



The Next Environmental Policy: Preventing Pollution



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"Meet the malady on its way."

Persius, *Satires*, Book 3

For the United States to make as much environmental progress in the next twenty years as it has in the last twenty, we need to adopt a bold new approach to environmental policy—and a strong new ethic of environmental stewardship. Simply put, we have to work much harder to *prevent* pollution before it occurs; cleaning it up after the fact is no longer good enough.

Environmental protection has been an American success story—perhaps the premier public policy success of the past two decades. Since the celebration of the first Earth Day in April, 1970, the United States has substantially curbed air and water pollution, cleaned up much of the accumulated arrears of past generations, and altered forever the meaning of doing business in an environmentally conscientious society. Our environmental commitments of twenty years ago established precedents now being followed by the rest of the world.

But the quest for environmental quality has turned out to be far more complex than we supposed two decades ago. Our discovery of new environmental dilemmas has more than kept pace with our ability to solve old ones. The techniques that we have been using to protect the environment, as effective as they have been in the past, now need to be augmented with innovative new strategies.

The State of the Environment

The closing decade of the 20th century is an appropriate time for the United States to reevaluate how we think about and deal with environmental problems. Environmental issues have again surged to the top of the nation's agenda. Business leaders, citizen activists, politicians, and consumers alike have expressed renewed concern for the quality of life and the future of the planet. When the Wirthlin Group asked respondents in a recent poll to name the coun-

try's top concern, the environment was one of the three issues most often cited. The poll also found that the proportion of Americans who think of themselves as environmental activists doubled during the past decade. More than half of the respondents reported changing their behavior because of concerns about the environment. Reflecting this heightened level of public concern, President Bush and Congress worked together last year to enact a stringent and far-reaching new Clean Air Act—serving notice that the 1990s will indeed be the "Decade of the Environment."

At this crucial juncture, the environmental "glass" can be seen as either half-full or half-empty. Last year, in its twentieth annual report, the President's Council on Environmental Quality observed, "After two decades of unprecedented environmental activism, some facets of the environment show remarkable improvement, while the quality of others has deteriorated sharply."

The investments that the United States has made in pollution control since 1970 have paid handsome dividends. Over the past two economically robust decades, while the U.S. gross national product grew by 70 percent in real dollars, the nation made significant and indisputable progress in cleaning up its air and water. For example, in every major category of air pollution except nitrogen oxides, total emissions have either leveled off or declined since 1970. Emissions of particulates are down 64 percent; sulfur oxides are down 25 percent; volatile organic compounds are down 29 percent; carbon monoxide is down 38 percent; and lead is down 96 percent.

And there has been substantial progress on other fronts as well: Hundreds of primary and secondary wastewater treatment facilities have been built; ocean-dumping of wastes has almost been eliminated; land disposal of untreated hazardous wastes has largely stopped; thousands of hazardous waste sites have been identified, and clean-up is well underway on hundreds of the most degraded sites; and the production and most uses of such toxic substances as asbestos, DDT, and PCBs have been banned. Taken together, these and other actions have had a measurable, positive effect on environmental quality in this country, and they have set an example for other nations around the world.

Consider just one concrete example of the net benefits of environmental protection: The Environmental Protection Agency (EPA) conducted an extensive study of benefits and costs during the phase-out, over an eight-year period, of leaded gasoline. The study found that the lead ban cost refiners about \$3.6 billion. Yet the *quantifiable* benefits added up to more than \$50 billion, including nearly \$42 billion in medical costs avoided for both children and adults; \$1.6 billion in pollution-related environmental damages averted; nearly \$6 billion in lower vehicle maintenance costs; and more than \$1.1 billion in improved fuel economy. Those figures do not include the non-quantifiable, really priceless value of saving more than 5,000 lives and preventing 8,000 heart attacks, strokes, and cases of high blood pressure in just one year.

New environmental laws, such as the revised Clean Air Act, will do even more to reduce pollution-related disease and damage to buildings, sculptures, monuments and bridges; to water bodies and recreation areas; and to wildlife habitats and productive ecosystems.

