Part I

America and the Environment:

Past, Present, and Future

CHAPTER ONE

America and the Environment:

A 25-Year Retrospective

Over the past 25 years, Americans have witnessed remarkable changes in policy and perspectives about the environment.

It was not so long ago that most environmental problems were thought to be largely local in nature and to have short-term, benign effects. Even when the effects were neither short-term nor benign, as in the case of coal mine workers' exposure to coal dust, there was in some quarters a willingness to accept such conditions as an unalterable part of life.

In this 25-year period, we have learned that environmental problems can be local, regional, or global in scale, and that many effects are both long-term and life-threatening. Furthermore, we have learned that some environmental problems actually threaten the most fundamental global systems and cycles.

In response, we have taken action on numerous fronts. For example, in just 25 years, we have:

- substantially reduced most conventional air and water pollution;
- taken international action to phase out chlorofluorocarbons (CFCs), after

Reflections on 25 Years

"When something is complicated, you don't get a revolution overnight. When the Surgeon General first said smoking is hazardous to your health, not a single scientist in this country that I know of challenged it. This was a very simple proposition; not complicated like the environment. Still, it took us 25 years to stop smoking in airplanes and restaurants. There is no other issue like the environment that has the political, economic, technical, and cultural ramifications and that involves every discipline of science. If it took us 25 years to quit smoking in airplanes, do you expect that we would have solved all the problems in the environment? When you contrast that, it's revolutionary what has happened in the past 25 years."

Gaylord Nelson (U.S. Senate, Wisconsin, 1963-81)

learning they could deplete the stratospheric ozone layer;

- made significant progress in reducing children's average blood lead levels, after learning that lead can have devastating impacts on children's intellectual development;
- made significant strides in encouraging farmers to adapt new practices that reduce soil erosion and nutrient and pesticide runoff into streams; and
- found that industrial emissions of toxic pollutants can often be reduced or avoided through changed practices and better management.

Over this same period, we have struggled to define what we are talking about, to develop a better sense of what needs to be done, to determine how far we have to go to protect ourselves and the planet, and to try to develop methods to measure our progress. To some extent, this will always be a work in progress, as new information and new research continually increase our understanding of the impact of human activities.

We have witnessed a substantial broadening of the definition of environmental quality. The term now means far more than simply cleaner air and water, safe drinking water, healthy ecosystems, safe food, toxic-free communities, safe waste management, and the restoration of contaminated sites.

Today, the term connotes a stewardship ethic: that is, an active effort to manage our lands and communities in ways that minimize environmental damage.

The stewardship ethic is also an effort to reconcile environmental goals with economic goals. In particular, in the words of the World Commission on Environment and Development, the term "sustainable development" denotes development that "meets the needs of the present without compromising the ability of future generations to meet their own needs." There are important social dimensions to this term: bringing communities into the decisionmaking process, ensuring that the disadvantaged are not disproportionately affected by environmental problems, and strengthen-

Reflections on 25 Years

"Twenty-five years ago, almost nobody knew what the word 'ecology' meant. Twenty-five years ago, there were few graduates of any environmental science or law program. There has been a major increase in courses and graduates. People trained in those fields have implemented and enforced the rules and regulations. Industry hired a lot of these people. Some have combated the environmental movement, but many have helped it. There are still companies who will oppose environmental regulation, so we have to keep educational programs going."

Russell Peterson (CEQ Chair, 1973-76)

ing efforts to inform and educate the public about the environment.

We have gone back to looking at the fundamentals: the links between population, economic growth, and the environment. What we have found is that population and economic growth inevitably affect the environment, but there are a host of ways to reduce those impacts.

Many are "win-win" choices. For example:

- Improvements in energy efficiency reduce pollution, may reduce costs, and (depending on relative prices) may reduce our dependence on imported energy.
- Capture or substitution of solvents often can cut costs for companies and reduce harmful pollutants.

Certainly, "win-win" solutions are not always possible. In such cases, as in the realization that overcapitalization was an important factor in the depletion of cod and haddock fisheries in the Northeast, programs to minimize adverse economic impacts should be part of the bargain.

We have learned that it is better to prevent an environmental problem before it happens rather than clean it up later. Many American companies have made great progress in changing production processes to prevent pollution. Although motivated by many factors in addition to preventing pollution, the switch by many American farmers to low-till and no-till farming practices greatly reduces soil erosion and helps protect clean water.

In cases where pollution is inevitable, we have found many ways to reuse or recycle waste. In fact, these practices are expected to absorb most of the additional waste we generate as our population grows over the next few decades.

We have learned that cooperation can often lead to faster progress than confrontation, though we cannot abandon the need for fundamental compliance with basic national standards that protect human health and the environment and strong enforcement of these standards to ensure that noncompliance does not lead to a competitive advantage. At the same time, simplified permitting, reduced paperwork requirements, and alternative performance-based strategies all symbolize a new process of constructive engagement between government, industry, individuals, and communities.

A LOOK BACK

Beginning in the mid- to late 1800s, the nation began changing from a primarily rural, agricultural society to a primarily urban, industrial society. Accompanying this transition, municipalities and industry were spewing tons of pollutants into the air and water and paying little attention to the consequences.

Public concerns about the quality of the environment, which date back to about the turn of the century, began to reach a critical mass in the 1960s. Initially, much of the worry was about the local effects of pollution. Many remembered the temperature inversion and dense smog that occurred in the small industrial town of Donora, Pennsylvania, in 1948, killing 20 people and causing vary-

Reflections on 25 Years

"Twenty-five years ago, two great rivers of concern had not yet converged: public health, especially the causes of cancer on the one hand, and nature conservation—wilderness, forests, parks, and rivers protection on the other. Those constituencies began to converge in the latter 1960s and became and continue to be a powerful political force. That's what changed politically in this country and put the environment on the map in a way that will keep it there. That convergence occurred for a reason. The environment was something you could taste and smell and was making people sick. The rivers were putrid and waste from all kinds of industrial facilities and waste-water treatment plants was manifest."

William Reilly (EPA Administrator, 1989-93)

ing degrees of illness among 43 percent of the people in the area.

In Los Angeles, the number of automobiles in the city had tripled between 1940 and 1960, immersing that poorly ventilated city in clouds of noxious auto exhaust fumes. By the 1960s, Los Angelenos were outraged about pollution levels in the city.

