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**The New Clean Air Act:
What It Means to You**



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FUNNY... HE NEVER MENTIONED IT WAS GOING TO BE ACID RAIN.

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*Front Cover: The U.S. Capitol
on a clear day. Photo by
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In 1970, Congress passed the Clean Air Act amidst the euphoria of Earth Day and the creation of EPA. This landmark legislation, among its other provisions, for the first time gave the federal government authority to set national standards that would protect human health and welfare.

Twenty years later, it is plain that we've accomplished a great deal. However, it is also plain that we haven't by any measure lived up to the expectations of that original law. Nearly half the population still lives in cities that fail to meet the national standards; hazardous air pollutants, for the most part, haven't been controlled; and serious new problems, acid rain and ozone depletion, have emerged.

After a decade of debate, Congress

has come up with a sweeping revision in the Clean Air Act Amendments of 1990, a revision the President has called "the most significant air pollution legislation in our nation's history." The hallmark of the new act, as underscored by Administrator Reilly and elaborated upon by others, is the attempt throughout to harness the forces of the marketplace to the work of protecting the environment.

This issue of the magazine focuses on the new clean air law, its provisions, the air pollution problems that led up to them, and the implications of the new act. Presented along the way are the viewpoints and reminiscences of some of those who were closely involved in the debate leading up to the legislation.

EPA is charged by Congress to protect the nation's land, air, and water systems. Under a mandate of national environmental laws, the Agency strives to formulate and implement actions which lead to a compatible balance between human activities and the ability of natural systems to support and nurture life.

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The New Clean Air Act: An Environmental Milestone

by William K. Reilly

Twenty years ago, with a law whose modest size belied its revolutionary impact, Congress made a promise to all Americans: the promise of clean air. Now, as EPA takes on the challenge of carrying out the sweeping and complex changes in the clean air law adopted last fall, that promise is finally back on the path to fulfillment.

The 1990 Clean Air Act was a legislative landmark in many ways. It marked a high point in Congressional concern for the environment up to that time, and it incorporated what were then major departures in the nation's approach to regulation, including national, as opposed to regional, air quality standards and statutory deadlines for compliance. In fewer than

Charles Tasnadi photo. AP/Wide World.



After signing the Clean Air Act Amendments of 1990, President Bush presents a ceremonial pen to EPA Administrator Reilly as Energy Secretary James Watkins looks on. The new law sets an example for economically sound environmental stewardship.

(Reilly is Administrator of EPA.)

50 pages—tiny compared to the nearly 800 pages of the 1990 law—the 1970 Clean Air Act also sent a compelling message to the nation: The time had come for us to get serious about protecting the environment. Much of this country's environmental progress over the last two decades can be credited to the changes in attitude signaled by the 1970 Clean Air Act.

But while this clean air law accomplished a great deal—substantially reducing emissions of such pollutants as sulfur oxides, volatile organic compounds, carbon monoxide, particulates, and especially lead—we are not yet able to say we achieved its goals. Ninety-six of our cities have still not attained the national standard for ozone, the primary ingredient in smog. Forty-one cities do not meet the standard for carbon monoxide, and 72 do not meet the standard for particulate matter. And since 1970, EPA has been able to regulate only seven hazardous air pollutants, out of a potential list of several hundred, because of controversy and legal challenges over provisions of the 1970 law.

It has been obvious for nearly a decade that the Clean Air Act would have to be revised, and revised substantially, before its promise could be realized. Yet it was not until last year that Congress, responding to the determined leadership of President Bush and Congress members who had long championed clean air, finally was able to overcome paralyzing regional and sectoral differences and follow through on the initial burst of environmental enthusiasm that had produced the hope, but not yet the reality, of clean air.

Like the 1970 law, the Clean Air Act Amendments of 1990 represent a significant departure from the past. In its innovative approaches to pollution control, in the extent to which its implementation envisions an unprecedented degree of cooperation between government and the private sector, and in its promise of a renewed national commitment to environmental protection, the new law is a major milestone in the evolution of environmental protection in the United States.

The law also presents one of the most daunting regulatory tests yet faced by EPA. The Agency is required to publish more than 55 new rules in the next two years—five times as many clean air

rules as our average until now. To meet this challenge, we have committed 70 percent of the proposed increase in Agency operating funds for Fiscal Year 1992 to Clean Air Act programs; and we are hiring 200 new employees to work in the air program, including scientists, engineers, public policy experts, analysts, and writers.

In the face of this monumental task, EPA also has committed itself to making some fundamental changes in the way we do business. Instead of relying on traditional rule-making—and risking the time-consuming litigation it often provokes—we are working hard to build consensus at the outset of the process. Collegiality and cooperation will be the hallmark of the Agency's implementation strategy. Every step of

Much of this country's environmental progress over the last two decades can be credited to the changes in attitude signaled by the Clean Air Act.

the way, we intend to involve state and local governments and to consult with industry, labor, and environmental groups through advisory committees, regular informal consultations, and a formal regulatory negotiation process. Such consensus-building efforts are essential if we are to achieve the multiple objectives of the new law within the tight deadlines set by Congress.

Our regulatory approach is entirely consistent with the basic thrust of the new clean air law—to achieve specific and ambitious environmental goals without unnecessarily damaging the nation's economic health or hampering its growth.

This is, above all, a flexible, results-oriented law. It is not wedded to hard and fast formulas or specific technological requirements. Instead, the law was designed with the marketplace in mind. The Clean Air Act sets specific air quality standards, yet it also allows industry a great deal of latitude in deciding how to achieve these objectives.

Equally important, the law provides real incentives for companies to seek environmental solutions that work best

for them, instead of waiting for EPA or state and local authorities to impose solutions through government directives. Ultimately, the Clean Air Act challenges industry to seize the initiative—to take the lead in the business of environmental protection.

Since the Clean Air Act was passed last October, numerous articles have appeared describing the impact of its costs. Such costs are indisputable. They are also unavoidable if the nation is to have cleaner air even as more jobs, factories, and cars are added to the equation. It is important, however, to see these costs in the context of the remarkable policy breakthroughs embodied in the new law and the economic implications of these new policies. Two critical new directions for clean air policy—two innovations not previously seen in environmental policy—deserve particular attention as part of that context.

The first is clean fuels as a means of controlling air pollution, particularly in the “nonattainment” areas that have failed to meet the national standards for ground-level ozone. Congress endorsed the President's goal of cleaning up our automobile fuels by setting tough standards for the reformulation of gasoline in the nation's nine most polluted cities. Before the end of the year, EPA will be issuing regulations setting specific requirements for this reformulated fuel program. Other cities have the option of joining the program if they choose.

Congress also required the introduction of hundreds of thousands of clean-fuel cars in California beginning in 1996, and through a voluntary “opt-in” provision, the California pilot program could be extended to other states as well. This provision, intended to stimulate clean-fuel technology, makes real-world sense. For as a practical matter, without altering what goes into car and truck engines, a number of polluted areas—most notably Southern California—could not possibly attain clean air standards. As a consequence of the new law, an array of innovative fuels—compressed natural gas, methanol from natural gas, ethanol from corn, electricity, and others—will be getting a real-world test. And very likely, many areas in addition to California will choose to require their use.

The second and broader innovation has to do with economics. The United

States now spends more than \$100 billion a year on environmental protection—more than three times as much, in constant dollars, as we spent in 1972. That figure will continue to rise over the next 10 to 15 years as the Clean Air Act gradually takes effect and as the nationwide cleanup of hazardous and operating waste sites proceeds. Expenditures for environmental protection are expected to reach about 2.7 percent of our Gross National Product by the year 2000. It seems clear, given these figures, that the nation must devote a good deal more attention than in the past to meeting environmental commitments in cost-effective ways.

To say this is not to use costs as a rationale for pulling back on environmental progress, nor is it to imply that the nation cannot afford an

In the face of this monumental task, EPA also has committed itself to making some fundamental changes in the way we do business.

ambitious environmental program. After all, the clean air bill President Bush proposed was costed somewhere between \$14 and \$19 billion per year: The Administration's bona fides should be indisputable. The point is simply this: New environmental proposals should pay careful regard to cost-effectiveness so that expensive new measures carry with them commensurate benefits in terms of reducing threats to health and the environment.

The new Clean Air Act meets that test. Forged in a crucible of genuine compromise and cooperation, the legislation evolved first within the Administration as many diverse interests, including those of EPA, the Council of Economic Advisors, and the Office of Management and Budget, were reconciled through the White House domestic policy process; and then on Capitol Hill as Members of Congress and representatives of the Administration, industry, and environmentalists debated its provisions. Bearing the clear imprint of all the individuals and groups that participated in its shaping, the final bill

not only gives Americans the promise of clean air but also moves the nation into a new era of economically sound environmental stewardship.

To achieve environmental gains within a reasonable timeframe at the lowest feasible cost, the new law will take hold in incremental stages, with most controls fully in effect by 2005. What, specifically, are some of these gains? Emissions that cause acid rain (sulfur dioxide and nitrogen oxides) will be cut to roughly half of 1980 emission levels. More than 30 million tons of noxious air pollutants will be removed from the air each year. Every part of the country finally will have means to attain healthy air on a realistic schedule. And the risk from toxic air emissions will be cut by three-fourths.

Overall health risks, including risks of cancer, respiratory disease, heart ailments, and reproductive disorders, will be reduced dramatically. Also drastically reduced will be damage to sensitive ecosystems and to buildings, monuments, and other manmade structures. To cite one particularly dramatic benefit, well over half the toxic substances that contaminate the Great Lakes should be eliminated.

These badly needed environmental improvements would not be possible without a fundamental shift in our approach to environmental policy. The President's proposals, on which the new legislation is largely based, were not only sensitive to the costs of pollution control; they also included provisions to supplement traditional "command-and-control" regulations with flexible, market-based programs that will enlist the power of the marketplace on behalf of the environment.

The use of economic incentives, such as an innovative system of tradable emissions "allowances" for sulfur dioxide, will enable the nation to achieve significant improvements in air quality at compliance costs \$1 billion lower than would otherwise be possible. The emissions-trading program we designed drew heavily on concepts put forward by the Environmental Defense Fund. (See article on page 21.)

The statute also introduces a number of other market-based innovations,

many of which are discussed elsewhere in this issue of *EPA Journal*. These include, for example, performance-based standards for hazardous pollutants; incentives or "credits" for companies which act quickly to reduce toxic emissions or go beyond minimum compliance requirements; tradable emission credits for producers of certain kinds of reformulated fuels, for manufacturers of clean-fuel vehicles, and for vehicle fleets subject to clean-fuel requirements; and performance targets for reformulated fuels, allowing industry to meet these emission-reduction targets in the most cost-effective way possible.

With the Clean Air Act Amendments of 1990, the United States set a precedent for cost-effective environmental policy that will be followed around the world. Economic incentives are given prominence in a recent British White Paper on the environment, for example, and we can look for new policy directions in Britain and other countries.

Moreover, advanced pollution-control technologies developed in the United States will help to meet worldwide needs for environmental protection and cleanup, especially in the newly emerging (and heavily contaminated) democracies of Eastern and Central Europe. Last year, the Soviet Union announced its intention to purchase \$1 billion in air-pollution control equipment from the United States. The new Clean Air Act will stimulate further positive developments in environmental technology.

At home, the cost-effective, market-based approach to environmental protection embodied in the statute will serve as a model for other Administration proposals—and not just environmental proposals—in the future. The lesson of the Clean Air Act is clear: The nation need not give up its aspirations for a cleaner, healthier environment, or for other worthwhile social goals, even at a time of limited economic resources.

The key is to devise programs that harmonize economic and social goals: programs that put the marketplace to work on behalf of the environment. Thanks to the example of the 1990 Clean Air Act, we now know this can be done. □

Questions and Answers: An Interview with William G. Rosenberg

A strenuous legislative process drew to a close on November 15, 1990, when President Bush signed into law the Clean Air Act Amendments of 1990. But the work associated with the new law is far from over. The statute sets an ambitious regulatory agenda which EPA, working in consultation with state and local governments and affected groups, must move swiftly to accomplish. At this critical juncture in the implementation of the new law, EPA Journal interviewed William G. Rosenberg, the Agency's Assistant Administrator for Air and Radiation, concerning the new law and the agenda that lies ahead. The questions and answers follow:

Q Briefly, how would you list the major elements of these new amendments to the Clean Air Act?

The goal of the act, the environmental objective, is to reduce pollution by 56 billion pounds a year. That is 224 pounds for every man, woman, and child. The reduction will come from cutting the emissions from several principal sources.

Acid rain from power plants, principally sulfur dioxide and nitrogen oxide emissions, will be drastically curtailed. Urban smog, or ozone pollution, produced by motor vehicles and factories will also be cut substantially. For motor vehicles, which still account for 50 percent of the urban problem, we will focus not only on the volatile organic compounds and nitrogen oxides that go into smog, but also on carbon monoxide and what we call air toxics. Air toxics are those special pollutants we associate with increased cancer risk and other health risks. Air toxics from major factories will also be reduced. Finally, those emissions that deplete stratospheric ozone, chlorofluorocarbons (CFCs), and related chemicals, coming from a number of sources, will be severely curtailed. There are programs in each of these areas to reduce emissions.

Q How soon will Americans see cleaner air as a result of this act?

A That will depend on how successful we are in getting early voluntary compliance. If we have the worst-case scenario, if all that happens is that industry responds to rules as we grind them out, then in 1992 we will begin to see a reduction in carbon monoxide in those areas where it is a particular problem. The reduction will be brought about by the wintertime blending of oxygen in fuels.

Most of the smog, air toxics, and acid rain initiatives are not required by the law to begin until 1995. However, we are going to do everything we can to

promote compliance prior to that time, to harness the good will of industrial leaders not only to meet their obligations under the law, but meet their corporate responsibilities to their communities. They can engage communities in the work by providing their own incentives to individuals in meeting the requirements.

To give you one example, this year we will begin negotiating voluntary-compliance programs under the air toxics portion of the act. If a firm agrees now to a 90-percent reduction in emissions of a toxic chemical, then we will extend the deadline by which the firm must meet the final 10-percent reduction.

So we expect to get reductions earlier than the dates specified in the act. Firms will have the opportunity to craft programs to their particular corporate and marketplace circumstances, and I believe that by 1992 we will start to see voluntary action in advance of regulations being issued.

One of the principal problems we will have is writing regulations that encourage early, voluntary reduction and provide flexibility for it, but that also make sure recalcitrant companies meet their responsibilities within the statutory timetables.

Q From what you've said, this is a huge undertaking. Over the long haul, are we headed for a different kind of society in the United States?

A Let me try to put it in perspective. By 2005, when the act is fully implemented, it will have cost approximately \$25 billion a year. We estimate, for example, that in 1992, 10 percent of the costs will be incurred. In 1995, that will rise to 50 percent. Then the last half of the costs will phase in over the 10 years that follow.

That is a lot of money. However, on a per-person basis it breaks down to about 24 cents a day, or the cost of the morning newspaper. We spend 63 cents



National Park Service photos.

per day per person, on average, for alcoholic beverages, and 43 cents for tobacco products. The latter two adversely affect health, whereas the 24 cents for clean air will reduce public health costs as well as improve the quality of life.

My feeling is we will see changes in how things are produced and how they work, but not much change in how we live. We're talking about cleaner cars and cleaner fuels, not restricted use of cars. We'll see pollution prevention practiced in factories, but the same products will come out of those factories and go into commerce. We're talking reductions in acid rain, not less electricity.

So I don't think the act means a fundamental change in lifestyle at all. It means, instead, that we are incorporating, as a part of the cost of doing business, safeguards for the air that all of us breathe. And we are going to accomplish that in a way that is consistent with the competitiveness of those industries involved.

Q What would you say is the most innovative feature of the new Clean Air Act?

A Without question the most innovative feature is the effort throughout to harness marketplace forces in the work of protecting the environment. Other articles in your issue, I understand, will cover the

acid-rain emissions trading program, voluntary compliance credits for industries that control air toxics ahead of schedule, and the stimulation of new fuels and new technologies in the provisions on acid rain and motor vehicles. We are going to set performance standards for industries and let them find their own best ways of meeting them, rather than dictate the controls they apply. This will encourage industry to develop new technologies.

If industry and government respond to this innovative theme of the new act, then I think we will see more engineers being hired and fewer lawyers: engineers to solve problems, rather than lawyers to litigate EPA procedures.

Q The principal departure, then, from previous amendments is the introduction of marketplace inducements?

A Yes, we will be pushing the envelope in that regard. One basic policy we will apply in carrying out the law is "E to the power of three." That means we intend to achieve our environmental goals in a way that is consistent with economic and energy-security principles. In phasing out CFCs, for example, we want not only a replacement for freon that is less damaging to stratospheric ozone, but one that is more efficient: in other words, one that will, for example, demand less use of electricity by a refrigerator. By making appliances more efficient, we not only reduce the cost to

the consumer of operating them, we reduce the amount of energy they use.

Q Why should this new law be able to clean up the air when the 1970 Clean Air Act fell short?

A We learned a lot about what works and what doesn't work in the last 20 years, and the new act expands on that experience. We know that cleaner cars and cleaner fuels work. And so as we turn over the fleet, the cars that will be built in the next 10 years will be much cleaner than the cars that they replace.

We learned that technology standards, rather than risk-based standards, work in dealing with air toxics. So we will set new standards that focus on the entire plant rather than on particular chemicals. The new acid rain title, which incorporates a revolutionary allowance trading program, mandates absolutely that we will reduce by 10 million tons a year the amount of sulfur dioxide coming out of power plants. Inevitably, if you reduce what comes out of power plants, you have a lot less air pollution. Also, in fulfilling the U.S. obligations under the Montreal Protocol, the act virtually precludes the use of CFCs in this country by the end of the decade.

And so the mechanisms and the commitment are much stronger in this law, and they build on the experience of the past. There is no doubt in my mind that they will encourage



Now you see it; now you don't. The picture on the left shows Shenandoah National Park in Virginia on a day when pollution transported from other areas has settled in. The photo on the right, taken from the same vantage point, captures a clearer day. EPA expects that improved visibility will be one of the benefits of the new Clean Air Act.

industries to apply pollution prevention in modifying their processes, and that they will bring about the use of cleaner fuels in automobiles and power plants. They will, in other words, stimulate new technologies that are both energy- and cost-efficient, as well as environmentally more protective: E to the power of three.

Q Are the sanctions in the act strong enough to force compliance if standards are not met, and will the sanctions be vigorously enforced?

A The answer to the second half of your question is easy: The law requires EPA to establish a level playing field, and the sanctions will certainly be vigorously enforced.

There are two kinds of sanctions. One set can be imposed on a state if it fails to put into place and implement a plan of action. We estimate that \$300 million of additional funds will be made available to state regulatory agencies to perform their part of the job, which is very complex. Further, a new permitting program should enable the states to get the resources to develop and monitor their plans. I believe the ability of EPA to assure that the states carry out their plans is significant.

The second kind of sanction can be imposed on a particular industry if it fails to follow the state plan. Here, I think we are seeing a new culture

develop. In the 1970s, there was a real distinction between where Congress and EPA wanted to go and where industry wanted to go. Industry felt that what was friendly to the marketplace was antagonistic to the goals of EPA. A real confrontation developed whenever the two approached each other.

In the 1990s, we see lots of industries leading the way voluntarily. For example, McDonald's never had any obligation to phase out its styrofoam, but it is doing so. Johnson & Johnson committed to reducing its use of CFCs seven years before the target in the Montreal Protocol. Monsanto has agreed to phase out air toxics to 90 percent of what the company was releasing in the late 1980s. Soon after the President proposed the introduction of cleaner-burning automotive fuels, ARCO in California started selling cleaner gasoline. And there are many other examples.

So here we see industries in many cases moving in the same direction as the act. I believe there will be much more cultural willingness on the part of industry to work with EPA in the years ahead.

That is a challenge for EPA. When we see people going in the right direction, we should not get in their way. Instead, we should encourage them with incentives.

Of course, there will still be industries and particular companies that will follow a confrontation mode. And, in their case, the law requires us to assure by regulation that they, too,

meet the public health obligations under the statute.

Q If industry is going to be encouraged to move in EPA's direction, won't EPA have to move in theirs?

A It is not a matter so much of moving in industry's direction; we remain, after all, a federal regulatory agency. It is more a matter of developing a new culture at EPA.

That culture, I believe, is one that seeks to capture the forces of the marketplace and to foster private initiative in reaching public policy goals. As I said earlier, we believe that by harnessing these forces to the work of protecting the environment we can be much more effective than by simply regulating people against their will in the direction Congress has established.

This means we have to reach out and educate people, and we have to consult with them. We have to have a lot of buy-ins, in a psychological sense, on where we're going. And that is a new approach that we are already taking. Even before we propose regulations, we consult fully with industry, environmental groups, consumer groups, and with the states. We talk to them in a formal way and in informal ways.

Formally, in some cases, we are negotiating regulations at meetings in which all interested parties are encouraged to come into the room, lock

the door, bang it out, and come up with a consensus. In other cases, we use a structure like the Acid Rain Advisory Committee, in which leading academics and representatives of high- and low-sulfur coal markets, plus miners, utilities, environmental groups from all over the country, and economists work hand in hand with us to propose regulations for public comment.

In still other cases, we are departing from the traditional format in which industry, environmentalists, consumers, and the states all come in for separate meetings, after which we try to synthesize in our own minds what everyone said. Instead, we try to have one meeting, or two meetings, or five meetings in which we all sit around the table talking to each other at the same time to clarify and provide the full range of information to all parties.

So these regulations are not just the product of EPA staff. They are the product of all interested parties. We are doing our utmost to build a consensus for action around the agenda established by the President and the Congress and to avoid the litigious attitudes that wasted so much of our energies in the past.

Q What is EPA's role in implementing the act as opposed, for example, to that of the states?

A The states clearly are our partners. In many regards, they are the ones who implement the law. They issue the permits, and they enforce them. With their help, we hope to develop a permitting program that will be uniform across the country but that will still allow adjustments to be made for problems that are local in nature. Further, we want to provide state agencies with adequate resources to implement the statute.

Highlights of the 1990 Clean Air Act Amendments

Urban Pollution

Cities currently failing to meet standards for human health must "attain" them by deadlines set in the law: Most have 6 years or less to attain; an extreme case, Los Angeles, has 20 years. State programs for these cities will complement EPA efforts; see *Motor Vehicles*.

- **Ozone.** The 96 cities failing for ozone are ranked from *marginal* to *extreme*, with the more severe cases required to institute more rigorous controls, but given more time to attain. States may have to initiate or upgrade inspection/maintenance (I/M) programs; install vapor recovery at gas stations and otherwise reduce hydrocarbon emissions from small stationary sources; and adopt transportation controls that will offset growth in vehicle miles travelled. Major stationary sources of nitrogen oxides will have to reduce emissions.

- **Carbon Monoxide.** The 41 cities failing for carbon monoxide are ranked *moderate* or *serious*; states may have to initiate or upgrade I/M and adopt transportation controls.

- **Particulate Matter.** The 72 areas failing to attain for particulate matter (PM-10) are ranked *moderate*; states will have to implement Reasonably Available Control Technology (RACT); use of wood stoves and fireplaces may have to be curtailed.

Permits

The new act strengthens the ability of EPA and the states to enforce standards by requiring that all air-pollution-control obligations of an individual source be contained in a single, five-year operating permit. The states have three years to develop permit programs and submit them to EPA. EPA has one year to issue regulations describing the minimum requirements for such programs. Sources must pay permit fees to the states to cover the costs of operating the programs.

Motor Vehicles

- **Vehicle Emissions.** Tailpipe emissions of hydrocarbons, carbon monoxide, and nitrogen oxides will be cut beginning with the 1994 model year, and standards will have to be maintained over a longer vehicle life. On-board charcoal canisters to absorb evaporative emissions may be required.

- **Fuels.** In 1995, reformulated gasolines having less aromatics will be introduced in the nine cities with the worst ozone problems; other cities can "opt in." Beginning in 1992, oxyfuels, gasolines blended with alcohol, will be sold in winter in those cities having the worst carbon monoxide problems.

In the cases of cars, fuels, acid rain, and CFCs, the federal government directly implements the law, and here we have to coordinate what we do with the states. So we have reached out to them to make them part of our work groups.

Q Was there ever a time in the long debate over the act when you thought it might not pass?

A Interestingly, one of the most critical moments came when Iraq invaded Kuwait. Some forces opposed to the bill claimed we couldn't undertake an environmental initiative in the middle of what appeared to be an energy crisis.

EPA responded by showing that pollution prevention and cleaner air would have a positive impact on our oil import balance: We would be wasting less fuel, and we would be substituting cleaner, domestic fuels for imported oil. For example, northeast utilities could be expected to convert from high-sulfur oil to natural gas in producing electric power. The natural gas would come from Canada and the United States; the high-sulfur oil they are now using is imported.

In the automotive sector, by requiring oxygenated fuel as part of the effort to clean up carbon monoxide and ozone, we would be substituting alcohol made out of natural gas and corn for gasoline components made out of imported oil.

● **Clean Cars.** In 1996, a pilot program will introduce 150,000 cars to California that meet tighter emission limits through a combination of vehicle technology and "clean" fuels—substitutes for gasoline or blends of substitutes with gasoline. Other states can "opt in."

Air Toxics

Emissions of 189 toxic pollutants, typically carcinogens, mutagens, and reproductive toxins, must be reduced within 10 years. EPA will publish a list of source categories within one year and issue Maximum Achievable Control Standards (MACT) for each category over a specified timetable. Companies that initiate partial controls before deadlines set for MACT can receive extensions.

Acid Rain

A two-phase, market-based system will reduce sulfur-dioxide emissions from power plants by more than half. By the year 2000, total annual emissions are to be capped at 8.9 million tons, a reduction of 10 million tons from 1980 levels. Plants will be issued allowances based on fixed emission rates set in the law and on their previous fossil-fuel use. They will pay penalties if emissions exceed the allowances they hold. Allowances can be banked or traded. In Phase I,

large, high-emission plants, located in eastern and midwestern states, will achieve reductions by 1995. In Phase II, which commences on January 1, 2000, emission limits will be imposed on smaller, cleaner plants and tightened on Phase I plants. All sources will install continuous emission monitors to assure compliance.

Nitrogen-oxide reductions will also be achieved, but through performance standards set by EPA.

Ozone Depletion

The new act goes beyond the Montreal Protocol in restricting use, emissions, and disposal of chemicals. It phases out production of CFCs, carbon tetrachloride, and methyl chloride by 2000; and methyl chloroform by 2002; it freezes production of CFCs in 2015, phasing them out in 2030. Companies servicing air conditioning for cars will be required to purchase certified recycling equipment and train employees by January 1, 1992. By July, EPA regulations must require reduced emissions from all other refrigeration sectors to lowest achievable levels. By November 1992, use of CFCs in "nonessential" applications will be prohibited. The act mandates warning labels on all containers and products (refrigerators, foam insulation) that enclose CFCs and other ozone-depleting chemicals.

there is a significant acid rain problem in American and Canadian lakes and streams and in high-elevation forests. The NAPAP study data show that, nationwide, 4 percent of lakes larger than 4 hectares (about 10 acres) and 8 percent of streams surveyed were acidic, and the percentage is considerably higher for lakes smaller than 10 acres. In addition, another 20 percent of both lakes and streams are very sensitive to acidification. Plus, the Canadians report some 31,000 total lakes acidified in Eastern Canada. To me, the surface water data alone suggest a pretty big problem.

Further, acid rain, specifically sulfur and nitrogen compounds, impairs visibility, corrodes building and construction materials, and can pose a threat to public health. About 50 percent of the Eastern visibility problem is a function of sulfates from acid rain. Visibility in the Shenandoah National Park, for example, is significantly impaired as a result of emissions from power plants. That was not even discussed in the program. Then, the Harvard School of Public Health and others have found that acid aerosols—that result from acid rain precursors—may pose a significant public health risk.

In spite of what was said on the TV program, Congress fully understood the science that supports the acid rain title. After 10 years of debate and \$50 million worth of studies, Congress made the judgment that it would be prudent, for both environmental and public health reasons, to phase down acid rain. The program is reasonable and measured: Over a 10-year period, large power plants that were built in the early 1970s and 1960s will have to meet standards that were subsequently imposed on plants built in the later 1970s and 1980s.

And we are revisiting older plants, the ones that were previously grandfathered out of controls. We will

We were able to say that these measures and others would reduce oil imports by more than the amount we were currently importing from Kuwait and Iraq put together, a reduction of as much as a million barrels a day. And if more cities than those required by the act were to choose cleaner fuels, our estimate might go up to over two million barrels a day. I believe this argument was the turning point in assuring that the crisis in the Middle East did not derail the Clean Air Act.

Q Controversies about the act persist. How do you respond to the scientist who appeared recently on "60 Minutes" and claimed the government's own study has shown that acid rain is really not much of a problem?

A First of all, you should know that we had asked the news program to allow EPA to speak during the segment, but we were not given the chance. Second, we responded in a letter to what was said in the segment, but the letter wasn't aired either.

