Chesapeake Bay originates in acid rain and associated dry deposition falling directly on the bay or onto its watershed." The analysis found that 34 percent of the nitrogen comes from fertilizers, 23 percent from point sources such as sewage treatment plants, 14 percent from atmospheric ammonium, and 4 percent from animal waste runoff.

The contribution of atmospheric nitrate would climb to 42 percent by 2030 if rising nitrogen oxides emissions are not checked and the Chesapeake Bay program is successful in reducing the contribution of other nitrogen sources by 40 percent, the study says.

"Previous studies have either ignored or seriously underestimated the contribution of atmospheric deposition to coastal waters," the study says.

EPA officials believe the study probably overestimates the contribution of atmospheric deposition, based on preliminary analysis. The agency is trying to refine the analysis and develop a better estimate, an official said.

The Bay: In a process called eutrophication, nitrogen (in the form of nitrates) and phosphorus stimulate excessive algae growth that reduce the amount of sunlight that reaches submerged plants. The respiration and decay of the algae reduces levels of dissolved oxygen in the water.

In the upper Chesapeake Bay, the number of algae blooms has increased since the 1950s. The study, citing other sources, says decreased light and oxygen levels in the bay may have caused or contributed to decreases in submerged vegetation, a reduction in waterfowl populations that feed off the vegetation, decreased oyster harvests in the upper bay, decreases in the populations and diversity of other bottom dwellers, and decreases in populations and diversity of fish that spawn in fresh water.

The degree to which nutrient pollution is causing the decline in bay life is unclear. Other factors that may contribute to the decline include toxic pollutants and pesticides, overfishing, climatic trends, and physical alterations of the bay associated with dredging and filling.

Health effects

Scientists disagree on whether current levels of acid rain and its precursor pollutants pose a serious threat to human health. Some controversial statistical studies say that tens of thousands of people may be dying prematurely; industry groups say that studies show there is no significant health threat.

In 1987, four doctors told the Senate Environment and Public Works Committee that the potential health threat is too great to wait for more study before enacting acid rain legislation. The doctors — affiliated with the American Academy of Pediatrics, the American Lung Association, the American Public Health Association and Mount Sinai Medial Center in New York City — warned of effects ranging from impaired breathing to the possibility of chronic lung disease and premature death.

But in April 1988, EPA proposed retaining the existing Clean Air Act health standards for sulfur dioxide, saying it had tentatively concluded that the standards are adequate to protect public health with a margin of safety.

The utility, coal and mining industries agree with EPA that the health-based standards under the Clean Air Act provide protection against known health effects of SO2. After the Senate Environment hearing, American Mining Congress President John A. Knebel said that "equally or better qualified medical experts" who did not testify reject the view that acid rain precursors "present a significant threat to public health."

The air pollutants in question are sulfur dioxide, nitrogen oxides, and acid aerosols formed from SO2 or NOx. EPA has established air quality standards for sulfur dioxide, nitrogen dioxide and fine particles, which include acid aerosols and many other substances.

Another concern is that acid rain could increase levels of toxic metals in drinking water and fish.

SO2: Sulfur dioxide concentrations in the United States have declined over the past decade, and most urban centers are in compliance with the air quality standard. Approximately 1.6 million people were living in counties with SO2 levels that exceeded the standards in 1987, according to EPA.

EPA, in proposing to retain current SO2 standards in April 1988, said that available data provide some qualitative evidence that high annual sulfur dioxide exposures may reduce defenses against respiratory infection. The agency also said "there does appear to be some consistency" among recent epidemiological studies indicating a possibility of respiratory effects (such as cough) from persistent exposures to sulfur oxides in areas with long-term averages only slightly above the current standards. However, the studies are unclear on whether SO2 or other pollutants, such as particulates, are primarily responsible.

Much of the recent concern about SO2 has focused on short-term peaks, which are not prevented by the existing 24-hour standard. Clinical human exposure studies have documented narrowing of airways in mild to moderate asthmatics and atopics (people with allergies) exposed during exercise to as little as 0.4 parts per million of SO2 for short periods — 5-10 minutes up to an hour. The change in respiratory function, often accompanied by shortness of breath, wheezing and coughing, usually diminishes within one hour after either exercise or exposure is discontinued.

EPA and some scientists said the effects are transient, reversible, and less severe than those associated with asthma "attacks." They also argue that the effects are within the range of daily variation that asthmatics typically experience, likening the effects to those caused by dust and cold air.

But Dr. Dean Sheppard of the University of California at San Francisco says the symptoms he observed are the same as an asthma attack — anxiety, air hunger, use of accessory muscles of respiration, and requirement for immediate bronchodilator therapy.

Rough EPA estimates indicate that approximately 100,000 asthmatics — 1 percent of the U.S. asthmatic population — would experience at least one exposure of concern per year. Less than 25 percent of these exposed asthmatics are likely to experience moderate respiratory function changes or symptoms, EPA said. The Natural Resources Defense Council contended that the estimates were too low.

Environmentalists, who say everyone should be protected from the effects of pollution, favor establishment of a one-hour SO2 standard to protect against short-term peaks. Industry groups such as the Utility Air Regulatory Group and American Mining Congress oppose a new standard. EPA tentatively concluded that the short-term exposures do not "constitute a significant public health problem" because of the number of people affected, the seriousness of effects, and the theory that severe asthmatics may be protected because they tend to exercise less and often already are taking medication.

Nitrogen oxides: Low levels of nitrogen dioxide, the nitrogen oxide of primary health concern, can cause reduced lung function, chest tightness and cough, and may reduce resistance to infection.

In 1987, only Los Angeles County, which in 1980 had a population of 7.5 million, exceeded the Clean Air Act health standard for nitrogen dioxide, according to EPA.

EPA said in an August 1982 assessment that the available evidence suggests the possibility that current NO2 levels may cause adverse health effects in sensitive groups. However, EPA said little credible evidence existed that links specific human health effects to NO2 concentrations at or near current levels.

Pam Johnson, NOx project officer for EPA's Office of Air Quality Planning and Standards, says recent studies conflict on whether short-term peaks of NO2 cause reduced lung function in asthmatics. Some studies have found that exposure to NO2 levels of .3 to .5 ppm for one to two hours reduces the volume of air subjects could expel rapidly. Other studies found no effects, including one study that exposed asthmatics to levels as high as .6 ppm, she said.

Dr. Thomas Godar of the American Lung Association told a Senate Environment panel in April 1989 that nitrogen dioxide exposure has been linked with increased frequency and severity of respiratory tract infections in animal studies and epidemiologic surveys.

Animal studies showing lung inflammation and other lung changes from NO2 have led to concerns that NO2 may contribute to development of lung diseases such as emphysema.

Nitrogen oxides also combine with volatile organic chemicals to form ozone, and contribute to formation of fine particulates. Preliminary EPA data indicates that ozone levels exceeded the Clean Air Act standard in about 90 cities and other areas, with a population of over 100 million, in 1986-88. Ozone can cause respiratory difficulties such as reduced lung function and cough. Animal studies suggest the possibility that ozone may reduce resistance to respiratory infection, cause permanent lung damage, and lead to lung diseases such as emphysema and chronic bronchitis. Chronic effects are unproven in humans.

Acid aerosols: Sulfur dioxide and nitrogen oxides can react with moisture in the atmosphere to form acidic particles known as acid aerosols. A subcommittee of EPA's Clean Air Scientific Advisory Committee recommended that the agency list acid aerosols for regulation, but the full committee in October 1988 recommended that EPA conduct more research.

According to a draft EPA acid aerosols issue paper dated February 1988, strong acid sulfates such as sulfuric acid aerosol are the focus of health effects research. However, other acids in aerosols, especially nitric acid, may be of concern in some circumstances such as acid fogs in Western coastal cities. There is little data on the health effects of acid fogs or nitric acid in the atmosphere.

Studies show that inhalation of sulfuric acid aerosol causes narrowing of airways at high levels, and changes in the lung's clearance of foreign particles at lower levels. Animal studies raise concerns that long-term inhalation might produce chronic lung disease, possibly asthma and chronic bronchitis.