Similar gains have been made in curtailing water pollution. For example, \$10 billion spent on municipal sewage treatment programs has succeeded in drastically reducing the volume of conventional pollutants in the Great Lakes. Nutrients are down, algae is down, fecal coliform bacteria are down, biological oxygen demand is down. Lake Erie was once the classic horror story of the ravages of uncontrolled water pollution: Commercial fishing was all but decimated there as recently as twenty years ago. Now Lake Erie is the largest commercial fishery in the Great Lakes.

But even as this progress has been made, new and more complex environmental challenges have emerged. Despite our success in curbing conventional pollution in the Great Lakes, for example, fish are accumulating toxins that make them inedible. PCBs and even DDT, which was banned in this country in 1972, continue to show up in the lakes—presumably transported by air from applications in Mexico or Central America, where DDT is still used. Pesticides, herbicides, and petroleum run off of farms and city streets into ditches and streams, eventually making their way into the lakes.

Solid waste, another growing concern, illustrates the extent to which individual actions can accumulate to create widespread environmental problems. According to EPA's most recent report on municipal solid waste, the amount generated in this country increased by 13 million tons between 1986 and 1988. The United States now generates more than 180 million tons of new solid waste annually—an average of

four pounds a day for every American! This is a record level of per-capita waste generation for this country; it is two times the per-capita level of West Germany, three times that of Italy.

Despite two decades of unprecedented environmental investment, the creation of waste continues to accelerate. Many persistent or emerging environmental problems are caused by diffuse, widely scattered, difficult-to-control sources of pollution. These sources reflect patterns and practices of resource use and waste generation that at times seem almost out of control. They do not lend themselves readily to traditional government regulation.

Moreover, we are increasingly visited with the adverse effects of environmentally unsound development: the devastation of natural habitats, the disruption of the ability of wildlife to migrate, the rapid extinction of plant and animal species. Internationally, we must deal with alarming new discoveries of urgent global environmental problems with localized impacts. Stratospheric ozone depletion, acid rain, the destruction of tropical rain forests, climate change, severe soil erosion—this daunting array of global challenges threatens to overshadow the environmental gains already made and to destabilize the very natural systems that sustain life on this planet.

Why Pollution Prevention?

If we want to continue making progress in environmental protection, we will need to move significantly beyond the programs already in place and the actions already taken. In my view, the most important advance we can make is to shift from an emphasis on expensive end-of-pipe or top-of-stack pollution control and cleanup to a dramatically more productive and less costly focus on preventing pollution in the first place.

The environmental problems most effectively brought under control so far have been relatively obvious and straightforward—belching smokestacks, raw sewage and industrial effluent dumped directly into rivers and lakes, rusting drums of hazardous waste carelessly buried in or near human settlements. Our efforts have focused primarily on the *correction* of environmental problems—treating pollution, disposing of waste, mitigating the effects of environmentally unsound development. But the environmental challenges of the next ten years will be increasingly subtle, complex, and costly to resolve—and they will be less readily ameliorated with the kinds of corrective measures that have worked well in the past.

There is also a compelling economic rationale for shifting our emphasis from cleanup to prevention.

Benjamin Franklin's homily, "an ounce of prevention is worth a pound of cure," is no less applicable to environmental protection than to medicine. Environmental cleanup is expensive. EPA estimates that the cost of pollution control, just from commitments already in place, will grow in constant dollars from more than \$100 billion a year today to about \$155 billion in the year 2000—approximately 2.7 percent of GNP.¹ The most rapid growth in environmental protection costs over the next decade will be in expenditures for cleaning up pollution on land—primarily from operating and hazardous waste sites, both in the private sector and at federal facilities, and from leaking underground storage tanks. In light of these substantial and growing costs, it seems only prudent to ask if society's resources are being used in ways that will contribute most efficiently over the long haul to the health and well-being of our citizens and our environment. And we will be unable to give a positive answer to that question as long as we continue to spend the bulk of our environmental resources on cleanup, while neglecting front-end investments in pollution prevention and environmental planning.