The National Acid Precipitation Assessment Program (NAPAP) study alluded to on the program shows that

impose less stringent controls on them, but they will at least have to reduce emissions commensurate with what we've been asking of the newer plants over the last 20 years.

Q Can you tell us how many people you have working on the new Clean Air Act?

A Before the act, we had approximately 1,800 people in the air office. We've reprogrammed probably 1,500 towards the implementation of these amendments. In the last several months we increased our staff by 150 people, which we called "the Class of 1990." Some are experienced; some are right out of school. We are seeking to create a diverse work force, as well as to provide new skills, new energy, and new enthusiasm for the task.

We would expect in the current fiscal year to add another 100 to 150 people, and we are hopeful that the budget recommendations of the President will give us additional resources in 1992. These are substantial increases. However, I believe that the strength of EPA is very much in its people. And the energy levels, the enthusiasm, and the capability of the air staff are among the strongest in the Agency.

We intend to be a prototype for the Agency in incorporating market-based principles into programs and in building consensus with external interest groups. We will push the envelope on regulatory negotiation, on cost-benefit analysis, and on understanding the full implications of environmental initiatives on the economy and on the energy picture of the nation. It will be an exciting time of new ideas, new people, and new energies.

Q Is this new law primarily a public health statute, or does it also respond to the increasing concern over ecological values?

A In my view, it is both. Clearly, there is an emphasis on public health in meeting national ambient air quality standards and in reducing air toxics. However, much of the act is motivated by and will help the environment.

Under the acid rain title, for example, we are concerned about the quality of our lakes and streams, our trees, and about visibility, all of which I would label environmental concerns. Reducing urban and regional ground-level ozone will benefit forest ecosystems, as well as crops. And the stratospheric ozone provisions will help protect natural ecosystems from the effects of harmful ultraviolet radiation. And so both health and environment are protected.

One of the more challenging aspects of this new law is going to be sustaining the burden of proof for programs that address both environmental and public health problems. It is always easier to estimate costs than it is benefits. Here our regulatory analysis must not only measure the value of public health benefits but also of ecological benefits. And that is a relatively new undertaking for us.

Q Just how will you show that this act is worth all the effort and all the costs that will be going into it?

A We will, of course, have to develop more fully that side of the equation, and we are working on it. For one thing, we must show a measurable improvement in air quality. We measure air quality every year through our monitoring networks. We have to measure the number of jobs that are created by making this improvement. After all, if the act is going to cost some industries \$25 billion, someone else is

going to have a new \$25 billion market for cleaner products and cleaner services.

And this market can be worldwide. One of the first things that happened after the Bush-Gorbachev summit, for example, was that Russia placed a \$1 billion order to General Motors for pollution-control components. They had to have them if they were to sell their cars to Western Europe, which has stiffer emission limits than does Moscow.

We want to make sure that we provide incentives for voluntary initiatives and that we stimulate the development of new technologies and pollution prevention measures that will minimize the costs of compliance. Then, we analyze the other side of the equation as to what the benefits are, and we tell people where we are succeeding and where we are failing. Where we are failing, we modify the policy. Above all, we must be candid about how well we're doing.

Again, putting it in perspective, this act is targeted at about 24 cents per day per person. And the American people have said that if we can reduce the amount of air pollution by the billions of pounds projected, they are willing to pay that amount. I don't know where else you can buy that much for 24 cents anymore. □



Mike Brisson photo.

What You Need to Know About the New Clean Air Act

In the special section that follows, six pairs of articles examine the provisions of the new Clean Air Act in six key areas: motor vehicle emissions and fuel quality, acid rain, urban air quality (the "nonattainment" problem), toxic air pollutants, stratospheric ozone depletion, and enforcement procedures—particularly a new operating permit system.

In each area, an outside writer assesses the nature and extent of the

air quality problems leading up to the new law; and an EPA official profiles key provisions of the law and the Agency's implementation plans. The last set of articles, in which contrasting perspectives are presented concerning the new permit system, varies this pattern slightly. Graphs and charts are included to illustrate present trends and projections for cleaner air under the new law.

Motor Vehicles and Fuels:

The Problem

by Michael P. Walsh

When we analyze the failure of the 1970 Clean Air Act Amendments to reduce pollution from automobiles to the extent envisioned by Congress, several factors stand out. First, the growth in the total number of automobile vehicle miles travelled every year, combined with less stringent control requirements for other mobile sources, reduces the overall gains achieved by the standards that apply to the individual automobile. Moreover, the standards as such are not achieving the full benefit intended, mainly because of poor vehicle maintenance. Deterioration in fuel quality and the stipulation in the law that emission-control requirements apply only for five years or 50,000 miles—roughly half the lifetime of a car—also contribute to the problem.

Fortunately, over the past two decades, specialists have learned a great deal about vehicle emissions and fuels: This knowledge provided a framework for Congress as it contemplated changes in the law. I will touch on some of the more salient lessons.

Evaporative Emissions

Between 1970 and 1987, the volatility of gasolines increased by more than 20 percent as manufacturers strove to substitute other high octane-blending components for the lead which was

being phased out. As a result, vehicle evaporative emissions, which appeared to be quite low when tested using standard reference fuel under laboratory conditions, were actually several times the standard. Also, according to EPA data, increased purging to the engine caused by the excess vapors raised exhaust emissions of volatile organic compounds and carbon monoxide emissions.

Evaporative emissions also exceeded standards in cases where control systems became disabled, either because of tampering or defective components. Further, it was discovered that the heating up of the fuel tank during vehicle operation could produce evaporative "running losses" that could be very significant. Finally, gasoline spillage and the vapors escaping from the gas tank when a car is refueled can significantly increase volatile organic emissions.

Thus, evaporative emissions from actual cars on the road are substantially greater than emissions from prototype cars as tested in the laboratory. Obviously, the prototype vehicles tested in order to certify that manufacturer models meet standards do not experience the deterioration or the tampering that happens to actual cars.

Nevertheless, these factors account for only a small part of the difference in emissions between laboratory test results and real-world conditions. Increased fuel volatility, a development which occurred after EPA adopted its regulations under the pre-1990 law, is the primary culprit. The Agency did propose restricting fuel volatility, modifying the evaporative test procedure, and mandating onboard refueling controls. But strong industry opposition and the lack of Congressional support prevented EPA from fully implementing these proposed changes.

Full Useful Life

The 1970 Clean Air Act authorized EPA to regulate light and heavy trucks for their full lifetimes. However, the law prohibited the Agency from extending requirements for automobiles beyond five years or 50,000 miles. In other words, automobiles were legally exempt from emission-control requirements during roughly the second half of their lifetimes. This problem was compounded in that, as EPA studies showed, increasingly advanced control technology tended to deteriorate more rapidly during the second half of the lifetime of an automobile than during the first.

Emission-control systems should have been required to last for the actual life of a vehicle or, at a minimum, up to 100,000 miles. For passenger cars, changing this requirement meant a change in the Clean Air Act.

Inspection and Maintenance Programs

Vehicles in actual use consistently emit pollutants well in excess of the standards set for them. Major reasons: poor maintenance; deliberate tampering with or removal of pollution controls, especially catalytic converters; and use of leaded gasoline in cars that require unleaded. Inspection and Maintenance (I/M) programs are the best way to rectify these problems. These programs identify cars that need remedial maintenance or adjustment, and they force repair of cars so identified. In short, I/M programs encourage owners to keep their cars in good repair, force the service industry to do the maintenance properly, and encourage manufacturers to make vehicles more serviceable and durable.

Although I/M programs were previously required under the Clean Air Act, the details of their administration were left to the discretion of state or local officials provided they kept within broad policy guidelines laid down by EPA. Years of

(Walsh is a former Director of EPA's Office of Mobile Sources and currently an independent consultant to many governments around the world and to such international organizations as the World Bank, the Organization for Economic Cooperation and Development, and the United Nations Environment Program.)



South Coast Air Quality Management District photo.

King of the Road: Americans drive more cars more miles every year, outstripping emission controls required under the 1970 law. The 1990 law takes a more comprehensive approach to the problem, emphasizing cleaner cars, cleaner fuels, and improvements in the overall transportation system.

experience with these programs in various states have yielded several principles:

- The best programs separate inspection from repair. A central facility that has no direct involvement in vehicle repair focuses solely on high-quality, efficient inspections. Such programs consistently achieve the greatest emission reductions and at the lowest cost to the public. And contrary to expectations, centralized I/M programs have also proven to be the most convenient to the public, substantially reducing the hassle associated with this pollution-control strategy.

- As vehicles become increasingly complex, I/M programs will need to keep pace if problems are to be diagnosed properly and repairs performed efficiently. The testing of a car under load—that is, forcing the engine to work as if it were moving a car on the road—which is feasible only in a centralized facility, will be a key element of future I/M programs. This kind of testing will identify many more

failures than will a simple idle test or visual check under the hood. Since significant amounts of nitrogen oxides are created only when a vehicle is under load, a loaded test is necessary to measure emissions of this pollutant.

- The complexity of vehicles also makes repair of defects increasingly difficult. Fortunately, many vehicles today are equipped with some form of electronic onboard diagnostics. Centralized I/M programs, which are best equipped to interrogate these systems and identify the causes of high emissions, enable the owner to get the correct repairs at the lowest cost. But too often the process is still one of trial and error, frequently missing the real problem and resulting in unnecessary expense.

Vehicles Other Than Automobiles

Emission reductions from other vehicles have been significantly smaller than reductions from autos. For example, even though many light trucks are used mostly in the same manner as cars, their emission standards are more lenient. Heavy trucks, especially diesels, are much less

stringently controlled than cars.

Emissions from urban buses should be highlighted. Buses are important well beyond their numbers for several reasons:

- Urban buses tend to be used almost continuously in the corridors where the greatest numbers of people are concentrated.
- The buses now in use—and there are many—will remain in use for many years before they are replaced.
- Emissions from these vehicles are quite high compared to other mobile sources.

These factors make retrofitting urban buses with diesel-particulate traps or converting them to alternative fuels attractive options.

Federal Test Conditions

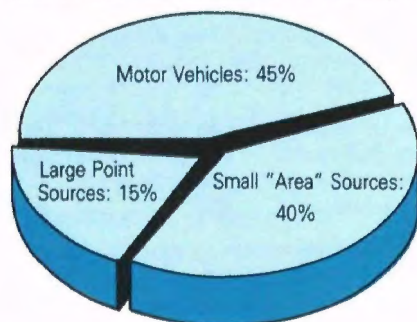
Achieving air quality standards for automotive pollutants depends on whether emission controls function over the wide range of conditions under which vehicles are actually used.

The test conditions EPA currently imposes on the models manufacturers submit for certification simulate a trip

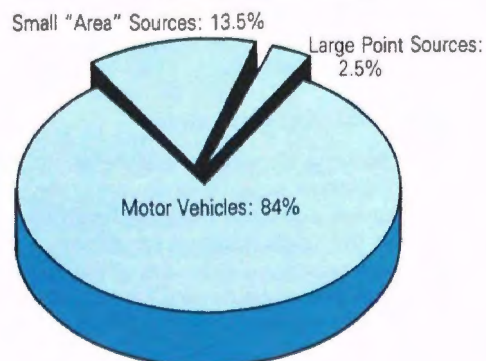
to work in Los Angeles in temperatures conducive to ozone production. However, in carbon monoxide production, other conditions are important. Cold engine choking, to assure starting, increases emissions of both carbon monoxide and volatile organic compounds. At colder temperatures, this operating mode becomes even more important.

Heavily congested traffic leads to lower speeds and increased stop-and-go operation. These, in turn, lead to higher emissions and slower catalyst light-off. (A catalyst doesn't begin to reduce vehicle emissions until it reaches operating temperature, or "light-off" temperature.)

Urban Hydrocarbon Emissions: Motor Vehicles Contribute Nearly Half



Carbon Monoxide: Motor Vehicles Contribute Most



Source: Office of Air and Radiation, EPA

As a result of these real-life departures from the conditions simulated in the federal test, actual emission reductions have fallen short of what Congress envisioned. Simply put, car models that "pass" the federal test are emitting substantially more pollution than test results indicate. This is particularly true for carbon monoxide.

Adequacy of Federal Compliance Program

Properly maintained cars emit substantially less pollution than the typical American car on the road, which receives less maintenance than it should. However, for carbon monoxide and volatile organics, even properly maintained cars usually exceed the emission standards by the time they reach 30,000 miles. Over their lifetimes, they substantially exceed emission levels intended by Congress.

EPA's ability to ensure that vehicles meet the standards for the specified 50,000 miles, even on average, seems to be limited by resources. If additional resources cannot be made available to the Agency in the form of contract dollars and more people, then Congress should amend the law to require that manufacturers pay for enforcement testing. EPA could then ask the manufacturer to test any vehicles or engines the Agency believes are not conforming to regulations.

Vehicle Miles Travelled

It is now clear that technological improvements to the motor vehicle itself increasingly are being offset by the growth in the number and usage of vehicles. Not only does high growth directly increase emissions, it leads to more congestion, which further increases emissions. Transportation measures to reduce this growth were given a strong push throughout the country in the late 1970s, but they were rolled back in the early 1980s. They should be tried again. □

Motor Vehicles and Fuels: The Strategy

By Richard D. Wilson

In all the world, the United States demands the most stringent control of emissions from motor vehicles. Nevertheless, cars, trucks, and buses emit nearly half the pollutants that go into our air every day, including unburned gasoline, diesel soot, and other harmful compounds. Not surprisingly, the problem is most serious in highly populated metropolitan areas, where traffic congestion is severe.

The car and truck population in this country is growing faster than the human population. The number of vehicle miles travelled has doubled from 1 trillion, in 1970, to 2 trillion, in 1990. As a result, motor vehicles account for about one-half of the hydrocarbon and nitrogen-oxide pollutants that form smog in our cities,

up to 90 percent of the carbon monoxide, and over half of the toxic air pollutants. The steady growth in miles driven is projected to continue into the next century. New methods of control would be needed even if our goal were merely to hold auto emissions constant. To achieve healthy air, we must go further.

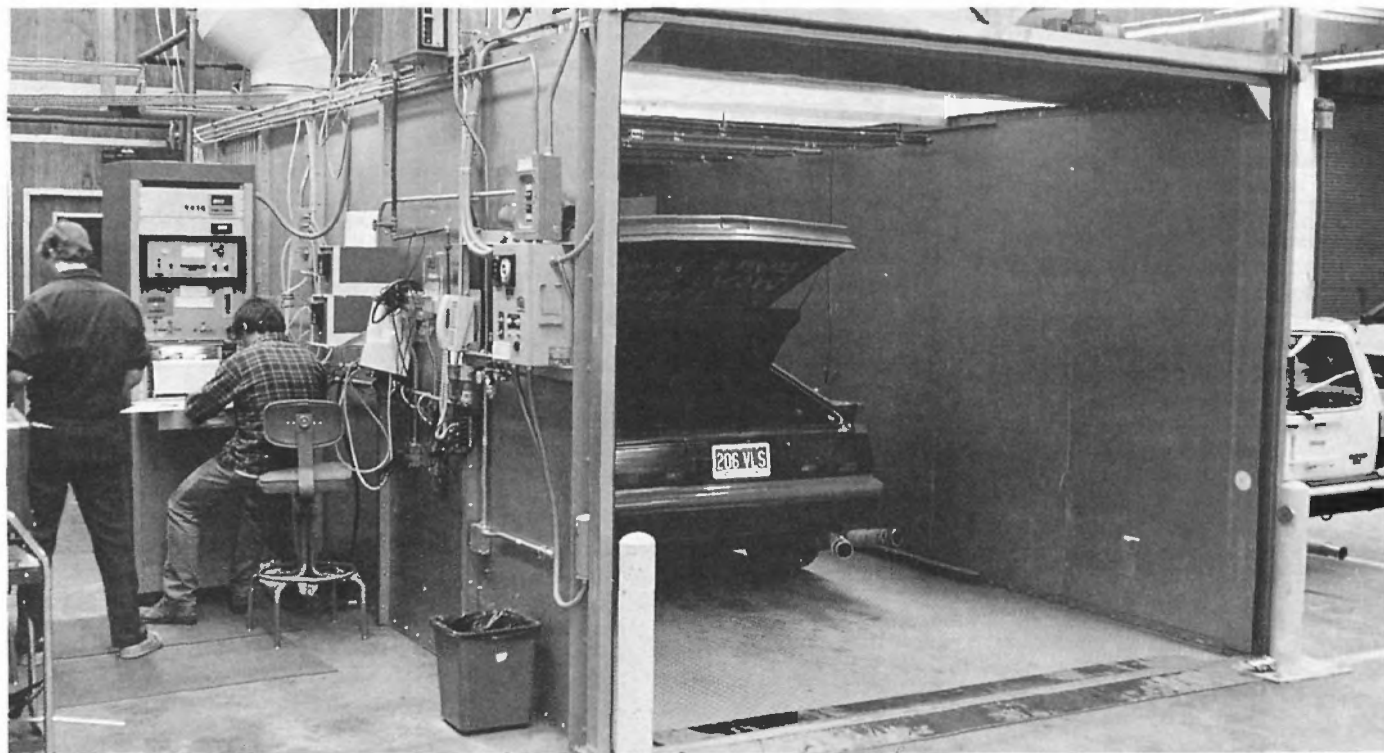
In early 1989, as EPA was developing options to be considered by President Bush for inclusion in his proposed amendments to the Clean Air Act, it became apparent that there were three choices for reconciling the automobile

and the environment. One was to require that new cars and trucks meet even more stringent tailpipe emission standards. The second was to stimulate the development of cleaner-burning fuels. And the third choice was to get people to drive less.

The last option, though successful on a small scale in the past and deserving of continued efforts, would likely never provide large-scale emission reductions. We Americans place too high a value on personal mobility. A positive sign, however, is that people are beginning to demand that their elected officials address the problem of clogged streets and highways. Most steps that succeed in making traffic flow freely, such as improved mass transportation, help improve air quality.

The President proposed his

Getting ready for evaporative emissions testing at EPA's Motor Vehicle Emission Lab, Ann Arbor, Michigan. The new Clean Air Act sets limits for how volatile gasoline can be.



(Wilson is Director of EPA's Office of Mobile Sources.)

John T. White photo, EPA.

Buses used in urban areas must do even better than trucks in controlling harmful emissions.

amendments, including the above options, in July 1989. During the 15 months of Congressional debate that followed, these amendments were modified. However, the final law contains key elements of all three options. Here are the highlights of the motor-vehicle and fuels provisions of the 1990 Clean Air Act amendments:

Cleaner Vehicles

A new car today emits about 95 percent less pollutants from the tailpipe than does an uncontrolled car. The device most responsible for this cleanup is the catalytic converter, which has been installed on almost all cars built since 1975. Other improvements include the widespread use of electronic feedback controls and fuel-injection systems in place of carburetors. They allow a car's micro-computer to send into the engine the precise amount of fuel needed, thereby making combustion more efficient and less polluting.

Under the new law, new cars sold in 1994 and later will emit about 30 percent less hydrocarbons and 60 percent less nitrogen-oxide pollutants from the tailpipe than cars do today. The law also extends the durability requirements of emission-control equipment from 50,000 miles to 100,000 miles.

New trucks must also meet more stringent tailpipe requirements. In particular, large diesel trucks will have to cut emissions of particulate matter by 90 percent compared to

uncontrolled levels; this should eliminate the visible black smoke that regrettably is so common with these vehicles. Buses used in urban areas must do even better than trucks in controlling harmful emissions.

Currently, on a cold day, most carbon-monoxide emissions occur during the first few minutes after vehicle start-up. But the current carbon-monoxide emission standard applies at 75 degrees Fahrenheit. Under the new law, for the first time, new cars,

minivans, and small trucks must meet an emission limit for carbon monoxide under cold temperature conditions; specifically, 20 degrees.

Starting in a few years, new cars nationwide will be equipped with "on-board" diagnostic systems. These systems, made up of under-hood computers coupled with a dashboard display, must be capable of alerting drivers and mechanics to malfunctioning emission-control equipment.

T. O'Driscoll photo. USDA.



Ethanol, made from corn, will be put to use in a new emphasis on cleaner-burning automobile fuels. Ethanol can be used either as an alternative fuel or as an oxygenated fuel additive to reduce carbon monoxide emissions.

The law establishes a California Pilot Program to encourage and demonstrate the production of even cleaner fuels and vehicles.

EPA is given new authority to regulate any category of non-road mobile engines that contribute to urban air pollution. The Agency is directed to control, at a minimum, locomotive emissions and to consider emission limits for construction and farm equipment, lawn and garden equipment, boats, and other machines driven by internal combustion engines.

Gasoline vapors that escape from the fuel tank of a car as it is refueled will be controlled. The vapors will be recycled and used as fuel, instead of contributing to pollution.

As a complement to the control of vapor during refueling, improvements will be made in the systems which prevent the evaporation of gasoline from vehicles both when they are operating and when they are parked on hot summer days.

The new law requires EPA to review the procedures used to test vehicle compliance with emission standards and to make any revisions needed to reflect actual driving conditions.

EPA's ability to enforce all existing and new requirements on vehicle and fuel manufacturers is strengthened under the amendments. For example, the Agency is now able to collect fees from auto makers to recover the cost of EPA compliance monitoring.

Cleaner Fuels

Compared to cleaning up the emissions from cars, less has been done on cleaning up the fuels they use. It is not difficult to understand how the quality of fuel burned in an engine affects its emissions. The most environmentally successful fuel-related program, to date, has been the virtual elimination of lead in gasoline. Another EPA program, which took effect all across the country in the summer of 1989, reduced the volatility of gasoline. Reducing volatility means that less fumes

evaporate into the atmosphere on hot weather days which, in turn, means significantly reduced smog levels. The new amendments require that additional steps be taken by fuel producers to improve fuel quality.

During summer months, beginning in 1992, all gasoline in the country will evaporate less rapidly, as required by a second step in the volatility-reduction program.

Beginning in the winter of 1992-1993, the amendments mandate the addition of oxygen to all gasoline sold during winter months in any city with carbon monoxide problems. Adding oxygen, in the form of alcohols or ethers, greatly reduces carbon monoxide emissions from all cars, new and old.

Oil refiners will be required to reduce the amount of sulfur in diesel fuel as of October 1, 1993.

Beginning in 1995, all gasoline sold year-round in the nine cities with the worst air pollution must be reformulated to reduce smog-forming and toxic pollutants. For example, the amount of benzene, a component of gasoline known to cause cancer, will be lowered. Other cities may choose to have this "clean" gasoline sold within their boundaries as well.

The law establishes a California Pilot Program to encourage and demonstrate the production of even cleaner fuels and vehicles. Beginning in 1996, auto companies must sell 150,000 cars in California that have emission levels one-half that allowed for other new cars. The number of cars increases to 300,000 a year in 1999; in 2001 emission levels are reduced by half again.

As early as 1998, a percentage of new vehicles purchased in centrally fueled fleets in 22 polluted cities must meet tailpipe standards that are about one-third of those in place for general passenger cars. This program is intended to stimulate development of new, low-polluting fuel/vehicle combinations.

The View from the Driver's Seat

Most car owners probably will not be aware of the many vehicle and fuel changes that auto and oil companies make in response to the Clean Air Act. The reductions in emissions will be sizable, but the cost will be reasonable: less than \$200 added to the cost of a new car after all the programs have been phased in over the next 10 years, an additional few cents per gallon for gasoline in the most heavily polluted cities.

There are a few programs drivers may notice. About 40 metropolitan areas will begin annual vehicle inspection programs. (Seventy cities have them now.) Most of them will start up in the Northeast states, which often send air pollution to their downwind neighbors. Additionally, many existing inspection programs will be improved; drivers may notice more checks being made on their cars in the inspection lanes.

Another program will be noticed in those cities having the highest smog levels. Here large employers must increase the number of employees who car pool or take mass transit to work. Incentives offered by employers could take the form of subsidizing vans for their commuters or free parking for van or car poolers. □

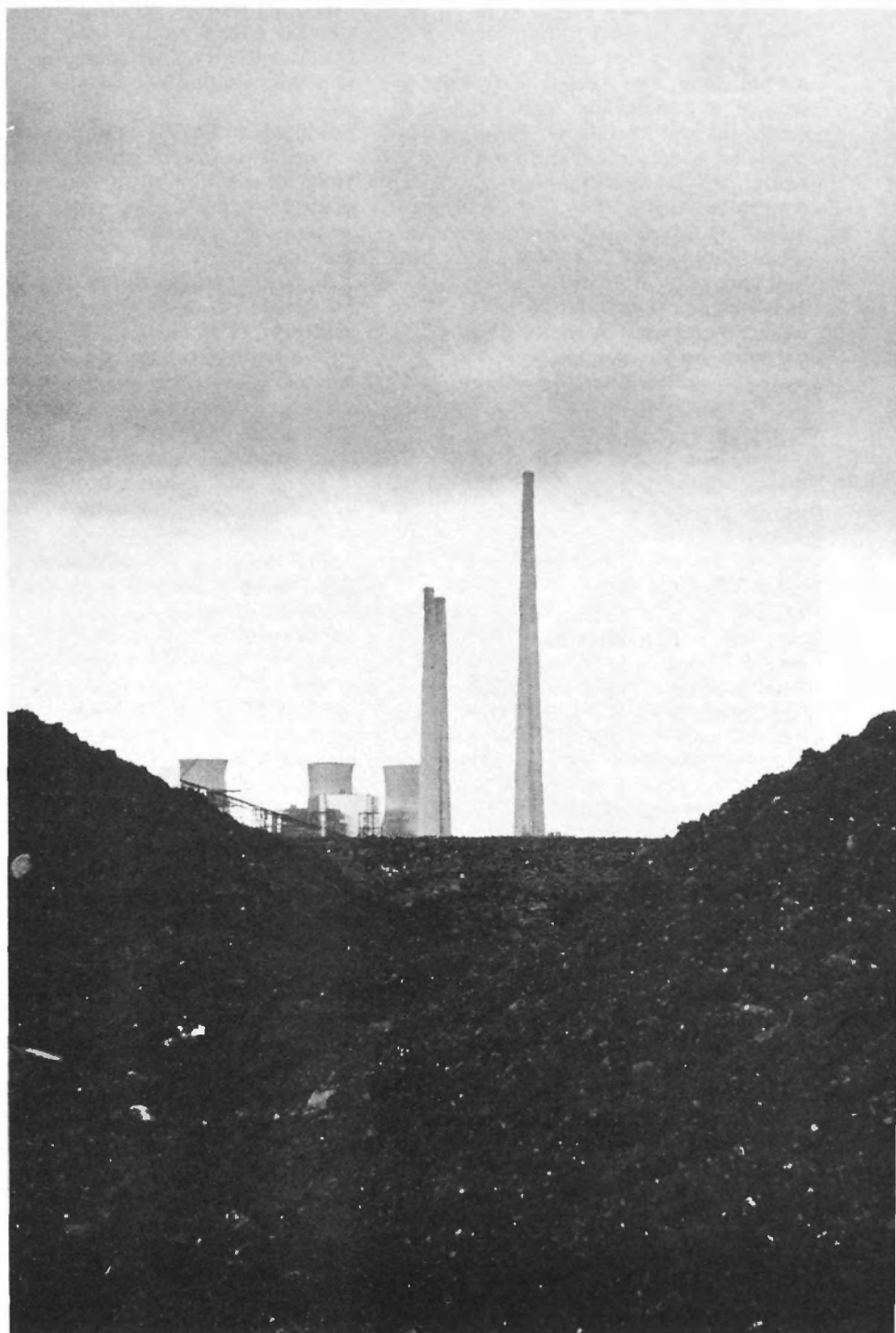
Acid Rain: The Problem

by Ned Helme
and Chris Neme

Acid deposition, popularly known as acid rain, has long been suspected of damaging lakes, streams, forests, and soils, decreasing visibility, corroding monuments and tombstones, and potentially threatening human health in North America and Europe. The National Academy of Sciences and other leading scientific bodies first gave credence to these concerns in the early 1980s when they suggested that emissions of sulfur dioxide from electric power plants were being carried hundreds of miles by prevailing winds, being transformed in the

How to curb emissions of sulfur dioxide and nitrogen oxides from coal-burning electric power plants has been the central issue in the national debate on acid rain. Pictured is an electric power plant in Pennsylvania and the coal it will burn to produce electricity.

(Helme is Executive Director of the Alliance for Acid Rain Control. Neme is Senior Policy Analyst.)



National Coal Association photo.

atmosphere into sulfuric acid, falling into pristine lakes, and killing off aquatic life.

Acid rain in the United States is caused mainly by man-made pollutants. It results primarily from the reaction of sulfur dioxide and nitrogen oxides with other substances in the atmosphere. Coal-burning electric power plants are the primary source of sulfur dioxide and a leading source of nitrogen oxides.

Sulfur dioxide, the most important of these two pollutants, is created when the sulfur in coal is released during combustion and reacts with oxygen in the air. The amount of sulfur dioxide created depends on the amount of sulfur in the coal. All coal contains some sulfur, but the amount varies significantly depending on where the coal is mined.