Controlled studies have not demonstrated that acid aerosols cause health effects at levels near those currently found in the air, but some epidemiological studies do suggest that current levels may pose a threat.

Most of the epidemiology studies do not have direct acid measurements, but find correlations between health effects and other air pollutants where there is reason to believe that high acid aerosol levels existed. Those studies — which measured pollutants such as sulfates, fine particles, sulfur dioxide and ozone — found correlations with chronic cough, bronchitis, small and temporary decreases lung function, and elevated mortality rates. Scientists differ on the validity and implications of the studies.

Among the few studies where acid levels were measured, some found no relationship with health effects. Others found possible relationships but were inconclusive.

Deaths: Harvard University researcher Haluk Ozkaynak told a Senate Environment subcommittee in 1987 that studies by Harvard's Energy and Environmental Policy Center repeatedly have found that air pollution is statistically associated with 2- to 5-percent of mortality (death) and morbidity (illness).

The studies often associated sulfates, which form from sulfur dioxide, and fine particle mass with mortality rates, he said. Sulfates make up a large proportion of fine particles in the East.

However, Dr. Frederick Lipfert of the Brookhaven National Laboratories, another researcher in the field, has said that Ozkaynak's conclusions are overstated and unsupported. The studies do not show consistent effects for the same pollutants, Lipfert said.

The 1984 OTA report, *Acid Rain and Transported Air Pollutants*, noted that some researchers conclude that airborne sulfates and particulates have a negligible effect on health, while others have found a significant association, ranging up to 5 percent of the deaths per year in the United States and Canada.

"Though further research and data are needed to resolve this controversy, this pollutant mix could be responsible for about 50,000 premature deaths per year (about 2 percent of annual mortality), particularly among people with pre-existing respiratory or cardiac problems," the report said.

(For more, see Sept. 16, 1988, *Special Report*, "Health issues getting more attention in acid rain debate.")

Indirect effects: Another concern is that acid deposition may create drinking water hazards or elevated mercury levels in fish eaten by people.

Acidic waters can dissolve metals — such as lead and mercury — and release asbestos from pipes in drinking water systems and from rock and soil in watersheds.

The 1984 OTA report says that water samples in some areas receiving high levels of acid deposition show elevated metal concentrations, raising concerns about a possible connection. Drinking water samples in the Adirondacks have shown lead concentrations of up to 100 times health-based water quality standards, the OTA report said.

Mercury concentrations above public health standards have been found in fish from acidified lakes in Minnesota, Wisconsin, and New York, OTA said.

The 1987 NAPAP report said that direct causal links between acidic deposition and health effects from elevated levels of metals in drinking water have not been demonstrated by limited studies to date. NAPAP said acid-related leaching of metals would not likely be a problem for the majority of U.S. drinking water systems because they are advised to adjust pH if acidity is low enough to cause a health threat.

Much drinking water is naturally corrosive enough to leach lead from pipes in drinking water systems. Acid deposition may increase the corrosivity of water supplies in some areas.

EPA estimates that hundreds of thousands of Americans are suffering health damage from lead in water from public water systems. The agency has proposed making the lead standard more stringent and requiring many systems to raise the pH of their water. EPA says low levels of lead in the blood have been linked to stunted growth, reduced IQ in children, pregnancy risks, high blood pressure, heart attack, stroke and hearing loss.

The OTA report said acidified well water in rural areas is more difficult to detect and mitigate than contamination of public water systems. The NAPAP report said that most soils can neutralize acid deposition before it reaches groundwater aquifers, although there is a potential for acidification of localized, extremely shallow aquifers in rock types with little buffering capacity.

NAPAP said there is concern that acid deposition may increase trace metals in drinking water by corroding home distribution systems, including roof catchment systems, cisterns and piping. The 1987 report says research is needed on the population exposed to possible effects of acidification of drinking water through use of roof catchments, shallow wells or surface waters.

Forests

Millions of acres of European forests and several tree species in the eastern United States are declining. The symptoms vary, but include reduced growth, foliage damage, and tree death. In the United States, the most dramatic decline is in high-elevation red spruce forests high in the Appalachians, where 40-70 percent of the spruce have died since the 1960s on mountaintops in Vermont, New York and North Carolina.

Many scientists suspect that air pollution may be one of multiple factors causing forest declines. Air pollution's effects may weaken trees, making them more susceptible to natural stresses such as insects, disease, drought or frost. However, forest researchers say it will be several years before they will be able to definitively assess the impact of air pollutants.

The main pollutants of concern, NAPAP said, are acid deposition, its precursors — sulfur dioxide, nitrogen oxides and volatile organic compounds — and the oxidants of those pollutants, mainly ozone and hydrogen peroxide. So far, only ozone is proven to have damaged forests.

A September 1988 report by the World Resources Institute said, "There is growing evidence that acid deposition and ozone are important contributors to the declines of several ... stricken tree species in the East, including the high-elevation red spruce in the Appalachian Mountains from Vermont to North Carolina, and Fraser fir in the Southeast. Air pollution is also suspected as a factor in the decline of sugar maple and beech in Vermont's mountains and in the reduced growth (a common sign of ozone injury) of commercial yellow pines in much of the Southeast."

NAPAP said in its Sept. 1987 report, "With the possible exception of above-cloudbase forests where high mortality has occurred from unknown causes, most U.S. forests are not expected to show an abrupt change in health at current ambient air pollutant concentration levels and deposition rates." NAPAP said that it could not estimate economic damage to forests from acid deposition or its precursor pollutants, largely because of lack of demonstrated effects.

European forest decline: More than 8 million hectares of forest lands in 15 European countries have been affected by forest decline or death, a representative of the World Resources Institute testified in June 1987. West Germany is hardest hit; a 1986 survey showed that 54 percent of its forests were affected.

The NAPAP report said the West Germany damage survey was misleading because the low end of the damage scale — the largest category — was considered normal forest health in some countries. Disregarding the lowest category, the area with moderate to severe damage grew from 9.7 percent to 19.2 percent from 1983 to 1985.

A November 1988 article in *Nature* reports that the 1987 West German forest damage survey found that damage had increased in some areas and for some species, but that some areas and species were showing signs of recovery.

The damage is most dramatic in high-elevation forests, but sporadic and less severe symptoms have been found in low-elevation forests. Symptoms in silver fir and Norway spruce, the first species affected, included discoloration and loss of needles, followed by a general reduction of tree vigor leading to a loss of fine roots and ultimately tree death.

Discoloration and premature leaf fall have been reported for virtually all major forest tree species in West Germany, the WRI report said.

Research on the causes of the decline is continuing. The WRI report said that research supports the hypothesis that air pollutants, through mechanisms that vary by site, contribute importantly to the decline. A 1986 study of Black Forest spruce hypothesized that ozone and acidic fog could be accelerating leaching, causing a nutrient shortage in the tree, and the initiation of decline symptoms, NAPAP said.

U.S. forest declines: In the United States, air pollution has been named as a possible contributor to several confirmed or reported regional forest declines, according to the NAPAP report.

- Ozone pollution, perhaps in combination with other oxidants, has been shown unambiguously to kill trees and cause forest decline in the San Bernardino Mountain region of the Los Angeles air basin and in the southern Sierra Nevada, the 1987 NAPAP interim assessment said.

Ponderosa and Jeffrey pine and other species have been showing damage since the 1950s. Severely damaged pine showed reduced growth and reduced tolerance to other stresses; many later succumbed to attack by the western pine beetle, NAPAP said. By 1985, 87 percent of surveyed trees showed some injury, the WRI report said.

- Sensitive genotypes of Eastern white pine show needle damage from ozone across much of the eastern United States. WRI says sensitive white pines in high-ozone regions grow less in height, diameter and needle length than more resistant genotypes. NAPAP says no general decline of the species is evident because eastern white pine have wide genetic variation in ozone sensitivity.

- Both ozone and acid deposition are being investigated as contributors to the dramatic decline of red spruce in above cloudbase forests in the Appalachians. Less severe foliage damage, growth reductions and some mortality in red spruce have been found at low elevations throughout the eastern spruce-fir range.