Cost is only one shortcoming of the conventional approach to pollution control. An even more fundamental problem is the fact that the end-of-pipe focus is reactive rather than preventive, and thus inherently incapable of correcting the root cause of most environmental degradation: waste. By concentrating on treating the *symptoms* of environmentally damaging human activities, we are in danger of constantly losing ground in the long-range struggle to protect and improve environmental quality.

The continuing problem of toxic pollutants in the Great Lakes is an example of this phenomenon. As I noted earlier, large investments by the United States and Canada in municipal wastewater treatment plants have paid off in substantial reductions in conventional pollutants, such as fecal coliform, nutrients, and algae. But air deposition of toxic chemicals, as well as runoff from farms, urban surfaces, industrial sites, and mining operations, continues to contribute pollutants to the Great Lakes, which contaminate bottom sediments—and accumulate in fish and in such wildlife species as the bald eagle, damaging the latter's ability to reproduce. The lesson we are learning is clear: When we focus on *treating* waste, rather than on *preventing* waste, new environmental problems tend to outstrip whatever progress we can make.

This is not to say that EPA should or will abdicate its responsibilities for pollution control and mitiga-

tion. In fact, EPA has redoubled its traditional regulatory and enforcement efforts; in the last two years we have set records in nearly every enforcement category. In particular, EPA has dramatically increased the number of administrative and criminal enforcement actions. Yet while EPA is continuing to improve and enhance its enforcement programs, we will also work to develop and apply a variety of creative *new* strategies to meet today's complex environmental challenges.

Decentralized Pollution Problems

Even though EPA has made great strides in eliminating large, obvious, and acute forms of pollution during a time of substantial economic expansion, troubling increments of more insidious and elusive pollution remain. Furthermore, the world now faces pollution problems that are different in kind and in scope. Some of the most intractable of these problems come from scattered, decentralized sources—pollution that does not emerge from a smokestack or a pipe, but results instead from the activities of millions of citizens going about their daily lives. Emissions from the tailpipes of cars, the use and release of ozone-depleting chlorofluorocarbons, agricultural and urban runoff, indoor air pollution, the use and disposal of consumer products containing toxic substances—all are examples of large, decentralized pollution problems generated by millions of small sources. Reducing these remaining increments of decentralized pollution through traditional *ex post facto* control and cleanup programs would be extremely costly, if indeed such programs could even achieve the desired results.

The distinctive nature of these problems suggests that they will be solved only by a different array of approaches than EPA has used in the past. Fortunately, there is a growing consensus that pollution prevention offers a good framework. *Pollution prevention is a decentralized approach to a decentralized problem.*

Accordingly, EPA has embarked on a comprehensive effort to make pollution prevention a top priority on the nation's environmental agenda. We have established a hierarchy of various approaches for dealing with waste. In this hierarchy, the preferred approach is source reduction—the minimization or outright elimination of waste generation. A strong preference for recycling is next in EPA's hierarchy; if waste cannot be prevented, at least we should recycle and reclaim as much as possible, thereby conserving

¹ These figures represent only the costs of pollution control, without taking into account any of the very substantial benefits from this investment.

resources for the future. On the bottom rung of the hierarchy, to dispose of waste that cannot be prevented or recycled, come safe incineration and proper landfilling as last resorts.

Pollution Prevention at Work

Many of the initiatives that already have been taken, and that have produced substantial environmental benefits, could be classified as examples of pollution prevention: banning DDT, eliminating lead in gasoline, phasing out most uses of asbestos, cutting down on the range of permissible uses of certain pesticides and herbicides. But even more impressive reductions in pollution can be achieved by putting pollution prevention to work in *every* sector of society.

Within the *industrial sector*, pollution prevention means changes in products, materials, practices, and processes or increased efficiencies in existing processes. For instance, a new technique developed by the Department of Defense replaces solvents in paint removal. The new process, called "plastic media blasting," uses tiny plastic pellets instead of solvents to strip paint. The Defense Department reports that this technique cuts the time it takes to strip an F-4 fighter from 340 to 40 hours while reducing the amount of waste generated from 10,000 pounds of hazardous, wet solvent sludge to 320 pounds of dry paint chips. Emissions of pollutants into the air are virtually eliminated. As an additional bonus, this technique sharply cuts the cost of complying with a myriad of hazardous waste disposal regulations.