The sulfur content of western coal, for example, is typically very low—about 0.5 percent. Western states produce about 40 percent of the coal currently sold to electric utilities. The East produces both low-sulfur and high-sulfur coal. Low-sulfur coal from southern Appalachia (typically about 1 percent sulfur) currently commands about 20 percent of the national utility market. High-sulfur coal from northern Appalachia and the lower midwestern states (about 2 to 3 percent sulfur) accounts for most of the rest of the sales to electric utilities.

Today, the United States gets more than 55 percent of its electricity from coal and the trend is upward. Utility coal consumption has nearly doubled since the mid-1970s to more than 750 million tons a year, about 85 percent of total U.S. coal consumption. Although acid rain emissions have actually decreased somewhat over the last 15 years, because of the installation of some pollution controls and greater reliance on low-sulfur coal, emissions were predicted to increase again for the next decade or two in the absence of acid-rain control requirements.

Acid rain doesn't stop at political boundaries. High-sulfur coal-burning power plants in the Ohio River Valley and lower Midwest contribute to acidification of lakes as far away as upstate New York, New England, and Canada. Roughly half of the acid rain in Canada results from pollution in the United States.

In our own Adirondack Mountains—a particularly vulnerable area—up to 15 percent of medium and large lakes (greater than 10 acres) are chronically acidic due primarily to acid rain; more than 25 percent of small lakes (2 to 10 acres) in the Adirondacks are likewise chronically acidic due largely to acid rain. A smaller percentage of lakes and streams in New England, the upper Midwest, and the Appalachian Mountains are chronically acidic.

Many other lakes and streams experience episodic acidity. When acidic snow melts in the spring, significant adverse effects on aquatic life can result. Perhaps of even greater long-term concern is the number of lakes and streams that have little acid-buffering capacity and are susceptible to future acidification in the United States. Roughly 20 percent of lakes and streams fit this description, according to a draft report by the National Acid Precitation Assessment Program (NAPAP), a 10-year scientific study sponsored by Congress.

Acid rain also adversely affects the environment beyond the acidification of lakes and streams—a critical point often lost in the controversy over acid rain policy. For example, acid rain has damaged high-elevation spruce forests in the eastern United States, and it has also accelerated the corrosion of buildings and monuments.

Acid rain has contributed to reduced visibility at scenic vistas throughout North America. Byproducts of sulfur dioxide, acid rain's principal precursor, are recognized as major contributors to regional haze in the East and parts of

the West. These byproducts, known as sulfates, have received a great deal of attention lately because of the impaired visibility at a number of U.S. national parks. At times, the sulfate pollution is so great that people can't see the bottom of the Grand Canyon or across Virginia's Shenandoah Valley.

More recently, it has become apparent that acid rain facilitates the accumulation of mercury, a toxic metal, in fish. Studies show correlation between the acidity of lake water and high mercury levels in fish, although the biological and chemical processes underlying this relationship are not fully understood. Elevated levels of mercury have led many states—particularly the upper Great Lakes states of Minnesota, Wisconsin, and Michigan—to advise against eating sport fish caught in their inland lakes. In Michigan, the public health advisory extends to every one of roughly 10,000 inland lakes in the state.

Also, there is growing concern about the potential health risks associated with acid rain. Recent reports suggest, for example, that downwind derivatives of sulfur dioxide, known as acid aerosols, may pose serious health threats throughout the eastern United States. Inhalation of acid aerosols may lead to bronchitis in children and decreased lung function in adults, particularly asthmatics. Controlling acid rain will play an important role in reducing these risks.

Despite growing awareness of the acid rain problem among citizens and public officials, designing an effective strategy to control it proved to be one of the nation's most intractable environmental policy problems. The Congressional debate bogged down for years in a sometimes acrimonious political stalemate.

The mid-1980s saw renewed efforts to resolve the debate. In 1985, for example, a bi-partisan group of state governors concluded that the

Roughly half of the acid rain in Canada results from pollution in the United States.

environmental threats posed by acid rain were well-enough established to warrant remedial action. The group formed the Alliance for Acid Rain Control to seek a pragmatic, consensus-based solution that could win broad support from government, industry, and the environmental community.

Last fall, Congress finally enacted long-overdue clean air legislation. The acid rain program, part of the Clean Air Act Amendments of 1990, embodies the major policy principles supported by the Alliance for Acid Rain Control: reducing national sulfur-dioxide

emissions by 10 million tons below 1980 levels, giving industry the flexibility to choose the cheapest means for reducing emissions and making polluters pay for their own cleanup.

Nevertheless, some producers of high-sulfur coal and some midwestern utilities still contend that the American public was misled when acid rain legislation was enacted last year. Most recently they have argued that the soon-to-be-released final NAPAP report concludes that acid rain is not a catastrophic environmental problem. The NAPAP study concluded that the number of acidic lakes has grown only

slightly over the last 10 years and that forest damage from acid rain has been limited to high-elevation stands.

These arguments recently received a wide public airing on CBS's "60 Minutes." Unfortunately, the program's coverage seemed to imply that legislation and remedial action were needed only if acid rain is an environmental "catastrophe." This approach misses the main point: If acidification of lakes has not become much worse over the last decade, this does not negate the need to address the problem we already had 10 years ago.

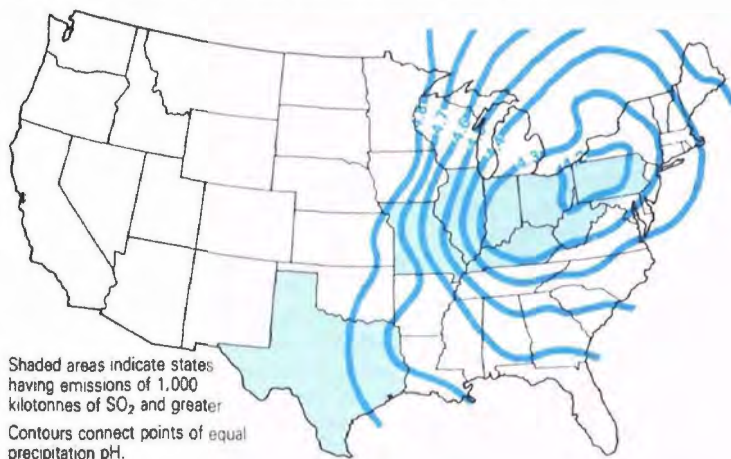
Acid rain control will provide significant environmental benefits. In 1989 testimony before Congress, NAPAP Director Jim Mahoney agreed that a 10-million-ton emission reduction "would benefit aquatic resources and would mitigate other environmental effects caused by acidic deposition and its precursors."

"The only question," as he later noted for the *Washington Post*, "is how much reduction is appropriate and how much benefit are we going to get from the cost."

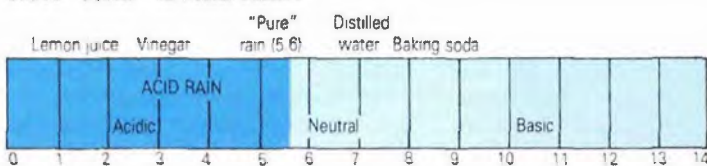
All available evidence suggests that the recently enacted acid rain legislation was indeed a response commensurate to the environmental threats at hand. A recent analysis by Resources for the Future, a leading research organization, suggests that the benefits of acid rain control will be worth roughly \$5 billion a year, about 50 percent greater than the costs of controlling acid rain. Similarly, a 1988 EPA analysis found that the benefits of reducing sulfur dioxide emissions outweigh the costs.

A decade of research has refined our scientific understanding of acid rain. But nothing we have learned in the past decade contradicts the basic conclusion that the combined impacts of acid rain are significant enough to warrant measured action to reduce it. President Bush and the Congress should be congratulated for taking such action last year. □

U.S. Areas Where Precipitation is Below pH5



How "Acid" is Acid Rain?



The pH scale ranges from 0 to 14. A value of 7.0 is neutral. Readings below 7.0 are acidic, readings above 7.0 are alkaline. The more pH decreases below 7.0, the more acidity increases.

Because the pH scale is logarithmic, there is a tenfold difference between one number and the next one to it. Therefore, a drop in pH from 6.0 to 5.0 represents a tenfold increase in acidity, while a drop from 6.0 to 4.0 represents a hundredfold increase.

All rain is slightly acidic. Only rain with a pH below 5.6 is considered "acid rain."

Source: *Meeting the Environmental Challenge: EPA's Review of Progress and New Directions in Environmental Protection* (Dec. 1990).

Acid Rain: The Strategy

by Eileen Claussen

Title IV of the 1990 Clean Air Act Amendments, which contains comprehensive provisions to control the emissions that cause acid rain, represents a legislative breakthrough in environmental protection. To begin with, it is the first law in the nation's history to directly address the problem of acid rain. The legislation calls for historic reductions in sulfur dioxide emissions from the burning of fossil fuels, the principal cause of acid rain. It also mandates significant reductions in nitrogen oxide emissions, which also contribute to the formation of acid rain. In addition, the approach embodied in the new provisions represents a radical departure from the traditional "command-and-control" approach to environmental regulation that prevailed

in this country during the 1970s and 1980s.

During those years, environmental regulations typically required industry to achieve a particular limit on each pollutant released to the environment by installing specific pollution-control equipment. The acid rain program that EPA is developing under the Clean Air Act Amendments takes a more flexible approach: It simply sets a national ceiling on sulfur dioxide emissions

Efficient use of flue gas desulfurization absorbers (FGD) can help reduce sulfur dioxide emissions. These FGD absorbers are at a coal-fired power plant.

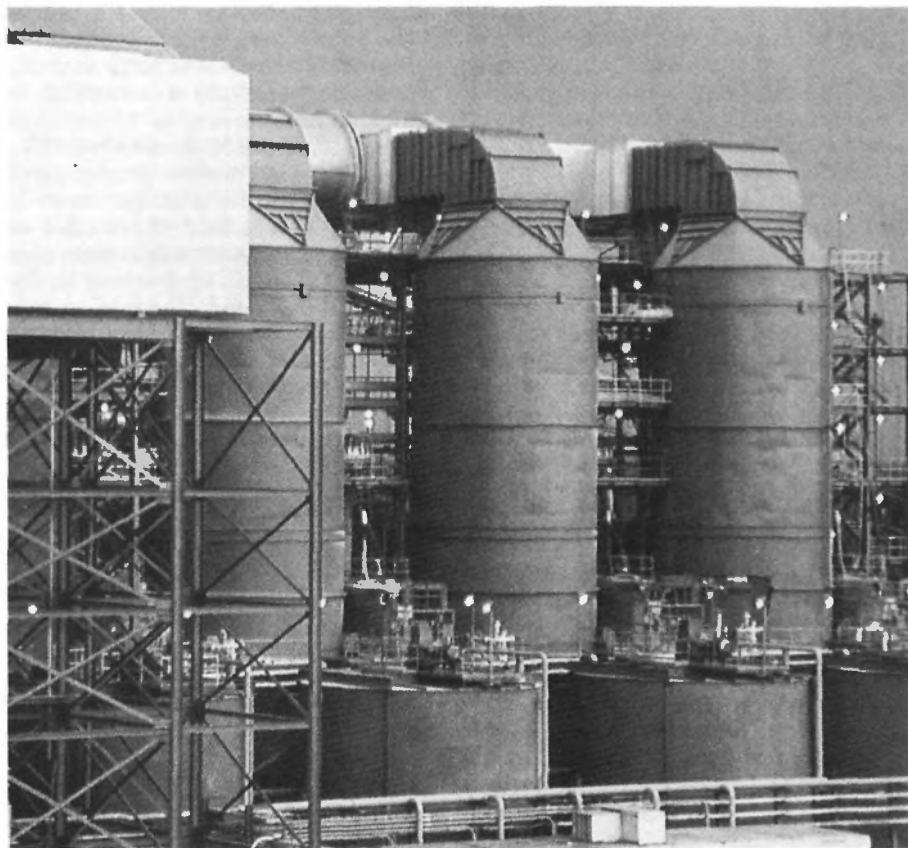
from electric power plants and allows affected utilities to determine the most cost-effective way to achieve compliance. It is estimated that this approach will result in at least a 20-percent cost savings over a traditional command-and-control program.

The legislation requires that, by the turn of century, sulfur dioxide emissions must be reduced 10 million tons annually from the levels emitted in 1980; this will amount to roughly a 40-percent reduction from 1980 levels. Because such reductions cannot be achieved overnight, EPA is implementing a two-phase approach that gradually tightens the restrictions placed on power plants that emit sulfur dioxide.

The first phase begins in 1995 and affects 261 units in 110 coal-burning electric utility plants located in 21 eastern and midwestern states. These plants are large and emit high levels of sulfur dioxide. Phase II, which begins in the year 2000, tightens the emissions limits imposed on these large plants and also sets restrictions on smaller, cleaner plants fired by coal, oil, and gas. Approximately 2,500 units within approximately 1,000 utility plants will be affected in Phase II. In both phases, affected utilities will be required to install systems that continuously monitor emissions in order to track progress and assure compliance.

The legislation also calls for a two-million-ton reduction in nitrogen oxide emissions by the year 2000. A significant portion of this reduction will be achieved by utility boilers, which will be required to meet tough new emissions requirements under the acid rain provisions of the act. These requirements will also be implemented in two phases. EPA will establish emission limitations for two types of utility boilers (tangentially fired and dry bottom, wall-fired boilers) by mid-1992; regulations for all other types of boilers will be issued by 1997. As with the sulfur dioxide emissions, these utilities will be required to install

Radian Corporation photo.



(Claussen is Director of EPA's Office of Atmospheric and Indoor Air Programs.)

The legislation calls for historic reductions in sulfur dioxide emissions from the burning of fossil fuels, the principal cause of acid rain.

equipment that will continuously monitor emissions.

The acid rain provisions also look to the future by placing a permanent cap on sulfur dioxide emissions and by encouraging energy conservation, the use of renewable and clean alternative technologies, and pollution-prevention practices. These ground-breaking provisions will help ensure that lasting environmental gains are made.

To help bring about the mandated sulfur dioxide emissions reductions in a cost-effective manner, EPA is implementing a market-based allowance-trading system that will provide power plants with maximum flexibility in reducing emissions. Under this system, EPA will allocate allowances to affected utilities each calendar year based upon formulas provided in the legislation. Each allowance permits a utility to emit one ton of sulfur dioxide. To be in compliance with the law, utilities may not emit more sulfur dioxide than they hold allowances for. This means that utilities will have to either reduce emissions to the level of allowances they hold or obtain additional allowances to cover their emissions.

Utilities that reduce their emissions below the number of allowances they hold may elect to trade allowances within their systems, bank allowances for future use, or sell them to other utilities for profit. Allowance trading will be conducted nationwide, so that a utility in North Carolina, for example, will be able to trade with a utility in California. Anyone may hold allowances, including affected utilities, brokers, environmental groups, and private citizens.

The legislation also establishes a permanent cap on the number of allowances EPA issues to utilities. Beginning in the year 2000, EPA will issue 8.95 million allowances to utilities annually. Although the lowest-emitting plants will be able to increase their emissions between 1990 and 2000 by roughly 20 percent, these utilities may not thereafter exceed their year-2000 emission levels.

Utilities that begin operating in 1996 and beyond will not be allocated

allowances. Instead, they will have to buy into the system by purchasing allowances. This will effectively limit emissions even as more plants are built and the combustion of fossil fuels increases. These measures will help ensure that the benefits gained from the emissions reductions will not be eroded over time.

The allowance allocation for each unit affected by Phase I of the new law is listed in the legislation. An individual unit's allocation is based on a standard formula: the product of a 2.5-pound sulfur dioxide per million Btu emission rate multiplied by the unit's average fuel consumption for 1985-87.

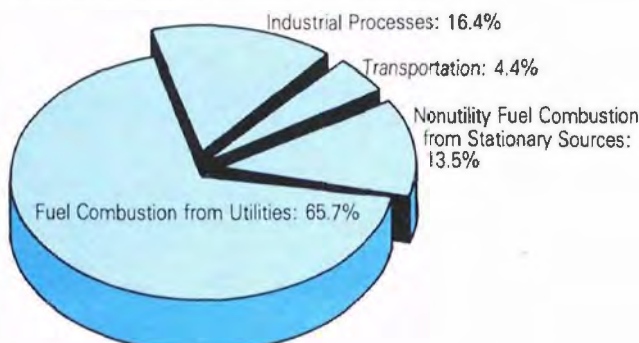
To illustrate how the allowance trading system will work, consider the following hypothetical example. Based on the list provided in the legislation, Utility X is allocated 40,000 allowances a year in Phase I. However, because the plant is presently emitting 80,000 tons of sulfur dioxide annually, it will need an additional 40,000 allowances to continue operating in the same manner. In the past, under a traditional approach, Utility X would have been required to reduce its emissions to the 40,000-ton allowance by installing pollution-control equipment or switching to fuel containing less sulfur. The Clean Air Act Amendments provide the utility a great deal more flexibility, as well as a reward for reducing emissions below the

40,000-ton limitation.

For example, instead of installing pollution-control equipment, Utility X might choose to purchase 40,000 allowances from another utility that has allowances to spare. Utility X would also have the option of instituting conservation measures that would reduce both electric generation and emission levels, thereby reducing the need for allowances. Finally, the plant might obtain allowances by purchasing them at auctions or sales, which EPA will conduct each year beginning in 1993 to facilitate trading. Auctions and sales will establish a market price early on and provide assurance to both new and existing facilities that allowances will be available to them.

The allowance system provides incentives for power plants to reduce their emissions substantially more than is required since allowances freed by installing pollution-control equipment can be sold for profit. If Utility X installed control technology that removed 90 percent of the sulfur dioxide from its original 80,000-ton emission, it would need only 8,000 allowances to continue producing the same amount of electricity. Since Utility X is allocated 40,000 allowances a year in Phase I, it would have excess allowances of 32,000 per year for the duration of Phase I. These allowances could be sold to other power plants that find it more cost-effective to comply with the law by purchasing

Utilities are the Primary Source of Sulfur Dioxide Emissions



Source: Office of Air and Radiation, EPA

The allowance system provides incentives for power plants to reduce their emissions substantially more than is required . . .

allowances rather than by installing pollution control equipment. The allowances could also be sold to new utilities or banked for future use.

EPA's role in allowance trading will be to receive and record allowance transfers and also to ensure at the end of the year that a utility's emissions did not exceed the number of allowances held. When two parties agree to an allowance transfer, their formally designated representatives will notify EPA in writing to make it official. EPA will record the transaction by entering it into an automated allowance tracking system, but will not otherwise participate in the trading process. The tracking system that will be developed by the Agency over the next two years will monitor compliance by keeping records of allowance holdings and the status of allowances traded. EPA will be writing regulations for such issues as calculating and allocating allowances, for the mechanics of allowance transfers, for allowance tracking, and for the operation of reserves, sales, and auctions.

EPA will maintain a reserve of 300,000 special allowances that will be allocated to utilities that develop qualifying renewable energy projects or use conservation measures. This reserve will be established by reducing Phase II allowances by 30,000 allowances annually over a 10-year period from 2000 to 2009. The allowances will be granted to utilities on a first-come, first-served basis starting in 1995 for conservation activities initiated after 1992. In addition to this reserve, EPA will be considering other mechanisms for promoting the use of conservation and renewable energy. The allowance system itself also creates an inherent incentive to conserve energy and promote efficiency, since for each ton of emissions reduced, there is one less allowance a utility will have to purchase or use to meet its allotted emission level.

EPA will also maintain a reserve of allowances for auctions and sales by withholding 2.8 percent of the total allowances each year for this purpose. Auctions and sales will be open to anyone. For the auctions, bidders will send in sealed bids specifying the

number of allowances they are requesting and the price. Auction allowances will be sold on the basis of bid price, starting with the highest-priced bid and continuing until all allowances for sale have been sold. A limited number of allowances will also be available for sale on a first-come, first-served basis at a fixed price of \$1,500 an allowance.

The legislation provides a strong incentive for utilities to comply with the law and not exceed their allowances. Utilities that do exceed their allowances must pay a \$2,000-per-ton excess emissions fee and then offset the excess emissions in the following year. Since the excess emissions fee will substantially exceed the expected cost of compliance through the purchase of allowances, EPA expects that the market will do much of the work of ensuring compliance with the mandated reduction requirements.

To keep track of emissions and trading activity, as well as to ensure compliance with the various provisions of the statute, each utility plant will be required to have an operating permit that spells out the specific program requirements that apply to the plant. These program requirements include sulfur dioxide and nitrogen oxide limits as well as emissions monitoring and recordkeeping and reporting procedures. The plant must also develop a compliance plan that specifies the company's choice of one or more of the compliance methods authorized under the act.

To facilitate cost-effective allowance trading, EPA will not require that permits and compliance plans be amended each time a utility engages in trading. The Agency will instead depend largely on allowance- and emissions-tracking to monitor compliance.

Recognizing the innovative nature of the Clean Air Act Amendments, EPA has established an equally creative process for developing and implementing the acid rain program. Several months before the amendments were signed into law, EPA asked for public assistance in selecting individuals to serve on an Acid Rain

Advisory Committee. The purpose of the committee is to provide expert advice on all issues related to the development and implementation of the program. EPA received over 150 nominations and selected a uniquely qualified team of approximately 40 individuals to serve on the committee. These individuals include representatives from public utility commissions, state air pollution control agencies, the utility industry, consumer groups, environmental groups, and the pollution control industry. The committee held its first meeting in December 1990, less than one month after the amendments were enacted. The input from this committee, together with feedback from all the affected groups, will help to ensure the development of a workable program.

The acid rain provisions of the Clean Air Act Amendments are already being viewed around the world as the prototype for tackling emerging environmental issues in a more cost-effective manner. EPA has no doubt that this innovative program will fulfill its early promises. Even now, more than four years away from required compliance with presently unwritten rules, utilities are embarking on energy conservation programs and planning to install pollution-control equipment that can remove 95 to 98 percent of the sulfur dioxide being emitted.

More surprisingly, high-sulfur coal producers are discussing the possibility of buying allowances to sell with their coal to make it more marketable, and manufacturers of emission-control equipment are examining the possibility of buying allowances to sell to utilities that will need to cover excess emissions while their technology is being installed. The potential markets for these allowances are truly growing daily. But, in fact, this was the idea behind the allowance system: to harness the creativity and incentives of the free market to achieve significant reductions of acid-rain-causing emissions at the lowest possible cost. □

Urban Air Quality: The Problem

by John A. Paul



George Rose photo. Gamma Liaison.

Six out of every 10 people in the United States today live in an area which fails to meet air quality standards that have been set to protect human health. That may come as a shock to most, but it is a fact. This situation exists despite two decades of efforts to control air pollution in the country. Why? What is causing the air pollution problem? What do we need to do in the future to get clean air to breathe? This article will attempt to answer these questions.

Under the 1970 Clean Air Act, EPA established national standards for six pollutants: ozone, carbon monoxide, sulfur dioxide, nitrogen dioxide, lead, and particulate matter. State and local air-pollution control agencies measured air quality for each of these pollutants and, in cooperation with each other and with the federal government, wrote and implemented plans to meet the standards. The formula was simple: If you measured poor air quality for a given pollutant, you controlled the

sources of that pollutant until the air was clean. In large part, this formula worked. Air pollution sources were controlled, and air quality improved.

In many cities the results have been dramatic. Compare Pittsburgh or Stuebenville, Ohio, today to what they looked like 20 years ago, and you can see the difference clearly. On the other hand, when you consider an area such as Los Angeles, you might well ask whether any progress has been made at all.

Most people, when asked about air pollution in Los Angeles, will immediately think of smog. When questioned about the causes of this smog, they will likely point to lots of people, lots of cars, and massive congestion.

However, most people fail to recognize the extent of the nation's smog problem outside the Los Angeles area. Los Angeles may indeed be the "king" of smog, but it is only one city out of 96 that fail to meet the standards for ozone, which is the principal component of smog. These cities are spread across the United States, from Southern California to Maine. In fact, it is difficult to name a major city which

does not violate the ozone standard. Moreover, 41 areas fail to meet the carbon monoxide standard, and 72 areas do not meet the standard for PM-10 (particulate matter with a diameter less than or equal to a nominal 10 microns). All this after 25 years of air-pollution control. Why?

In answering this question, considerable Congressional testimony was offered by EPA, local, and state officials at hearings in Washington and around the country. The reasons given for the large number of nonattainment areas included:

- Understatement of pollution-emission inventories as compiled by states and locals and reported to EPA
- Inadequacy of mathematical models used to predict the success of various control plans
- Failure of some control measures to obtain predicted emission reductions
- Lack of political will at all levels of government to implement difficult, but necessary, control measures
- Lack of adequate resources at the federal, state, and local levels to analyze and address the problem.

(Paul is Supervisor of the Regional Air Pollution Control Agency (RAPCA) in Ohio. Located in Dayton, RAPCA has jurisdiction over six Ohio counties.)

Although Los Angeles has justifiably been dubbed the "king of smog," it is only one city out of 96 presently failing to attain the air quality standard for ozone. Concerns about this widespread problem helped bring about passage of the new clean air law.

What these reasons come down to, in my estimation, is that we simply did not control enough. In the space remaining, I will use the case of ozone to illustrate my point.

Perhaps because they thought they had gone far enough, many areas in the period from 1980 to 1982 slowed their efforts to reduce ozone levels. And, many came close to meeting the ozone standard in the middle 1980s. However, they fell back into nonattainment in 1987 and 1988.

Seventy one of the 96 cities that currently fail to meet the standard are categorized as "moderate" or "marginal" nonattainment sites. This means that their ozone problem is close to being solved. However, it will not solve itself; further control must be exercised.

What controls are necessary to solve the ozone problem in these areas? To answer that question, we need first to describe how ozone is formed in the air.

Unlike other pollutants, ozone is not emitted directly into the air by specific sources. A poisonous form of pure oxygen, it is created by sunlight acting on nitrogen oxides and volatile organic compounds in the air. Often, these gases are emitted in one area but the actual chemical reactions, stimulated by sunlight and temperature, take place in another. The emissions can be carried hundreds of miles from their origins, forming high ozone concentrations over very large regions.

The most immediate and direct way of reducing ozone levels is to control emissions of volatile organic compounds (VOCs). These come primarily from three categories: point sources, "area sources," and motor vehicles. A brief discussion of each follows.

Point sources, or industries, emit air pollution from various processes that use solvents, paints, oils, and other chemicals to make a product. Emissions from point sources account for approximately 30 percent of the country's smog-forming VOCs. Such emissions are controlled by process

changes or by the addition of equipment to capture or destroy them. Control of point sources has been successful in the United States, but further controls should be specified and implemented.

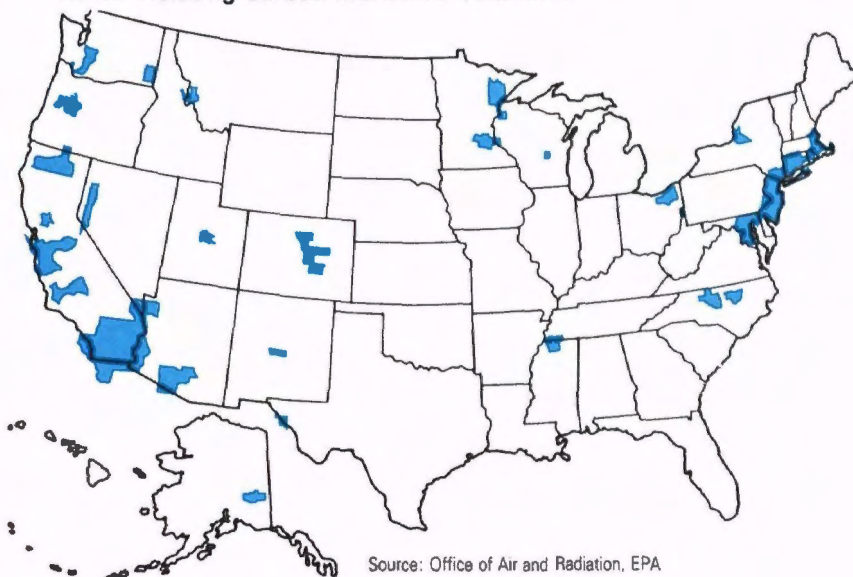
Area sources are made up of very small emitters such as small repair

shops, drycleaners, or print shops, plus a large number and variety of consumer products. Household paint, oil, charcoal lighter fluid, hairspray, and deodorants are examples of the consumer products that make up area sources. Because of their widespread use, area sources account for

Areas Violating Ozone Standards



Areas Violating Carbon Monoxide Standards



Source: Office of Air and Radiation, EPA

Based on information available at the time of publication, a total of 41 areas fail to meet the national standard for carbon monoxide. This compares with 96 areas failing for ozone (top map) and 72 areas failing for particulate matter (not shown).

approximately 20 percent of VOCs. Their control is through product substitution. Little has been accomplished to date for control of these sources.

Motor vehicles, with their vast numbers and extensive use, are the biggest source of VOCs, and they account for the remaining 50 percent of the emissions. The problem of motor vehicles is discussed fully in a separate article; however, I would like to underscore one point. Unfortunately, although the emissions of individual vehicles have been increasingly controlled over the years, the number of vehicles and the extent of their use have increased. Current estimates predict a doubling in vehicle miles travelled by the year 2000. Measures

must be provided to give people viable alternatives to the use of personal vehicles. Otherwise, any progress we make in one area will be completely offset by increased vehicle use.