The number of live spruce on Camels Hump in Vermont and Whiteface Mountain in New York has plummeted 40 to 70 percent since the mid-1960s. On several Northeastern mountains, fully 20 percent of the spruce alive in 1982 had died by 1987, the WRI report said.

High losses also have been reported in high-elevation stands in the southern Appalachians. Almost half of the red spruce and Fraser fir on Mt. Mitchell's west-facing slopes were dead by 1987, the WRI report said. The pattern of damage to foliage in the Northeast is different than in the Southeast.

NAPAP said it is generally agreed that the decline of the above-cloudbase Appalachian forests in recent decades is probably due to multiple stresses. "These declines may be attributed at least partially to air pollution, although climate and stand dynamics are also important factors," the report said. Further research is needed to determine the causal factors and their relative importance, the report said.

At high elevations in the Appalachians, 24-hour average ozone levels are about double those at adjacent low elevations. The average pH of acidic clouds is about 3.6, and wet acid deposition is much higher than at lower elevations. Hydrogen peroxide — which forms from volatile organic compounds in sunlight — also reaches high levels in the clouds. One experiment suggests that hydrogen peroxide can damage tree seedling foliage at levels found in the Appalachians.

A 1986 National Academy of Sciences report noted that ring width anomalies in red spruce during the 1960s appear in areas that vary in elevation and acid deposition levels. "The abrupt and synchronous changes in ring width and wood density patterns across such a wide area seem more likely to be related to climate than to air pollution," the report said. "Acid deposition or other airborne chemicals might play a role in predisposing the trees to the factors that are injurious."

• A 1985 Forest Service analysis found reduced growth rates in yellow pine in the Southeast, a major wood-producing region. The Forest Service found that average annual growth rates of most yellow pines under 16 inches in diameter have declined 30 to 50 percent over the past 30 years. Species of most concern include loblolly, shortleaf and slash pine.

• In the Pine Barrens of southeastern New Jersey, pine growth rings became abnormally narrow in about one-third of the trees, starting between 1955 and 1965. Acid deposition and nutrient leaching from the poorly buffered soils has been suggested as a cause. However, laboratory results have not supported that hypothesis, NAPAP said, and further study is needed.

• Sugar maples in southeastern Canada began to show crown dieback and elevated mortality in the late 1970s. In some locations the decline extends to other species such as yellow birch, American beech, white ash, white spruce and balsam fir. In recent years, crown dieback in sugar maples has been noted in the northeastern United States.

Some maple syrup producers believe the decline has reduced their yield, but the WRI report says slumps in maple syrup production in 1986 and 1987 are generally attributed to unfavorable weather.

The 1987 NAPAP report noted that the decline is in areas where ozone levels may be high enough to cause stress. Acidic leaching could play a role in local areas of nutrient-poor soils, but does not appear to be the dominant factor across the provinces, NAPAP said.

Some reports of damage to sugar maples in northeastern states in recent years can be explained by weather and insect damage, according to a May 1989 bulletin from the joint forest response program of EPA and the Agriculture Department. The least understood sugar maple decline is in the province of Quebec, where scientists speculate that weather and acid rain are possible causes, the bulletin said.

Acid rain damage theories: Scientists are investigating several hypotheses for how acid deposition might contribute to forest declines. The possibilities — which vary for different forests — include direct damage to foliage from highly acidic clouds at high elevations, the leaching of nutrients from foliage, and excess nitrogen fertilization. Some scientists suggest that too much nitrogen may reduce trees' resistance to winter frost damage and desiccation (water loss), or stimulate growth resulting in shortages of other nutrients.

Other theories suggest that soil changes caused by acid deposition could harm trees by:

• leaching of essential soil nutrients such as potassium, calcium, and magnesium, leading to nutrient shortages in the short- or long-term.

• reducing frost hardiness.

• reducing productivity of microorganisms important to the breakdown of forest litter and the cycling of forest plant nutrients.

• reducing the efficiency of mycorrhizae — root-like structures, symbiotically formed from soil fungi and tree roots, that are important for water and nutrient uptake and disease inhibition.

• releasing exchangeable aluminum in certain soils, which could damage fine roots.

• allowing trace metals that originated from industrial air pollution to move through forest soils, leading to damage to soil microorganisms.

Soil nutrient depletion: Over the long term, acid deposition may cause soil acidification and nutrient depletion in some soils with low buffering capacity. High elevation forest soils would be more susceptible because acid deposition levels are high and soils are thin. Most forest soils have adequate buffering capacity to prevent acidification at current levels, NAPAP said.

A 1986 study found that up to 40 percent of forested soils in the Appalachians and Southeast may be vulnerable to a decrease in nutrients because of leaching by acidic deposition. Studies in the Adirondack Mountains of New York suggest that acid deposition is acidifying soils and subjecting spruce to nutrient deficiency and fine root damage from aluminum, the WRI report said.

"Of great concern is the possibility that the forest damages now occurring primarily at high elevations could spread to lower sites and to other tree species," the WRI report said. "This pattern has already emerged in Europe and could occur in the United States if, for example, long-term acidification robs the soils at lower elevations of important nutrients."

NAPAP disagrees. "The advanced symptoms seen in above-cloudbase forests which have high levels of multiple stresses do not forebode the same damage level for low-elevation forests at today's air pollution levels," the 1987 NAPAP report said.

Visibility

The weather substantially affects visibility. But much of the haze that people notice is the result of pollution, especially in the East. Fine particles — to a large extent formed from acid rain precursors — cause decreased visibility throughout the country.

In addition to shortening the distance one can see, pollutants hamper the ability to discern colors and contrast, and can yellow or otherwise alter the apparent color of objects and vistas.

Pollutants reduce visibility in national parks throughout the country, drawing complaints from park visitors and environmentalists. Low visibility causes restrictions on air traffic and can reduce transportation safety and property values.

There are two types of visibility impairment from air pollutants: regional haze and visible plumes from a pollution source or small group of sources.

Causes: In the rural East, sulfate particulates are the main cause of visibility reduction from human activities, the 1987 NAPAP report said. Sulfates are formed largely from sulfur dioxide emissions. Measurements in the Allegheny Mountains found that sulfate alone accounted for 94 percent of the variability in light scattering, NAPAP said.

Humidity also plays an important role in reducing visibility. Humidity makes sulfate and nitrate particles grow in size, increasing their light-scattering ability. Nitrogen oxide emissions react to form nitrates, which like sulfates contribute to visibility impairment.

In the West and urban areas of the East, carbonaceous material also may be an important cause of reduced visibility. The sources can be natural or caused by human activities. Organic carbon can come from auto hydrocarbon emissions and vegetation; soot (elemental carbon) can come from diesels or from forest fires.

Sulfates also contribute to visibility decreases in the West. In the Grand Canyon, for example, visibility is impaired by ammonium sulfate that forms from sulfur dioxide gas emissions from distant copper smelters and coal-fired power plants.

Effects: Visibility in the East is much lower than in the West because of high pollution levels and relatively high humidity. Summer visual range in approximately 20-30 kilometers at rural sites in the East and 75-200 kilometers in the West. Because of the cleaner air, visibility reductions are especially noticeable in the West.

Air pollution in the Grand Canyon impairs visibility approximately 100 days per year, according to a Senate Environment Committee report (S.Rpt. 100-231). Visibility also is reduced in Eastern parks such as the Great Smokey Mountains National Park and Shenandoah National Park. "Air quality is endangered in approximately one-half of the national parks," the report said.

Visibility has increased since 1970, especially in winter, for the industrial states north of the Ohio River, the 1987 NAPAP report said. But visibility has dropped in the Gulf States since 1950.

Visibility trends in the Southeast are consistent with sulfur dioxide emission trends in the region, but are not consistent with emissions in the Northeast. Changes in emissions of volatile organic compounds and nitrogen oxides also may contribute to visibility trends, NAPAP said.