Another example—a process change—shows how simple prevention-based solutions can dramatically reduce pollution. As reported by INFORM, an environmental research organization, Borden Chemical Company slashed releases of organic chemicals from its Freemont, California, plant by 93 percent after conducting a pollution prevention audit. One of the most significant reductions came when Borden simply changed rinsing processes in an 11,000-gallon reactor vessel. Borden replaced a single rinse, which resulted in a moderately concentrated wastewater, with a two-stage process. The first rinse uses about one hundred gallons of water and yields a concentrated residual, which is reused. The second rinse is extremely dilute and easily handled by Borden's existing treatment systems. The total amount of waste organics released to the environment has been drastically reduced through this simple process change.

Nor is pollution prevention just for *Fortune* 500 companies. The managers of a one-hour dry cleaner in Anchorage, Alaska, cut discharges to zero by changing filtering practices and recapturing fugitive air emissions. In each of these examples, companies

actually reduced operating costs. And while that is not always the case, these success stories underscore an important point: The basis for pollution prevention is *efficiency*, both in process and in the use of raw materials.

In the *agricultural sector*, pollution prevention entails the adoption of such farm practices as integrated pest management—which reduces the need for toxic pesticides by employing natural pest control wherever possible—and soil conservation and planting techniques that limit reliance on fertilizers and other agricultural chemicals. The Department of Agriculture recently studied pesticide applications on cotton in the lower Rio Grande Valley of Texas. Before the study, pesticides were applied between 15 and 18 times every growing cycle to control boll weevils. Simply by destroying leftover cotton stalks, which had been providing a winter home for the pests, farmers were able to cut pesticide applications to only four in the following year. In studies in the wheat belt, researchers found that by monitoring soil nitrogen levels and applying nitrogen as needed, instead of on a predetermined schedule, farmers were able to reduce nitrogen use by 30 percent. Such practices as crop rotation and intercropping (mixing different crops together) are being tested in the Midwest to reduce the need for pesticides and to increase yields without chemical fertilizers.

In *energy and transportation*, prevention means reducing emissions through improved efficiency and conservation. Transportation and energy are responsible for a sizable share of the environmental burden placed on the planet by human activities. The National Acid Precipitation Assessment Program, a decade-long government study of the causes and effects of acid rain, estimated that half of the volatile organic compounds released by man-made sources come from transportation.

If the problems are substantial, so are the potential reductions. Using technology *available today*, the United States can drastically improve energy efficiency. Amory Lovins, director of the Rocky Mountain Institute in Snowmass, Colorado, estimates that the nation could save 44 percent of the energy used to drive electric motors by switching to high-efficiency models now on the market and by improving maintenance.

Another source of significant potential savings is lighting, which accounts for about one-fifth of the electricity we use. If Americans were to switch to the most energy-efficient lighting available today, wherever they could do so profitably, the amount of energy consumed by lighting would be cut roughly in half. This would represent a reduction in energy use

of about 250 billion kilowatt-hours a year—about 10 percent of our total annual consumption of electricity. Switching to energy-efficient lighting would save electricity users more than \$16 billion a year. The environmental benefits would be equally impressive. Carbon dioxide and nitrogen oxide emissions would decrease by more than three percent, and sulfur dioxide emissions would drop more than six percent.

EPA has developed an energy conservation program called Green Lights, in which corporations have agreed to replace their existing lighting with energy-efficient lights and lighting designs wherever they can do so profitably. Charter members of the Green Lights program include Gillette, Maytag, Johnson & Johnson, Polaroid, Gerber, Bell Atlantic, Citicorp/Citibank, Phillips Petroleum, General Dynamics, Digital Equipment Corporation, and Brown-Ing-Ferris. More companies are signing on every week. Green Lights is a "win-win" program in the classic sense. Companies save electricity, workers get better lighting, citizens breathe cleaner air, the nation reduces its reliance on foreign oil, and the economy becomes more competitive. This program is pollution prevention at its best.