Control of all three categories of emissions—point sources, area sources, and motor vehicles—will be necessary to solve the nation's smog problem. With 133 million people living in ozone nonattainment areas, the justification for further emission controls appears obvious. Of particular interest is the challenge of bringing the 71 "moderate" and "marginal" nonattainment areas into compliance. Air-pollution control officials at all levels of government—federal, state, and local—take this challenge very seriously. □

Dan Foote, Dallas Times Herald.



Urban Air Quality: The Strategy

by John Seitz

The 1977 amendments to the Clean Air Act set 1987 as the last deadline for metropolitan areas to meet health-based standards for air quality. As indicated in the previous article, many areas still violated the standards after that deadline, and they continue to do so today.

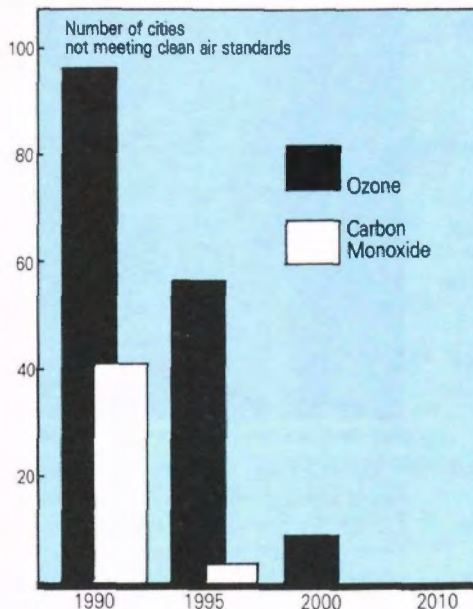
This continuing nonattainment problem is a clear signal that more needs to be done, but how can we be sure that what we do this time will bring better results? The 1990 Amendments contain at least three answers.

First, the previous "one size fits all" approach has been discarded. It is replaced by a system that recognizes the different degrees of nonattainment. Controls will be made increasingly stringent as the severity of the problem increases. Deadlines are set that will allow the areas with the worst problems to take more time to reach attainment.

Second, a blend of technology-based control and long-term planning is required by the new law. This approach gives us a quick start in that it calls for everyone, across the board, to apply specific controls to certain air-pollution sources. For the more difficult problems, the ones that will take more time to solve, it also calls for more sophisticated planning, planning that will provide more intensive controls.

Third, the possibility of not attaining the standards within prescribed dates, of areas failing to meet deadlines and milestones, is anticipated. The earlier legislation assumed that deadlines would be met and provided no guidance on what to do if they were not. The 1990 amendments carefully spell out the consequences.

Projected Urban Air Quality Benefits



Source: Office of Air and Radiation, EPA

Classification and Size of Areas

The new law establishes a classification system that groups nonattainment areas with similar air quality problems together. Areas within each classification apply similar control measures and share the same attainment deadline. In this way, control measures are more closely tailored to problems than was the case in the past.

Areas are officially designated by EPA as either attainment or nonattainment. If there are insufficient data, they are designated unclassifiable. Once designated nonattainment, an area is classified according to its "design value," a numerical value which represents the area's air quality condition. Congress specified five classifications for ozone: marginal,

moderate, serious, severe, extreme. It specified two classifications for carbon monoxide and for particulate matter: moderate and serious.

The designation/classification process is quite elaborate, and this article will not attempt to describe it. One important date to remember is July 15, 1991, the 240th day after enactment. On that day EPA will announce the designations of most areas. Those areas already having nonattainment status on the date the new law was enacted (November 15, 1990) were automatically designated nonattainment by operation of law.

Geographic size has been a problem for some areas because they haven't been large enough to include all of the emissions that contributed to their being designated nonattainment. The 1990 amendments require that serious, severe, and extreme ozone nonattainment areas be bounded by the same limits that mark the metropolitan statistical area (MSA), or the consolidated metropolitan statistical area (CMSA), unless the state can show that peripheral districts do not contribute significantly to the problem. MSAs are areas that contain similar population densities, commuting patterns, commercial and industrial bases, and the like. MSAs in close proximity are sometimes grouped together into CMSAs because of the social and economic interaction within an entire region. The Office of Management and Budget identifies MSAs and CMSAs.

Control of Ozone

Ozone controls begin with marginal areas, where the states must first of all complete commitments they made previously. In general, this means that measures EPA has defined as being "reasonably available control

(Seitz is Director of EPA's Office of Air Quality Planning and Standards.)

technology" (RACT) must be applied to a wide range of stationary sources, including auto painting, paper coating, and dry cleaners.

Measures such as these, plus the measures applied by EPA to motor vehicles (see article on page 15), are expected to bring marginal areas into attainment by November 1993.

Moderate areas face tougher requirements. To begin with, they must do everything that marginal areas are required to do. Then, they must plan to reduce emissions of volatile organic compounds (VOCs) by 15 percent within six years. This means the states must adopt and carry out rules that reflect all existing and future EPA control techniques guidelines (CTGs) for major sources; they must adopt and implement motor-vehicle refueling regulations to control emissions at the gas pump; and they must set up a motor vehicle inspection/maintenance (I/M) program if one is not already in place. Moderate areas are expected to reach attainment by November 1996.

Serious areas must do everything required in marginal and moderate areas, plus they must plan to reduce VOC emissions 3 percent a year after six years. They may control sources of nitrogen oxides, instead of VOC sources, if the result is at least equivalent in terms of ozone reduction. Further, serious areas must use more sophisticated mathematical air quality models to demonstrate attainment, and if their population is greater than 200,000, they must set up an enhanced I/M program within two years. Enhanced I/M requires the use of computerized analyzers and centralized inspection facilities. Most serious areas will also have to implement a clean fuels program. Serious areas are expected to reach attainment by November 1999.



South Coast Air Quality Management District photo.

Severe areas have 15 to 17 years to reach attainment. They are responsible for all the previously mentioned controls; they must also take steps to offset growth in vehicle miles travelled (VMT) and, if the area still fails to attain, adopt requirements for fees on major sources. Further, in the nine worst ozone areas refineries will be required to manufacture gasoline that yields lower levels of the pollutants that go into the formation of ozone.

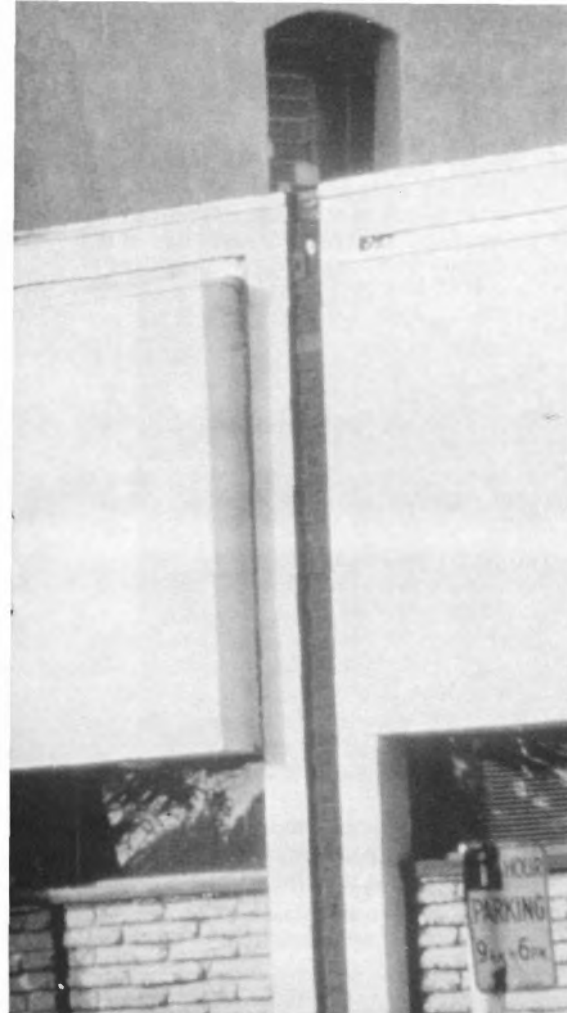
Only one area—Los Angeles—is in the extreme category. Besides implementing all of the previously mentioned controls, extreme areas will have to apply their new source review and RACT regulations to smaller stationary sources. Extreme areas must also phase in requirements for motor vehicles which emit extremely small amounts of air pollution. The attainment deadline for extreme areas is November 2010, 20 years after enactment.

In addition to the above requirements, which state and local agencies must fulfill, EPA must develop certain federal measures. Within three years the Agency must issue 13 new CTGs, including ones for aerospace

coating and shipbuilding operations, and must review all existing CTGs. Also within three years, EPA must publish alternative control techniques (ACT) documents for VOC or nitrogen oxide sources that emit over 25 tons per year. The documents will recommend levels of control for these sources. A federal rule on marine-vessel loading and unloading is due within two years. Finally, within three years the Agency must complete a study of commercial and consumer solvents. The study is to focus on the emissions given off by the use of these and on the options for controlling such emissions. Federal regulation of these emissions is required in subsequent years.

Transport Regions

The 1990 amendments also focus on the problem of ozone and its precursor gases being transported long distances. Many areas face air quality problems that are totally or partially caused by sources not in their jurisdiction. The act establishes a transport commission for the Northeast, and it allows the establishment of commissions in other parts of the country. Generally speaking, an entire transport region, including its rural areas, is subject to the same requirements as moderate areas.



Some small businesses, such as painting enterprises, may be affected by regulations in cities and states with nonattainment problems.

Control of Carbon Monoxide

Carbon-monoxide controls work similarly to ozone controls. However, as mentioned earlier, there are only two classifications—moderate and serious.

All moderate areas must inventory their emissions, set up vehicle I/M programs, and make oxygenated fuels available to motorists. Oxygenated fuels contain alcohol or other compounds that reduce carbon-monoxide emissions from cars. Moderate areas may also have to prepare forecasts of VMT, set up enhanced I/M, and demonstrate that they have reached attainment. All moderate areas are expected to reach attainment by the end of 1995.

Serious areas must take all the steps required for moderate ones, plus they must institute transportation control measures that will offset VMT growth. Serious areas have until the end of 2000 to reach attainment.

Control of Particulate Matter

The 72 areas designated as moderate nonattainment for particulate matter

(PM-10) range from large cities like Denver, Phoenix, Las Vegas, and Los Angeles to very small towns such as Presque Isle, Maine; Aspen and Pagosa Springs, Colorado; Anthony, New Mexico; and Wallula, Washington.

In the East, violations of the PM-10 standards are often caused by emissions from industrial sources. In the West, smoke from residential wood combustion and dust from roadways, construction, and agricultural activities often cause violations.

Particulate emissions from industrial sources can be reduced by applying control technology or making changes in manufacturing processes. Smoke from residential wood combustion can be reduced by measures such as using EPA-certified stoves, practicing routine stove maintenance, and burning dry wood. In many areas, it is necessary to curtail use of woodstoves and fireplaces to avoid PM-10 violations at times when the air flow is stagnant.

Attainment plans for the 72 designated areas are due by November 15, 1991. These plans must include the implementation of RACT measures and must demonstrate that the areas will attain the PM-10 standards by December 31, 1994. Areas that cannot attain by the end of 1994 will be reclassified as *serious nonattainment* areas, and more stringent controls will apply.

Consequences of Failing to Attain

A major distinction between the 1990 amendments and the earlier legislation is that the new law specifies the consequences of missing deadlines and milestones.

For missing emission-reduction milestones, the remedies include "bumping up" to the next higher classification, which means having to meet the requirements of that classification. Additional measures to meet the next milestone may be called for, and an economic incentive program may be put in place.

If a state fails to submit a plan, or its plan is disapproved or isn't implemented, EPA has the choice of restricting federal highway funds or requiring that new sources offset by twice the pollution reductions called for but not achieved by existing sources. At least one of these sanctions is to be applied if the state fails to correct the problem within 18 months. A second sanction will also apply if the failures are not corrected then or in cases where EPA finds there is lack of a "good faith" effort on the part of the state. If the corrections are not made within two years, EPA has the power to promulgate a plan in place of the state plan.

If the attainment date is missed, an area is "bumped up" to the next higher classification, except for severe and extreme ozone areas. The latter receive several other penalties, including an excess emission fee program. The specificity of these sanctions should remove any ambiguity about the consequences of failure to meet milestones.

The requirements of the 1990 Clean Air Act Amendments reflect a more realistic picture of today's air quality problems than did earlier legislation. At the same time, the amendments present an ambitious agenda for EPA and our partners in this "joint venture" on behalf of clean air: state and local government, business and industry, and the American public. The amendments also provide us with improved tools so that, this time, we will be able to achieve our statutory goals and leave a legacy of clean air for the generations to come. □

Air Toxics: The Problem

by Senator David Durenberger

Coke ovens used in making steel are a major source of toxic air pollutants; the problem of regulating air toxics figured prominently in the debate over the new air quality statute. Shown is one of the nation's large coke oven complexes at USX Clairton Works in Pennsylvania.

Two kinds of pollutants are regulated under the Clean Air Act. There are only six in the first group, but they are discharged in relatively large quantities by a variety of sources, and they threaten human health and welfare across broad regions of the country. EPA sets national standards for each of these "criteria pollutants." The states must take action to assure the standards are met. Failure to meet the standards is called "nonattainment."

The other kind of pollutants—and there are literally hundreds in this second group—are the ones that are immediately hazardous to human health and that are, for the most part, associated with certain, specific sources. Some of these air toxics are cancer-causing; some produce other health and environmental problems. The threat is highest for people living near large industrial facilities or in heavily polluted urban corridors.

The list of toxics emitted into the air is a long one, and it includes some familiar names. Benzene, for example, is a potent cancer-causing substance. Gasolines sold in the United States are on average 1.6 percent benzene. Eighty-five percent of human exposure to benzene comes from gasoline.

A second example is mercury. Mercury is a metal found in trace amounts in coal; it is released to the air when the coal is burned. Mercury is also released by incinerators burning garbage. It is used in latex paints to prevent mildew; as the paint weathers, substantial amounts of mercury may be released into the air.

Ammonia, a familiar chemical, is widely used in industry. In fact, it is emitted by major manufacturing plants in 30 different industrial groups. It is also a fertilizer and is distributed broadly in commerce for that purpose. Although low exposures to ammonia are safe, high exposures can burn the eyes, skin, and lung tissue. Ammonia emissions in 1987 were larger than the emissions of any other air toxic.

The fluid that dry cleaners use to clean our clothes is a suspected carcinogen and is released in large amounts to the air. So is the solvent that hospitals use to sterilize equipment.

The list of air toxics touches every major industry, from the mining of base metals to the manufacture of high-tech electronics. And the amounts of these substances discharged to the air are, in some cases, staggering.

Recently, under the Emergency Planning and Community Right-to-Know Act of 1986, major manufacturing facilities in certain industrial sectors were required to report to EPA their emissions of 359

toxic substances. The total amount of emissions reported for the year ending July 1987 was 2.7 billion pounds. That is estimated to be about one-fifth of all air toxics emissions. Texas had the largest total, 240 million; Ohio, 173 million; Louisiana, 138 million; Tennessee, 135 million; and Virginia, 132 million pounds.

Not surprisingly, individuals living near large industrial facilities or in highly developed urban areas experience high risk of health problems.

EPA, for example, examined cancer risks at more than 2,600 industrial facilities across the United States. For

Health Effects of Regulated Air Pollutants

Criteria Pollutants	Health Concerns
Ozone	Respiratory tract problems such as difficult breathing and reduced lung function. Asthma, eye irritation, nasal congestion, reduced resistance to infection, and possibly premature aging of lung tissue.
Particulate Matter	Eye and throat irritation, bronchitis, lung damage; also impaired visibility.
Carbon Monoxide	Ability of blood to carry oxygen impaired; Cardiovascular nervous and pulmonary systems affected.
Sulfur Dioxide	Respiratory tract problems, permanent harm to lung tissue.
Lead	Retardation and brain damage, especially in children.
Nitrogen Dioxide	Respiratory illness and lung damage.

Hazardous Air Pollutants

Asbestos	A variety of lung diseases, particularly lung cancer.
Beryllium	Primary lung disease, although also affects liver, spleen, kidneys, and lymph glands.
Mercury	Several areas of the brain as well as the kidneys and bowels affected.
Vinyl Chloride	Lung and liver cancer.
Arsenic	Causes cancer.
Radionuclides	Causes cancer.
Benzene	Leukemia.
Coke Oven Emissions	Respiratory Cancer.

Source: *Meeting the Environmental Challenge: EPA's Review of Progress and New Directions in Environmental Protection* (Dec. 1990).

(Durenberger (R-Minnesota) serves on the Senate Committee on Environment and Public Works and was a key figure in the development of the air toxics provisions of the new law.)



John Ficarra photo.

the people living nearest to more than one-quarter of these plants, toxic emissions produced cancer risks greater than 1 in 10,000: that is, 1 additional cancer for each 10,000 persons. If these sites were abandoned waste dumps, they would qualify for cleanup under the federal Superfund program.

A 1987 South Coast Air Basin study found that the mix of air pollutants from industry, highway fuels, and small business produced a cancer risk in the Los Angeles area of greater than 1 in 1,000. Based on the actual ambient concentrations recorded as part of the study, cancer deaths due to air toxics, alone, were projected at 222 per year.

In addition to the fact that air toxics increase the risk of cancer and produce other adverse health effects, they cause widespread environmental degradation. It is estimated, for example, that a large percentage of the toxics in the waters of the Great Lakes (up to 80 percent in Lake Superior) are deposited from the air, rather than from surface runoff. Lakes all across the northern tier of the United States are posted with warnings for pregnant women and children because of the high mercury levels found in fish. The mercury is attributed to emissions from coal-fired powerplants and to municipal incinerators.

Another aspect of the air-toxics problem is the sudden and potentially catastrophic chemical accident. It seems the headlines are continuously filled with stories of explosions and fires at chemical plants and oil refineries. For the period 1982 to 1986, EPA released in August of 1988 an Acute Hazardous Events Data Base

covering 11,048 events in the United States in which extremely hazardous substances were released accidentally. These events caused 309 deaths, 11,341 injuries, and the evacuation of 464,677 people from homes and jobs.

As part of its work on the database, EPA analyzed 29 events that had the highest potential for damage to health and the environment. They were compared to the release at Bhopal, India, which killed 3,000 and injured over 200,000 in 1984. Considering only the toxicity and volume of the chemicals released in the U.S. events, 17 had the potential for more damage than Bhopal, and all 29 had a potential of 50 percent or more of the Bhopal effects. That relatively few were killed or injured in these accidents (650 were injured in one event and 5 killed in another) is due principally to the location of the facilities, the climate, and the operating conditions at the time of the release.

The Clean Air Act of 1970 required EPA to list each hazardous air pollutant that was likely to cause an increase in deaths or in serious illnesses. Within a year after listing, EPA was to establish emission standards that would apply to sources of the listed pollutant.

The law has not been implemented. In 20 years EPA has listed only eight pollutants: mercury, beryllium, asbestos, vinyl chloride, benzene, radionuclides, inorganic arsenic, and coke-oven emissions. By way of comparison, OSHA regulates 500 toxic chemicals in the workplace, and the handful of states with air toxics programs have regulated 708 substances.

The problem under the 1970 law has been, in part, a disagreement about the regulation of cancer-causing pollutants. The law included a very stringent health standard for air toxics: EPA was to provide an "ample margin of safety to protect public health." EPA has been unable, or unwilling, to define a safe level of exposure to cancer-causing substances. And the other approaches to standard-setting which it has tried, including cost-benefit calculations and proposals to defer toxics regulation to the states or to other environmental laws, have met stiff public opposition.

The air toxics program also suffered from the general attack on environmental regulation which dominated the agenda of the executive branch in the early 1980s. Health effects research begun in 1977 on 30 of the most threatening toxic pollutants was put on hold. Congressional oversight during the 1980s brought promises that the program would be revitalized, but only one additional pollutant was listed.

In the 1990 Clean Air Act Amendments, Congress turned to technology-based standards to get the program moving again. The new law specifically lists 189 toxic pollutants and establishes a schedule requiring EPA to set standards for all major sources of those pollutants over a 10-year period. A further provision requires major sources to install best technology even if EPA fails to issue the standards. The debate over "safe" levels of pollution is set aside, and the regulatory discretion, which has allowed the Agency to ignore the air toxics problem, has been withdrawn. □

Air Toxics: The Strategy

by Lydia Wegman

The air toxics program established by the Clean Air Act Amendments of 1990 is a dramatic change from the one called for previously in the 1970 law. Industrial plants from large petrochemical complexes down to the corner dry cleaner are potentially affected by the sweeping program. The key component of the program is a federal regulatory effort that includes strong incentives for innovation and pollution prevention in industry.

The new law names 189 toxic air pollutants. Typically, they are carcinogens, mutagens (substances that can cause gene mutations), or reproductive toxins, and they have as their source certain specific industries.

For the most part, these chemicals and their potential effects on human health have been known for some time. However, disputes arose between EPA, industry, and environmental groups over how to interpret the language in the 1970 act that called for their control. That language, "protect the public health with an ample margin of safety," was particularly controversial in the case of carcinogens, because they pose some risk at even very low emission levels. As a result of the disputes and the numerous lawsuits that followed, EPA was unable to fully implement the regulatory program called for in the law.

The Agency did succeed in setting standards for seven air toxics: arsenic, asbestos, benzene, beryllium, mercury, radionuclides, and vinyl chloride. Standards for coke oven emissions were in preparation when the 1990 amendments were passed.

In the 1990 amendments, the regulatory program for air toxics reflects an entirely new approach. Up front, the amendments specifically identify the chemicals that must be brought under control. EPA must



Mike Brisson photo.

Within three years, EPA must report to Congress on the deposition in lakes and rivers of air toxics such as lead and mercury. In some areas, toxic chemicals have built up in some fish to levels considered unsafe to eat. The anglers pictured are trying to catch coho salmon in Lake Michigan, one of the bodies of water affected by airborne toxics.

identify categories of the major sources of these chemicals. A major source is one that emits more than 10 tons per year of a single toxic or more than 25 tons per year of any combination of toxics. Then, the Agency must develop "maximum achievable control technology" (MACT) standards for each category over the next 10 years. These standards are to be based on the best control technologies that have already been demonstrated in these industrial categories. State and local air-pollution agencies will have primary responsibility to make sure industrial plants meet the standards.

In setting the MACT standards, EPA will look not only at pollution-control equipment, but at pollution-prevention methods, such as substituting nontoxic chemicals for the toxic ones currently in use. The new law favors setting standards that industry must achieve,

rather than dictating equipment that industry must install. This flexibility will allow industry to develop its own cost-effective means of reducing air-toxics emissions and still meet the goals of the act.

For example, for a factory that currently emits 100 tons of chloroform annually, the MACT standards might require a reduction of 95 percent, or 95 tons per year. The plant could meet this standard by eliminating the use of chloroform in their process, or by modifying the production process to be more efficient and emit less chloroform, or by adding pollution-control equipment.

It is estimated that this 10-year regulatory program will reduce air toxics annually by over 1 million tons. EPA will consider later what emissions remain in each industrial category and then determine whether further control

(Wegman is Deputy Director of EPA's Office of Air Quality Planning and Standards.)

The program will substantially decrease the number of cancer cases caused by air pollution, and it will reduce many other health effects.

is necessary to protect the health of the general public. But the MACT standards are expected to go a long way toward protecting public health and to be all that is needed in many cases.

The law includes unique incentives for industries to reduce their emissions early, rather than waiting for federal standards. Sources that reduce emissions by 90 percent or more before the MACT standards go into effect will have six additional years to comply with them. This provision should lead to significant reductions in air toxics both immediately and into the future.

For example, let's assume that our hypothetical factory were to voluntarily reduce emissions by 90 tons beginning this year. If this factory were covered by one of the earliest MACT standards developed by EPA, it would have to meet them approximately five years from now. By then, it would already have achieved a total reduction of 450 tons (90 tons per year times five years). If the reduction set by the standards is 95 percent, or 95 tons annually, then, in the six additional years that the factory has before it must comply with

the standards, it can emit a total of 30 tons more than the standards would have allowed: five tons per year multiplied by six years. But the factory has already cut emissions, under the early reduction program, by 450 tons. Therefore, the net reduction achieved by the program is 420 tons.

EPA is already working closely with industry representatives, state and local air pollution agencies, and environmental groups to encourage participation in the early reduction program. The Agency expects the program to stimulate industry to develop more cost-effective ways of controlling toxic emissions—or better yet, to prevent them entirely. At the least, EPA expects the program to bring about the necessary reductions at an even faster pace than that required by the law.

We don't know enough about some air-toxics problems to pass judgment on their significance or to decide how best to address them. For example, some air toxics, such as mercury and lead, last a long time in the environment. If emitted from industrial plants into the atmosphere, these toxics can be deposited in lakes and rivers where they can be taken in by fish and plants, thus causing significant harm to sensitive ecosystems. There is concern that this is already happening in the Great Lakes, Lake Champlain, Chesapeake Bay, and the coastal waters of the United States. The 1990 Clean Air Act Amendments require EPA to develop monitoring networks that can take measure of such problems and to report to Congress, within three years, on the problems' nature and extent, industrial sources contributing to them, and corrective actions needed.

Other provisions of the act call for the following:

- Studies by the National Academy of Sciences and EPA that will review, and recommend improvements to, techniques for estimating risks to public health from exposure to air toxics;

- A program to assess the public health risk in urban areas from the small, numerous sources of air toxics, such as dry cleaners;

- A program for the prevention of accidental releases of air toxics from industrial plants;

- The creation of a Chemical Safety Board to investigate accidental releases of air toxics from industrial plants;

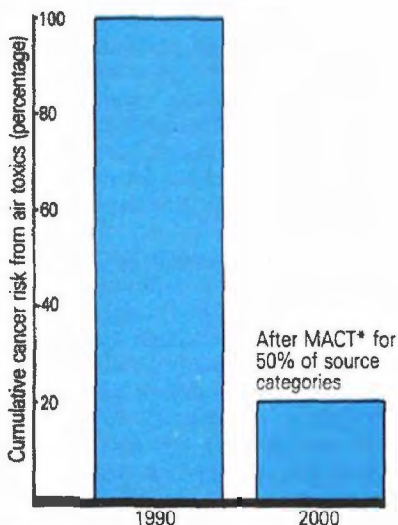
- The establishment of a National Urban Air Toxics Research Center;

- A study on air toxics emitted from electric utility power plants.

The Council of Economic Advisors has estimated that the cost to industry of the air-toxics program could be as much as \$1 billion in 1995 and \$6 to \$7 billion in 2005. These costs, however, do not take into account the program's incentives for industry to develop less costly controls or to practice pollution prevention—incentives which should reduce the costs to both industry and consumers.

On the other side of the ledger, the program will reduce emissions of air toxics by more than 1 million tons per year by 2005. The substantial benefits of these reductions are difficult to quantify. Air toxics, such as carcinogens, do their damage over long periods of time; the benefits of reducing them may not be seen for many years. Reducing the number and severity of accidental releases of air toxics also may take a number of years to achieve. Nevertheless, the program will substantially decrease the number of cancer cases caused by air pollution, and it will reduce many other health effects. Consequently, medical costs associated with these effects will be substantially diminished. □

Air Toxics: Technology Standards Will Drastically Cut Cancer Risks from Stationary Sources



*MACT: Maximum Achievable Technology Standards

Stratospheric Ozone:

The Problem

by Senator John H. Chafee

Although ozone at ground level is a toxic pollutant responsible for smog and all kinds of health and environmental problems, ozone in the stratosphere, 6 to 30 miles over our heads, is "good" ozone. While we are trying to eliminate ozone down here, we want it to stay up there.

The stratospheric ozone layer is the Earth's main shield against the Sun's ultraviolet radiation. A decrease in stratospheric ozone allows more ultraviolet rays to reach Earth. The experts tell us that this will cause increased rates of skin cancer, cataracts (the leading cause of blindness in this country), and, potentially, suppression of the immune system. If our immune systems are affected, all of us will be more susceptible to diseases of all types. Further, damage to the ozone layer presents a serious threat to our food crops by reducing crop yields. All forms of life on land and in the sea are at risk.

The problem is this: CFCs and similar compounds are persistent, extremely stable chemicals that rise up into the atmosphere intact until they reach the stratosphere. In the stratosphere, the Sun's radiation breaks the molecule apart and frees the chlorine component. The chlorine then attacks and destroys ozone.

In 1974, Drs. Sherwood Rowland and Mario Molina from the University of California published a paper demonstrating how CFCs destroy ozone in the stratosphere. There were no measurements of actual ozone loss, just the scientific theory. However, in this country the theory led to a ban on the use of CFCs in most aerosols in 1978.

Recognizing the problem, industry began to look for safe substitutes.

Progress was being made when, in the early 1980s, the threat of further government regulation subsided, the search for substitutes came to a virtual standstill, and worldwide use of CFCs continued to grow.