In 1962 Rachel Carson, who spent most of her professional life as a marine biologist and writer with the U.S. Fish and Wildlife Service, published *Silent Spring*.

Silent Spring was really a story about unanticipated consequences. In 1960, U.S. Fish and Wildlife Service scientists found DDT in the tissues of fish where there had been mass spraying for the control of the spruce budworm in a Western creek. More significantly, when they examined fish in a creek 30 miles away from the spraying, they also found DDT.

In the summer of 1960, at the national wildlife refuges in Tule Lake and Lower Klamath in California, refuge staff found hundreds of dead and dying fish-eating bird species—herons, pelicans, grebes, and gulls. Plankton, fish in the lakes, and the birds were all found to contain residues of toxaphene, DDD (a close relative of DDT), and DDE. Follow-up studies found that these pesticides lingered in the tissues of fish and birds long after spraying, and that DDT was thinning the eggs of birds and dangerously disrupting their reproduction. Carson reported that in the 1950s, a retired banker named Charles Broley observed that the production of young bald eagles was declining along the western coast of Florida. Between 1952 and 1957, about 80 percent of the nests failed to produce young.

Carson's book proved a revelation, showing the public that some pesticides were poisoning both people and wildlife, that these poisons were lingering in tissues long after spraying events, that they were turning up in areas that had never been sprayed, and that they were threat-

ening to quickly wipe out species by destroying their ability to reproduce.

Silent Spring was attacked by the chemical industry, which spent hundreds of thousands of dollars attempting to discredit the author and the book. President Kennedy, however, set up a special panel to study the problem; the panel's report completely vindicated Carson's thesis.

At about the same time, the public was getting more bad news about the condition of the nation's rivers, lakes, and estuaries. Rivers such as the Potomac were described as "open cesspools," and beach closures and shellfish contamination were common events. Industries were pouring new man-made chemicals into rivers, with uncertain effects. The Cuyahoga River in Cleveland erupted in flames, becoming a vivid symbol of the state of many of America's waterways.

In January 1969, the blowout of an oil rig in Santa Barbara, California, spread a coat of oil across hundreds of square miles of beaches and sanctuaries. In setting the conditions to permit oil leasing in the channel, the federal government had largely ignored the need to protect commercial, recreational, aesthetic, and ecological values of the area.

By 1970, all these events had created a broad political and public consensus that more had to be done to protect both the environment and the public from the hazards of pollution.

One of the first legislative accomplishments was the passage of the National Environmental Policy Act (NEPA), which was signed into law by President Richard Nixon on New Year's Day, 1970. In addition to creating the Council on Environmental Quality (CEQ), the act

Reflections on 25 Years

"The results of NEPA have been altogether a plus, but it has fallen short of what we had hoped. One of its greatest strengths has been environmental impact statements (EISs), because one, they can be reviewed in the courts, and two, they led to better decisions about proposed projects. By requiring the impact analysis, we were able to change some policies, partly because the public, for the first time, got its foot in the door. A notice goes in the Federal Register about the intent to do an impact statement. Then the statement has to circulate for public review. NEPA also includes, by reference, the Freedom of Information Act."

"In the days before NEPA, the Corps of Engineers or the Forest Service or another agency would have a public hearing on a proposal, but they had it when everything about the project was already set. If people objected to the project, they'd be told, "Sorry, we're too far down the road, we can't change it, but we wanted to inform people." The bulldozers were sometimes even beginning to roll when they had their public hearings. NEPA put a stop to that."

Lynton Caldwell (Social Scientist, author)

imposed an important new directive on the entire federal establishment. NEPA required that all federal agencies would now have to consider and describe the environmental consequences of their major decisions—including alternative courses of action (see Chapter 3, "National Environmental Policy Act").

Earth Day, on April 22, 1970, attracted millions of Americans to events around the country, calling for action to protect the environment. But many still wondered if this was a long-term movement or a passing fad. A front-page story in *The Washington Post* noted: "The next several months will show whether Earth Day was the high-water mark of another short-lived protest movement or the manifestation of a new political coalition that must be reckoned with for years to come." It did not take long to realize that 1970 did mark the beginning of a new political coalition.

The White House moved ahead in the early 1970s with a long list of initiatives, including creation of the Environmental Protection Agency and the National Oceanic and Atmospheric Administration; major new legislation on air and water pollution controls; national standards for drinking water; laws to restrict ocean dumping and to control noise; considerable expansion of wilderness areas; and protections for endangered species.

During the Ford Administration, CEQ published some of this country's first assessments of the economic costs of pollution control, examining at all income levels who pays and who benefits. CEQ also has consistently explored how to use the market for the most efficient reductions in pollution, and its report on the costs of sprawl provided local governments with solid information on the environmental, economic, and social consequences of suburban growth. Past annual reports have included seminal chapters on global climate change (1970), tropical deforestation (1978), and the importance of biological diversity (1980).

Along with political momentum, the crisis atmosphere created a sense of anxiety among members of the public that—combined with a relatively defensive position generally taken by the business community—led to a polarization of the various groups involved and a strong mood of distrust. This polarization tended to lead to adversarial situations, with litigation as the end result. The adversarial nature of these issues continued through the 1970s and into the 1980s and 1990s. Generally, the adversarial posture was characteristic of the parties most directly involved, while the public as a whole continued to support environmental progress.

Some Key Issues

Agreeing that more had to be done still left unresolved many difficult questions about how to go about it. For example, should environmental protection be mostly a federal or a state responsibility?

As described by a recent National Academy of Public Administration (NAPA) report, cities and states interested in controlling pollution faced a potentially difficult trade-off with economic growth, since factories could always

threaten to move to an area with less costly environmental regulations. "Smokestack chasing" on the part of local economic development officials created a "race to the bottom" that made it difficult for state or local governments to regulate pollution.

Through the 1960s there was a growing determination that federal intervention was a way to avoid this problem. In the Air Quality Act of 1967, the federal government directed states to establish air quality regions and called for the federal government to establish scientific criteria for regulating air pollutants. This act did not authorize a federal regulatory role, and most of the states declined to implement provisions of the 1967 law and the original Clean Air Act of 1963.

The federal government finally assumed a national regulatory role with the passage of the Clean Air Act of 1970, which called for national ambient air quality standards and required state implementation plans (see Chapter 10, "Air Quality").