And Green Lights is only one manifestation of our genuine desire to work *with* industry—to be supportive of those firms that display the intention to work on their own for pollution prevention. Another is a cooperative EPA-industry effort to secure dramatic reductions in emissions of toxic pollutants. In the summer of 1989, I invited the heads of nine well-known petrochemical manufacturers, whose firms operated 40 facilities presenting high risks because of their emissions of toxic air pollutants, to a meeting at EPA. Everyone in the room knew we could wait for Congress to enact a stricter Clean Air Act, let a few years pass as regulations were proposed, debated, and litigated, and then wait a few more years after that for emissions reductions to take place.

But we took a different tack: I asked the leaders of the nine companies to prepare plans to reduce the risks posed by their plants *sooner* rather than later. In response, they developed programs to cut emissions of their most egregious toxic pollutants by as much as 90 percent. Ultimately, the corporate leaders entered into written agreements with EPA, and the emissions already are beginning to drop. By 1993, reductions of more than 80 percent will be achieved, and more than nine million pounds a year of toxic releases will have been eliminated from the environment.

Through these voluntary agreements, with their ambitious environmental goals, we have achieved significant environmental advances quickly, with a minimum of bureaucratic intervention, burden on industry, and taxpayer expense.

Commitments Beyond Compliance

Now, EPA is ready for the next step. In a Pollution Prevention Strategy announced in February, we targeted 17 high-priority toxic pollutants for reduction. These are high-volume industrial chemicals, some highly toxic, that are associated with a variety of environmental ills. Benzene, for example, is a known carcinogen and also contributes to ozone pollution; lead is a notorious toxin that is a major health risk to our children. These pollutants are all controlled by existing regulations, yet their releases from more than 10,000 industrial plants still total more than a billion pounds a year.

I have set goals of reducing aggregate environmental releases and off-site shipments of these pollutants one third nationwide by the end of 1992, as measured against a baseline of emissions reported to EPA in 1988, and at least one half by the end of 1995. I have created an Industrial Toxics Project—a team of EPA specialists who will work with interested companies to achieve the goals. The project will focus on bringing about reductions through pollution prevention—actions that eliminate wastes *at their sources*. (Companies will, however, be encouraged to participate even if some part of their reductions are achieved through more traditional recycling or control methods.)

In the end, companies need to find the ways to achieve reductions that work best for them. As the recent experiences of the companies cited above show, an ounce of prevention can achieve dramatic environmental benefits while actually saving money and improving productive efficiency. I have written to more than 600 CEOs asking them to begin considering their responses to the Industrial Toxics Project; more companies will be contacted in the coming months. EPA officials are meeting with industry leaders to discuss reduction commitments. In those meetings, EPA representatives emphasize the voluntary nature of the Industrial Toxics Project, but they also stress the substantial benefits of pollution prevention—including enhanced community relations, employee pride and satisfaction, and savings from reduced material loss and waste management expenses. We are emphasizing as well the nation's simple and profound desire for a cleaner environment.

We are asking companies to consider a range of voluntary commitments. Some may pledge to do what they can and leave the specifics to be worked out between now and 1995. Others may feel comfortable embracing more explicit goals—setting timetables and targeting specific chemicals and facilities for reductions. Still others may elect to expand their commitments, exceeding EPA's goal of a 50 percent re-

duction by 1995, targeting more than the 17 priority chemicals, or even carrying out reductions at all facilities here and abroad, regardless of the environmental frameworks under which they operate. Some companies are, in fact, *already* way ahead of us. Monsanto, General Dynamics, Polaroid, and AT&T have all made public commitments to reduce toxic chemical releases by more than 50 percent. And, of course, other firms may well decide, for whatever reasons, that the Industrial Toxics Project is not for them. That will be their choice to make—EPA will in no way penalize companies that choose not to participate.

Although EPA is taking a strong leadership role in this effort, we expect that others—state and local governments, supported by environmental groups and community organizations—will want to negotiate their own agreements with businesses. We are preparing to devote technical know-how and personnel to assisting in these efforts and to identifying whether our existing regulatory programs might create unintended disincentives to early toxics reductions.