In 1985, scientists discovered a significant loss of ozone over a portion of the southern hemisphere the size of North America. Measurements have since revealed losses greater than 50 percent in the total column and greater than 95 percent at an altitude of 9 to 12 miles. The discovery of this "hole" over Antarctica gave renewed impetus to international efforts to understand and protect the ozone layer.

While we are trying to eliminate ozone down here, we want it to stay up there.

In September 1987, the Montreal Protocol on Substances that Deplete the Ozone Layer was negotiated and signed by more than two dozen nations. The Protocol entered into force in January 1989; 68 nations are now parties to it (at last count).

Unfortunately, shortly after the Protocol was signed, scientists observed and measured losses of ozone on a global scale, and they discovered that destruction is not limited to remote, uninhabited portions of Antarctica. Losses were measured, for example, over vast areas of this country, which brought the problem dangerously close to home.

These measurements of actual ozone loss were significantly greater than computer models had predicted, and they raised serious questions about the adequacy of the control measures set forth in the original Montreal Protocol and EPA regulations. Even the strengthening Protocol amendments that were adopted at the June 1990 meeting in London do not go far enough. Four major areas warrant further attention by national

legislatures and by the parties to the Protocol: accelerating the CFC and methyl chloroform phase-out schedules; controlling and ultimately eliminating production and use of hydrochlorofluorocarbons (HCFCs); eliminating emissions of ozone-destroying compounds; and implementing effective trade sanctions. Each of these areas is covered by the Clean Air Act Amendments of 1990.

The natural concentration of chlorine in our atmosphere is 0.6 parts per billion. When the "hole" over Antarctica was discovered in 1985, we were up to around 2.5 parts per billion—largely due to emissions of CFCs, methyl chloroform, and similar chemicals. Today, we are at more than 3 parts per billion, a record high level, and going up. Action to halt this pattern has not come too soon.

The United States is the largest producer and user of ozone-depleting chemicals in the entire world. Even though we banned aerosol uses in 1978, our per-capita consumption continues to exceed that of Western Europe, Japan, the Soviet Union, China, and India by a substantial margin. We use CFCs as refrigerants in home appliances, automobile air conditioners, and commercial heating and cooling systems. We use them as blowing agents in the manufacture of furniture cushions and packaging materials. We use methyl chloroform as a solvent for cleaning and degreasing metals and as a component of adhesives. We created these chemicals; we have a responsibility to lead the world in eliminating them and finding safe substitutes.

EPA has estimated that the phaseout of CFCs and similar compounds scheduled in the act will benefit the entire U.S. population born before 1975 by eliminating almost 162 million cases of skin cancer, more than 3 million cancer deaths, and over 18 million cases of cataracts.

Further, the Agency has estimated that in addition to the health impacts described above, the economic and environmental benefits of the phaseout

(Chafee (R-Rhode Island) is the senior Republican on the Committee on Environment and Public Works and was the primary author of the new Clean Air Act provisions designed to protect the stratospheric ozone layer.)

in the United States will be approximately \$58 billion through 2075. This includes \$41 billion in the form of reduced damage to our food crops.

And there is another benefit. Most of us are familiar with the connection between CFCs and destruction of the ozone layer. Less well known, however, is the connection between CFCs and global climate change that is predicted to occur as a result of an intensified greenhouse effect.

The threat of uncontrolled global climate change is due to the

***We created these chemicals;
we have a responsibility to
lead the world in
eliminating them and
finding safe substitutes.***

accelerating accumulation of greenhouse gases in the atmosphere, primarily carbon dioxide, CFCs, and methane. These gases act as a thermal blanket, trapping heat in the Earth's atmosphere and causing temperatures to rise.

Carbon dioxide emissions account for an estimated 50 percent of the predicted global warming. CFCs are estimated to account for a substantial portion of the problem—from 15 to 20 percent.

The fact that each molecule of CFC has approximately 20,000 times more impact on global climate than does a single molecule of carbon dioxide makes the control of CFCs an important part of any strategy to combat global warming.

Elimination of these ozone-destroying chemicals, then, is a double winner. First, it is absolutely essential if we are to stop destroying the ozone layer. Second, it is the most effective single step we can take to curb the phenomenon known as the greenhouse effect. □



Mike Keefe. Reprinted with permission.

Mike Keefe THE DENVER POST '82

Stratospheric Ozone: The Strategy

by Stephen R. Seidel

Murray Corporation photo.



By 1992, firms that work on motor vehicle air conditioners must purchase certified recycling equipment to prevent CFC emissions from escaping into the atmosphere. Employees will be required to complete special training programs.

(Seidel is Deputy Director of the Global Change Division in EPA's Office of Air and Radiation.)

Title VI of the new Clean Air Act, "Protecting Stratospheric Ozone," represents one more significant link in the global effort to safeguard the critical part of the atmosphere that protects the planet from harmful ultraviolet radiation.

Not only was 1990 the year of this landmark legislation, but significant progress was made on the international front with the substantially strengthened requirements agreed to last June at the second meeting of the parties to the Montreal Protocol. Thus, this past year will be remembered as a turning point in the political response to the threat of ozone depletion.

Efforts to protect the ozone layer have come a long way in a short period. Following a decade of much debate and little action, a growing international consensus began developing around 1986 on the need to reduce the use of chlorofluorocarbons (CFCs) and other ozone-depleting gases. The ozone layer came to be seen as truly a global commons which would require an international response to protect it. Negotiations under the auspices of the United Nations Environment Programme reached a breakthrough in September 1987, when the Montreal Protocol was signed by 23 nations, including the United States.

In the three years since the Protocol was signed, a great deal has happened. In an almost continuous stream of events, new scientific evidence established CFCs as the cause of the Antarctic ozone hole, showed that ozone levels in the northern mid-latitudes (i.e., above the United States) had dropped more than anticipated, and revealed the potential for an Arctic ozone hole.

The international political community, faced with even greater threats of ozone depletion, stepped up its efforts to gain widespread participation in the Protocol and to strengthen its requirements. As a result, by January 1991, 68 nations had joined in the agreement. Six months earlier, at the June 1990 meeting in London, amendments had been adopted to completely phase out CFCs and halons, to add and phase out other significant ozone-depleting chemicals, and to establish a landmark fund to support developing countries' participation in meeting the control requirements of the Protocol.

The new scientific evidence also increased Congressional interest. With

broad support and widespread grassroots interest, Congress included in the new Clean Air Act major provisions which expand broadly on previous legislation aimed at domestic efforts to protect the ozone layer.

Perhaps the single most appropriate word to describe Title VI is comprehensive. Like the Montreal Protocol, Title VI restricts production of ozone-depleting chemicals, but it goes further in that it also restricts their use, emissions, and disposal.

Title VI tells companies not only what ozone-depleting chemicals they must stop making, but also establishes a program to review their proposed substitute chemicals. This section contains a phase-out schedule both for CFCs and for hydrochlorofluorocarbons (HCFCs). HCFCs are a family of chemicals that will serve as transition chemicals to replace some of the uses of CFCs. But over the longer run, HCFCs must also be eliminated because they contain chlorine.

While most of the provisions directly affect the industrial sector, consumers, too, will be affected by the provisions for mandatory recycling of car and home air conditioners and by the warning labels required on many products they buy.

Following are the major provisions of Title VI:

- **Phase-out Requirements.** The title sets out scheduled reductions leading to the phase-out of production of CFCs, halons, and carbon tetrachloride by 2000 and of methyl chloroform by 2002. It also freezes the production of HCFCs in 2015 and phases them out by 2030. Since these restrictions focus on production limitations, to the extent that these chemicals can be recovered, recycled, and reused, they may continue in commerce past the applicable phase-out date.

- **National Recycling and Emission-Reduction Program.** This section calls for EPA regulations by July 1992 formally requiring emissions from all refrigeration sectors (except mobile air conditioners) to be reduced to their "lowest achievable level." Regulations affecting emissions for all other uses of CFCs, halons, and methyl chloroform—and for all uses of HCFCs—are to take effect by November 1995. This section also prohibits any person from knowingly venting any of the controlled substances, including

HCFCs, during the servicing of refrigeration or air-conditioning equipment (except for cars) beginning July 1, 1992, and requires the safe disposal of these compounds by that date.

- **Motor Vehicle Air Conditioner Recycling.** CFCs released from car air conditioners, which represent the single largest source of emissions, are treated in a separate section of the title. The section requires that by January 1, 1992, each firm purchase certified recycling equipment and that employees operating the equipment complete a training program. To reduce emissions from do-it-yourselfers charging their cars' air conditioners, the act limits sales of small containers to individuals with proper certification.

- **Ban on Nonessential Products.** This provision prohibits the use of CFCs and other controlled substances in nonessential applications beginning November 1992. It specifically lists "silly string," commercial photographic equipment, and noise horns; it also establishes general criteria for EPA when adding products to this list. Beginning in 1994, the list will be extended to products with HCFCs.

- **Warning Labels.** To assist consumers in choosing among products and to aid service personnel in deciding when recycling and disposal are necessary, the act establishes mandatory labeling requirements on all containers holding CFCs, other major ozone-depleting chemicals, and all products containing these chemicals (refrigerators, foam insulation, etc.). Under certain circumstances, warning labels may be required on products made with, but not containing, ozone-depleting chemicals (e.g., many electronics products and flexible foams) and over a longer period of time, products made with or containing HCFCs.

- **Safe Alternatives.** To ensure that the chemicals used as substitutes for ozone-depleting substances do not themselves create environmental problems, EPA must be notified of, and evaluate, the overall environmental risks associated with the use of substitutes.

- **Federal Procurement.** While the above provisions affect primarily the private sector, this provision seeks to ensure that federal agencies take

whatever steps are possible through their procurement programs to facilitate the early, orderly transition away from ozone-depleting chemicals. The provision requires EPA to work with the General Services Administration in developing guidelines for all agencies to alter their procurement regulations to meet this title's requirements.

- **Assistance to Developing Nations.** This section provides a legislative mandate for EPA to provide technical and financial support for developing countries' participation in the Montreal Protocol. It builds on the agreement reached at the London meeting of the Protocol parties to establish a multilateral fund specifically for this purpose and authorizes U.S. contribution to that fund.

- **Methane Studies.** The final major section of Title VI goes beyond ozone protection to require a series of studies over the next two years on the potential contribution of methane to global climate change. The studies will involve developing improved inventories of the sources of methane emissions, evaluating cost-effective options for reducing those emissions,

and developing a plan for stabilizing methane concentrations.

Because it is so comprehensive, Title VI presents an enormous challenge for EPA and all affected parties. Fortunately, recent actions by the private sector provide a strong foundation on which to build. Many industries have already achieved considerable success in reducing their use of CFCs and halons; many have developed and are well along in implementing strategies to achieve further reductions.

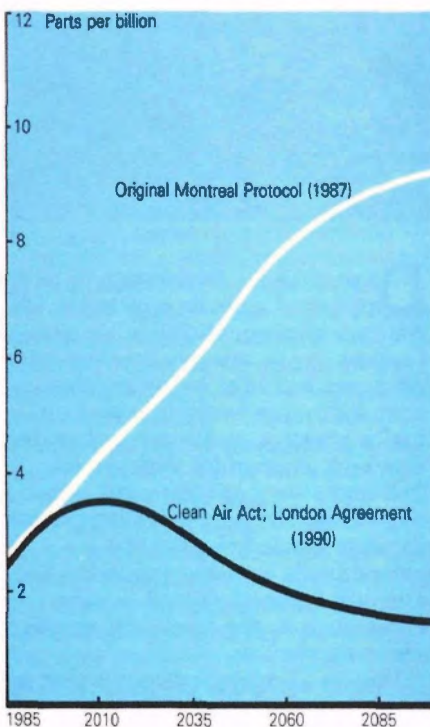
For example, many of the large electronics companies such as American Telephone and Telegraph, Northern Telecom, and IBM have announced corporate goals for a phaseout by 1994 or earlier. The auto companies expect to begin shifting to alternative refrigerants for car air conditioners beginning with their 1994 models. Voluntary recycling efforts have also played a large role in many companies' plans, a role that will expand dramatically as mandatory regulations take effect.

The Agency's existing system of marketable production permits allocated to manufacturers of CFCs provides a foundation on which EPA can build in implementing the new Clean Air Act's production limits. In the first year of regulation, actual CFC production was 23 percent below the allowable level, reflecting the success of early efforts to reduce private sector use. This sizable drop in production also reflects the impact of a tax on ozone-depleting chemicals that took effect on January 1, 1990.

In implementing Title VI, EPA will continue its efforts to use market-based approaches to regulation and to work collaboratively with industry, the environmental community, and interested state and local governments.

Despite widespread political support for a rapid and smooth transition away from ozone-depleting chemicals, the magnitude of the undertaking remains enormous. Title VI significantly strengthens EPA's hand in accomplishing this goal, but the Agency fully recognizes the need to act judiciously and to work in a cooperative spirit to solve the many problems likely to arise before we attain this goal. □

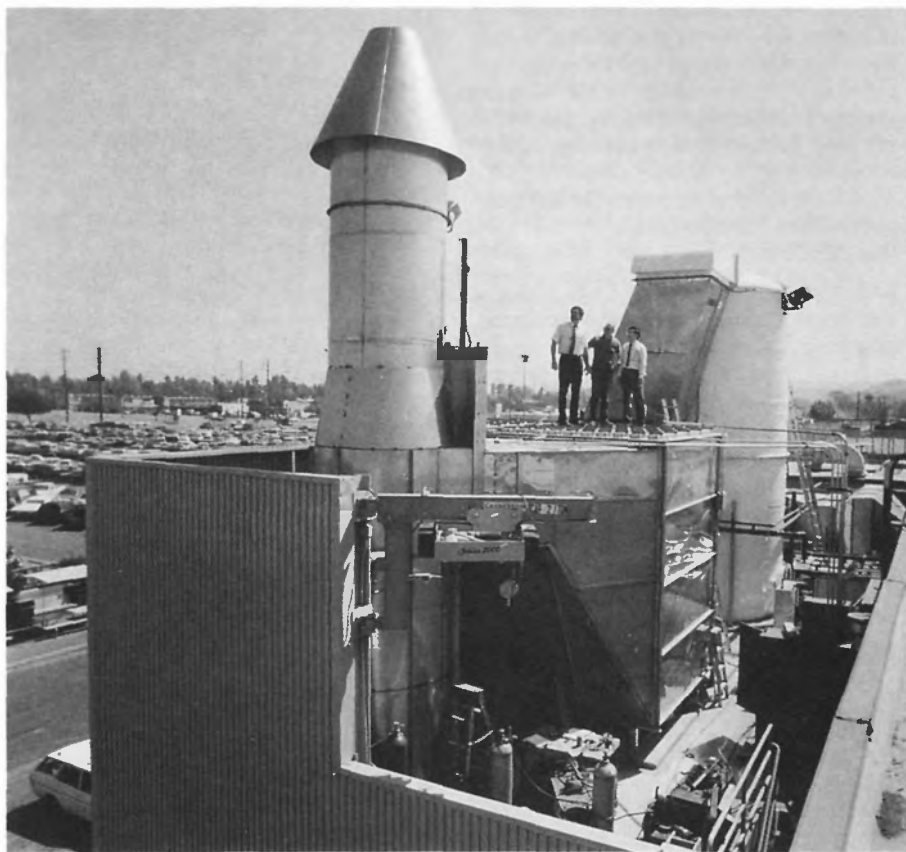
Projected Atmospheric Chlorine Concentrations (1985-2100)



Chlorine from CFCs has been linked with stratospheric ozone depletion. The new Clean Air Act and the 1990 London Agreement amending the Montreal Protocol will substantially reduce the amount of chlorine that enters the atmosphere.

Operating Permits: The New Program

by Alan W. Eckert



General Dynamics photo.

Through voluntary environmental measures, companies may qualify for reduced permit fees, which can be a significant cost item. Pictured is pollution-prevention equipment installed by General Dynamics' Pomona Division to remove airborne solvent emissions from a company paint shop.

During the long deliberations over proposed amendments to the Clean Air Act, much public attention was focused on the massive new regulatory programs included in the legislation: acid deposition controls, a new air toxics program, and a comprehensive clean-up program for widespread pollutants such as ozone and carbon monoxide. The new operating permits program created by the 1990 amendments attracted somewhat less attention; nevertheless, it is a key component in the regulatory agenda for clean air.

Why is an operating permit program needed, and where did the concept for such a program come from? To answer these questions, a little history is in order.

Since the groundbreaking 1970 amendments, the Clean Air Act has had at its core the State Implementation Plan, or SIP. These amendments were simple in concept, but dizzyingly complex in execution. Under the 1970 law, EPA set nationwide standards for the principal air pollutants of concern, the "criteria pollutants," specifying the concentrations that would be allowed in the ambient air over a given time period. (See article on page 24.) For example, the national ozone standard limits the concentration of ozone anywhere in the country to not more than 0.12 parts per million, averaged over a one-hour period. The states then identified their significant emission sources and, through mathematical modeling, determined what reductions those sources would need to make in order to meet the ambient standards.

Based on the modeling results, the states developed SIPs by rulemaking, setting out enforceable measures to achieve the necessary reductions. Through notice-and-comment rulemaking, EPA approved each state's rules or, if it disapproved them, issued a federal plan by rulemaking.

The SIP program, as it developed in practice, showed both the strength and weakness of the Clean Air Act. Strength, because the SIP system focuses on environmental results: The states need regulate only as necessary to attain the standards. Weakness, because rulemaking was necessary at both federal and state levels to establish enforceable requirements that apply to sources. That meant SIPs tended to become very detailed. Moreover, when changes were needed, rulemaking was again required at both the state and federal levels.

The typical SIP is not a single document. Instead, it may be a file cabinet full of rules, amendments to rules, detailed technical tables, and analytical and monitoring methods. A SIP is also a hodgepodge of different sorts of rules. Some rules apply only to a single facility, such as a large steam electric utility plant, while others set

(Eckert is EPA's Associate General Counsel for Air and Radiation.)



Operating permits, to be renewed every five years, will be required for facilities affected by provisions of the new Clean Air Act. Permits will spell out the clean air requirements that apply to particular facilities.

out general rules for whole classes of emission sources, such as auto-body painting shops or printing plants. Some rules set numerical emission limits; others set work practices or operation and maintenance requirements. Some include waivers for particular sources or groups of sources.

Despite the complexity, rarely is a SIP indexed or organized so that a lay person can navigate through it. Often only a handful of people in the state regulatory agency and the EPA regional office even knows where the SIP is, much less what is in it. Enforcement is hampered because sources can argue in court that, due to ambiguities in the SIP, it does not apply to them or that they are subject to different SIP limits than the government claims. SIP enforcement poses other problems. Many SIPs do not adequately identify the monitoring techniques necessary to measure compliance, and few require the sources themselves to conduct testing necessary to show compliance.

All this complexity and confusion also make it difficult to revise SIPs. State rulemaking on SIP revisions is time-consuming. In addition, further delays of at least a year (sometimes up to four years or more) are common before EPA approves a SIP revision submitted by a state. Enforcement is further hampered by these delays. When EPA brings enforcement actions against sources, it is not unusual for states to submit SIP revisions that, if approved, would bring the sources into compliance. Courts have proved reluctant to impose penalties in such cases when EPA has not yet approved or disapproved the SIP.

To address these problems, thoughtful observers have long favored a permit program for the Clean Air Act. Fortunately, there is a highly successful model ready at hand: the National Pollutant Discharge Elimination System (NPDES) program under the Clean Water Act. The NPDES program has operated effectively for over 18 years and applies to all point sources of

discharge into the nation's waters. Under that program, the regulatory requirements of the Clean Water Act are collected in a permit for each source. The permit sets out monitoring and reporting requirements. Both the permit and the source's self-monitoring reports are available for inspection in EPA regional offices. William Pedersen, former Associate General Counsel for EPA's Office of Air and Radiation, proposed in a thoughtful 1980 law review article that this program be adapted for the Clean Air Act.

That idea bore fruit during development of the President's proposed amendments to the Clean Air Act. Drafters of the bill wanted a comprehensive permit program that incorporated the best features of the Clean Water Act program while preserving the Clean Air Act's focus on environmental results. We had four major objectives:

- To make the Clean Air Act readily enforceable (see box on enforcement tools)
- To gather the information needed to measure and predict environmental results as well as to enforce the law
- To provide a clear emissions baseline to facilitate emissions trading
- To encourage the states to raise the fees necessary to support the permit program itself.

The result was Title IV of the President's proposal. With few major changes, this became Title V of the Clean Air Act Amendments of 1990. Following are the major features of Title V:

- Operating permits are required for all major sources and all other sources covered by federal regulatory programs.
- Permits must be renewed every five years.
- Permits must set forth all those requirements of the Clean Air Act that apply to the source, as well as

monitoring and reporting requirements that help enforce these requirements.

- States must develop permit programs, but EPA retains backup authority to establish a program in any defaulting state.
- EPA may veto a state permit that fails to comply with federal law; EPA must subsequently act to issue or deny the permit if the state fails to fix it after a veto.
- The states must collect a fee from permit applicants adequate to support their programs, ordinarily \$25 per ton of regulated pollutant emitted.

The permit program can never replace the SIP system. It will always be necessary to gather emission inventories, prepare mathematical models, and decide how much sources must reduce their emissions. However, with the help of the new permit program, the SIP system can be streamlined in important ways.

Initially, permits will simply translate requirements developed under other titles of the law into individualized enforceable requirements for each source. Originally, the Administration had loftier ambitions for the program: During the Congressional debates, it asked Congress to address the problem of SIP revision backlogs by allowing permits to modify SIPs. Congress rejected that approach. However, the permit program outlined in Title V will change the regulatory background against which SIPs are written in a way that will ultimately help make the process work better.

Right now, many SIP revisions, with all their attendant delays, are necessitated because SIPs contain all the detail necessary for enforcement. If some of that detail can be excised from SIPs and left to the operating permit process, not only will the system work more smoothly, but SIPs themselves can become more compact and accessible.

Permits can also facilitate emission trades. Currently, such trades must be processed as SIP revisions. If SIPs can be written so as to allow the substitution of equivalent limits through permits, subject to EPA approval in the SIP review process, environmental goals may be achieved more flexibly and at lower cost.

Title V provides a framework on which EPA can construct a permit program that works, but a great deal of work remains to be done to make this

happen. The law requires EPA to issue regulations for state permit programs by November 15, 1991—the earliest deadline in the law for an important, precedent-setting rule. To meet that deadline, we must issue proposed rules this spring. That accelerated timetable, in conjunction with the difficult issues involved, demands a creative rule-development process to enable our proposal to be as carefully thought-out as possible.

To help bring this about, William G. Rosenberg, EPA's Assistant Administrator for Air and Radiation, and E. Donald Elliott, Assistant Administrator and General Counsel, participated in a series of pre-proposal "roundtable discussions" with representatives of those who would be

most affected by the rule—states, industry, and environmental groups. As a result, the Agency has already identified many of the concerns these groups might have about alternative approaches and started identifying ways to address those concerns while meeting the law's requirements.

For example, a principal argument raised by industry against the permit program during the legislative debates is that permits would stifle industrial flexibility and innovation. Industry officials feared that the permit program would be administered in a cumbersome way. For example, one such cumbersome scenario would require modification of permits by the states, subject to public notice and comment and EPA veto, before

New Enforcement Tools Under the 1990 Amendments

—Michael S. Alushin

Civil Authorities

EPA has new authority to assess penalties without filing a court case. This new "administrative authority" allows the Agency to order payment of penalties of up to \$200,000 and to order that violations be corrected. People who get orders can request an administrative hearing (much less formal than a court proceeding) to present their side of a case. EPA can also issue "field citations" of up to \$5,000 per day. These traffic tickets will be issued to violators by EPA inspectors immediately upon finding certain types of violations. Again, recipients are entitled to an administrative hearing. A detailed schedule, with types of violations and corresponding penalties, will be published by EPA after working with the Department of Justice.

These new authorities will allow EPA to act on smaller cases without starting a federal court action. If an inspector finds that monitoring equipment is not working, for example, he can issue a ticket assessing a small fine on the spot. A routine pollution violation can be handled through orders which impose a fine and require the problem to be fixed.

The amendments expand EPA's authority to respond to emergencies by including threats to the environment. Previous authority was limited to threats to human health. When EPA does respond to an environmental emergency, it can issue an order directing the violator to correct the situation. Fines for violation of emergency orders are increased from \$5,000 to \$25,000 per day of violation. The amendments add a criminal penalty of up to five years in jail for knowing violation of an emergency order.

Congress encouraged more citizen action to supplement EPA's enforcement efforts. In the past, citizens could sue only to make a violator comply with the Clean Air Act. They can now also sue for cash penalties, which will then be used by EPA for enforcement activities. However, a federal court can order that up to \$100,000 of any penalty be used for a project to benefit the environment. EPA is working with the Department of Justice and citizen groups to develop a policy which will define permissible projects.

Congress authorized awards up to \$10,000 to citizens who provide information leading to criminal convictions or civil

companies could make changes now considered routine and made without government scrutiny (or after minimal state procedures).

In response to this concern, Congress adopted a so-called "operational flexibility" provision in the final law. This provision allows permittees to make routine changes in production or operations without a permit modification if the permittee gives seven days' notice to the state and the changes do not result in violation of specific permit emission limits. During the round-table discussion, EPA was able to develop approaches for administering this provision that address legitimate industry concerns but preserve the right of the public to

participate in the decision-making process.

This innovative roundtable technique, in short, holds great promise as a tool for developing well thought-out rules in less time than has been traditionally required. The Office of Air and Radiation is using that tool, as well as regulatory negotiation and input from formal advisory committees, to find workable solutions to key issues even before rules are proposed. □



penalties for violations of the act. State and federal employees, whose duties involve environmental laws and regulations, are ineligible.

Criminal Sanctions

For serious violations, the amendments provide up to five years (up from one year) in jail and increased fines for knowing violations of the act. Punishment for a second offense is doubled for almost all these crimes.

The amendments create a new crime for a knowing release of hazardous air pollutants which places another person in

imminent danger of death or serious bodily injury. Punishment includes up to 15 years in jail and a fine of up to \$1 million for violations by companies. Negligent releases are punishable by up to one year in jail and a fine.

The act requires that those regulated give EPA reports detailing information such as data from pollution-monitoring devices. This information is critical to the efforts of EPA inspectors, and the law makes it a criminal offense to knowingly submit false or altered reports or to tamper with pollution-monitoring devices. The amendments increase punishment for these offenses to a maximum of one year in jail (up from six months).

Other Enhancements to Enforcement

The amendments make it easier for EPA to show, in an enforcement action, that a violation has continued for a long time. Once EPA proves a violation has occurred, the number of days of violation are presumed to include the day EPA gives notice of the violation and all subsequent days until the

company/owner proves he is complying with the act. The idea behind this change is that the company/owner is in the best position to demonstrate that he is complying.

Information on what companies are putting out is crucial to EPA's enforcement efforts. Here, Congress made a number of improvements. First, the amendments make clear that EPA can require that a wide range of information be collected and submitted by those regulated. Second, EPA can require those regulated to identify the standards to which they are subject and to certify that they are complying with the standards. Finally, EPA is now authorized to use "administrative subpoenas" to compel those regulated to submit certain information needed to enforce the act. Previously, the Agency had to ask a federal court to issue subpoenas, which many times prevented timely information-gathering and enforcement of the law.

(Alushin is EPA's Associate Enforcement Counsel for Air.)

Operating Permits: Business Concerns

by John Quarles

The new operating permit program is destined to become one of the major components of the Clean Air Act regulatory framework. In a practical sense, permits will be the engine to pull the rest of the freight. They will provide the mechanism through which all other regulatory requirements are made applicable to individual facilities, and they will establish the operating limitations against which plant operators must measure compliance.

The permits, at least in theory, can provide significant benefits to the regulatory system. They will tend to force a resolution of uncertainties as to which requirements are applicable in particular cases and clarify ambiguities as to their precise meaning. They may also foster a better understanding of those requirements at the operating level. They are also expected to facilitate enforcement by collecting all of the pertinent requirements in a single document, although many critics feel that this advantage has been overblown as to its actual significance.

As an old enforcer myself, and drawing from my intensive experience in starting the federal water permit program (the National Pollutant Discharge Elimination system, or NPDES) in the early 1970s, I have reservations as to the ultimate net benefits of the air permit program. Moreover, I have deep concerns as to its prospective adverse effects.

There is an obvious need for regulatory requirements to be precisely defined, but most of the air regulations

are now effectively set forth in the State Implementation Plans (SIPs)—a component of the clean air framework which the water pollution control program never contained. I do not think the case was ever convincingly made that our continuing air pollution problems result from any failure in the requirements applicable to stationary sources being adequately defined, or adequately understood, or adequately enforced. The cause of the air pollution lies not in the administration of established requirements but in their substance. It also lies in the failure to restructure basic systems of transportation and in the failure to

The new air permits must accommodate dozens or hundreds of emission points at each large facility.

achieve effective control of sources other than stationary industrial plants. Thus it is doubtful that any significant air quality dividend can be squeezed out of better administration, as is implicit in the ambitious new air permit program.