Similarly, water pollution legislation gradually moved towards a stronger federal role. The 1965 Water Quality Act required states to set water quality standards for interstate waterways within their borders, but most states lacked the capacity to set their own standards and had trouble resolving problems created by the interstate nature of waterways. Congress finally passed the Federal Water Pollution Control Act of 1972, which established a national goal that all surface waters should be "fishable and swimmable."

The act gave states and the Environmental Protection Agency, which was created in July 1970, the authority to regulate industrial point sources of pollution and municipal wastewater treatment facilities.

In terms of the federal budget, one of the most important federal commitments was the program of grants to municipalities for the construction of wastewater treatment facilities. The construction grants program proved to be a massive investment by the federal government: between 1972 and 1995, EPA provided $66 billion to municipalities under this program. Of EPA's initial budget of $1.4 billion, about 80 percent was construction grant money.

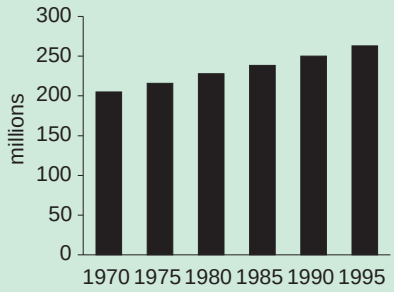
With the passage of these two major laws for water and air quality, the question of federal-state relations had largely been answered. The people, through their representatives in government, directed the federal government to take the lead in setting standards and goals for the country, assume a substantial share of the financial burden, and work with the states to implement those laws.

A second question was: What were the most effective ways to reduce pollution?

The early federal approach is usually described as "command- and-control," in which federal agencies issued directives to the states and industries and expected them to obey those directives. The term is also associated with the federal government's early emphasis on technology standards, which required facilities to install specified control technologies.

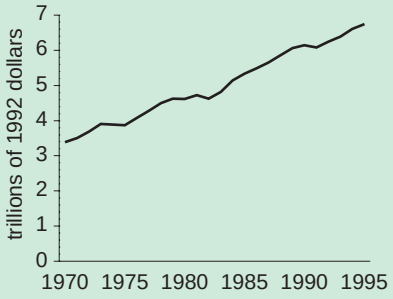
According to the NAPA study and many other analyses, command-and-control approaches, with the help of a strong monitoring and enforcement effort, have

Figure 1.1 U.S. Population, 1970-1995



Source: See Part III, Table 1.

Figure 1.2 U.S. Gross Domestic Product, 1970-1995



Source: See Part III, Table 9.

been successful in controlling large point sources of pollution such as industrial facilities or mass-produced products such as cars. They have been somewhat less successful when the targets are more numerous and diverse and there are many control options.

As the strengths and weaknesses of this approach have become clearer, a host of new approaches have emerged that can be an effective complement to the traditional approach. Some of these approaches are discussed later in this chapter and in the next chapter.

REVIEWING THE RECORD

Driving Forces

Population growth, economic activity, and rising per capita income all tend to put pressures on the U.S. environment.

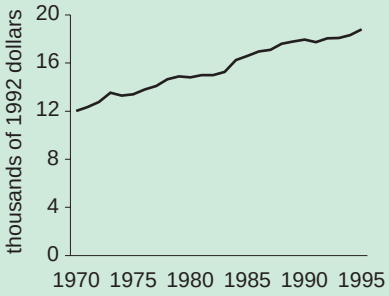
For example, from 1970 to 1995 U.S. population rose from about 205 million people to 263 million people, or 30 percent (Figure 1.1). There were substantial changes in distribution, with population shifts toward the South and West.

The principal measure of economic activity, gross domestic product, grew (in constant 1992 dollars) from about $3.4 trillion in 1970 to more than $6.7 trillion in 1995 (Figure 1.2). GDP per capita (in constant 1992 dollars) grew from $16,520 in 1970 to $25,700 in 1995; over the same period, per capita disposable personal income rose from $12,022 to $18,800 (also in constant 1992 dollars) (Figure 1.3).

Rising numbers and wealth both result in rising consumption, which shows up in a variety of forms, such as increased demand for energy and natural resources, more cars on the road and a doubling in vehicle-miles traveled, and more solid waste.

In the face of these pressures, the record of improvement in many environmental, energy, and natural resource areas is impressive, as briefly reviewed below.

Figure 1.3 U.S. Per Capita Disposable Personal Income, 1970-1995



Source: U.S. Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business* (GPO, Washington, DC, November 1996), and earlier issues.

Air Quality

Overall, between 1970 and 1994 the combined emissions of the six principal pollutants declined 24 percent. (Trends for four of these pollutants are shown in Figure 1.4.)

Carbon monoxide (CO). From 1970 to 1994, emissions of carbon monoxide declined from 128 to 98 million tons per year, or 23 percent. During the 1985-94 period, national average CO concentrations were down 28 percent and emissions were down 15 percent.

Lead (Pb). The transition to unleaded gasoline in automobiles has resulted in a drastic decline in emissions, which are down 98 percent over the 1970–94 period and 75 percent over the 1985–94 period.

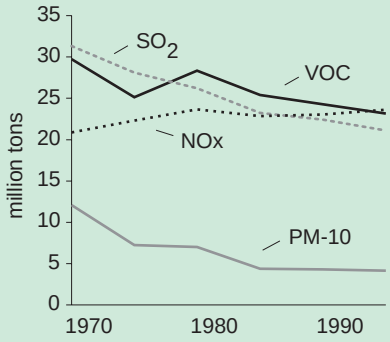
Nitrogen oxides (NOx). Over the 1970–94 period, emissions of NOx are up 14 percent, from 20.6 to 23.6 million tons per year. Since 1985, emissions from highway vehicles decreased 7 percent while fuel combustion emissions increased 8 percent.

Ozone. High levels of ozone persist in many heavily populated areas, including much of the Northeast, the Texas Gulf Coast, and Los Angeles. It is estimated that about 50 million people lived in counties with ozone levels above the national standard in 1994.

Particulate Matter (PM). Over the 1970–94 period, particulate emissions declined about 78 percent. During the 1988–94 period, emissions were down 12 percent and concentrations down 20 percent. Emissions from sources such as fuel combustion, industrial processes, and transportation declined by 17 percent during the 1985–94 period.