Materials damage

Acid deposition, alone or in combination with other pollutants, can accelerate corrosion or weathering of metals, building stone, and paints.

Studies have suggested that a variety of other materials — including paper, leather, textile dyes, photographic materials and ceramics and glass — can be damaged by air pollutants. But the NAPAP report said that materials vary in their sensitivity to pollution damage, and that most current research is focused on carbonate stone used in monuments and building facings, zinc/galvanized steel, and paints and other surface coatings.

A study cited by the 1987 NAPAP report says sulfur oxides and other acid gases can corrode and tarnish metals, reducing physical strength and affecting surfaces. They also can damage building stone through erosion, soiling and black crust formation. Sulfur oxides and ozone can damage paint, causing surface erosion, discoloration and soiling, and perhaps cracking and peeling. Preliminary evidence from NAPAP studies suggests that wet and dry acid deposition may affect paints, but the degree to which pollutants speed weathering of surface coatings remains unknown, a NAPAP official said.

Damage to national monuments and statues, even if repaired, in some cases may permanently detract from their historical or aesthetic significance by destroying their original character. Other damage to common buildings and materials can be remedied, at a cost, through repair or replacement.

Extent: Environmentalists have cited studies indicating that pollution may cause materials damage costing billions of dollars per year. But NAPAP says credible economic estimates of damage do not yet exist.

Henry L. Magaziner, representing the American Institute of Architects, said at a 1989 House hearing that general assessments of acid deposition's physical or economic impact are premature. But he added, "While no precise dollar figures can be placed on the economic consequences of acid deposition, numerous studies have suggested a cost of enormous dimensions."

A NAPAP official said Magaziner's assessment is extremely controversial. To estimate damage, he said, more information is needed on the extent of resources at risk, levels of deposition on structures, the portion of damage caused by pollutants, the effect of damage on materials' service life, consumer maintenance on materials for reasons other than acid deposition, and cost estimates for reasonable repair and replacement scenarios.

Magaziner said that because pollution sources and quantities of sensitive material are concentrated in urban areas, "most researchers consider that local-scale pollutants account for the bulk of currently recognized materials damage."

Crops

Ozone is far more of a threat to crops than acid deposition or its precursors, according to the 1987 NAPAP report and the 1988 World Resources Institute report.

~~At current levels,~~ NAPAP said, ozone is causing crop yield reductions ranging from 1 percent or less for sorghum and corn to about 7 percent for cotton and soybean to greater than 30 percent for alfalfa. The total loss in crop production is in the range of 5-10 percent, NAPAP said. Reducing ~~ozone pollution~~ could have annual crop yield benefits worth $1 billion to $5.4 billion, according to ~~estimates cited by NAPAP and~~ WRI.

The WRI report said that the possible role of acid deposition at ambient levels remains to be determined. Although most studies indicate present levels do no identifiable harm to foliage, highly acidified simulated rain or fog can cause leaf spotting, acceleration of epicuticular wax weathering and changes in foliar leaching rates, the report says. The threshold for damage to some crops may be lowered by environmental conditions such as extended moisture stress, but further study is needed, NAPAP said.

NAPAP said available evidence indicates that "the impact of acid deposition on regional crop production in the United States is negligible." This conclusion was based on field studies of 13 varieties of eight important crop species. Mechanistic and screening experiments involving grains, vegetables, fruits and nuts and other crops supported the conclusion, the report said.

The sulfur and nitrogen from acidic deposition helps fertilize agricultural land and grasslands.

Sulfur dioxide and nitrogen dioxide gases may reduce crop yields in local areas such as near an uncontrolled smelter or in an area of multiple pollution sources, but have negligible impacts on regional crop productivity, NAPAP says.

Science and control issues

Scientists continue to study and debate a number of issues relevant to acid rain legislation — for example, how fast additional acidification of surface waters will occur, how long it will take for acidified lakes to recover, what level of deposition will protect most sensitive watersheds, and whether a reduction in emissions will result in an equal reduction in deposition.

How would reducing emissions affect deposition?

In arguing that acid rain control legislation would be premature, industry groups have said that scientists cannot predict with confidence how reducing emissions in one region would affect the deposition in another region because of complex chemical reactions and variable weather patterns. "Advancements in understanding the atmospheric processes that link emissions to deposition must be verified before source-to-receptor models can determine where to reduce emissions, if such reductions are found to be needed," a March 1987 Utility Air Regulatory Group paper says.

Environmentalists support legislation that would require a national rollback in emissions, saying there is no question that reducing emissions substantially will reduce acid deposition substantially. They cite a 1983 National Academy of Sciences report that concluded reducing SO2 emissions would result in a proportionate reduction in sulfate deposition in the Eastern United States overall.

EPA has developed a Regional Acid Deposition Model. NAPAP plans to use this model to help describe the geographic relationship between emissions sources and deposition patterns in its 1990 assessment. NAPAP Director James Mahoney said at a 1988 hearing such information is necessary for developing emissions reduction plans that will achieve desired limits on deposition.

George Hidy of the Electric Power Research Institute, the research arm of the utility industry, said that Congress should wait for NAPAP studies that would "give the opportunity to consider geographically specific legislation that in our minds will no doubt be much more economically sound than a simple national rollback program."

However, Robert Friedman of the Office of Technology Assessment told EESC that for purposes of designing an acid rain control program, extremely detailed information on sources and receptors makes little difference. "We understand the broad pattern right now," he said. Even with perfect information, he said, one still would have to make political choices about which sources to control.

Detailed source-receptor information could raise more issues than it answers, Friedman said. For example, he said, the same source would contribute different amounts of acid deposition to different lakes. On what basis would sources be targeted for controls? Would all lakes be valued equally? Would health, visibility, and other effects be taken into account as well?

Linearity: Part of the source-receptor question is whether a given reduction in sulfur and nitrogen emissions in one area will result in a proportionate, or linear, decrease in deposition in another area.

What goes up must come down, somewhere. However, the effect of an emissions reduction on deposition in particular areas, or over time spans shorter than a year, could vary because of complex reactions in the atmosphere and variable weather patterns. There is disagreement among scientists and policymakers over whether the variation is likely to be substantial enough to matter for policy purposes.

If non-linearity were substantial, a 50 percent emissions reduction might cause a much smaller reduction in deposition in some areas. A greater reduction in S02 emissions might be needed to provide the same level of environmental protection, making acid rain controls more costly. Some consider the linearity issue relevant to whether acid rain controls should be geographically targeted, and whether acid rain legislation should allow interstate trading of emissions control requirements.

Many scientists say that a 50 percent reduction in sulfur emissions in the Midwest and East would result in a similar reduction in annual average sulfate deposition over the eastern United States overall. The 1983 National Academy of Sciences report said that within the limits of current data and assumptions, "there is no evidence for a strong non-linearity in the relationships between long-term average emissions and deposition. ... If we assume that all other factors, including meteorology, remain unchanged, the annual average concentration of sulfate in precipitation at a given site should be reduced in proportion to a reduction in SO2 and sulfate transported to that site from a source or region of sources."

A 1984 study by Environmental Defense Fund scientists also concluded that "major non-linearities are absent from the atmospheric chemistry of SO2 over extended areas of the United States."

The 1987 Utility Air Regulatory Group paper disagreed, saying studies show that many of the processes involved in the transformation of SO2 to sulfate are non-linear and that precipitation acidity is determined by many other chemical species besides sulfate. "Thus, an emission control strategy involving only SO2 may not yield equivalent reductions in sulfate deposition or precipitation acidity," the paper said.

The 1987 NAPAP report said that in the northeastern United States, the formation of sulfuric acid in cloud water from sulfur dioxide and hydrogen peroxide appears to be limited by the availability of hydrogen peroxide in winter and perhaps in other seasons as well. "Thus, although reducing the emissions of sulfur dioxide in any season is likely to result in the reduction of dry and wet deposition of sulfur compounds, the magnitude and extent of the reduction are uncertain," the report says.

In 1990 NAPAP will assess how significant non-linearity is on a regional basis, a NAPAP official said. He said that in part of the East, non-linearity may be substantial enough to be important to policymakers.