Issuing air permits will be a huge administrative challenge. It may become an administrative nightmare. There are dangers both to EPA and to American industry if the program does not run smoothly. The challenge will be to streamline the process so that permits can be issued promptly and so that the permit program does not become an embarrassment to government or a severe handicap to American industry.

A big problem in issuing air permits is the huge number of emission points at large industrial facilities. This marks a contrast to water permits. Industrial wastewaters at each plant are collected internally before discharge into the river, so they can readily be handled in

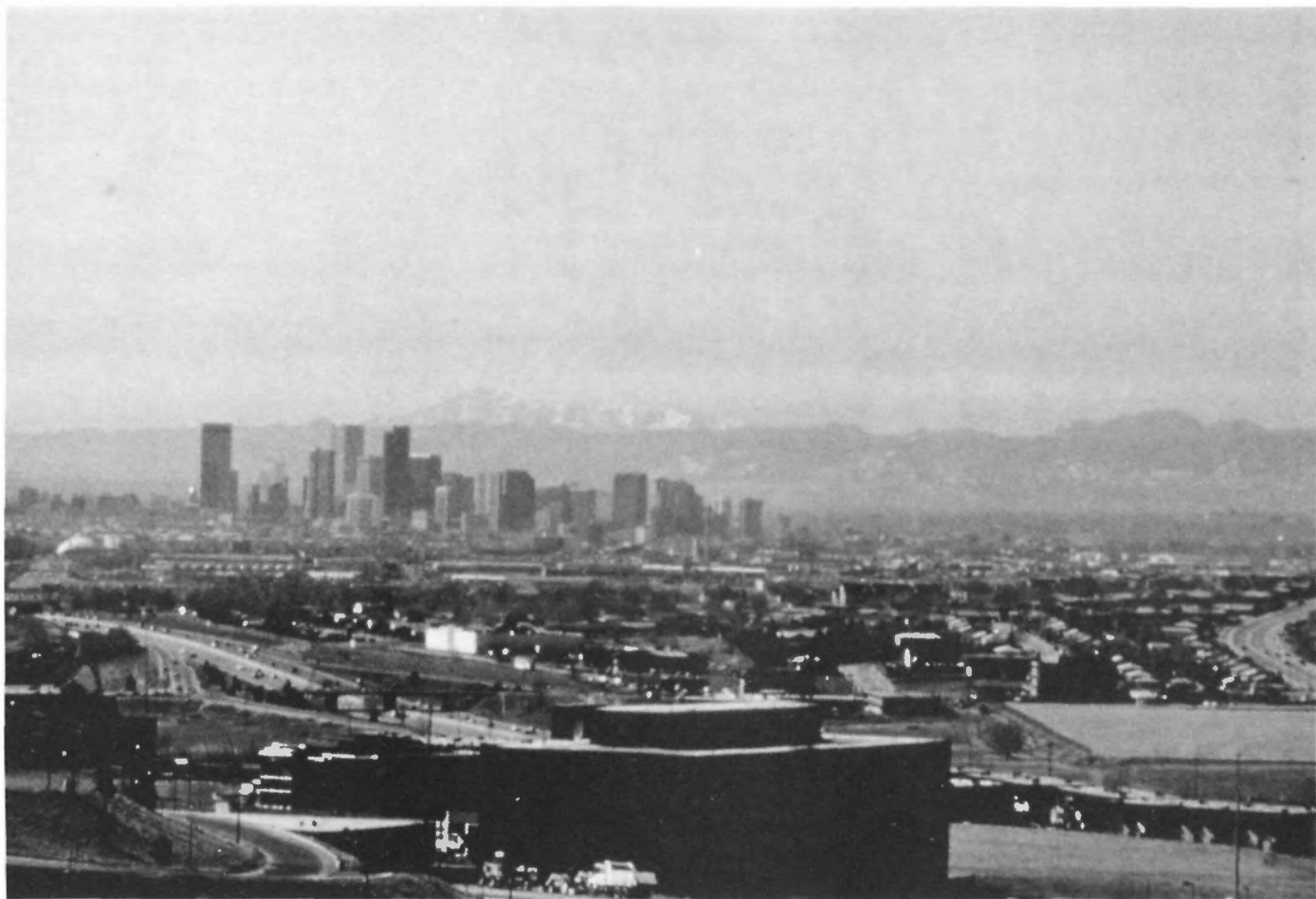
a single treatment process and can also easily be regulated by a single permit. The hypothetical "bubble" which air regulators have struggled over exists automatically with respect to water discharges. The new air permits, however, must accommodate dozens or hundreds of emission points at each large facility. They must either set emission limitations for each emission point or find a way to aggregate the emission limitations under a single set of restrictions.

The prospect of individually tailored emission limitations strikes fear into the heart of an economist. While the regulatory advantages are understandable, the danger is that highly detailed permit restrictions may constrict operational flexibility. Since many businesses experience operating cycles and changing market demands, their success depends on rapid adjustment to changing market conditions. Their competition—often international competition—may necessitate an immediate shift to different levels of production, different products, or different raw materials. All these changes can alter air emissions or move emissions from one point in the plant to another.

The issue is whether the permits will obstruct operational change. If the permits commit an industrial facility to a pre-determined schedule of production and selection of material, they can put American industry into an operational straitjacket.

This potential problem has been well recognized by EPA. Unfortunately, it is not easy to solve. The mandate of the Agency to implement the new Clean Air Act requires that permits be issued and that they prescribe stringent and detailed regulatory controls. It is not on either side a question of good faith. There is a real dilemma. Some compromises will be needed, and even then some adverse effects are going to occur.

(Quarles is a partner in the Washington law firm of Morgan, Lewis & Bockius. From 1970 through 1977 he served as Assistant Administrator for Enforcement and General Counsel, then as Deputy Administrator of EPA, and during that period was directly responsible for implementation of the NPDES water pollution permit program.)



Colorado Department of Health photo.

Residents of cities like Denver, which has frequently been enshrouded in brown haze, hope that the new law will bring them cleaner air. Some industries are worried about the paperwork and expense involved in making this a reality.

One key to reducing adverse impacts is to provide substantial flexibility in the terms of the permit to make minor changes in emissions without requiring a revision of the permit. Freedom to move emissions from one point to another within an industrial plant, without increasing the total, must be provided. Some freedom to shift emissions from one substance to another is also a must. Setting reasonable ground rules to assure such flexibility is a responsibility the Agency cannot duck.

Another key is to assure that if a permit must be revised to accommodate a minor increase in emissions which will not have significant air quality impacts, then a fast-track procedure should be provided to allow such revision without protracted delay. The original permit provisions should authorize such fine-tuning revisions either upon mere notification or through a governmental quick check that would not exceed 30 or 45 days.

The other huge issue that will determine whether the air permit program causes serious disruption to

the national economy concerns the procedures for issuing pre-construction permits. Replacement, modernization, and expansion of industrial production facilities are indispensable to the health

Setting reasonable ground rules to assure such flexibility is a responsibility the Agency cannot duck.

of our national economy. The Clean Air Act already imposes an extraordinarily complex set of new source review and permit requirements which must be satisfied before major industrial sources can be constructed or modified.

In areas already meeting air quality standards, sources must comply with intricate rules designed for the prevention of significant deterioration of air quality (PSD). In so-called nonattainment areas, even more complicated and onerous requirements must be satisfied, including the

installation of lowest achievable emissions rate (LAER) equipment and also the provision of "offsets." No comparable requirements exist under the Clean Water Act as barriers to economic growth.

Many months are required to satisfy these Clean Air Act restrictions whenever they apply. Often it takes years. Much of the delay results from detailed specifications for data collection and analysis and the resolution of technical disputes. Sometimes the requirements cannot be satisfied. In other instances the economic benefits of an industrial project may disappear before the regulatory hurdles can be crossed.

The new permit requirements will aggravate existing difficulties in achieving approval for projects of industrial growth and modernization. The necessity for permits will be given broader coverage, and the procedural obstacle course will be lengthened. In addition, the regulatory officials will be overwhelmed by the challenge of processing permit applications for



ARCQ photo.

Petroleum refineries will be affected by several new clean air provisions. In order to produce the reformulated fuel mandated by the statute, they will likely need new processing units. As new emission sources, such units will require operating permits. The author argues that any delay in issuing these permits could work against the statutory deadline for alternative fuel production.

existing sources, distracting their attention from those permits which must be issued to give the green light to new projects. If the waiting lines backed up for action on permit applications become sufficiently long, there could be a serious obstacle to national economic growth.

The pressure to issue permits for new facilities will be particularly intense in some situations as a result of other requirements in the Clean Air Act. Title II of the law calls for the production of alternative clean fuels in order to reduce mobile source emissions. To meet that air quality objective and that legal requirement, petroleum refineries will need to install additional processing units. These units will create new emissions and require pre-construction permits. If the Agency cannot find a way to issue these permits without delay—far more rapidly than its track record would indicate as normal—there is no way that the statutory deadlines for production of clean fuels can be met. In this instance, one Clean Air Act requirement is bumping up against another.

Many other administrative and regulatory questions are also of great concern to affected industry. An issue of immediate importance concerns the ground rules for determining whether a permit application is complete. Under the statutory provisions, if a company submits a "complete and timely"

application, it is authorized to continue operations until the permit is issued or denied. If, however, the permitting agency concludes that the application

Some compromises will be needed, and even then some adverse effects are going to occur.

is not complete, then it will be too late to submit an application that is "timely and complete" and the plant would have to shut down, since it could not operate legally until a permit actually is issued. This means that a company must be able to determine with absolute certainty that it has submitted a "complete" application, which in turn means that the instructions must be foolproof.

EPA confronted a similar situation when starting up the permit program for land disposal facilities required under the Resource Conservation and Recovery Act (RCRA). The problem was solved then by requiring only a "Part A" permit application containing very basic and simple information. More detailed information requirements came into play only at the Part B permit stage. Some comparable arrangement is needed in the air permit program.

Another important question concerns the relationship between SIPs and operating permits. It must be made clear that questions resolved by the

permit have been conclusively decided so that if by chance the permit and the SIP are inconsistent, the permit would be controlling. The reason for this is that once a permit is issued, a company will be relying on it as an authoritative determination of its obligations. A related question involves when a permit can be reissued in the event that a SIP is revised or other new regulatory controls are established. These issues need to be resolved in a manner that provides reasonable planning certainty to companies to carry out new pollution control efforts in an efficient and integrated manner.

As with any major new regulatory effort, it is unrealistic to expect that there will not be a number of start-up problems. Most of industry, albeit with significant apprehensions, now accepts the reality that new federal air permits will be required. Launching this program and making it work, however, will require good faith and hard effort on all sides.

The Agency has started off on a positive basis of striving hard to obtain advice and input from all directions. It has also clearly demonstrated that it is listening, and trying to respond, to outside opinion. That is a good sign. We may be off to an encouraging start, but the road ahead will be long and difficult. □

The Economic Impact

by Keith Mason

Economic impacts will be widely dispersed over the entire U.S. economy and gradually incurred over a 15-year time period.

In the recent debate in Congress and the media over a stronger Clean Air Act, questions about the economic implications of the proposed amendments figured prominently. Honest and earnest opinions were aired concerning the costs of the amendments, their potential impacts on employment, and possible ramifications for U.S. industry in international competition. The debate was at times enlightening, at times filled with an economics of advocacy and hyperbole.

These deliberations produced far more economic discourse than did the Clean Air Act amendments of 1970 and 1977. Of course, this is not really surprising considering the forum of the debate—a Congress consumed by the savings and loan scandal and the great budget battle. Yet these Congressional preoccupations were not the sole reason for the economic tenor of the deliberations.

In large part, the economic debate was triggered by the nature of the expanded air-pollution control programs included in the new act and the costs of these programs. EPA and the President's Council of Economic Advisors estimate that the new Clean Air Act will cost approximately \$12 billion per year by 1995—and approximately \$25 billion per year when fully implemented in the year 2005. This is in addition to an already extensive level of air-pollution control: EPA estimated that expenditures for air-pollution control were approximately \$27 billion annually in 1988.

Considered as a lump sum, this cost is enough to give anyone pause. In fact, however, economic impacts will be widely dispersed over the entire U.S. economy and gradually incurred over a 15-year time period. The new law will have only modest impacts on such things as the price of an automobile or electricity rates. When the new requirements are fully phased in, the cost per day per person is around 24 cents.

(Mason is an Economic Impact Analyst in the Office of Policy Analysis and Review within EPA's Office of Air and Radiation.)

When all provisions of the new law are fully in place, the cost of achieving the goals of the act's three main objectives will be as follows. The estimated annual cost of the acid rain provisions is approximately \$4 billion in 2005. Controls necessary to bring the numerous "nonattainment" areas into attainment with the national health-based standards for pollutants such as ozone and carbon monoxide are expected to cost approximately \$14 billion per year when fully implemented. Control of toxic air pollutants is estimated to cost approximately \$7 billion per year by 2005.

Further scrutiny of these individual cost components is revealing. The economic impact of the acid rain provisions has received more analysis than the impacts of the other major titles of the act. Concerning electricity rates, national average increases on the order of 2 percent can be expected when the acid rain program is fully phased in. Rate increases will be minimal in the early years of the program, and in general, rate changes will vary among states and utilities. A number of states could experience significantly higher rate increases depending on the amount of pollution reduction the utilities in those states must achieve and the method of compliance the utilities choose. For example, West Virginia, Ohio, Indiana, Kentucky, and Missouri are expected to have average rate increases greater than 4 percent by the year 2004.

These electricity rate increases could ultimately affect the price of goods made with the use of electricity. Potential price increases will depend upon the extent to which the utility is allowed to pass cost increases along as well as on the percentage of a product's price that is related to electricity use. There are only a few products (aluminum is an example) for which the cost of electricity is a major component of the final product price. More typically, electricity costs account for 1 to 5 percent of the product's final price. Thus, even a 10-percent increase in the price of electricity would have a very small effect on the final product price. The President's Domestic Policy Council confirmed this in 1987 when

Concerning electricity rates, national average increases on the order of 2 percent can be expected when the acid rain program is fully phased in.

analyzing an acid rain control bill that would have required more pollution reductions than the bill recently passed. They concluded that aggregate price impacts of less than 0.1 percent could be expected.

If many utilities choose to switch to other fuels (natural gas or low-sulfur coal) to meet sulfur dioxide emission limits, high-sulfur coal mining jobs could be lost. However, these losses are expected to be offset by gains in low-sulfur mining regions. In one scenario, EPA estimates that approximately 14,000 high-sulfur mining jobs in northern Appalachian and Midwest regions would be lost by the year 2000, and approximately 17,000 low-sulfur mining jobs would be gained in central and southern Appalachia and the western United States.

The issue of coal-mining employment and acid rain is not new; it has been nationally debated for years. Although the act's nationwide impact on coal-mining employment is negligible, the potential impact on some

high-sulfur coal mining regions is not. To help ease the transition for persons who have lost their jobs as a direct result of the new Clean Air Act, the bill provides for significant strengthening of worker assistance and job retraining programs.

The economic impacts of the "nonattainment" and air toxics titles of the bill are more difficult to estimate. This is due to the vast number of industrial source categories affected by these titles and the relative lack of detailed data on all of these sources. Also, some of the impacts of these titles will become known only after progress in reducing pollution through mandatory measures is assessed.

Still, some observations can be made. The mobile source provisions to lower auto emissions of ozone precursors, when fully phased in, will result in an additional cost to consumers of less than \$200 per car. And the additional price per gallon of cleaner, "reformulated" gasoline that will be required in the nation's nine worst-polluted cities is estimated at

approximately 5 cents (EPA estimate).

Also subject to considerable debate was the nature of some of the new pollution-control strategies embodied in the new act. Instead of traditional pollution-control requirements that give industry little choice as to how pollution is controlled, the new law incorporates strategies designed to foster choice and enhance economic efficiency.

For example, there will be incentives for early reductions of air toxic emissions in the form of credit for emission reductions made ahead of schedule. The acid rain control program is designed to afford the maximum choice of control strategy for reducing pollution, thereby resulting in the least control costs. The acid rain emissions-trading program is designed to reduce compliance costs by as much as 20 percent compared to a traditional "command-and-control" approach. (See article on page 21.)

Finally, as in any debate involving economic predictions, the cost estimates themselves were grist for argument. As with any cost estimate associated with a complicated piece of legislation that must be implemented over an extended period, uncertainty is the rule rather than the exception. Part of the difficulty lies in predicting future methods of pollution control. Air-pollution control technology and the cost of that technology change over time. The cost estimates generated by EPA and other groups have no built-in mechanism to account for future changes. As a result, experience has shown that estimates by both industry and the government are often on the high side.

For example, in 1987 EPA estimated that it would cost approximately \$4 billion for the steel industry to control emissions of hazardous air pollutants from coke ovens. The current estimate to achieve the same level of control is \$250 to \$450 million. Much of the difference is due to new technologies that were not foreseen when the earlier estimates were made. Often, when faced with high costs for pollution control, industrial innovation acts to lower the predicted costs. In the late 1970s, faced with per-plant cost projections of \$350,000 for benzene emission control, certain chemical



Ken Kerbs photo.

According to a recent *New York Times* poll, many Americans feel that environmental improvements must be made regardless of cost.

Experience has shown that estimates by both industry and the government are often on the high side.

production plants developed a process that substituted other chemicals for benzene and thus virtually eliminated control costs.

On the other hand, it is also possible for actual compliance costs to increase beyond predictions. For example, cost estimates of energy-intensive pollution controls such as the incineration of volatile organic chemicals depend on accurately predicting future energy prices. Rapid rises in energy prices can turn the most thoughtful analysis into wishful thinking.

Of course, pollution-control costs may also be underestimated if the magnitude of the problem being addressed is underestimated or the effectiveness of the control method being applied is misappraised. The experience of trying to estimate measures needed to bring U.S. cities into compliance with the national ozone standard is a relevant example here.

Despite cost prediction uncertainties, innovation and the development of less polluting technology in the face of regulation are commonplace. Even before the new Clean Air Act was signed, numerous oil companies developed and delivered to the market new "cleaner" gasoline with lower levels of toxic emissions, ozone precursors, and carbon monoxide. Automobile manufacturers are already responding by announcing the development of alternative-fueled truck fleets.

Given the difficulty of predicting the future cost of air-pollution control, it is even more difficult to predict how increased pollution-control

expenditures will affect such economic indicators as employment, growth, productivity, and trade. In terms of an approximate \$7 trillion economy in the year 2005, \$25 billion represents much less than 1 percent of the size of that economy.

Real economic growth and productivity impacts are likely to be small, according to the Council of Economic Advisors. To the extent that productivity gains are decreased slightly, the impact is likely to be transitional and not permanent. The Council has said that some temporary unemployment will result from the act (such as with high-sulfur coal miners), but the new law is not likely to have significant permanent negative effects on aggregate U.S. employment.

Moreover, expenditures on pollution control bolster a growing U.S. industry. The pollution-control industry is an important part of our economy. Expenditures on pollution-control create domestic high-skilled jobs (some estimates are that for every \$1 billion of air-pollution control expenditure, between 15,000 to 20,000 jobs are created). As an added benefit, the reduced air-pollution levels lead to improvements in worker health and productivity.

As for impacts on international trade, exact studies concerning the impact of the new act on competitiveness have not been completed. However, a preliminary comparison of selected industries among major trading partners indicates that other countries with strong national economies and trade surpluses have relatively greater degrees of air-pollution control for

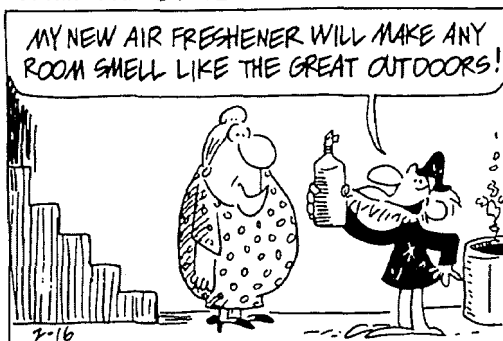
some industries than will be required in the United States under the new Clean Air Act. For instance, sulfur dioxide and nitrogen oxide emission control requirements that will apply to U.S. power plants are less stringent than the controls already in place in Germany. The notion that additional environmental protection necessarily endangers international trade is to date unsubstantiated.

What has been substantiated are the enormous trade opportunities for pollution-control equipment and expertise. The Soviet Union's recent \$1 billion order of General Motors pollution-control equipment is just one example.

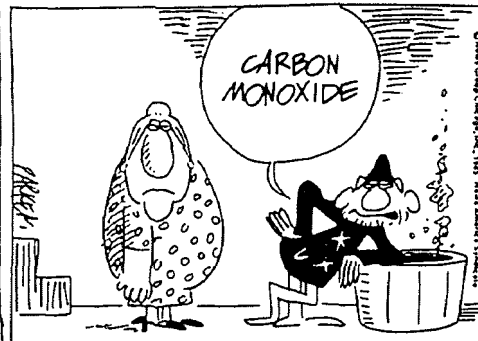
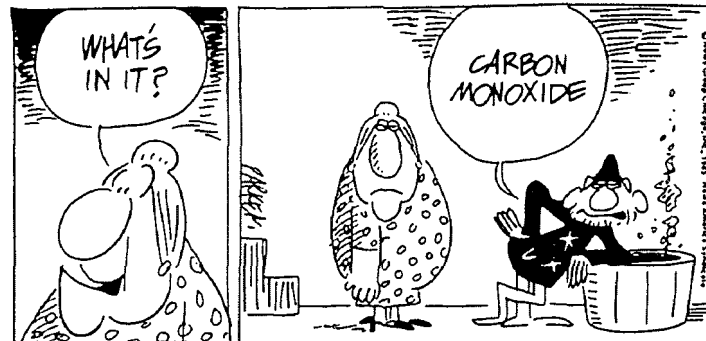
Finally, while it is difficult to predict the economic impact of the new Clean Air Act, the estimated levels of expenditures seem to reflect current public support for clean air. In an April 1990 Roper poll, 75 percent of Americans indicated they would be willing to pay three times the final cost of the new law—today. This same poll found that the average consumer would pay 8 cents more for cleaner, reformulated gasoline. In a *New York Times* poll in March 1990, 75 percent of Americans said that environmental improvements must be made regardless of cost.

Considering public opinion and the overwhelming support for the new law in Congress, the economic debate over the new Clean Air Act provisions seems to have been brought to a successful conclusion. □

WIZARD OF ID



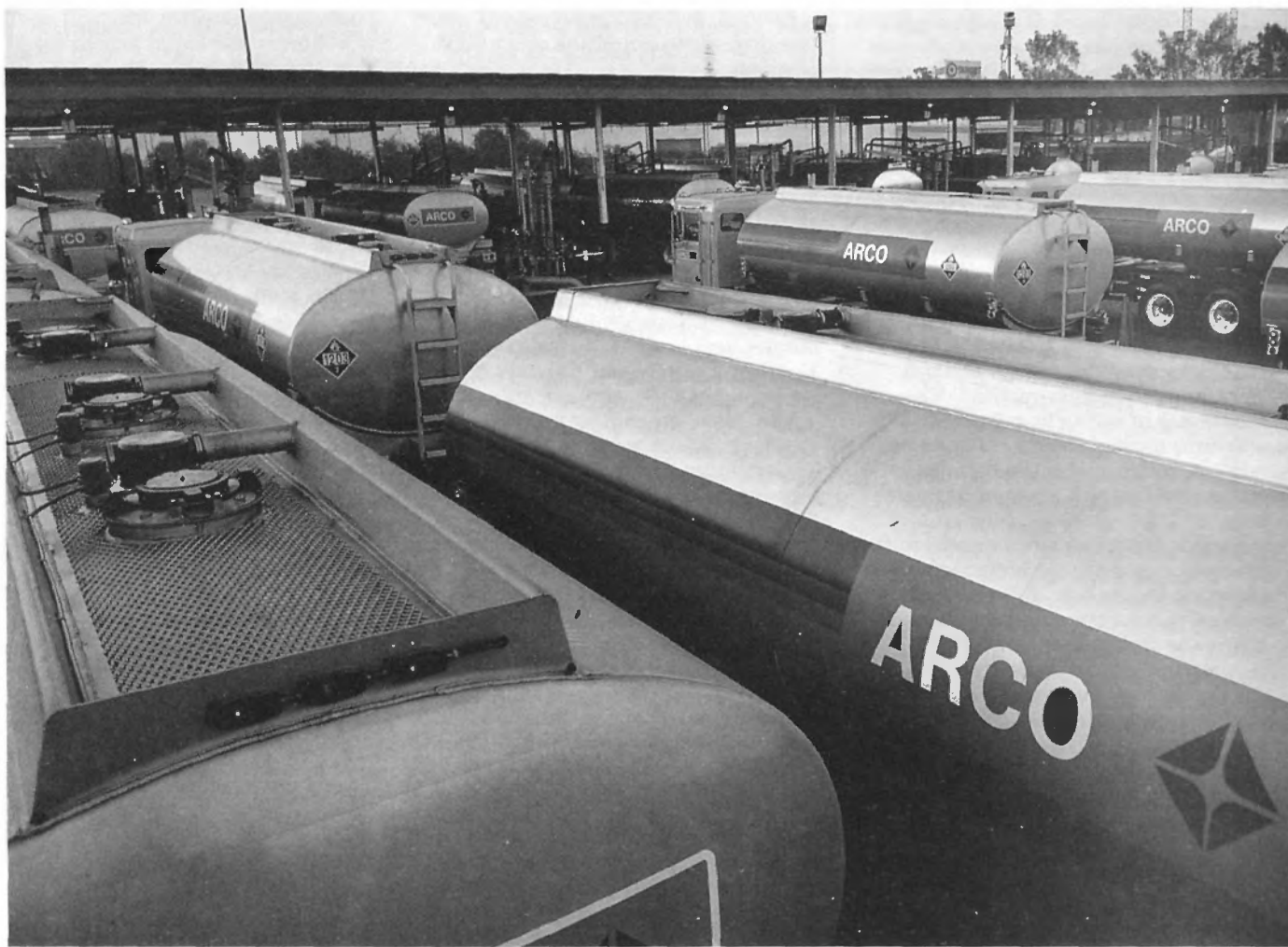
BY BRANT PARKER & JOHNNY HART



By permission of Johnny Hart and NAS, Inc.

At the Gasoline Pump

by Kenneth R. Dickerson



ARCO photo.

Dawn lineup. ARCO trucks arrive at Vinvale Terminal, South Gate, California, for their first fill-up: ARCO is reformulating gasoline to reduce air-polluting emissions.

(Dickerson is Senior Vice President of ARCO.)

The Clean Air Act Amendments of 1990 portend revolutionary changes in the cars people drive and in the fuels that power them. As spelled out in an earlier article, the new law mandates drastic reductions in motor-vehicle emissions over the next 10 years.

For the oil companies, this means that new kinds of gasolines, ones that burn more cleanly, must be offered to consumers. Cleaner fuels also mean fundamental and costly changes for the industry. And, because oil is essential to the world's industry and economy, everyone from the producer on down

will be affected. For consumers, the most visible evidence of this change will be seen at the gas pump.

In Southern California, reformulated gasoline, pioneered by ARCO, has been on sale for more than a year. Virtually unheard of only a short time ago, reformulated gasoline has proven so effective in reducing tailpipe emissions that it has qualified under the new Clean Air Act to compete with other alternatives, such as methanol or electricity.

Under both U.S. and California regulations, reformulated gasoline—in combination with advanced automotive

In Southern California, reformulated gasoline, pioneered by ARCO, has been on sale for more than a year.

technology—will provide an option for meeting low-emission standards in the years ahead.

That's good news for drivers and for air quality, because reformulated gasoline offers the only immediate means of reducing automotive emissions: It is priced competitively with conventional blends; it is readily available through existing facilities; and it can be used in existing vehicles without costly engine retooling. No other fuel can meet these criteria.

As the largest gasoline marketer in Southern California, ARCO chose to take the lead in clean fuels development. A new computer model of the area's atmospheric mix, developed by the California Institute of Technology and used by local air quality regulators, enabled ARCO's chemists to determine precisely which gasoline formula would produce the maximum reduction of air-polluting emissions.

Because older vehicles—cars manufactured before 1975—are responsible for most vehicular pollution, the company decided to produce its first reformulated gasoline

specifically for these cars. ARCO tested its EC-1 gasoline at two independent testing facilities and shared the results with both the South Coast Air Quality Management District (SCAQMD) and the California Air Resources Board (CARB). The results were impressive. EC-1, which replaced ARCO's old leaded regular gasoline in September 1989, reduced emissions from older vehicles by at least 20 percent. A year later, ARCO EC-Premium, a high-octane fuel designed to burn cleaner in high performance cars, came on the market. Using these emission-control gasolines, ARCO customers have reduced emissions in the Los Angeles basin by more than 100 million pounds. Other companies soon followed ARCO's lead, entering their own brands into the reformulated gasoline market.

ARCO received numerous commendations from state and local government bodies, environmental organizations, and industry for developing reformulated gasoline. However, the most important testimonial came from the new gasoline's performance: It worked. In 1990, a combination of weather conditions and cleaner fuels produced southern California's cleanest air in 40 years.