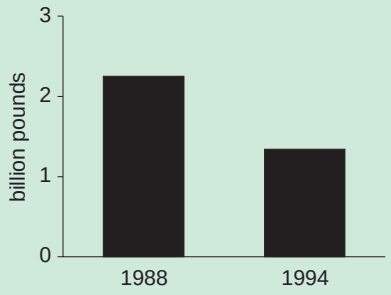
Sulfur Dioxide (SO_2). Over the 1970–94 period, emissions of sulfur dioxide are down 32 percent. During the 1985–94 period, emissions were down 9 percent and concentrations were down 25 percent.

Figure 1.4 U.S. Emissions of Selected Pollutants, 1970-1994



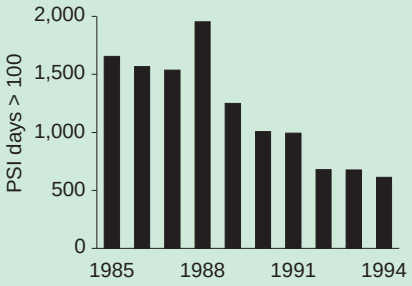
Source: See Part III, Table 27.
Note: NO_x=nitrogen oxides. PM-10=particulate matter with a diameter of 10 microns or less. SO_2=sulfur dioxide. VOC=volatile organic compounds.

Figure 1.5 U.S. Emissions of Air Toxics, 1988 and 1994



Source: See Part III, Table 72.

Figure 1.6 U.S. Urban Air Quality, 1985-1994



Source: See Part III, Table 33.
Note: PSI=Pollutant Standards Index. PSI days > 100 are within the unhealthy range. See notes for Table 33. Data are for all 1,204 trend monitoring sites.

TRI Air Emissions. Data on annual air emissions, starting with the 1987 reporting year, have been collected annually for the Toxics Release Inventory (TRI). The reports have been submitted annually since 1987 by manufacturing facilities with 10 or more employees. Not all chemicals are listed under TRI reporting requirements, although chemical coverage was greatly expanded for the 1995 reporting year and now includes almost 650 chemicals and chemical categories.

Over the 1988–1994 period, total TRI-reported air emissions declined by over 40 percent, from about 2.3 billion pounds in 1988 to about 1.3 billion pounds in 1994 (Figure 1.5). Of the TRI listed chemicals, 10 account for over half of all reported releases to air. Of these chemicals, all but hydrochloric acid have declined since 1988.

Overall Trends. The Pollutant Standards Index (PSI) is an overall assessment of air quality for a given day. These values are reported daily in all cities with populations over 200,000. A PSI value over 100 indicates that at least one criteria pollutant exceeded air quality standards on a given day (Figure 1.6). Between 1985 and 1994, the total number of PSI days greater than 100 decreased 72 percent nationwide (excluding Los Angeles and Riverside, California). PSI days greater than 100 decreased 35 percent in Los Angeles and 27 percent in Riverside.

Water Quality and Aquatic Resources

Since passage of the Clean Water Act in 1972, most of the conspicuous water pollution from point sources has been eliminated. More than 57,000 industrial facilities now operate under a pollution control permit.

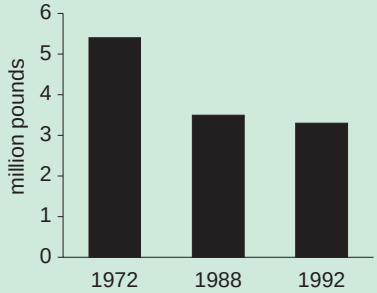
During the 1972–92 period, population and pollutant loads arriving at treatment plants each rose about 30 percent, yet biochemical oxygen demand (BOD) and total suspended solids (TSS) from

treatment plants declined by 36 percent (Figure 1.7). Direct industrial discharges of toxic pollutants are down dramatically since 1972.

EPA's 1994 National Water Quality Inventory is based on surveys conducted during 1992 and 1993. The inventory included 17 percent of the nation's total river miles, 42 percent of the nation's total lake area, and 78 percent of the nation's total estuarine area.

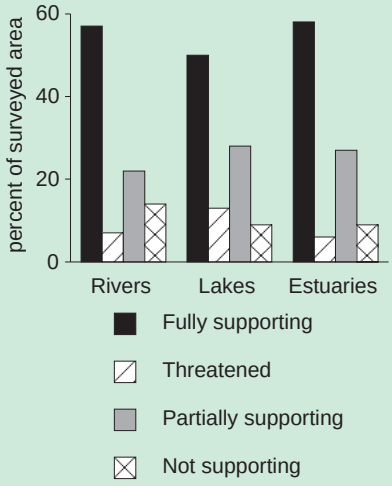
The survey of rivers found that 57 percent of all river miles showed good water quality and broadly met the standards associated with their designated use, while 7 percent were in good condition but threatened by future degradation. About 22 percent were in fair condition, partially supporting their designated uses. Another 14 percent showed poor quality (Figure 1.8). Bacteria and siltation were the problems most often found, each affecting 34 percent of all impaired rivers. Pollutants from agricultural activities were identified in 60 percent of all impaired miles.

Figure 1.7 U.S. BOD Discharge From Sewage Treatment Plants, 1972-1992



Source: U.S. Environmental Protection Agency.
Note: BOD=biochemical oxygen demand.

Figure 1.8 Overall Use Support in U.S. Surface Waters, 1994

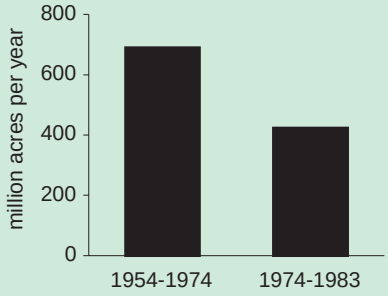


Source: See Part III, Table 38.
Note: Based on an assessment of 17% of U.S. river and stream miles, 42% of U.S. lake acres, and 78% of U.S. estuary square miles.

The lake survey found 50 percent of the nation's lake area in good condition, 13 percent in good condition but threatened, 28 percent in fair condition, and 9 percent in poor condition. Leading pollutants included nutrients, which were found in 43 percent of all impaired lake acres, followed by siltation (28 percent), oxygen-depleting substances (24 percent), and metals (21 percent).

The survey of the nation's total estuarine area found 57 percent in good condition, 6 percent in good condition but threatened, 27 percent in fair condition, and 9 percent in poor condition. Nutrients and bacteria were the pollutants most often found in impaired estuaries.