As the nation's environmental protection efforts mature, more managers are finding that the elimination of wastes goes hand in hand with an emphasis on Total Quality Management—a philosophy of continuous improvement—to make industrial operations more efficient and more profitable. A commitment to continuous improvement can succeed in the reduction of chemical waste just as it has in the pursuit of quality and customer satisfaction. Some corporate executives have even said that their ultimate pollution prevention goal is *zero discharge* of toxics—a notion that, just a few years ago, would have invited derision from serious observers of business. In the end, zero discharges may *not* be possible—but what an energizing standard to hold aloft! A very informative article in the *New York Times* quoted an executive from a firm that has pioneered in the field of pollution prevention, 3M, as explaining, "If we get rid of the pollution, we get out from under the regulations." For 3M, this is one more reason, besides profitability, to pursue pollution prevention.

For firms that are not so enthusiastic, my proposed goals will pose a fundamental question: Does it make sense to wait until the last minute to comply with the deadlines set by the Clean Air Act and other statutes? Or can these companies do more, both to improve the environment and to enhance their corporate bottom line, by taking early actions that reduce contaminants at the source—avoiding, perhaps, the need for expensive end-of-pipe treatment later on? The Clean Air Act helps to answer this question by providing a

six-year exemption from compliance with maximum achievable technology standards for those companies that attain 90 to 95 percent reductions in toxic air emissions through enforceable agreements before specified dates. Since all of the contaminants targeted in EPA's Industrial Toxics Project are also subject to the new Clean Air Act standards, this incentive will play an important role in helping to achieve our objective of 50 percent reductions by 1995. At the same time, I recognize that not every company has operations or resources that lend themselves to going beyond existing legal requirements. That is why this new program is strictly a voluntary effort.

We at EPA also have something important to learn from this venture in obtaining commitments beyond compliance. The nation's environmental laws, and the great successes achieved over the past twenty years, have depended on command-and-control approaches to regulation. It is becoming increasingly clear that in a number of areas these approaches have taken us about as far as they efficiently can. Further reductions in pollution are frequently limited in scope and very expensive to achieve. But incentives that work *with* rather than *against* the market, and policies that afford industry greater discretion to choose the means to achieve ends determined by government, can help us to make further progress in the most cost-effective fashion. Government, as much as industry, needs to experiment with new ways of doing business, even as we continue to enforce the laws vigorously and consistently. If our efforts in the Industrial Toxics Project are successful, we will have powerfully advanced the reconciliation of the nation's environmental goals with its economic aspirations, to the benefit of both.

General George Patton once wrote, "Never tell people *how* to do things. Tell them *what* to do and they will surprise you with their ingenuity." The Pollution Prevention Strategy takes that advice to heart. In the future as in the past, EPA will not shy away from setting societal goals and regulatory standards. But increasingly, we will defer to businesses regarding choices of means and technologies. These are business decisions, and as long as they are made with due regard for the needs and constraints of the environment, they should be made by business executives.

Setting Risk-Based Priorities

Pollution prevention is not the only EPA initiative that reflects the wisdom of planning for environmental protection at the front end. Another major thrust in the Agency's environmental agenda for the 1990s

is a complementary effort to evaluate the relative risks of environmental problems, so that we can focus our efforts—and help to focus those by industry, conservation groups, and others—on those activities, preventive and otherwise, that are likely to do the most to reduce risks to human health and the environment.

Recognizing the need for EPA to do a better job of setting priorities across the range of its programs, my predecessor, Lee Thomas, instructed EPA's in-house scientists and environmental managers to rank environmental problems on the basis of the risks associated with them. The result of this exercise was *Unfinished Business: a Comparative Assessment of Environmental Problems*, a provocative and pioneering report published in 1987.