The success of reformulated gasolines in southern California has demonstrated that significant improvements in air quality are not dependent on the development of entirely new fuels. However, gasoline cannot be reformulated to meet the tough standards of the new law without making major changes in refining processes and in refineries. Refining crude oil into gasoline is a complex process that sorts out and rearranges hydrocarbon molecules. EC-1 and EC-Premium are marketed only in southern California and were produced with minor refining changes. But reformulating all the gasoline that ARCO produces—that is, radically changing its chemical structure for the total market—will require major changes. ARCO estimates that the necessary retooling and processing plant additions to its two West Coast

refineries will entail costs of \$3 billion over the next four or five years.

Can gasoline be improved enough to meet the ultimate Clean Air Act standards, the ones that go into effect in the year 2000? We believe so, but not with our current reformulated fuels.

Last year, three major U.S. automakers and 14 petroleum companies joined forces in a research-and-testing program to assess the air-quality benefits of combining improved vehicles with cleaner fuels. The program will continue through 1993.

In 1990, a combination of weather conditions and cleaner fuels produced Southern California's cleanest air in 40 years.

Tests now underway lead us to believe that we can make gasoline meeting the legislative requirements for an additional cost to the motorist of about 15 cents a gallon (ARCO estimate). This is far less than the cost of alternatives such as M85, a mixture of 15 percent unleaded gasoline and 85 percent methanol.

The tests should be completed by late spring. The data from them, combined with the information we are getting from the auto/oil task force, should provide conclusive evidence as to what it takes to make gasoline that will burn as cleanly as alternatives and at a much reduced cost.

What about alternative fuels? Where do they fit into the picture? In our view, they cannot replace gasoline until at least mid-21st century, but they will be useful as "niche" or special-purpose fuels in the meantime. All are less powerful, requiring twice as much fuel to achieve the same mileage. All require new distribution and refueling facilities.

Propane, compressed natural gas, and methanol already power many fleet and

limited-mileage vehicles. But each has limitations for mass use when compared to gasoline. Methanol, for example, is an odorless and tasteless toxic that presents several hazards: It could pollute ground water if spilled; it burns with an invisible flame; and a byproduct of its combustion is formaldehyde, which disperses into the air. At present, no one knows what effects large amounts of formaldehyde would have on air quality.

Several auto manufacturers have developed prototype electric cars, but their range is limited to anywhere from 50 to 200 miles, after which they must be recharged. In addition, every 20,000 miles batteries must be replaced at a cost of about \$1,500, and disposal of used batteries presents another environmental problem.

Another problem associated with battery-powered cars is generation of the power for recharging. Most power plants operate on fossil-fuels and contribute to air pollution to some degree. No new power plants are planned in severe non-attainment areas, such as the Los Angeles basin, and locating them elsewhere means

exporting the area's pollution. Nuclear energy might solve this problem, but it is an unpopular source of power. No new nuclear plants are planned.

Alternative fuels have an increasing role in clean air technology, and researchers, with support from the oil industry, will continue to seek the combination of fuel and vehicle modifications that will be both cost efficient and environmentally sound. But for the foreseeable future, America's drivers will continue to fill-up with gasoline wherever they travel. What the oil industry can promise is that it will burn much cleaner.

This is good news for environmentally concerned consumers because they can continue to operate their current vehicles—and without significant increases in cost. And as they buy new vehicles, they can help reduce air pollution even more by using the same reformulated gasolines.

In this way, each of us can make an immediate impact on air quality in the areas where we live and work. □

Reformulated Gasoline: What Makes It Different?

In Southern California, which has the nation's worst smog despite the toughest air quality laws, it is estimated that vehicular emissions, primarily nitrogen oxide and volatile organic compounds, are responsible for about 50 percent of the air pollution problem.

As the state's leading gasoline marketer, ARCO decided to tackle the problem by developing a cleaner-burning, "emission-control" gasoline. The first, called EC-1 Regular, was aimed at vehicles that pollute the most—pre-1975 cars and pre-1980 trucks, which run on leaded gasoline and are not equipped with catalytic converters. When ARCO introduced EC-1 in 1989, these vehicles comprised only 15 percent of the auto/truck population in Southern California, but they produced 30 percent of vehicular air pollution.

In formulating EC-1, ARCO eliminated lead, replacing it with another octane enhancer, methyl tertiary butyl ether (MTBE). MTBE boosts performance and produces a cleaner-burning mixture. In addition, aromatics were reduced by one-third, and benzene was reduced by 50 percent. Vapor pressure was cut by one pound per square inch below the state-mandated nine-pound standard. Sulfur content was reduced by approximately 80 percent.

Two independent, government-approved laboratories tested the new formula. EC-1 was shown to emit less of the gases that form ozone, the main component of smog. EC-1 also gives off less carbon monoxide than conventional fuel.

EC-Premium, ARCO's second reformulated gasoline, was introduced in September 1990 for high-performance cars. Benzene

content is less than half that of ARCO's earlier premium fuel and more than 60 percent below the average premium sold in Los Angeles, according to the Motor Vehicle Manufacturers Association. Aromatics and olefins are reduced by 25 percent, and MTBE has been added to increase octane. Further, vapor pressure is lowered (a pound below the California state standard) to reduce pollution by evaporation.

What are the results?

Independent tests show that compared to conventional premium gasolines, EC-Premium reduces carbon monoxide by 28 percent, exhaust hydrocarbons by 21 percent, and evaporative emissions by 36 percent.

ARCO customers using EC-1 Regular and EC-Premium are reducing air pollution by about 150 tons a day in southern California.

Opportunities in the Cleanup

by Kenneth Leung



Sylvania photo.

(Leung is Managing Director of Smith Barney, an investment banking firm.)

Many companies are worried about the expenses they will incur due to the new Clean Air Act. Others are seeking ways to profit. The lighting industry is working closely with businesses that want to reduce air pollution, save energy, and cut costs.

One blanches at the numbers. The Administration's official estimate pegs the cost impacts of the Clean Air Act Amendments of 1990 at some \$25 billion a year by 2005, when the law swings into full effect. That's on top of an estimated \$27 billion that American business already spends annually on air-pollution cleanup (1988 EPA estimate). More pessimistic assessments place the new legislation's ultimate yearly cost around \$50 billion. In the heat of the debate leading up to the statute's enactment, one industry lobbyist complained that the new law could usher in "the cleanest Depression since the 1930s."

Perhaps. But business is, as they say, a zero-sum game. And for every utility plant manager wondering how to comply with the new rules, there's a supplier or entrepreneur who will be more than happy to show him—for a price.

Just where do the Clean Air Act's business opportunities lie? For more than two years, investment analysts have spaded the soil in search of answers. They've turned up a bevy of potential beneficiaries, ranging from the obvious ones, like producers of natural gas and other alternative fuels, to some more offbeat possibilities. A few Wall Street newsletters even suggested a potential play in makers of corn-based sweeteners for soft drinks and other packaged foods. Their reasoning? The new law's requirements for reformulated fuels could energize the market for corn-based ethanol, increasing the demand for raw corn by 250 to 300 million bushels, according to the Corn Growers' Association. That, in turn, might lead to tighter supply and higher prices for other corn-based products.

Whether or not these and other scenarios work out, the new legislation clearly will bring heady days for companies that make money cleaning the air. These include more than just suppliers of pollution-abatement equipment. Indeed, the earliest beneficiaries are likely to be the swarm of small and mid-sized environmental consultants. Even before the law was passed, some of these companies saw business boom because they provided computer modeling, analysis, and other services for both sides of the lobbying game. Now they may glean added revenues from virtually every section of

the new act—from the urban-smog title to operating permit requirements to air toxics to acid rain—as they advise corporations, municipalities, and others on how to comply.

There are also opportunities in some tightly focused business niches. Consider, for example, the acid-rain title of the new law. Among other things, this title allows relatively clean utilities to sell emission “credits” to dirtier plants. Although the Administration has maintained that the emissions-trading provisions will work “as easily as a checking account,” a couple of companies are trying out profit opportunities here by acting as middlemen between the buyers and the sellers.

The acid-rain section also mandates continuous emissions monitoring at coal-fired utilities by 1993, and other titles of the law also beef up monitoring requirements. Consequently, those firms that manufacture emission-measurement instruments are licking their chops. For some of these companies, business has merely plodded along; now, they’re gearing up for what could be a doubling of demand.

Notwithstanding these and other opportunities, the largest share of Clean Air Act dollars will probably go to makers of big-ticket equipment. Most of the \$7 billion annually expected to be spent complying with the air toxics title and the \$4 billion or more to be spent under the acid rain provisions are likely to funnel into such items as flue gas desulfurization units (popularly known as stack scrubbers) and other costly control devices. Sales for these products can be expected to pick up gradually in the next several years, and they will probably surge in the middle of the decade as the deadlines imposed by these two sections of the legislation draw uncomfortably close.

It’s important to note, though, that while the law will pump up revenues in the clean-air sector, profits may be harder to come by. The air-pollution control industry is already a highly fragmented one, and competition, even for a huge new pool of business, will likely be fierce. In fact, in the wake of the Clean Air Act Amendments, the siren song of fat revenues may well lure many new players to a complex and treacherous market. The result could be slim profit margins all around, at least until the industry sorts itself out.

The profitability of traditional pollution-abatement equipment companies will hinge on how many potential clients choose alternative methods to pare emissions. To achieve acid-rain reductions, many coal-fired utilities (particularly those located relatively near mining areas) will no doubt simply start burning low-sulfur coal. That will divert money that might otherwise have gone toward stack scrubbers into the coffers of miners of low-sulfur coal—and of the railroads that transport it. Still other utilities are taking a hard look at so-called clean-coal technologies—a fledgling

Recall, however, that it was the 1970 Clean Air Act that spawned the catalytic converter that is now standard equipment on American automobiles.

industry that could allow power plants to burn sulfur-saturated coal but still comply with the new act at a cost lower than the \$75 million that a single 500-megawatt facility might pay to install a scrubber.

Many clean-coal technologies—and other technical wizardry envisioned by the new clean air law—have yet to be developed: Whether they can be supplied in time is an open question. The oil industry, for example, has repeatedly grumbled that it “simply can’t” produce the reformulated gasoline required under the law’s mobile-sources title by the 1992 deadline. Obviously, the availability of technology is a very real concern.

Recall, however, that it was the 1970 Clean Air Act that spawned the catalytic converter that is now standard equipment on American automobiles. Many companies are already hard at work on the next generation of technology. For instance, one major chemical company reportedly has earmarked 10 percent of its annual R&D budget to Clean Air Act work. Developing new technologies won’t be easy, of course, but the potential for profit has greased the wheels of ingenuity many times before.

Along the same lines, one possible plus of the Clean Air Act has been hardly noticed in the hand-wringing over its costs. Particularly in light of the air-toxics provisions, which eventually will regulate 189 separate hazardous substances, many industrial companies will likely take a hard look at changing their front-end production methods in order to lower their

emissions levels and, thus, the costs of their back-end pollution control. Obviously, this will mean a nice jump in business for selected engineering and design firms with the expertise to help the regulated community in that effort.

But it could mean much more than that. Last December, a *Wall Street Journal* article reported that a major industrial concern had saved an estimated \$41 million in the past three years as a result of manufacturing changes intended to cut pollution. In the same article, Joel Hirschhorn, formerly of the Congressional Office of Technology Assessment, observed that American companies produce five times the waste per dollar of goods sold as Japanese firms. If the Clean Air Act spurs a lot of companies to fundamentally rethink the way they produce things, the resulting changes could ultimately make us a better match for some of our overseas rivals.

All of this is not to suggest, of course, that American industry will welcome the changes wrought by the Clean Air Act Amendments. The new law swings a heavy hammer, and many companies will suffer. This is particularly true for small business, which will bear the onus not only of direct regulation, but also of higher costs for cars, fuel, power, and a host of raw materials. Larger companies will experience the same costs multiplied tenfold, and although they may be better able to cope with the financial burdens, they’re not about to applaud them.

Yet for the nation’s commerce as a whole, there’s some reason to believe that the new law’s ultimate impact may be less harrowing than the raw numbers would indicate. Even as environmental spending is forced upward, a range of companies will benefit, some entirely new business segments may be created, and American manufacturing firms will have yet another incentive for more efficient, productive operation. It’s worth remembering, too, that we’ve all seen worse. American industry has prevailed through two world wars, dozens of financial panics, and the Great Depression. When future business historians sit down at their writing desks, the Clean Air Act Amendments of 1990 may seem a relatively small event—just another way station on the road to bluer skies and, in the best financial sense, greener pastures. □

Recollections of a Key Player

by Senator George J. Mitchell

Shortly after I came to the Senate in 1980, I became interested in the issue of acid rain out of concern about the effects on New England lakes and forests. In 1981, I introduced the first control bill, which called for an 8-million-ton reduction of sulfur dioxide in 13 years by the 31 states east of the Mississippi. The bill was included in the package of clean air amendments reported by the Senate Committee on Environment and Public Works in 1982. It was never considered by the full Senate.

In 1984, the Committee tried again, this time reporting legislation that included a sulfur-dioxide reduction of 10 million tons to be achieved in 10 years. This bill also did not pass the Senate.

On February 3, 1987, as chairman of the Senate Subcommittee on Environmental Protection, I held a hearing that marked a turning point in

the debate. We heard detailed testimony on the adverse impacts of acid rain on human health. The president-elect of the American Academy of Pediatrics, the president-elect designate of the American Lung Association, the past president of the American Public Health Association, and the director of Environmental and Occupational Medicine at Mount Sinai Medical Center all recommended that control of acid rain be justified solely on the basis of health effects.

After hearing the testimony, I introduced a bill that required a 12-million-ton reduction in sulfur dioxide in 10 years. Representatives of high-sulfur coal states were concerned that acid rain controls would close their mines. To make Senate consideration and passage of the bill possible, concerns about the jobs impact needed to be addressed. I spent

two months negotiating with the president of the United Mine Workers, and we finally agreed on a compromise bill. It must have been a true compromise, because few senators would support it. On October 4, 1988, I announced that there would be no clean air legislation in that Congress.

In July 1989 George Bush reversed the anti-environment position of the previous administration by proposing clean air legislation. This completely changed the political landscape. For the first time in a decade, the balance tipped in favor of enactment. The proposed legislation was in some respects similar to my 1987 bill, although it was less aggressive in some areas.

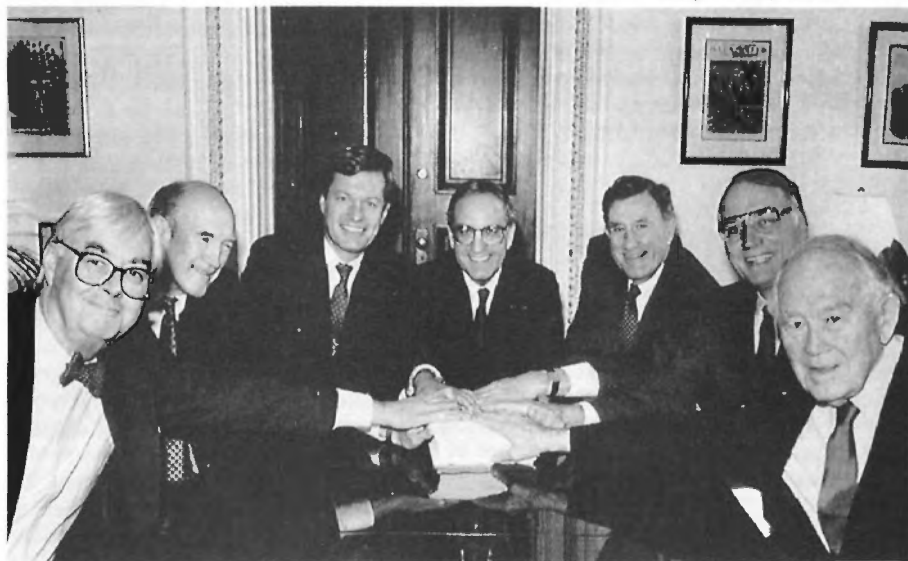
When the next Congress convened in 1989, I was elected Senate Majority Leader. The Senate Environment and Public Works Committee reported a 10-million-ton sulfur-dioxide control bill in November 1989. Before Congress recessed, I announced that the full Senate would begin consideration of the bill on January 23, 1990.

In January, as promised, for the first time in 13 years the Senate began debate on clean air legislation. But it soon became apparent that there were not the 60 votes necessary to terminate debate. At the same time, there was no group of senators with whom an agreement would produce the necessary votes. The only other place to garner enough votes was the Administration.

On February 2, 1990, we began negotiations with the Administration in a conference room adjacent to my office. For one month, we worked long hours to reach agreement on a compromise. The agreement was weaker than the Committee bill, but it was stronger than the Administration's original proposal.

The acid rain discussion was regionally divisive. The Committee bill and the President's proposal were similar. Both achieved a 10-million-ton reduction; both adopted a system of emissions trading through purchase and sale of "allowances." Individual

George Tames photo. NYT Pictures.



Senators celebrate after the 1990 Clean Air Act passed in their chamber. Left to right: Senators Daniel Patrick Moynihan (D-NY); Alan K. Simpson (R-WY); Max Baucus (D-MT); George J. Mitchell (D-ME); John H. Chafee (R-RI); Dave Durenberger (R-MN); and Quentin N. Burdick (D-ND).

(Mitchell (D-Maine) is Senate Majority Leader and was instrumental in the passage of the new Clean Air Act.)

Pizza at Midnight

by Rob Brenner
and John Beale

emission limits were placed on every utility boiler. Many senators argued that the system wasn't equitable, that it didn't take into account their particular circumstances. This put us in the unenviable position of responding to unit-specific concerns, and we were faced with literally dozens of requests to make adjustments during and after negotiations with the Administration.

As part of the negotiations, we provided extra bonus allowances for those utilities that used technology during the first phase of the reduction. The bonus allowances would provide additional job-protection incentives for high-sulfur coal miners. But this led western senators to argue that their low-sulfur utilities were not adequately compensated for past efforts. Working with these senators, I helped draft a compromise that provided second-phase bonus allowances to these "clean" states as well.

After a weekend of frantic legislative drafting, I, Senator Dole, and others introduced an amendment on March 5, 1990. That began a month-long effort on the Senate floor to reconcile concerns about allocation of acid rain allowances, toxics and smog controls, limits on ozone-depleting chemicals, and municipal incinerator controls. Finally, on April 3, the Senate overwhelmingly passed clean air legislation by a vote of 89 to 11. Never in my experience had the Senate remained on one issue for so long, and never had so many senators focused on such technical legislation.

After this victory, we waited almost three months for the House to act, so we could begin a conference to reconcile differences between House and Senate bills. The conferees reached agreement in principle on October 22, and the Senate passed the conference report on October 27. On November 15, President Bush signed the 1990 Clean Air Act Amendments into law. There were many happy but tired faces at the ceremony. □

It was well after midnight during the third week of Clean Air Act negotiations between key senators and the Administration. The negotiators were trying to resolve one of the more formidable issues: Should automakers be required to cut emissions of new cars once in the mid-1990s and then meet a second round of even tighter standards after the year 2000 (so-called "Tier II" controls)? The potential compromise laid on the table was a

Staffers from many offices worked 60- to 80-hour work weeks for long periods of time . . .

Tier II "trigger." The additional controls would be required only if a significant number of cities were not meeting the health standards and were likely to need the emission reductions provided by additional vehicle controls.

The problem was determining what constitutes a significant number of cities and how far out of attainment they would need to be to justify imposing expensive controls on new cars. As the meeting was breaking up, Senator Mitchell pulled aside some of the EPA staff. He said he did not think an agreement could be reached unless some data could be provided indicating the frequency of violations in nonattainment areas.

Senator Mitchell wanted the information by 9 o'clock the next morning (which meant that the White House would want to see it before then). Although the task required pulling some analysts out of bed and some early-morning computer runs, the data were provided the next morning. And although several more hours of discussion were needed, agreement was reached: Tier II controls would be imposed if more than 11 cities

remained out of attainment in the year 2001. In this case, and in countless similar cases over a two-year period, agreement was possible only because EPA staff were able to provide the authoritative information, virtually (and often literally) overnight.

Beyond the unprecedented demands for accuracy and speed, the highly contested political situation surrounding the clean air debate added an unaccustomed dimension to an already difficult task. Our challenge was to provide technical assistance and policy insights to the White House, Congress, and senior EPA officials without becoming targets in what was an often savage political crossfire.

Although most of the public attention focused on the 101st Congress, intensive EPA involvement began two years earlier, in 1987, at the start of the previous Congress. At that time, EPA established the "Clean Air Work Group," composed of staff from numerous EPA offices and outside the Agency. Air, Policy, Congressional Liaison, Public Affairs, Water, OPPE (Office of Policy, Planning, and Evaluation), ORD (Office of Research and Development), OARM (Office of Administration and Resources Management), OSWER (Office of Solid Waste and Emergency Response), Enforcement, General Counsel, and Administrator's offices, as well as the Department of Justice. All contributed staff and resources to the effort.

The work group's first task was to develop analyses, briefing papers, and policy options to encourage thoughtful deliberations. But the previous year's bruising battle between EPA and Congress over Superfund reauthorization made another task equally important: Rebuilding severely strained working relationships with Congress.

After a year of internal and external discussions and debates, the Agency produced three innovative proposals: more realistic deadlines with interim progress requirements to address the problem of "nonattainment" of the national air quality standards; an air toxics control program featuring a technology-based approach backed up

(Brenner is Director of EPA's Office of Policy Analysis and Review (OPAR).
Beale is Deputy Director of OPAR.)

by additional control of any remaining unacceptable risks; and comprehensive revisions to the government's enforcement authorities under the Clean Air Act. Although these proposals raised many questions and triggered some controversy, they re-established the Agency as an important and respected participant in the Congressional debate. Agency staff were frequently called upon to provide technical expertise at legislative mark-ups and to brief members of Congress as they attempted to craft legislation.

But the 100th Congress failed to enact Clean Air Act legislation: The problems were too contentious and the positions too rigid to resolve without strong presidential leadership. Fortunately, by the time the 101st Congress began, the new president, George Bush, had voiced strong support for new legislation, and had also appointed Bill Reilly and Bill Rosenberg to EPA and instructed them to make it happen. Their leadership, along with the efforts of key White House officials, resulted in the development of a presidential proposal by early summer of 1989.

The intensive involvement of EPA staff in those efforts was unprecedented. Career staff accompanied Administrator Reilly and Assistant Administrator Rosenberg to virtually all of the White House planning and strategy seminars (well over a hundred in the course of the two years). Never before in the history of EPA did career staff work so closely with senior White House officials such as the Counsel to the President, his chief domestic policy advisor, and members of the Council of Economic Advisors—primarily because no environmental initiative has ever before been such a key component of any president's agenda.

As is typical in such situations, many of the breakthroughs in crafting the policy occurred in smaller, less formal sessions—often around Bob Grady's table at the Old Executive Office Building. (Bob Grady is the Associate Director for Environment and Natural Resources at the Office of Management and Budget.) Unfortunately, we soon learned that the best time to work with

Bob was late at night when he seemed to get his "second wind." We spent many a midnight in his office over Chinese food or pizza, working through problems of policy drafting and consensus building.

Thanks to fax machines and an EPA headquarters/regional personnel rotation program, it was not just the Agency's Washington staff who directly contributed to the new Clean Air Act. Key staff around the country were able to provide their expertise in an extremely short turnaround (much to the chagrin of their families). That extra

Intensive EPA involvement began two years earlier, in 1987, at the start of the previous Congress.

help enabled us to write the legislative language at the same time we were completing the policy-development process at the White House and working with the Congress and outside groups. The Agency's ability to provide expertise simultaneously in these different arenas meant that EPA's concerns were largely reflected in almost all the key documents produced during the legislative process.

Some specific examples of the Agency staff's efforts are instructive:

- The acid rain program: Working with the Environmental Defense Fund (EDF), EPA staff crafted the market-based acid rain trading program, building on concepts developed by EDF and others.
- The Senate compromise: Working with key senators and Administration officials during a month of marathon sessions in Senator Mitchell's conference room, EPA staff helped to produce a bipartisan compromise. The effort was a success, thanks largely to the patience and skill of chief White House domestic policy advisor Roger Porter and Senator Mitchell. EPA staff

provided the data and insights necessary for key compromises on the allocation of acid rain allowances, the conditions under which to trigger tighter automobile tailpipe requirements, and a program to address any remaining risks after the application of air toxic controls.

- The permitting program: This program, essential for ensuring effective compliance, is largely the product of the previous and current Associate General Counsels for Air, both of whom recognized the need to provide a means to implement more explicit compliance requirements without overburdening the state planning process. Of particular note are the central provisions on program flexibility, as well as those which address small business concerns, both of which were adopted at EPA's recommendation over more rigid procedures.

All in all, it was the experience of a lifetime—and to many it seemed like a lifetime! The work-load was staggering: Staffers from many offices worked 60- to 80-hour work weeks for long periods of time, not only in the Air Office in Washington, but also in the General Counsel's office and the Office of Air Quality Planning and Standards in Durham, North Carolina. And all who were part of the process agree: The results are remarkable. The legislation passed by overwhelming majorities (89-11 Senate, 401 to 25 House) and was enthusiastically signed into law by President Bush in a White House ceremony attended by many from EPA.

As we move into the implementation stage, the new law has the full support of the President and the entire Administration. Perhaps the most compelling example of that support is that in an era of fiscal austerity, EPA's air program budget for the first two years of implementation has been increased by 76 percent. This increase is concrete evidence of the President's commitment to seeing his new law implemented effectively and of his confidence that EPA will implement the law with the same energy and effectiveness that went into writing it. □

An Environmentalist's Perspective

by Richard E. Ayres

The new Clean Air Act, to the credit of the Bush Administration and the Congressional leaders who fashioned it, addresses all the major air-pollution issues that trouble this country. Without question, the law will produce cleaner skies. Even so, whether the act will achieve the goals of protecting health and natural resources remains to be seen.

The national process of putting together this comprehensive initiative has renewed momentum in a program that was stalled for nearly a decade. At EPA and elsewhere, there is a new enthusiasm for attacking the scourge of air pollution. But, the law is not self-executing. Moreover, it entails extended clean-up schedules stretching more than two decades into the future.

Whether the law will achieve its ambitious goals depends on the commitment of this and succeeding administrations in Washington. It also depends on whether state and local officials—and leaders of American industry—choose to see the new law as an opportunity to address the fundamental causes of atmospheric degradation and to move beyond the baleful stalemate that so often has characterized past efforts.

The problem of urban smog illustrates the point forcefully. Currently, the emissions that cause the unhealthy blankets of smog in our urban areas come about equally from motor vehicles and so-called “stationary sources” that range from factories to small businesses to consumer products and activities in our homes.

Over the past 20 years, the nation has demonstrated remarkable technological capability to reduce pollution levels from motor vehicles and some stationary sources. However,

improvements in air quality have lagged far behind these technical accomplishments.

Our new cars are far cleaner than they were 20 years ago (though far less clean on the road than indicated by the certification test figures often cited by the auto industry). But our nation now drives twice as many miles as it did in 1970, when these technical improvements were mandated. And although our factories are cleaner, our economy has grown massively. Yet, without question, new technologies now on the shelf can further reduce pollution from conventional vehicles and from industrial production methods.

The new law is filled with requirements for improved pollution controls for both motor vehicles and stationary sources. It mandates further reductions in tailpipe emissions of cars, trucks, and buses; new measures to reduce “running losses” and emissions from refueling; more durable pollution-control devices; reductions in the pollution potential of motor-vehicle fuels; and better inspection and maintenance programs to assure that vehicles perform better on the road. Pollution-control requirements are extended to more factories and other commercial activities that contribute to smog. And EPA is under mandate to develop new standards to reduce emissions from polluting products such as paints, other coatings, and common household products.

But the past 20 years teach that achieving the President's goal of healthy air for all Americans will require fundamental changes in how we organize society and manufacture products. The basic cause of continuing high levels of motor-vehicle pollution lies in the sprawling, wasteful way that American urban areas have been allowed to develop. Land-use patterns require Americans to drive more and

more miles each year and to spend more and more hours sitting in traffic jams that waste time and resources. And the major cause of much pollution from “stationary sources” lies in the failure to devote the attention and creativity needed to find less polluting ways to make the products our advanced society wants.