Figure 1.9. Average Annual U.S. Wetlands Losses, Mid-1950s to Mid-1980s



Source: See Part III, Tables 48.
Note: Data exclude wetlands in Alaska and Hawaii.

In all three cases, less than 1 percent of rivers, lakes, and estuaries had such poor water quality that use support was not attainable due to various biological, chemical, physical, or economic/social conditions.

The conversion of wetlands (both federal and nonfederal) to other uses has slowed considerably over the past several decades, dropping from an average of 690,000 acres per year in the 1954–74 period to about 423,000 acres annually in the 1974–83 period (Figure 1.9). During the 1982–92 period, it is estimated that 156,000 acres were lost annually on nonfederal lands (estimates for federal lands during this period are not yet available).

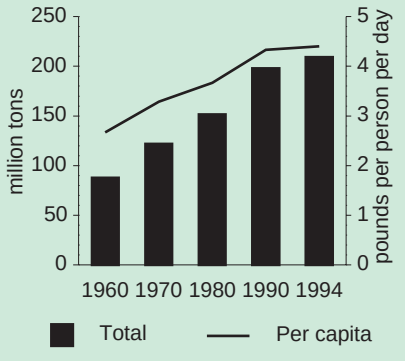
Of the 1.56 million acres of nonfederal wetlands lost over the 1982–92 period, about 1.4 million acres became uplands and about 200,000 acres became deepwater habitat. During the same period, about 769,000 acres of deepwater or upland habitat became wetland. Thus, though absolute losses were estimated at 156,000 acres annually, the average "net" loss of wetlands on nonfederal lands averaged 70,000 to 90,000 acres annually.

Solid and Hazardous Waste

In absolute terms, municipal waste generation has grown steadily and is expected to continue to grow (Figure 1.10). From 1960 to 1994, waste generation increased from 88 million tons to 209 million tons, and projections indicate that it will rise to 262 million tons by the year 2010. Per capita generation, which rose from 2.7 pounds per day in 1960 to 4.4 pounds per day in 1994, is projected to hold steady at 4.4 pounds through the year 2000, but increase to 4.7 pounds by the year 2010.

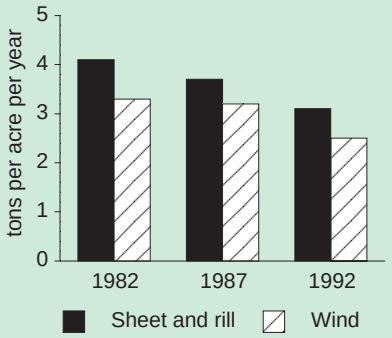
By September 1995 EPA had identified 40,094 potentially hazardous waste sites across the nation, including sites potentially contaminated with radioactive waste. About 94 percent of these sites

Figure 1.10 U.S. Total and Per Capita Solid Waste Generation, 1960-1994



Source: See Part III, Table 67.

Figure 1.11 Erosion on U.S. Cropland, 1982-1992



Source: See Part III, Table 54.

have been assessed by EPA to determine if further action is needed. To clear the way for the economic redevelopment of sites that are not of federal concern, the Clinton Administration by 1995 had removed more than 24,000 sites from the Superfund inventory, leaving 15,622 remaining in the inventory.

The Superfund law's National Priorities List (NPL) identifies the nation's most seriously contaminated hazardous waste sites, which are given highest priority for Superfund cleanup. By September 1995, a total of 1,374 sites had been listed or proposed for listing. Work was underway at 93 percent of these sites and permanent cleanup construction was in process or complete at 60 percent.

In the last few years, studies, plans, and designs have been completed and the pace of cleanups has quickened considerably. Through 1995, permanent cleanup construction had been completed at 346 sites, or 25 percent of the sites on the NPL since the inception of the program. In 1994 and again in 1995, nearly twice as many Superfund cleanups were completed in 12 months as were completed in the program's entire first decade.

Agriculture

Conservation tillage practices, which reduce soil erosion, were used on less than 5 percent of planted acreage prior to 1970, rose to about 20 percent in 1989, and exceeded 35 percent by 1994.

The Conservation Reserve Program (CRP) is a voluntary program under which farmers temporarily convert highly erodible and other environmentally sensitive cropland to soil-conserving uses, such as grass or trees. Since the first CRP signup, in 1986, farmers have enrolled more than 36 million acres in the program, or roughly 13 percent of the nation's cropland.

Erosion reduction because of the CRP is about 700 million tons annually for the entire CRP cohort—nearly 19 tons per acre per year. CRP also provides benefits in terms of wildlife habitat and populations, water quality, and wetland and forest area. Additionally, the program has reduced federal outlays for farm deficiency payments, strengthened farm income, and helped balance the supply and demand for agricultural commodities.

The average annual rate of sheet and rill erosion on cropland was 3.1 tons per acre in 1992, nearly 25 percent below 1982's average annual rate of 4.1 tons per acre. Cropland wind erosion declined commensurately during the period, from 3.3 to 2.5 tons per acre annually (Figure 1.11). Pre-

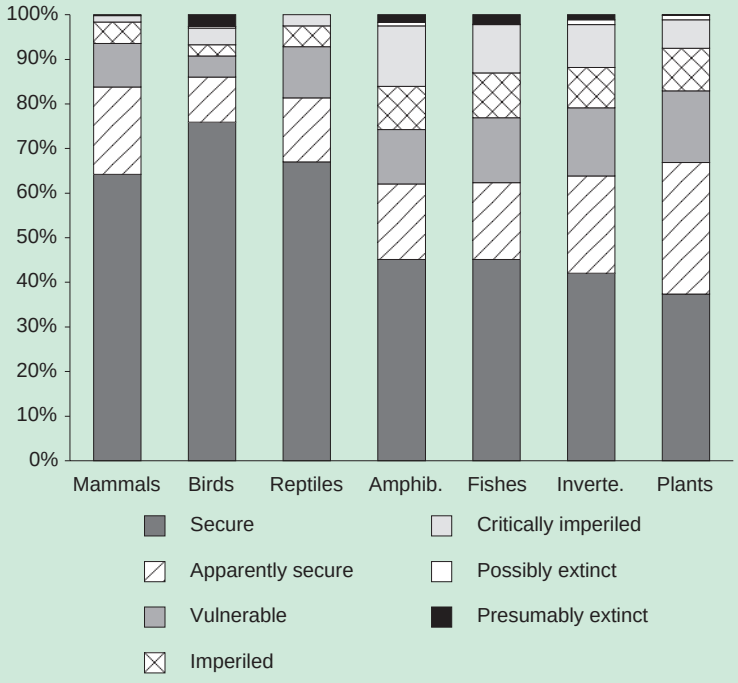
liminary results of a special erosion study conducted in 1995 suggests that the downward trend in soil erosion on cropland is continuing.