When I took office in 1989 I asked EPA's Science Advisory Board—an independent panel of outside scientists, engineers, and other technical experts—to review the rankings in the *Unfinished Business* report, drawing on the best technical and scientific knowledge available. I also asked the group to suggest ways to improve risk assessment and to identify risk reduction strategies that could be particularly effective. The Board's report, *Reducing Risk: Setting Priorities and Strategies for Environmental Protection*, was released in September. It is a thoughtful and significant contribution to the debate over the future of environmental protection in this country.

The new report builds on the *Unfinished Business* project by spelling out a set of fundamental principles for achieving broader, more integrated, and more carefully targeted environmental policy-making. Among its key recommendations:

- "EPA should target its environmental protection efforts on the basis of opportunities for the greatest risk reduction."
- "EPA should attach as much importance to reducing ecological risk as it does to reducing human health risk."
- "EPA should reflect risk-based priorities in its strategic planning and budget processes."
- "EPA—and the nation as a whole—should make greater use of all the tools available to reduce risk. . . [with] pollution prevention as the preferred option."

Taken together, these principles provide a basic framework for addressing some of the most pressing environmental problems of the 1990s and beyond. The Science Advisory Board identified four such problems that, based primarily on the degree of direct public exposure to known toxic agents, continue to pose relatively high risks to human health despite the progress of the last two decades:

- ambient air pollution;
- worker exposure to chemicals in industry and agriculture;
- indoor air pollution, including radon and environmental tobacco smoke; and
- drinking water contamination.

The Board pointed out that additional data, which EPA is now working to gather and analyze, may reveal that other problems, such as pesticide residues in food and toxic chemicals in consumer products, may pose human health concerns as well.

The Board also identified four problems that, owing to their geographic scope and the amount of time it will take to reverse them, present relatively high risks to the environment and thus to human welfare:

- habitat alteration and destruction;
- species extinction and loss of genetic diversity;
- stratospheric ozone depletion; and
- global climate change.

Let me be clear: The Science Advisory Board did not suggest, nor do I, that conventional approaches to environmental problems not cited as high risks, such as the cleanup of hazardous wastes, should be abandoned. EPA is firmly committed to continued and intensified enforcement of the environmental laws already on the books, as evidenced by the record-setting enforcement actions in 1989 and 1990. But, guided by the best information we can find on the relative risks of various environmental problems, we are thinking carefully about where our limited discretionary resources can most effectively be spent.

Actually carrying out the Science Advisory Board's recommendations will not be easy. Any effort to set environmental priorities based on relative risk—to rethink the environmental agenda for the 1990s and the 21st century—will be arduous and contentious.

Just look at what almost invariably happens even now when EPA announces a regulatory decision. Some scientists, environmentalists, and citizens who understand risk point to the uncertainties inherent in risk-based decision-making and charge that our approach is not sufficiently protective, or that it underestimates the environmental and health problems that will result from not taking stronger action. At the same time, others in academia or business or the agricultural community assert that the assumptions used in our risk models, which are purposely designed to err on the side of safety in order to ensure public health protection, are *too* protective—that they undervalue the economic and other *benefits* of pesticides and other chemicals.

Reactions are so disparate because decisions about environmental risks are complex and require a great

deal of information—about the health and ecological effects of pollutants, about their presence and persistence in the environment, and about the extent to which human beings and natural systems are exposed to them. Given this complexity, government regulators, who must live in the interval between the discovery of a problem and its solution (typically before the science is adequately established) have to get used to the fact that disputes and disagreements go with the territory. But disagreements can co-exist with trust. To build and maintain the public's trust in EPA, we need to improve the public's understanding of how we make regulatory decisions. While we must and will listen carefully and respond to the public's concerns, we have to make it clear that we also must and will continue to rely on a rational, science-centered process to guide risk-management decisions. And we need to assure the public that decisions will be based on the best available science and that when we do not have all the data that we would like to have, we will take a cautious, protective approach unless and until new information supports a finding of lesser risk.

The public should also know that we are constantly updating our risk assessment guidelines as scientific knowledge advances. We are insisting that these assessments be subjected to rigorous internal and external peer review. And we are looking for ways to achieve greater consistency in our use of risk assessments across the range of EPA decision-making.