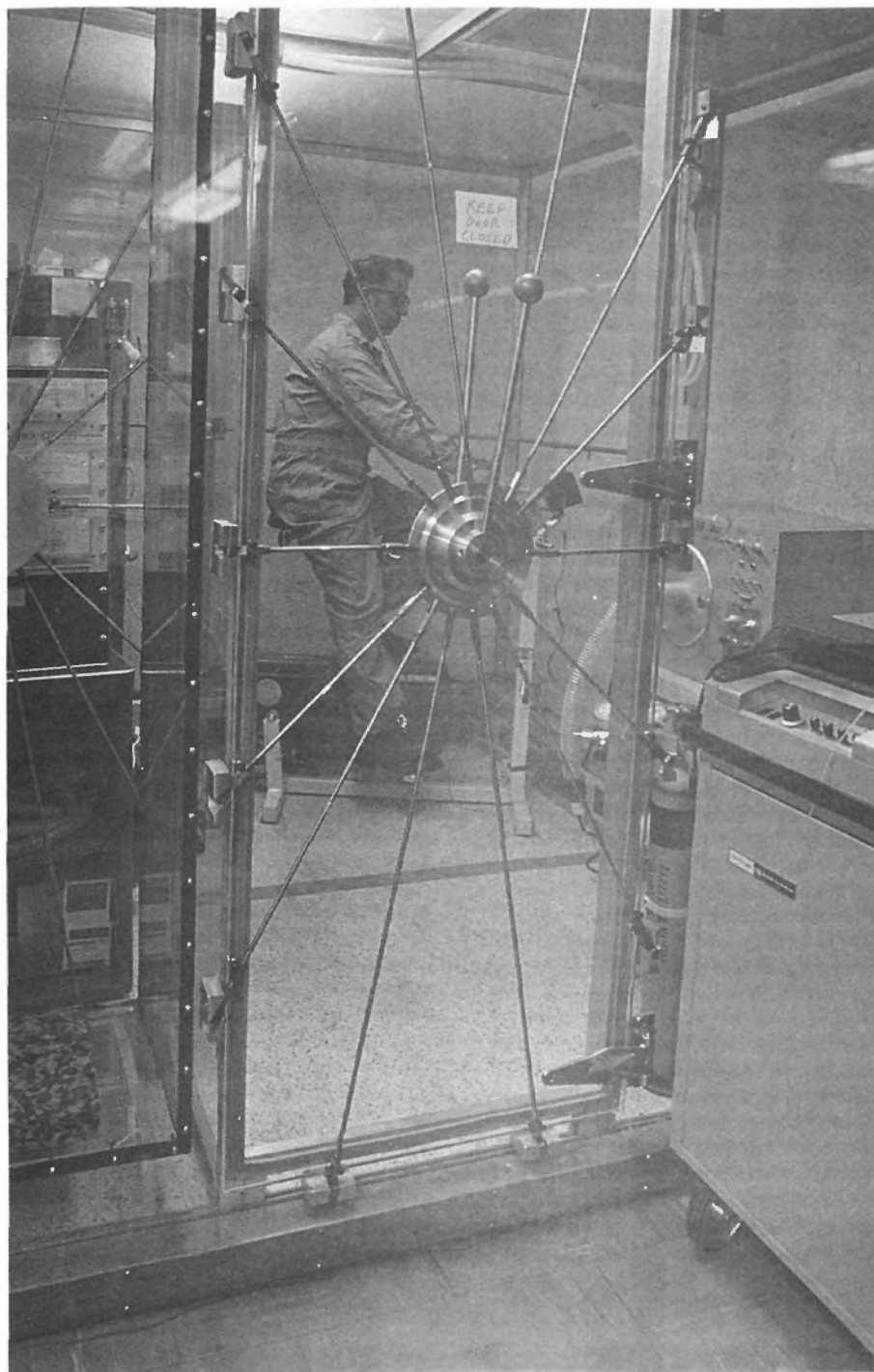
According to the California Energy Commission (CEC), traffic congestion in California already costs 360 million person years, a figure worth \$17 billion in wasted fuel and lost time, annually. The CEC expects this to triple in the 1990s! Assuming the rest of the country is only two-thirds as congested, nationwide costs would translate annually into more than 1.2 billion person hours and more than \$57 billion for the country as a whole. Does anyone really believe that this is progress towards a higher standard of living?

It is time to face the music. We need to deal with basic questions of land use, zoning, and mass transit that have been political taboos virtually since World War II. The mindless construction of accidental cities can no longer represent the definition of progress. The casual acceptance of 8 percent—or even 4 percent—annual increases in vehicle miles travelled can no longer pass as transportation policy. The slavery of hours spent commuting in a car each day can no longer masquerade as freedom.

It has become fashionable to despair of addressing these fundamental causes

The Clinical Research Program at EPA's Health Effects Research Laboratory in Chapel Hill, North Carolina, has performed key studies on the health impacts of exposure to air pollutants. This chamber is used to evaluate pulmonary and cardiovascular functions in human subjects exposed to air pollutants.

(Ayres is a Senior Attorney with the Natural Resources Defense Council and chaired the National Clean Air Coalition.)



EPA photo.

of smog on the grounds that the necessary steps would require changes in "lifestyle"—as if the result would necessarily be unacceptable reductions in the American standard of living. What is needed now is the perception and courage to recognize the obvious: that attacking the fundamental causes of pollution would improve our standard of living and save Americans and American businesses billions of dollars wasted in resources and time.

The new Clean Air Act prescribes a new beginning on these issues, at least in the more polluted cities. But the federal act is a prescription, not a cure. The patient's own actions will determine the cure. It will take a new political coalition at the local level, one built on enlightened self interest on the part of business leaders and state and local government.

The remarkable experience of Portland, Oregon, illustrates the kind of boldness needed. Two decades ago, Portland was more committed to freeways than any city. But when Oregon adopted a state land-use law, Portland abandoned plans for new freeways and instead built a light rail system. The rail system now carries the equivalent of two additional traffic lanes on every road entering downtown. The result: better air quality and a rejuvenated city economy. Downtown has added 30,000 jobs without any increase in the number of cars while increasing its share of the regional retail market from 7 percent to nearly 30 percent. Meanwhile, health-threatening smoggy days are down from about 100 per year to none.

The same willingness to see with fresh eyes will be necessary for industry. For too long, too many have accepted the zero-sum conception of environmental problems—that any improvement in environmental quality must be paid for with sacrifices elsewhere in the economy. But very often pollution is waste, and eliminating its cause means saving money: a win-win situation.

The case of the furniture makers in

the Los Angeles basin is one among many that illustrates how the application of intelligence to solving pollution problems pays off in both better environmental quality and lowered production costs. When a new air-pollution control plan for the Los Angeles basin was unveiled, furniture makers complained that its strict limits on pollution from painting and drying operations would force them out of the basin, taking thousands of jobs with them. But then they looked for the first time at the costs of the drying method they had been using, one that burned massive quantities of fuel to generate

hot air to dry their products. They found that an alternative approach using infrared drying gave a better product at lower cost, and without pollution.

The new Clean Air Act has set the stage for more such innovative thinking. For instance, states are obligated to achieve and document annual percentage reductions in smog-causing emissions. In most cities, this will require not only slowing the rate of increase in aggregate vehicle mileage but also the kind of success in new process development that was demonstrated by the furniture makers.

For motor vehicles, the law also requires localities to adopt additional measures, beyond those in the state implementation plan, if actual mileage growth does not slow as needed to meet health standards. While this requirement is categorical, its primary purpose is to challenge states and localities to develop programs that answer transportation demands by moving people and goods with less effect on public health.

Providing mobility consistent with public health goals will require a new federal transportation policy. Although federal highway funding may not be the only force promoting suburban sprawl, the overwhelmingly pro-automobile tilt of federal transportation policy and funding has largely enabled such sprawl. This year Congress will have the opportunity to rethink transportation policy when it reauthorizes the Surface Transportation Assistance Act, known widely—and tellingly—as the “Highway Act.” For the sake of public health and our energy future, the next Transportation Act should emphasize cleaner, more energy-efficient public transportation. The reauthorization process will test whether the President and Congress are serious about restoring breathable air in our polluted urban areas.

In 1981, the National Commission on Air Quality confidently predicted that if the programs for air-pollution control then on the books were carried out, only about seven urban areas would still have unhealthy levels of smog by 1987; and only one or two areas would continue to expose residents to health-threatening levels of carbon monoxide pollution. This prediction fell victim to lax enforcement and lack of leadership in the environmental “lost decade.”

With enactment of the new Clean Air Act, the nation seems poised for a renewed effort to restore air quality as envisioned by the authors of the landmark 1970 Clean Air Amendments. Whether our leaders in government and in private industry seize this opportunity for a new beginning may determine whether this Clean Air Act will fulfill, at last, the promise of the 1970 Act. □

Will the New Law Protect Public Health?

—John R. Garrison

A look inside Eastern Europe suggests what our cities might look like today if Congress had not adopted the Clean Air Act of 1970. That law, for example, compelled the auto industry to develop the catalytic converter that is standard equipment on all cars today.

Nevertheless, 96 major metropolitan areas still exceed the ozone health standard. For the 133 million Americans living and working in these areas, clean air may seem as far away as ever.

Perhaps more alarming is what we've learned since 1970 about the health effects of air pollution. In 1981 a research group reported that asthmatics are especially sensitive to sulfur dioxide. Although the findings were met with skepticism at the time, today the scientific community agrees that sulfur dioxide affects asthmatics as well as others with hyperreactive airways.

Following quickly on this discovery, EPA's own clinical laboratories found that otherwise healthy, exercising individuals show significant effects after six to eight hours of breathing ozone at levels below the threshold of the current health standard. Consider your mailman walking 3.5 miles per hour during the “smog season.” By the end of the day he may suffer a sizable decline in his ability to breathe normally, thereby affecting his job performance. The long-term effect of repeated exposures to such levels is one of the many questions remaining in the area of

health-effects research.

Air pollution diminishes the lives of millions of Americans and shortens the lives of tens of thousands each year. Excess deaths from air pollution are in the same range as those from breast cancer or auto accidents. Translating these human costs into financial terms, the American Lung Association estimates the annual health cost of air pollution at \$50 billion. Twenty years ago, Congress declared that the health consequences of air pollution constituted a national emergency and developed a crash program to respond.

It is hard to believe, but that sense of urgency is lacking in the 1990 law. There is a subtle shift away from health-driven deadlines, and toward progress requirements; away from new technology-forcing standards and toward broader application of today's technology. Air pollution is, for the first time, considered not a health hazard, but an economic commodity. The goal of protecting public health may remain, but it is now more a compass than a roadmap for the almost 100 communities still facing unhealthy air quality.

Will the Clean Air Act Amendments of 1990 provide all Americans with clean and healthful air quality? To be honest, it is too early to tell.

(Garrison is Managing Director of the American Lung Association.)

A Skeptical Observer

by Frank Blake

Will the dream embodied in the new Clean Air Act come true? In light of past experience, can we rise to the challenge?



Chris Walker photo. The Chicago Tribune.

The Clean Air Act puts a new twist on the roadside advertising technique of announcing on successive billboards the approach of a desired destination. But in this case, instead of moving closer to the exit, the farther the nation travels, the more it moves away from its destination.

With each new version of the act, Congress announces that the goal of attainment of the national ambient air quality standards is even more distant. One projection for the next decade that can be made with confidence is that by the time the act is next considered for reauthorization, nationwide attainment still will not have been achieved. This is the environmental version of the myth of Tantalus: The prize is always out of reach. And were we ever to

approach nationwide attainment, the standards would be revised—a possibility now lurking in the background for the ozone standard.

In fundamental respects, the Clean Air Act is designed to fail. Some might argue that this serves a political purpose. It provides a focus for fund raising and a perpetual cause. But there are also less cynical explanations. Although the page upon page of detailed legislative language may obscure the point, the act is, at heart, about technology, and unattainable goals are the whips for constant technological improvement.

What is unusual about this newest version of the act is the breadth and scope of improvement demanded. In addition to the standard recipe of tighter automobile-tailpipe controls and major stationary source controls, the new law calls for advances in the formulation of gasoline, the introduction of new alternative fuels, such as compressed natural gas and electricity, new controls on all

industrial sources of air toxics, new controls on small stationary sources, new controls on sulfur dioxide, nitrogen oxides, and particulate matter: The list could go on and on.

When we look back on the accomplishments attributable to the 1990 amendments, there is little doubt that we will see significant improvements in air quality and significant technological advances in air-pollution control. What is less certain is whether the blizzard of new requirements will contribute to or hamper this progress. The legislation is full of promises, and, as Samuel Johnson wrote, large promises are the soul of public debate. But he added this caution: "I cannot but propose it as a moral question to those masters of the public ear, whether they do not sometimes play too wantonly with our passions."

There are two cautionary notes here for the Clean Air Act. First, the rhetoric of massive health impacts from nonattainment, ecological damage from

(Blake is currently General Counsel with GE Industrial & Power Systems. He served as General Counsel for EPA from 1985 to 1988.)

There is more to be commanded and controlled under this legislation than has ever been attempted before.

"acid rain," cancer from air toxics and so on outstrips the reality of the health and environmental benefits to be gained from the legislation. This may prove harmful to the goal of continuing environmental improvement if the public were to receive more balanced presentations in the media on environmental issues; there may be a price to pay in the future in terms of lost credibility for playing "too wantonly" with environmental passions. But that appears a remote possibility, at least at this time.

The more immediate cautionary note concerns the burdens and challenges that will face EPA over the next 10 years and that will determine the success of this legislation.

Whatever one's ideological perspective on command-and-control regulations, the new Clean Air Act should press the outer limits of anyone's confidence in that approach. There is more to be commanded and controlled under this legislation than has ever been attempted before. The legislation is an odd mixture of marketplace philosophies with standard command-and-control approaches. The acid rain provisions are notable in their reliance on the marketplace and on the new allowance-trading system (this is also the one area where the act's goals, a 10-million ton reduction, will be achieved and can be verified).

But while the allowance system may have received the lion's share of attention, the remainder of the legislation is heavily oriented to a command-and-control approach. This is true in the nonattainment area where, for example, EPA is mandated to develop guidance documents for new control techniques. It is even more so in the air toxics area, where the Agency is faced with the overwhelming task over the next 10 years of developing control standards for nearly every form of industrial activity.

The availability of an adequate knowledge base, adequate personnel, and adequate resources to tackle these tasks is doubtful. And even if that base could spring into existence within the statutory time frames, the interrelationship of the various provisions of the act requires a level of planning and a field of vision that are elusive even under the best of circumstances. For example, controls of volatile organic compounds for ozone purposes will be linked with air toxics controls; air toxic controls will be linked to product reformulations; product reformulations will be linked to operating permit revisions; permit revisions to State Implementation Plans, and so on.

The issue is not whether EPA can manage this process. It cannot. The tighter the grip the Agency attempts, the more the hoped-for result will slip away.

The Agency is faced with a particularly difficult institutional challenge. On the one hand, the usual round of criticism of the Agency can be expected as the broad goals of the act fall short of accomplishment. This has been the history not only of the Clean Air Act but of most other environmental statutes. EPA bears the public criticism of missing targets that were designed to be unattainable.

On the other hand, the Agency's typical reaction to this situation, which is to gather more control for itself, will not work. The reaction is logical. There is a natural desire for any institution that knows it will be blamed for failure to attempt to gain control over what it is being held accountable for. But the breadth and complexity of this legislation do not permit typical solutions. The typical solutions are likely to be counterproductive. If EPA must approve each new development in control strategies or if those strategies are imposed by the federal government according to the federal government's time schedule and not through the logic of facility and product improvement,

the underlying technological goals of the legislation will not be achieved.

As with a physician, the Agency's first obligation in implementing the act is to do no harm. In trying to make good on an impossibly large promise, the Agency may sacrifice the realization of a series of smaller promises. Environmental performance is now a significant international competitive issue. Lower emissions provide a competitive advantage, and technological advancement and environmental performance are linked. This has many long-term consequences, the most immediate of which is that there may be a greater commonality of interest among EPA, the environmental community, and industry than has ever existed before.

A second consequence, however, is that EPA, with the vast and unwieldy mandate that it has been given, may create a regulatory structure that imposes unacceptably high transaction costs. Delay and regulatory confusion may prove the greatest barriers to progress. The criticism of command-and-control regulation has been, historically, that it is economically inefficient. Now the more pressing criticism may be that it is environmentally inefficient.

To its credit, the early signals from EPA are that it recognizes these dangers and that it will implement the act through a greater reliance on consensus rulemaking and flexible principles than has ever been the case. The temptations to veer from this path will be powerful: the Agency's own self-interest in exercising control, the interest of states in shielding themselves from difficult decisions by pointing to federal mandates, and the pressure from some industries to use environmental goals as a tool for market allocation. But the test of whether the legislation will be successful rests in large part on the Agency's resisting those temptations. □

EPA Launches Two Voluntary-Action Initiatives to Prevent Pollution

EPA Administrator William K. Reilly recently announced two major new initiatives for preventing pollution, and EPA is encouraging leading U.S. corporations to participate.

According to Agency and independent projections, the two programs will result in significant reductions in air and other pollution, and one of them could generate savings of more than \$18 billion a year for participating U.S. companies.

In the first of these programs, called "Green Lights," 23 major corporations signed voluntary agreements with EPA committing the companies to upgrade their facilities with more energy-efficient lighting. Lighting accounts for almost one-fourth of national electricity use. If enough companies join the Green Lights program and install modern lighting fixtures, the Agency estimates the nation would reduce electricity demand by 10 percent or more. Reducing demand reduces use of coal and other energy sources that generate electricity, thereby reducing pollution.

The Green Lights program, which incorporates new, energy-efficient fixtures currently available, is projected to reduce annual air pollution by 235 million tons—5 percent of the national total. Sulfur dioxide would be reduced by 7 percent of the national total, nitrogen oxide by 4 percent, and carbon dioxide by 4 percent.

Representatives of more than a hundred corporations recently attended a series of one-day workshops at EPA headquarters to learn technical details about the Green Lights program. Contact: Dave Ryan at (202) 382-2981.

In a second pollution-prevention action, Administrator Reilly has asked more than 600 U.S. companies to reduce voluntarily their emissions of 17 especially troublesome toxic chemicals. EPA's goal for this initiative, called the Industrial Toxics Project, is to

Philips Lighting photo.



This compact fluorescent bulb uses only 18 watts of electricity and lasts about three years.

cut nationwide releases and transfers of the 17 target chemicals by one-third by the end of 1992; and by one-half by the end of 1995.

The companies involved are the largest contributors to annual releases of 1.4 billion pounds of these 17 chemicals from more than 11,000 industrial facilities. Releases occur in all environmental media: air, water, and land.

Reilly's request for voluntary corporate action is part of a comprehensive EPA Pollution Prevention Strategy recently transmitted to Congress. The Industrial Toxics Project, headed by Susan Hazen, is being coordinated by EPA's Office of Pesticides and Toxic Substances.

"Pollution prevention can be the most cost-effective alternative to after-the-fact treatment of pollution," Reilly said. "Companies can

save on the costs of waste management, they can reduce their use of raw materials, and they can minimize their liability."

The 17 targeted chemicals, which include a number of heavy metals and volatile organic compounds, are widely used in the manufacture of a variety of products ranging from paper and plastics to furniture and transportation equipment. EPA selected the chemicals because they pose serious known health and environmental effects, have high production volumes, high potential to come into contact with humans or ecosystems, and offer a recognized potential for release reduction.

Reilly said the voluntary programs, coupled with the incentives for toxics reductions in the new Clean Air Act, can help achieve significant cuts in pollution in advance of statutory timetables and bring about earlier health benefits at lower cost to industry. Contact: Luke Hester at (202) 382-4383 or Gwen Brown at (202) 382-4384.

Agency Appeals Wetlands Decision

EPA is seeking to reverse a court ruling allowing the destruction of hundreds of acres of wetlands near historic Williamsburg, Virginia. The Agency is appealing a recent federal district court decision that overruled its veto of the proposed Ware Creek Dam.

EPA contends that the dam would damage wildlife and recreation areas and that alternatives to the project are available. Contact: Sean McElheny at (202) 382-4387.

Editor's note: "Newsline," introduced in this issue of the Journal, will appear as a regular feature highlighting significant news-breaking items.

EPA's 1992 Budget Upped to \$6.2 Billion

The President's proposed budget for EPA in fiscal year 1992 is \$6.2 billion, an increase of just under 2 percent from current levels.

Remedial programs and large environmental construction projects will continue to receive the largest share of money, \$3.65 billion, assigned to EPA. These include: Superfund, for correcting old and abandoned hazardous waste sites, \$1.75 billion; Construction Grants, to help finance municipal wastewater treatment facilities, \$1.9 billion; and Leaking Underground Storage Tanks, a program to help protect ground water, \$85 million.

Highlights of the President's budget include:

- Roughly 70 percent of the increase in operating program funds will be used in implementing the Clean Air Act Amendments of 1990.

- Natural ecosystems such as the Great Lakes and Chesapeake Bay will receive greater protection through multi-media (air, land, water) initiatives targeting specific geographic areas. Wetlands and coastal areas also will receive increased attention.

- By establishing an Environmental Education Office, focusing on elementary and secondary schools, the Agency will promote environmental literacy, individual stewardship of nature, and careers in environmental sciences. (See related item.)

- The Agency will strengthen programs affecting food safety through stringent pesticide registration standards, safer pesticides, and expanded public outreach and communication.

- To buttress its lead-reduction strategies, the

Agency will continue its study of the health effects of lead exposure, evaluate long-term abatement and in-place management, and pursue research and training related to the effects and reduction of this contaminant.

- Additional funding will strengthen the Agency's scientific and economic analysis, assisting decision-makers to make more effective use of market incentives and applied science.

Administrator Reilly said EPA will continue to strengthen the role of science to emphasize pollution prevention and risk reduction and to increase protection and restoration of natural systems. Many of the underlying principles in the Agency's 1992 budget were recommended by EPA's Science Advisory Board in a report entitled *Reducing Risk*, released last September. Contact: Lauren Milone at (202) 382-4355.

New Education Office at EPA

A new Office of Environmental Education has been created at EPA under the direction of Lewis Crampton, Associate Administrator for Communications and Public Affairs. The office was authorized by the National Environmental Education Act, recently signed into law.

The goal of the office is to increase environmental literacy and awareness among students and educators from elementary to postgraduate levels. Responsibilities include coordinating programs and information in government, private industry, and the education field; sponsoring grants supporting environmental education projects; and implementing programs such as the President's Environmental Youth Awards and Environmental Youth Forums. Contact: Michael Baker at (202) 382-4965.

Joint Study of Forest Health

EPA and the U.S. Forest Service have joined forces to develop a nationally consistent monitoring network to determine the environmental health of the nation's forests.

Air pollution, global climate change, and land management practices are thought by some experts to have the potential for causing long-term damage to forest ecosystems, including the economic and environmental benefits the forests provide. The new monitoring network will examine the relationships among forest conditions and human-induced and naturally occurring stresses.



A pilot project involving two different types of forest is under way in New England and Virginia. The pilot will examine the productivity, sustainability, and

biodiversity of the forests, aiming toward developing a more comprehensive forest monitoring program. Contact: Lauren Milone at (202) 382-4355.

Richard Frear photo. National Park Service

Nine EPA Offices Join Forces in New Lead Strategy

Responding to growing evidence that millions of American children still may be exposed to unhealthy levels of lead in their environment, EPA announced the creation of a cross-media task force to attack the problem.

"Lead can be a pernicious problem. Recent research shows children are seriously harmed when they have blood lead levels previously considered safe. EPA intends to use every authority at its disposal to reduce exposure of children to lead in the environment," Administrator Reilly stated.

Ingested lead can delay the development of children, cause cognitive and behavior problems, harm fetuses, cause reproductive disorders, and increase blood pressure. The three major sources of lead exposure are lead-based paint, urban soil and dust, and drinking water.

Since lead is a multi-media pollutant affecting air, land, and water, the Agency's new strategy involves integrated efforts by several programs, nine in all, as well as coordination with other federal and state agencies. Major actions include:

- Identifying geographic "hot spots" of lead pollution
- Implementing a pollution-prevention program
- Strengthening existing environmental standards
- Developing and transferring abatement technology
- Encouraging a recycling program
- Sponsoring a national educational campaign
- Adding to enforcement actions.

The Agency is allocating \$4 million to support the lead strategy, as initiatives are phased in over the next few months. Contact: Gwen Brown at (202) 382-4384.

On A Clear Day

National Park Service photo.



EPA has proposed rules to curb pollution from a Northern Arizona coal-fired power plant believed to contribute substantially to winter pollution haze in the Grand Canyon.

EPA's proposal is based on evidence provided by the National Park Service, supported by the National Academy of Sciences, that the Navajo Generating

Station, a 2,250-megawatt plant, is a significant contributor to the visibility problem in the Grand Canyon. The impaired visibility is caused mostly by a mixture of sulfates, nitrates, and dust particles. EPA is proposing a 70-percent reduction in currently allowable sulfur dioxide emissions from the power plant. Depending on the option selected by the power

plant, EPA estimates annual costs of pollution-control measures will range from \$92 million to \$128 million.

According to the National Park Service, the canyon had almost 900,000 wintertime visitors in 1989, about 21 percent of its annual total. Contact: Dave Stonefield, EPA's Air Quality Management Division, at (919) 541-5350.

First Rule Under New Clean Air Act

The first rule issued under the new Clean Air Act calls for advanced pollution-control technologies on large municipal waste incinerators. The rule will reduce overall air emissions from this source by 90 percent by 1994.

The new emission standards will require scrubbers at new large facilities to limit emissions of such metals as lead, cadmium, arsenic, and chromium by more than 99 percent; reduce organic chemical emissions such as

dioxin by 99 percent; reduce acid gas emissions such as sulfur dioxide and hydrogen chloride by 90 to 95 percent and cut nitrogen oxide gases by about 40 percent. Existing incinerators will be required to add scrubbers and take other steps to ensure proper burning and curb emissions.

The standards will be fully implemented at 100 existing incinerators by 1994 and apply immediately to 30 new plants expected to be built in the next five years or thereafter. Contact: Robin Woods at (202) 382-4377.

EPA Announces Grants to 17 Small Businesses for Pollution Prevention

EPA's Office of Small and Disadvantaged Business Utilization has awarded 17 grants for pollution-prevention projects to small businesses. The awards, worth up to \$25,000 each, help small businesses develop and demonstrate new pollution-prevention technologies. A total of \$400,000 is available for such projects in 1991, and 176 companies applied for the grants. The program is administered for EPA by the Center for Hazardous Materials Research at the University of Pittsburgh. Contact: Karen V. Brown, EPA's Asbestos and Small Business Ombudsman, at (703) 557-1938.



Thomas C. Voltaggio is the new Director of the Hazardous Waste Management Division for EPA's Region 3, which is located in Philadelphia, Pennsylvania.

Voltaggio has served in several positions in Region 3 since 1980. His most recent position was Director of the Superfund Program from 1983 to 1990. From 1981 to 1983, he was Chief of the Compliance Branch in the Air and Waste Management Division. He was also Acting Director of the Enforcement Division from 1979 to 1980 and Chief of the Air Enforcement Branch from 1977 to 1979.

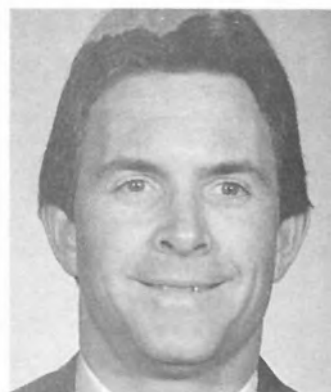
Voltaggio came to Region 3 from Region 5 in Chicago, Illinois, where he was Air Engineering Section Chief from 1974 to 1977 and Compliance Section Chief in 1973. He began his career with EPA in 1971 as a chemical engineer in the National Pollutant Discharge Elimination System (NPDES) Program in Region 6, Dallas, Texas.

Voltaggio graduated from the City College of New York with a bachelor's degree in chemical engineering. He then earned a master's degree in management science at Texas Christian University. He was awarded the EPA silver medal in 1989 and the EPA bronze medal in 1988.



The new Director of the Office of Toxic Substances is **Mark A. Greenwood**. His EPA career started in 1978 when he joined the Office of General Counsel as an attorney-advisor. Greenwood became the Assistant General Counsel for the Resource Conservation and Recovery Act (RCRA) program in 1983 and then served as Assistant General Counsel for Superfund in 1987. He was appointed Associate General Counsel for Pesticides and Toxic Substances in 1988.

Greenwood graduated from the University of Michigan in 1974 with a bachelor's degree in political science. He then earned a master's degree in public policy and a law degree from the University of Michigan in 1978. During his education, he worked as a legal intern for Wisconsin's Office of State Planning and Energy and the Office of General Counsel for the U.S. Council on Environmental Quality.



The new Deputy Director of the Office of Information Resources Management (OIRM) is **Paul Wohlleben**.

Wohlleben joined EPA in 1985 as a branch chief in the Financial Management Division, Office of the Comptroller. In that position, he managed the operation of the Agency's financial management and payroll systems. Since 1988, he has worked in OIRM as Deputy Director and Director of the Administrative Systems Division, where he managed the Agency's national administrative systems software portfolio.

Previously, Wohlleben worked at the Department of Treasury from 1976 to 1985. During that time, he held a variety of positions related to financial policy, operations, and systems within the Financial Management Service. His duties at Treasury included serving as project manager for the Treasury General Account Cash Concentration System. He also served as a staff advisor to the Fiscal Assistant Secretary, and in that capacity was the department's principal liaison with the Federal Reserve System on matters related to fiscal agency operations.

An alumnus of Virginia Tech, Wohlleben graduated in 1972 with a bachelor's degree in business administration. After a tour of duty in the U.S. Army, he earned his master's in business administration from George Washington University and attended the George Mason University Law School. □



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Lost River Range, Idaho: A breath of fresh air.

Back Cover: Closeup of springtime.
Photo by Bill Weems for Woodfin Camp.