Pesticides

In its early years, EPA concentrated its pesticide regulation efforts on the chlorinated hydrocarbons that were recognized as acutely toxic, persistent, and bioaccumulating in man and wildlife. Since then, most organochlorines have been either banned (aldrin, benzene, hexachloride, DDT, DDD, dieldrin, endrin, toxaphene) or severely restricted (chlordane, heptachlor). Inorganic arsenicals, another class of toxic pesticides, have been restricted to wood preservative uses.

Organophosphates, which can be acutely toxic and could possibly have longer term nervous system effects, have also become a focus of EPA regulatory action. Many of these chemicals are no longer on the market and others are now

Figure 1.12 Status Ranks for U.S. Species by Conservation Category, 1995



Source: The Nature Conservancy, *Priorities for Conservation: 1996 Report Card for U.S. Plant and Animal Species* (TNC, Arlington, VA, 1996).
Note: Fishes refers to freshwater species. Plants refers to vascular species. Data are based on number of species ranked within each group: mammals, 433; birds, 759; reptiles, 279; amphibeans, 237; freshwater fishes, 815; invertebrates, 1,728; and vascular plants, 18,156.

classified as "Restricted Use," which limits their use to certified applicators.

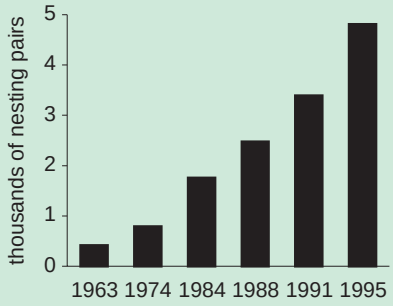
Over the past 25 years, EPA has taken specific actions to educate consumers and agricultural workers on the proper use of pesticides in order to reduce their potential risks from day-to- day exposures to these chemicals. Steps include efforts to improve labelling; the creation of child-resistant packaging for pesticides; and the development and dissemination of educational materials. EPA's Worker Protection Standard, which went into full effect in January 1995, also represents a major strengthening of national efforts to safeguard agricultural workers.

In 1988, a reregistration program was started to reassess the hundreds of pesticides approved before 1984 and bring them up to today's more stringent scientific standards. Hundreds of chemicals (in thousands of products) have been canceled, while about 100 chemicals have been formally approved for continued use.

Ecosystems and Biodiversity

The Nature Conservancy and state agency-based Natural Heritage Network maintain databases with information on more than 28,000 U.S. species and an additional 11,000 subspecies and varieties. In 1996, the Conservancy reported on the conservation status of 20,481 native U.S. species. This represents 13 major groups of plants and animals that have been classified and studied in sufficient detail to allow a status assessment for each of their species.

Figure 1.13 Bald Eagles in the Coterminous United States, 1963-1995



Source: U.S. Department of the Interior, Fish and Wildlife Service, Endangered Species Program.

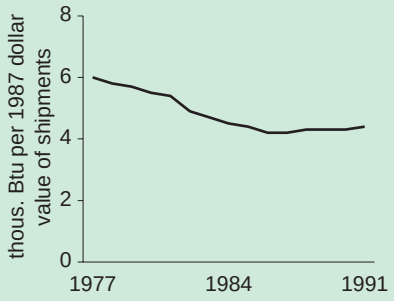
Based on their global rarity, the report found that almost one third (32 percent) of the species surveyed were in some danger. About 1.3 percent were presumed or possibly extinct, 6.5 percent were classified as critically imperiled, another 8.9 percent imperiled, and 15 percent were classified as vulnerable (Figure 1.12).

Among raptors, populations of ospreys, bald eagles, and peregrine falcons have increased in numbers as they recover from past effects of pesticides. Following the ban on DDT, the bald eagle has increased from a low of 400 nesting pairs in 1963 to 4,712 pairs in 1995 (Figure 1.13).

Energy and Transportation

The reduction in energy intensity that has occurred over the last two decades has been driven by energy efficiency advances on the demand side and a shifting of the economy away from energy-intensive industry. According to Department of Energy estimates, energy effi-

Figure 1.14 U.S. Industrial Energy Use, 1977-1991



Source: See Part III, Table 89.

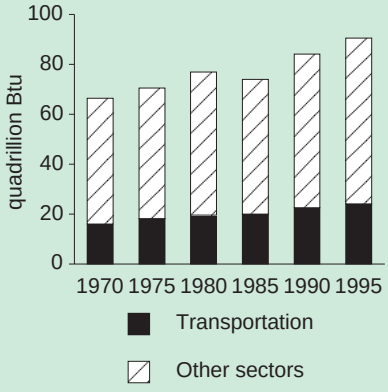
ciency and conservation efforts from 1973 through 1991 curbed the pre-1973 growth trend in primary energy use by about 31 quads (a quad is equivalent to 1 quadrillion British Thermal Units, a common measurement of energy use). Of the 31 quads in savings, it is estimated that about 56 percent comes from industry, 21 percent from residential buildings, 5 percent from commercial buildings, and 18 percent from transportation.

Between 1977 and 1991, industry reduced the amount of energy required for every dollar of output by 36 percent, with about two thirds of these savings coming from improvements in energy efficiency (Figure 1.14). When energy prices began to fall in the mid-1980s, the rate of efficiency improvement slowed. Between 1970 and 1980, energy intensity declined by 2.5 percent per year, but the rate of decline has dropped below 1 percent in recent years.

Transportation energy use as a percentage of total energy use has remained relatively constant, accounting for just over one fourth of U.S. energy consumption. In absolute terms, however, energy consumption by the transportation sector has risen from about 16 quads in 1970 to about 24 quads in 1995, or 50 percent (Figure 1.15). Cars and trucks alone account for about 20 percent of total U.S. energy use. Almost two thirds of total U.S. petroleum consumption is in the transportation sector.