The Senate Environment and Public Works Committee, in reporting clean air legislation in 1987 (S. Rpt. 100-231), said several lines of evidence suggest that the relationship between emissions and deposition "is linear or very close to it."

The committee cites, for example, the 1986 National Academy of Sciences report finding that there is a strong association between emission densities of sulfur dioxide, concentrations of sulfate aerosol, visibility range, sulfate concentrations in wet precipitation, and changes in sulfate levels in streams. "Changes in sulfate observed in [streams monitored by the U.S. Geological Survey] are consistent with changes in SO2 emissions on a regional basis," NAS said.

The relationship between NOx emissions and deposition of nitrates is complex and less well understood than the relationships between SO2 and sulfates. "Strict linearity may be a decidedly risky thing to presume," said Hugh Ellis, an environmental systems analyst at Johns Hopkins University in Baltimore.

How much would deposition have to be reduced to protect lakes and streams?

Environmental groups and the Canadian government say a 50 percent reduction in SO2 emissions is needed to protect most lake and stream ecosystems from acid rain damage.

However, the Utility Air Regulatory Group paper says that past estimates of "target loadings" have been flawed and subject to significant uncertainties, and that NAPAP's Direct/Delayed Response Project and Watershed Manipulation Project will result in improved estimates. The UARG paper also says that to calculate needed emissions reductions, further research is needed on the degree to which acid deposition in a specific area would be reduced by controls on a group of pollution sources.

Most scientists agree that reducing deposition of sulfuric acid will benefit aquatic ecosystems. However, estimates vary on how much deposition would have to be reduced to protect most sensitive lake and stream ecosystems from damage.

NAS: The most famous and oft-cited estimate was made by a 1981 National Academy of Sciences report. However, that estimate — still cited today — was misinterpreted and contained a mathematical error.

The 1981 report said, "It is desirable to have precipitation with pH values no lower than 4.6 to 4.7 throughout such areas, the value at which rates of degradation are detectable by current survey methods. In the most seriously affected areas (average precipitation pH of 4.1 to 4.2), this would mean a reduction of 50 percent in deposited hydrogen ions."

The 50 percent figure was a miscalculation. Actually, a change in pH from 4.1 to 4.6 would require a greater reduction in deposition of hydrogen ions — to one-third of current deposition levels — because the pH scale is logarithmic, says Myron Uman, a staff member with the academy's National Research Council.

In addition, the academy's conclusion was misinterpreted by newspapers and acid rain control advocates as a call for a 50 percent reduction in S02 emissions. The 1981 report did not indicate how much control of emissions would be required to reduce deposition to the goal.

The 1983 report, which investigated that question, found that given certain assumptions, a 50 percent reduction in SO2 emissions should result in a like reduction in wet sulfate on an annual average basis, and at least as great a reduction in hydrogen ion deposition. (See section on linearity above.) But the report also said, "Little has been done in modeling to translate NOx emissions into nitrate deposition or to link sulfate and nitrate to acid (H+) deposition."

Other: Most more recent estimates of "target loads" to protect aquatic ecosystems are based on deposition of sulfur or sulfate, largely because the relationship between sulfur emissions and wet sulfate deposition is better established than for H+.

Galloway, citing eight studies published from 1986 to 1988, testified in 1988 that the estimated critical loads "to protect some aquatic ecosystems but not necessarily the most sensitive ones" are generally within the range of 10 ±5 kilograms of total sulfur per hectare per year. If sulfur deposition were reduced to a level in that range, he said in an interview, the most sensitive aquatic systems would not recover, but they would not get any more acidic. Those that had higher initial alkalinity would recover, he said.

Galloway said the middle of the range of the estimated critical loads — 10 kg/ha/yr — is about half the current level of sulfur deposition in some parts of eastern North America, which he said is on the order of 20 to 25 kg/ha/yr. "From this analysis, it appears that a reduction of 50 percent in sulfur emissions is the least amount required," he testified.

In an interview, Galloway explained that the 50 percent estimate is uncertain because estimates of dry sulfate deposition are subject to substantial error, and because estimates of natural sulfate deposition vary. Also, the needed reduction would vary year to year because deposition varies year to year, he said.

Despite the uncertainties, Galloway said that so much of the sulfur deposited in North America is caused by pollution "that a reduction of 30 percent, 50 percent, is bound to have some beneficial impact."

The 1984 OTA report analyzed the reductions in wet sulfate deposition that would be needed to reach target loadings of pH 4.6, pH 4.7, 20 kg/ha wet sulfate (which would correspond to about 6.7 kg/ha wet sulfur) and a 50 percent reduction in hydrogen ion deposited in rainfall. The report said that the wet sulfate deposition reductions needed to meet the targets vary considerably, but that generalizations could be made:

"In regions of highest deposition, [wet sulfate] target deposition reductions range from 50 to 80 percent. For New England, deposition reductions required to reach the targets vary from about 30 to 70 percent. For sensitive areas south of the peak deposition region (e.g., the southern Appalachians in Tennessee), wet sulfur-deposition reductions needed to reach the targets are on the order of 20 to 50 percent. In the upper Midwest (e.g., the lake regions of Wisconsin and Minnesota), deposition would have to be reduced by 0 to 40 percent to reach the targets."

The OTA report said that the deposition reductions that might result from reducing SO2 emissions can only be compared tentatively to the deposition reductions required to meet targets for protecting sensitive resources. "This is because deposition targets are expressed in terms of wet sulfur deposition, and because of uncertainties in estimating how emissions reductions would affect wet and dry sulfur deposition," OTA said.

Aquatic ecosystems: How much more damage would occur if controls are delayed?

A key question for policymakers is how much more damage to lakes and streams will occur if acid rain controls are delayed for several years. Some acid rain bills set later deadlines for emissions reductions or provide deadline extensions to allow more time for development and deployment of clean coal technologies.

Aquatic effects researchers agree that delaying controls would result in additional acidification of some watersheds. However, there is much uncertainty and controversy over how quick, how extensive, and how serious changes in the acidity of lakes and streams would be.

One assessment of the range of possibilities was given by Robert Friedman of the Office of Technology Assessment, in a May 1988 hearing before the House Energy Subcommittee on Energy and Power.

"For some resources in some areas, for example lakes in the Northeast, much of the damage from acid deposition that is likely to occur may already have happened. Even in the Northeast, however, we have yet to be sure whether this means that the number of acidified lakes in the Northeast will remain at current levels or double over the next several decades. In other areas, for example the Southeast, additional aquatic resource damage is likely under constant deposition levels, but the rate would probably be slower."

Streams in the mountainous parts of the mid-Atlantic region may be in most jeopardy of significant additional acidification in the short term, NAPAP and EPA officials say. They are conducting studies that will help establish whether many streams in the region would become acidic if control deadlines were delayed five or 10 years.

Environmentalists and industry representatives strongly disagree on the severity of the threat. Hidy of the Electric Power Research Institute said "there is little risk that significant ecological damage will be incurred if controls are delayed for five to 10 years." He said surface water acidification is believed to be slow or at steady state at present deposition rates.

Environmentalists stress that some lakes and streams will continue to acidify, and that even in waters that do not change acidity, aquatic life will suffer additional damage from the stress of acidic waters. Rodney Fujita, a staff scientist with the Environmental Defense Fund, said that many lakes will take longer to recover from acid deposition if controls are delayed because the recovery of pH and alkalinity depends partially on the replenishment of base cations (positively charged neutralizing substances), which is counteracted by acid deposition.

Scientists are developing advanced watershed models to better predict how acid deposition will affect watersheds. NAPAP has underway a major project — the Direct/Delayed Response Project — to study how vulnerable watersheds are to acid deposition, and to estimate how fast waters will degrade and recover in response to changes in acid deposition.

Initial forecasts of chemical change in the Northeast and the southern Blue Ridge area of the Southeast were expected in early July. They lend support to NAPAP's 1987 conclusion that additional acidification will not be dramatic or rapid in those areas at current deposition levels, NAPAP officials say. A more extensive project report including predictions of biological change is due in 1990.