The threats to the environment are sufficiently serious—and time is growing sufficiently short—that we cannot afford to go without a long-range plan for environmental protection. The nation needs a better understanding of the sources of environmental risk; it needs the best available scientific evidence of which health and environmental risks may be most significant; and it needs a comprehensive strategy to reduce those risks, both with traditional regulation and enforcement and with non-traditional tools—public information and education, aggressive research and technology development, international cooperation, and economic incentives that enlist the power of the marketplace on behalf of environmental protection.

The new Clean Air Act is a giant advance in the grounding of environmental protection in economic incentives. The centerpiece of the legislation is an innovative system of tradeable emissions allowances for sulfur dioxide that will enable the nation to achieve significant improvements in air quality at compliance costs some \$1 billion lower than would otherwise be incurred. The Act also introduces a range of other market-based mechanisms, including incentives, noted above, for companies to act quickly to reduce toxic emissions and to go beyond minimum require-

ments; commercially tradeable 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 that allow industry to reduce emissions in the most cost-effective possible way.

EPA's "Quiet Revolution"

Far from being the inflexible bureaucracy depicted by some of its critics, EPA is now undergoing a fundamental cultural change—what *Science* magazine called a "quiet revolution"—in which pollution prevention and risk reduction are being woven into the fabric of virtually every regulatory decision and policy directive. *Front-end environmentalism* increasingly is becoming the guiding principle underlying all of EPA's activities.

More than 200 years ago, Thomas Jefferson made an observation that is relevant to the challenge of refocusing environmental priorities today. In a letter to a friend, Jefferson wrote that while he was not an advocate for frequent changes in laws and institutions, he nonetheless believed that institutions should make progress hand-in-hand with the progress of the human mind:

With the change of circumstances, institutions must also advance to keep pace with the times. We might as well require a man to wear still the coat which fitted him as a boy, as civilized society to remain ever under the regimen of their barbarous ancestors.

EPA's challenge—the nation's challenge—for the 1990s is to confront and breach the institutional barriers that previously have impeded the development of pollution-prevention and risk-reduction strategies. Internally, the most difficult barrier is EPA's historically compartmentalized organization. Reflecting the structure of the laws it must implement, EPA is set up to deal with pollution of the air, water, and land as if these were separate and distinct entities, rather than parts of an integrated, interrelated whole. We are working to overcome these organizational obstacles through education and training, through enhanced accountability and coordination within EPA, and through Total Quality Management.

Equally important, we need to break down the traditional special-interest barriers that have balkanized government and society as a whole. As the *Reducing Risk* report noted, solving the nation's continuing environmental problems is not something EPA can do by itself; all parts of government and all sectors of society must participate. The quality of the environ-

ment is directly affected by energy extraction and use, by agriculture, by transportation, by our relations with other nations, by our trade policies and tax policies. Across all of its activities, government must pay much more attention to environmental considerations at the *outset* of policy-making.

This is not to suggest that EPA should be getting into every other agency's business. Rather, I am suggesting that all the other agencies start getting into *our* business—the business of protecting the environment.

And just as EPA cannot do it all, neither can government. Effective national responses to many of our environmental problems will be mounted only through countless individual acts of stewardship; only through the constant adaptations of millions of local neighborhood and community programs and thousands of companies to new information; and in the end, only through the inspired leadership and continuous learning of every individual citizen. Ultimately, *every American* must feel empowered to act on behalf of the environment.

Front-end environmentalism is essential to ensure continued progress in environmental protection. Our ultimate goals are the reduction of environmental risks to human health and to the integrity of natural systems—and the reduction (and wherever possible, elimination) of waste. Changing the nation's way of thinking, and ultimately the way we live, will take time and effort, but it can—and must—be done.

In meeting the environmental challenges of the 1990s, the most significant new progress we need is with ourselves—with our lifestyles, our energy use, the goods we buy and use, and the waste we generate. The extent to which we are able as a society to reconcile human activities, especially our economic activities, with the needs and constraints of nature will determine just how habitable and productive our nation—and indeed this earth that sustains us all—will remain, for this generation and the generations to come.

For Further Information

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