Since 1949, transportation energy consumption has increased at an average annual rate of 2.4 percent, though growth has not been uniform. Energy use in transportation has risen slowly over the past 15 years. Corporate average fuel efficiency (CAFE) standards for light-duty vehicles became effective in 1975, and this and other factors (such as rising gas prices) improved the efficiency of the light-duty vehicle fleet significantly between 1975 and 1985. However, increased vehicle-miles traveled have more than offset any increases in average vehicle fuel economy. Transportation

Figure 1.15 U.S. Energy Use, 1970-1995



Source: See Part III, Table 85.

energy use is the nation's largest source of air pollution. Energy use in vehicles is expected to continue to rise throughout the beginning of the 21st century.

The Unfinished Agenda

Despite the progress that has been made on some fronts, many challenges remain. In some cases, the pressures posed by population growth have been difficult to overcome. Partly as a result of the growth in the number of automobiles on the road, total emissions of nitrogen oxides (NOx) have increased since 1970, which has contributed to a continuing problem with ground-level ozone in many cities. Population and development pressures have played a role in the continuing degradation of coastal zones and estuaries and the wide-scale destruction of critical habitats, though in many cases creative policymaking and careful management can at least partially overcome such conflicts.

In addition, about 40 percent of the nation's rivers, lakes, and estuaries still don't meet basic clean water standards; wetlands losses on nonfederal lands were about 70,000-90,000 acres per year during the early 1990s; and localized cases of waterborne disease continue to threaten drinking water safety.

A few problems escaped attention under the early command- and-control approaches. The most notable was nonpoint source water pollution, such as pesticide and fertilizer runoff from farms and stormwater runoff in urban areas.

A few problems were late-bloomers, including the realization that indoor air pollutants such as environmental tobacco smoke and radon pose significant human health risks.

Finally, there was the growing realization that human activities could be affecting the global environment. In this realm, the emerging issues have included stratospheric ozone depletion, deforestation, declining marine fishery resources in some species and regions, and new evidence that some air emissions were affecting global climate. Since 1972, for example, worldwide generation of carbon dioxide, a common "greenhouse" gas, has increased by 8 percent. Most scientists now believe that such emissions have contributed to an increase in global temperature.

NEW GLOBAL IMPERATIVES

By about the mid-1980s, a combination of factors contributed to some fundamental changes in thinking about environmental policy and the roles of government, business, and the public.

First, there was a strenthening perspective that some environmental problems were actually global in nature and that human activities were capable of altering global systems. The most visible global problems were the role of CFCs in depleting the ozone layer and of carbon dioxide emissions from fossil fuels in contributing to climate change. Other significant problems included the decline of many regional fisheries and the widespread loss of tropical forests and biodiversity.

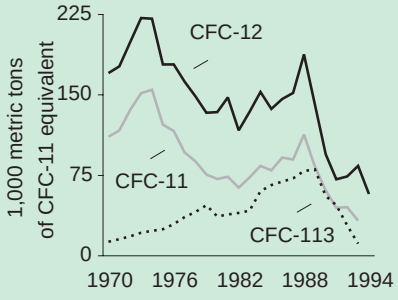
Global and domestic environmental problems differ in three fundamental ways. First, global problems cannot be solved by U.S. action alone. Second, global problems cannot be measured by monitoring in the U.S. alone. Third, global problems are generally less visible to U.S. citizens than most domestic environmental problems.

There was a growing recognition that such problems required more global cooperation than ever before. In many cases, this has presented a difficult political challenge, since these problems have serious implications for economic growth generally, require long-term coordination among nations, and raise difficult concerns about the tradeoffs between growth and environmental protection.

Given these political difficulties, the global community has made remarkable progress in working towards solutions. The 1985 Vienna Convention for the Protection of the Ozone Layer and the 1987 Montreal Protocol on Substances that Deplete the Ozone Layer are in place as agreements that will phase out the use of CFCs, and the Framework Convention on Climate Change has provided a starting point for the difficult effort to reduce global emissions of carbon dioxide and other greenhouse gases.

The effort to phase out CFCs is an interesting case study of the benefits of cooperation, of the new role of the federal government as a facilitator of solutions, and of the new economic opportunities provided by environmental protection requirements.

Figure 1.16 U.S. Production of Selected Chlorofluorocarbons, 1970-1994



Source: See Part III, Table 71.
Note: 1994 data for CFC-11 and CFC-113 not available.

Case Study: The CFC Phaseout

One of the unsettling characteristics of modern economies is the speed with which useful chemical compounds can spread into every nook and cranny of the industrial world. Only later are some found to have unforeseen environmental consequences.

An important example has been the introduction of CFCs and their rapid adaptation for a variety of industrial purposes, the discovery of their harmful effects on the stratospheric ozone layer, and the global consensus and agreement that emerged to phase these chemicals out. The consensus was embodied in the Montreal Protocol, which called for the ultimate phaseout of CFC production. An important milestone was reached on January 1, 1996, when chemical manufacturers stopped producing chlorofluorocarbons for consumption in the United States, except for a few essential uses (Figure 1.16).

According to a recent study by Elizabeth Cook of the World Resources Institute, there were several important ingredients to this success. First, an environmental goal, which can be adjusted to reflect new information, is crucial; it can send clear signals to the private sector and prompt needed investments. The phaseout of CFC production provided such a goal. Second, market-based instruments, such as marketable permits and excise taxes, created an efficient, responsive, and flexible policy framework for controlling ozone-depleting substances. Third, entrepreneurial government initiatives helped industry by removing regulatory barriers, creating opportunities for inter-industry problem-solving, and fostering collaboration among typically opposed groups. Fourth, scientific advances and public education both helped move the process forward.

CFCs have an unusual combination of properties. They are nonflammable, nontoxic, inexpensive to make, easy to store, and chemically stable. In the late 1940s, the invention of an inexpensive valve designed to take advantage of CFC characteristics—such as their ability to be stored under relatively low pressure—marked the beginning of the aerosol age. CFCs also proved valuable as solvents. For example, they could be used to clean semiconductor circuitry without damaging the plastic mounting boards. They were widely used in vehicular air conditioning and for blowing foams of all kinds, including those in fire extinguishers, foam insulation, and that used to make disposable hamburger cartons and coffee cups.