Sensitivity: Watersheds vary in their ability to neutralize or retain incoming acid deposition. Soils contain varying amounts of substances that can directly neutralize the acidity or retain the acidity in the soil by ion exchange processes. They also vary in their ability to retain sulfates and nitrates, preventing acidity from reaching surface waters.

Watersheds can be sensitive to acid deposition in two ways. One threat is large, short-term pulses of acidity that can be caused by heavy rainstorms and spring snowmelt. Sulfuric and nitric acids are stored in snow and can be released all at once in the spring, a threat to acid-sensitive fish larvae. Nitric acids are believed to be particularly important in spring snowmelt.

Another threat, for some watersheds, is gradual depletion of the watershed's buffering capacity and sulfate retention capacity. NAPAP says depletion is possible if buffering capacity is not replaced, through soil weathering and other processes, as fast as they are consumed by acid deposition. As the watershed's buffering capacity and sulfate retention capacity are reduced, acids from the sky increasing move through the soil in solution and reach lakes and streams.

Vulnerable areas: Thousands of lakes and streams in the East are thought to be vulnerable to acidification over some time scale.

Scientists use the acid neutralizing capacity (ANC) of a water body as an indicator of whether acid deposition is likely to cause acidification. Current ANC is not a perfect indicator because natural processes in the lake and watershed may be replacing ANC as fast as it is consumed by acids.

NAPAP says water bodies are generally considered sensitive if they have acid neutralizing capacity of 200 microequivalents per liter (μeq/l) or less. Those with ANC of 50 μeq/l or less are commonly considered very sensitive.

A 1984 OTA report — *Acid Rain and Transported Air Pollutants: Implications for Public Policy* — estimated that 9,400 lakes and 60,000 miles of streams in the eastern United States are sensitive to further acid deposition (ANC less than 200 μeq/l).

EPA's more recent eastern lakes survey found similar numbers of sensitive lakes. The EPA stream survey of the mid-Atlantic and Southeast regions found that nearly half the streams were sensitive, and 12 percent very sensitive.

In Canada, 350,000 lakes are very sensitive, with ANC less than 50 μeq/l, according to a 1988 study cited by Galloway.

The OTA report estimated that about 3,000 lakes and 23,000 miles of streams in the 31 Eastern states "are now extremely vulnerable to further acid deposition or have already become acidic." Friedman says this estimate indicates the number of water bodies that are vulnerable to damage from sudden episodes of acidity caused by heavy storms or spring snowmelt.

The OTA estimate comprises lakes with ANC less than 40 μeq/l, and streams with ANC less than 100 μeq/l, that are located in areas with soils and bedrock that allow acidity to travel to surface waters.

Rates of change: Current ANC values are not sufficient to determine how fast acidification may occur. Theories suggest that the rate of change depends on the rate of acid deposition, a watershed's ability to retain sulfate and nitrate, and a variety of complex factors that influence buffering capacity. Those factors include the type and amount of soil, the rate of weathering of bedrock, the amount of vegetation, the rate of organic decomposition, the rate at which water moves over land into the lake or stream, and other factors.

For example, a small mountain lake in a watershed with granite bedrock, thin soils, and steep slopes causing rapid runoff would have little buffering capacity and be sensitive to acid deposition. A lake on limestone would be insensitive because the limestone bedrock would weather fast enough to continue to neutralize incoming acids.

NAPAP divides watersheds into three categories — rapid response systems, slow response systems, and "capacity protected" systems where lakes and streams are unlikely to acidify. Although response times vary for lakes and streams within a region, some regional generalizations are possible.

Lakes in poorly buffered watersheds — including many in the Northeast, upper Midwest and mountainous West — can quickly reflect changes in precipitation acidity. These rapid response systems may show changes in zero to 10 years.

In other watersheds the buffering capacity may slowly be exhausted by acid deposition. For some watersheds with soils that can retain sulfate — such as many in the Southeast — release of acidity to surface waters may be reduced until sulfate retention capacity is filled. Watersheds that buffer or retain acidity for a time — perhaps 10 to 100 years — are called slow response systems.

Some lakes and streams are unlikely to acidify because the buffering or retention capabilities of their watersheds are very large.

The middle Appalachians: NAPAP and EPA officials say greatest risk of additional acidification may be to the mid-Appalachian region, which includes mountainous parts of Pennsylvania, Maryland, Virginia, and a small part of West Virginia.

"The real concern is not over the Northeast or Southeast, but the mid-Appalachian (region), where significant change could occur in the near term with constant deposition," an EPA official said.

A NAPAP official said that the threat of near-term acidification in the mid-Appalachian region is "a big unknown to be included in NAPAP's 1990 assessment." It is conceivable that significant additional acidification could happen in 10 to 20 years — a period relevant to the question of whether emissions reductions can be postponed to enable greater deployment of clean coal technologies, he said.

The region has have received high levels of acid deposition for many years. In question is whether most watersheds in the mid-Appalachian region are close to exhaustion of their sulfate absorption capacity, the NAPAP official said.

The Northeast: The Northeast, which contains many lakes that respond rapidly to acid deposition, has been receiving high levels of acid deposition for many years. Some researchers believe that most of the damage from acid deposition at current levels already has been done. Others say that significant additional damage would result if controls are delayed.

Galloway told a House Energy subcommittee in 1988 that in the absence of acid rain controls, "Some aquatic ecosystems in the northeastern U.S. and southeastern Canada will continue to acidify due to the net removal of neutralizing substances from the soils ... For those that do not increase their acidity, their biological populations will continue to degrade due to the continued stress of existing in acidic waters. The rate of both chemical and biological change will vary from ecosystem to ecosystem, but the important consideration is that these aquatic ecosystems will continue to change in areas of constant sulfur and nitrogen deposition."

The 1987 NAPAP report says that surface waters in most watersheds in the Northeast appear to be at or near steady state for sulfur, meaning that sulfur is leaving the watershed as fast as it is being added. NAPAP says that acidification of northeastern surface waters would be expected to be much slower and smaller after a watershed reaches steady state for sulfur.

"There is no indication that a significant number of lakes will change their acidity rapidly [within ten years] if deposition loadings continue at current levels," the report said.

That conclusion was strongly criticized by environmentalists, some scientists and the Canadian government. "There are many studies which clearly demonstrate that sensitive lakes in the Northeastern part of the continent are not in steady state with respect to current levels of emission (and) deposition and that chemical and biological deterioration is continuing ..." the Canadian critique says.

NAPAP officials say that at current deposition levels, some Northeastern lakes will become more acidic and some would recover, but some would stay the same. This is because different watersheds are sensitive at different levels of deposition.

NAPAP officials say that three watershed models being used for the Direct/Delayed Response Project are predicting that current deposition levels would cause little additional acidification in the Northeast over the next 50 years, on a regional average basis. Results for any given lake are highly uncertain.

George Hornberger, a professor of environmental sciences at the University of Virginia, co-headed a team that used one of the three watershed models for NAPAP. Hornberger said that the team's finding are subject to significant uncertainties about factors that are not part of the model — for example, levels of dry deposition. But he said the evidence is strong that on a regional basis, additional acidification in the Northeast will be slow.

The Southeast: Waters in the southern Blue Ridge area of the Southeast do not appear to be in steady-state for sulfur and conceivably may acidify gradually as the sulfate absorption capacity of the soil decreases, the 1987 NAPAP report says. In limited areas that have shallow soils, depletion may be more rapid. The Direct/Delayed Response Project report will forecast that acidification will be slow in the southern Blue Ridge area, and that few streams would reach zero acid neutralizing capacity in the next 10 to 20 years, a NAPAP official said.

Galloway said in an interview that streams in the Southeast — which he defines as the portion of the East that was not scoured by glaciers during the Ice Age, a line that bisects Pennsylvania — already are losing alkalinity, and that many have ANC of less than 50 µeq/l. Without controls, he said, some of those streams could lose their remaining ANC and become acid within the next 10 or 20 years, but it is not clear. That is why further development of watershed models is so important, he said.

Galloway testified in 1988 that the best evidence is that there are large numbers of sensitive aquatic ecosystems in the Southeast, and that their acidification rate is on the order of about 1 µeq/l per year. At that rate, a NAPAP official said, very few streams would reach zero ANC within 10 years. But Galloway, responding in an interview, said that zero ANC is not a "magic threshold." Biological changes would occur as ANC decreases from 40 to 30, or from 30 to 20, he said.

Friedman of OTA testified that "significant changes" in the Southeast might occur over a time scale of 50 to 100 years.

The West: Another point of debate is whether acid deposition threatens vulnerable lakes in the mountainous West. All agree that many lakes in high-elevation watersheds in the western mountain ranges have little buffering capacity, but there is disagreement over whether acid deposition levels are high enough to pose a threat.

An EPA survey of Western mountain lakes, released in 1987, identified no acidic lakes (except for one where acidity was caused by a hot spring), and found that 99 percent had a pH of 6 or more. But the survey found that 66 percent had ANC of 200 µeq/l or less.

Nearly 17 percent of the target population of 10,398 lakes had very low acid neutralizing capacity (ANC of 50 µeq/l or less). Some of these lakes could be affected by episodes of low-alkalinity water, such as during spring snowmelt or major storms, from natural factors and acid deposition, a NAPAP official said.

On the potential for chronic acidification, the 1987 NAPAP report says the Western lakes would be expected to respond rapidly to an increase in acid deposition. But NAPAP says little change is expected if deposition levels stay the same.

A 1984 report published by the Environmental Defense Fund painted a gloomier picture. The report — "Safeguarding Acid-Sensitive Waters in the Intermountain West" by Robert E. Yuhnke and Michael Oppenheimer — said available data "suggest that current deposition rates of strong acids in some areas of the West are currently consuming the acid neutralizing capacity in watersheds that have little to spare. ... Current sulfur deposition rates, and precipitation hydrogen and sulfate concentrations in some parts of the West, have reached the levels associated with acidification in the upper Midwest and in Scandinavia.

"Should these deposition rates and concentrations be consistently exceeded, acidification of some sensitive watersheds can be expected. These damage thresholds have periodically been reached or exceeded throughout most of the West."

The EDF report said that a major reduction in sulfur emissions from U.S. smelters would be more than offset by increased emissions could be expected from a large new smelter in Nacozari, Mexico, and new industrial facilities planned in the United States — coal-fired power plants, natural gas processing plants, and fertilizer plants.

A March 1985 report by the World Resources Institute, "The American West's Acid Rain Test," reached similar conclusions. The report said that U.S. Geological Survey data show small decreases in alkalinity and small increases in sulfate in Western streams over 10 to 15 years. The report said that some lakes in the West have temporarily lost all their alkalinity after snowmelt or acidic rainfall, citing the example of one lake in Sequoia National Park and another in the Colorado Rockies.

The WRI report warned that both NOx and SO2 emissions would rise in the West. At least one federal forecast — a 1986 base case by Argonne National Laboratory for the Energy Department — projects increases in both pollutants. Between 1985 and 2010, SO2 emissions in the West (federal regions 6 through 10) would rise 43 percent, NOx emissions, 37 percent.

How long would it take for lakes and streams to recover?

Research is continuing on to what extent, and how fast, lake and stream ecosystems will recover after acid deposition is reduced. Predictions of recovery times are very difficult and are more controversial than predictions of future acidification, a NAPAP official said.

Galloway told a House Energy subcommittee in May 1988 that in the northeastern United States and southeastern Canada, "the time scale of chemical and biological recovery will be on the order of a decade; in the southeastern U.S. it will be greater than a decade." The NAPAP official said that waters may regain their acid neutralizing capacity in that length of time, but that another possible measure indicates that recovery times may be longer. Some species may never return to a lake that had been acidified, D.W. Schindler said in a January 1988 *Science* article.

If acid deposition is reduced, recovery of lakes and streams will be delayed by physical, chemical and biological factors, Galloway testified.

Replacement of the water in acidified lakes will cause delays in chemical recovery on the order of one to 10 years, he said. Delays also will result from the time needed for streams and lakes to obtain chemical equilibrium with lower rates of sulfur deposition. In regions where lakes and streams have rapidly acidified, such as in the Northeast, recovery also should be rapid — on the order of years, Galloway said. Areas where soil types delay acidification, such as in the Southeast, will experience delays in chemical recovery. Models suggest these delays could be on the order of decades, he said.

Biological recovery depends upon a variety of factors, and is expected to take several years longer than chemical recovery, Galloway said. Citing a 1984 study, he said some heavily acidified ecosystems may never recover.

Galloway said a 1988 study of Swan Lake in Canada found recovery times of five to seven years for zooplankton, but no recovery of fish and crustacea over the same time period when lake pH increased from 4.0 to 5.2. Studies on a manipulated lake in 1988 indicate that after acidification to pH 5.0, several species of fishes and invertebrates were eliminated. Following recovery to pH 5.4-5.6, two of the remaining species of fishes resumed reproduction and several species of phytoplankton returned. However, lake trout did not resume reproduction and other species eliminated from the lake did not return.

The 1984 OTA report, using a simple theoretical model, estimated that if sulfate deposition were decreased by 20 percent, 10 to 25 percent of acid-altered streams and lakes in the East might show improvement. If sulfate deposition were reduced by 30 percent, about 15 to 40 percent might show improvement, OTA said. The figures represent best-case estimates that assume that continued acid deposition will not further degrade the soil's neutralizing capacity.

OTA said that in areas where waters are not in equilibrium with elevated sulfate deposition levels, some lakes and streams might continue to acidify slowly despite reductions in emissions. OTA said such effects might be most pronounced in the Southeast and upper Midwest.

Future emissions: Will acid deposition intensify?

A key part of the debate over whether Congress should enact acid rain controls has been whether emissions will increase in the future and cause greater environmental damage. Emissions projections also are relevant to control issues such as how urgently controls are needed and which sources should be controlled.

Emissions projections affect estimates of the costs of acid rain control programs. Faster emissions increases mean higher costs because a larger reduction in emissions must be achieved.

Environmentalists have long argued that emissions of sulfur dioxide and nitrogen oxides will increase significantly. The National Coal Association, in arguing that acid rain legislation is not needed, says that sulfur dioxide emissions will continue a decline that began after 1973.

Although there is much disagreement among emissions projections, most show that SO2 emissions will rise or stay approximately level at least through the turn of the century. Many projections show a decline starting between 2000 and 2010, but others do not.

NOx emissions are expected to increase substantially, partly because of a 30-percent rise in utility NOx projected between 1985 and 2000.

Uncertainty: Projections of future utility emissions are highly uncertain — so uncertain that "the modeling community does not know how accurate the projections are," the 1987 NAPAP report says. This is because projections depend on a variety of factors that cannot be reliably predicted.

The biggest factor affecting utility emissions projections is the lifetime assumed for pre-1971, dirty coal-fired power plants. A shorter lifetime means that dirty, older plants will be replaced sooner by new, cleaner plants required to meet the Clean Air Act's new source performance standards.

There is much controversy over how long utilities will keep the older plants in service. Various projections assume lifetimes of 45 to 70 years.

Other important factors are rates of growth in electricity demand, and assumptions about the relative contribution of nuclear energy and other forms of generation. For SO2 emissions, the relative mix of coal, oil and natural gas is a major factor.

The degree to which new demand will be met by existing coal-fired units, rather than construction of new units, also is important. Another key factor is to what degree innovative clean-coal or emission control technologies will be used in the absence of legislation.

New EPA projections for utility SO2: EPA in May 1989 adopted a revised base case forecast for utility SO2 emissions with two scenarios. A staffer said EPA believes future emissions are likely to be somewhere in between the two cases. The projections — developed by ICF Inc., working with EPA — show lower future emissions than previous ICF/EPA projections.

The high case shows a 27 percent rise in utility SO2 emissions between 1985 and 2010. Emissions grow steadily from 16.3 million tons in 1985 to 20.7 million tons in 2010.

The low emissions case projects approximately constant emissions, with a gradual decrease after 2005. In 2010, emissions would be 15.7 million tons — somewhat less than the 1985 level.

The low case projects lower emissions because the lifetime of fossil-fuel-fired plants larger than 50 megawatts is 55 years, rather than 65 years in the high case. Also, the low case assumes greater repowering with new technologies, smaller electricity demand growth, more new non-fossil-fired plants, more cogeneration and longer nuclear plant lifetimes.

A draft low-emissions scenario, which caused debate within EPA, showed declining emissions after 2000 and a sharp drop between 2005 and 2010 to 13.4 million tons — 18 percent below the 1985 level. The draft low case assumed a 50-year plant lifetime and significantly more repowered coal capacity by 2010.

The draft case already has been cited by the National Coal Association, which says EPA forecasts of SO2 emissions have been consistently and unrealistically high.

Other utility SO2 projections: There is a range of opinions on whether utility SO2 emissions will rise or fall in coming decades.

The 1987 NAPAP report reviewed a variety of emissions projections by consulting firms for EPA and the Department of Energy, the coal industry and congressional agencies. NAPAP found that recent utility SO2 emissions projections fall into two broad groups, depending on assumptions about coal-fired plant lifetimes.

Assuming a 45- or 50-year plant life, SO2 emissions are projected to be roughly constant between 1985 and 2005. Emissions then drop about 30 percent between 2005 and 2030.

Assuming a 60-year plant life, emissions are projected to rise until 2010 and then decline slowly to 2030.

NAPAP said all the projections assume no penetration of improved technology.

In reviewing the estimates, NAPAP found that the National Coal Association had lower estimates for 1990 SO2 emissions than the other studies. NAPAP said NCA's scenarios, which showed a drop in emissions, were lower because they were based on an extrapolation of factors contributing to recent trends in coal use.

A Congressional Research Service forecast also diverged from the others, showing a steep increase between 2020 and 2030, driven by an assumption of continued high growth rates in the long term, NAPAP said.

The Natural Resources Defense Council, in attacking an Energy Department base case projection presented by NAPAP in its 1987 report, said "a prudent scenario" shows steadily increasing emissions through the year 2030 and beyond. The DOE projection showed a decline starting in 2010.

Under the NRDC scenario, total SO2 emissions from all sources would increase 40 percent from the 1985 level through 2030, to 28.5 million metric tons.

NRDC assumed that coal-fired plants built in 1965 or later would not retire before 2030. Also, NRDC assumed that no nuclear plants would be ordered, but that nuclear plants in the construction pipeline will be built.

Total SO2: Two separate studies for EPA and DOE, cited by the NAPAP report, try to project future SO2 emissions from all sources from 1985 to 2030. They differ on the level of future emissions, but both indicate a slow rise in emissions followed by a decline to about the same level as today. Peak projected emissions range from 23- to 31-million metric tons, compared with 21.2 million metric tons in 1985.

In 2030, utility emissions are projected to be lower, but industrial emissions would be higher because of economic expansion, the studies said.

NOx: A variety of studies project a big increase in nitrogen oxide emissions in the next few decades. Electric utilities, industry and transportation all are projected to increase their emissions.

Substantial increases in NOx emissions would be contrary to the NOx protocol signed by the United States in October 1988. The protocol provides for a freeze on NOx emissions, technology-based standards for new sources and research on a long-term strategy that may establish future control levels.

Before the protocol, the 1987 NAPAP report said that total NOx emissions in 2030 are projected to grow 50- to 60-percent from the 1985 level (19.1 million metric tons), assuming current standards and technologies.

Utility NOx emissions grew 33 percent between 1975 and 1985, and are expected to continue to rise because of increased coal use, the NAPAP report said. Retirement of older power plants does not greatly reduce NOx because emissions from new plants that meet the new source performance standard are typically only one-third cleaner than pre-NSPS plants, NAPAP says.

"For the period 1985-2000, there is remarkably good agreement that [utility NOx] emissions will increase by approximately 30 percent (from about 6.5 to 8.5 million metric tons per year)," the NAPAP report said. "Estimates diverge after the turn of the century due to differing assumptions about long-term economic growth."

The May 1989 ICF/EPA base case forecast shows a somewhat slower increase in utility NOx emissions than the NAPAP report indicates. The high case shows a steady rise to 8.1 million metric tons by 2000 and 10.6 million metric tons by 2010. The low case shows emissions reaching 7.7 million metric tons in 2005 and remaining at that level in 2010.

Motor vehicle NOx emissions also are expected to rise. An April 1989 American Lung Association report, "Why NOx?", says that growth in the number of vehicles and miles traveled will result in significant increases in NOx from the transportation sector beginning in the 1990s.

For more information

For more information on acid rain legislation and issues, see the following EESC publications:

- Basic background — *Briefing Book*, p. 1 (Acid rain) and p. 13 (Clean coal).
- Outlook for 101st Congress — 1/26/89 *Special Report.*
- Review of 100th Congress action — 10/24/88 *Special Report.*
- President Bush's acid rain control proposal — 6/19/89 *Special Report*
- Sikorski acid rain control bill (summary and politics) — 3/20/89 *Weekly Bulletin*, p. B9.
- Acid rain controls and coal markets — 3/13/89 *Weekly Bulletin*, p. B15.
- Detailed summary of S 1894, the Senate Environment clean air bill in the 100th Congress — 4/20/88 *Special Report.*
- Summary of the potential fall 1988 Mitchell-Byrd compromise on acid rain — 10/3/88 *Weekly Bulletin*, p. A27.]

The Acid (Rain) Test

The $3 billion reduction in the cost of the Clean Air Act that President Bush is seeking could be obtained very easily if both the president and Congress would pay attention to the NAPAP report that was released on September 5. This was a summary of the findings of a 10-year study of acid rain that the government funded to the tune of $537 million. It pulled the rug from under the fearmongers in the environmental movement, the government and the media who have been portraying acid rain as one of those critical problems that must be solved if we are to save the country, civilization and the planet. The advocacy journalists have done much to convince the public that emissions from electric power plants are making the rain so acid that it is killing crops, forests and fish, endangering human health and even destroying buildings.

Fear-driven Waste

The fears created by more than a decade of exaggerated scare stories about acid rain would be hard to neutralize even if our media were to make a conscientious effort to tell the truth as we now know it. It would help if President Bush and his top aides, including William K. Reilly, the administrator of the Environmental Protection Agency, would give high-profile speeches on the subject. They could praise the work of NAPAP and point out that this half-billion-dollar investment will pay handsome dividends. It has made it clear that we can save as much as $4 billion a year by scrapping the costly controls on sulfur dioxide emissions proposed in the Clean Air Act. In the absence of such simple honesty, the government is careening ahead with plans to enforce unnecessary, costly and inefficient methods of dealing with acid rain.

The September NAPAP report's most valuable contribution lies in its analysis of the cost and benefits projected for different scenarios for dealing with acid rain. The first scenario is to rely on the gradual adoption by the electric utilities of improved clean technology to reduce sulfur dioxide and nitrogen oxide emissions. With this scenario, NAPAP projects a moderate increase in sulfur dioxide emissions over the next 15 years, followed by rapid decreases over the following 25 years when the new power plants will predominate. Under this scenario, it estimates that sulfur dioxide emissions in the year 2030 will be 37 percent below the 1980 level.

$3 billion would help the budget

Dear Gov. Sununu:

The Sept. 5 report of the 10-year National Acid Precipitation Assessment Program (NAPAP) study explodes the myths that have created excessive fear of acid rain. The controls proposed in the Clean Air Act to deal with this problem were based on those myths and fears. They will burden the consumers of electric power with costs of as much as $4 billion a year to solve problems that don't exist or can be remedied far more cheaply.

The media haven't delivered this vital message. President Bush must use his "bully pulpit" to tell the nation what NAPAP has reported and to persuade Congress to drop the costly acid-rain measures in the Clean Air bill. Please ask the President to do this.

Hugh W. Sanford Jr.

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