In June 1974, University of California at Irvine scientist F. Sherwood Rowland and Mario J. Molina, a colleague at Irvine, published a paper theorizing that CFCs, after decomposing in the stratosphere, would release chlorine atoms that would react with and destroy the Earth's thin layer of ozone molecules. If CFC emissions continued at the 1972 rate of about 800,000 tons per year, about half a million tons of chlorine would be released in the stratosphere within 30 years, destroying between 20 and 40 percent of the ozone layer.

In 1976, a National Academy of Sciences report validated the ozone-depletion theory. With this evidence in hand, federal regulators took action. By March 1978, the federal government had banned the use of CFCs in "non-essential" aerosols after December 15, 1978, but continued to allow "essential" uses. The decision to exempt essential uses defused much of the opposition to the broader objective of banning CFCs from the vast majority of aerosols.

The spray can debate proved to be just the beginning. To deal comprehensively with the problem, much more had to be done about the manufacture and use of CFCs in other countries, the use of CFCs in other industrial processes, and the use of other chlorine-bearing compounds similar to CFCs.

The Debate Goes Global

The 1982 discovery of the ozone hole over the Anarctic helped reignite international negotiations over CFCs. In 1985, the Vienna Convention for the Protec-

tion of the Ozone Layer established a framework for later international agreements and set up new international institutions to deal with the problem. By September 1987, representatives of 24 countries had agreed to the Montreal Protocol. As originally drafted, the agreement was intended to halve the production and use of CFCs in the industrialized countries between 1986 and the year 2000. The reductions were in three stages: a freeze at 1986 levels by 1990; a 20-percent reduction by the end of 1993; and a further 30- percent cut by the end of 1999. In later negotiations at London in 1990 and Copenhagen in 1992, the phase-out date for most CFCs was pulled back to 1996. The agreements also cover other ozone- depleting substances, including HCFCs, halons, methyl bromide, carbon tetrachloride, and methyl chloroform. These other substances will continue to be phased out over the next several decades. By 1993, over 140 countries had ratified both the Vienna Convention and the Montreal Protocol.

Because of the disparate uses of CFCs, each industrial sector presented a different challenge. The government response involved a wide range of approaches, encompassing national and local legislation, regulations, bans, new product reviews, and economic instruments.

In the case of foam packaging made with polystyrene, EPA in February 1988 rounded up the key players—four environmental organizations, nine packaging manufacturers, two trade organizations, and two chemical companies—to talk about economically and environmentally acceptable alternatives that could be adopted by the entire industry.

With EPA acting as a facilitator, the working group hammered out a voluntary phase-out agreement over the next two months. Under it, foam manufacturers would end CFC use by December 31, 1988; HCFC-22 would become an "interim alternative," and companies committed themselves to adopt any new, safe, and economically feasible blowing agent within 12 months of FDA approval. The agreement also encouraged the development of a substitute within five years. To promote enforcement of the voluntary agreement, the industry agreed to public monitoring of CFC and HCFC-22 consumption.

In the case of devising "no-clean" technology that re-engineered the soldering process to eliminate the need for CFCs to clean electronic components, an important breakthrough occurred in October 1989, when nine giant multinational companies, in partnership with EPA, formed the Industry Cooperative for Ozone Layer Protection. Through this public-private partnership, companies exploring no-clean technology would share and publicize developments, tour each other's facilities, conduct tests, distribute results, and jointly publish technical papers.

Cooperation among competitors, particularly large multinationals, helped defuse skeptics and persuaded other companies to join in or suffer competitive disadvantages as chemicals became scarcer and more expensive. The willingness of large companies to work cooperatively made it possible to commercialize and

implement no-clean technologies rather quickly.

The Government's Role

The federal government played an important role both as a policy-maker and as a catalyst. The government established pollution permits, which companies could trade, and excise taxes. EPA catalyzed action by diverse interests by trying to remove barriers and to help industry identify and use cost-effective solutions.

EPA officials in 1988 decided that the most efficient way to meet the CFC (and halon) consumption limits would be to set up a marketable permits program and assign allowances to the companies that produced or imported CFCs based on the size of each firm's market share in 1986. Companies were required to report both changes in the chemicals used and trades among companies of allowances to EPA. Any swaps had to balance larger quantities of less-potent chemicals with smaller volumes of strong ozone depleters.

In practice, companies have traded permits with each other and have shifted permits among their own operations domestically and internationally. As the use of CFC-11 and CFC-113 declined, companies increasingly traded their allowances into CFC-12, which was still in demand for use in the motor vehicle air-conditioning industry.

The system has three notable advantages. It lowered costs to both industry and the government. It gave companies great flexibility in responding to market demands, and it allowed the United States to quickly adapt to the changing requirements of the Montreal Protocol.

EPA officials thought that the permit system's consumption caps would restrict demand, push up prices, and encourage users to adopt alternatives. As it turned out, an "ozone-depleter" tax enacted by Congress in 1989 gave CFC producers and users an incentive to stay well below the consumption caps. The tax, which raised $2.9 billion in its first five years from manufacturers and importers, took effect in 1990 with a $1.37 per pound base rate on CFCs and halons and called for escalating rates over time. (One unfortunate effect of the tax is that it helped stimulate a black market in CFCs. An estimated 10,000 to 22,000 tons of CFCs illegally entered the United States in 1994 and 1995. Violations of restrictions on CFC imports must be subject to swift and strong punishment to effectively deter future noncompliance.)

The CFC phase-out is a remarkable story of effective policymaking and constructive cooperation among adversaries. The policy framework set a firm goal, gave industry flexibility in meeting it, and put a high priority on lowering public and private compliance costs. It utilized a combination of regulatory and market-based approaches. Of course, these efforts had significant costs: they altered investment strategies, required some firms to take some steps sooner than they might have ordinarily, and forced some to use more expensive alternatives. But these costs would have almost certainly been higher under a regulatory strategy blind to market signals and the strengths of the

public and private sectors. And, through the introduction of new practices, many industries are now reaping huge savings.

THE CHANGING ROLE OF THE PUBLIC

In recent years many communities have embarked on a new course of growth that uses the concept of sustainability as a benchmark.

A vital part of the effort is the participation of community residents in identifying a community's needs and working toward a collaborative solution. Bringing all elements of a community—individuals, elected officials, members of the business community, environmental groups, and civic organizations—together offers the best chance for lasting solutions.

Community participation is now an important focus for many cities. In Seattle, a local citizens' group led an effort to measure the progress or decline of key social, economic, and environmental indicators that were identified by the community as priorities. In the New York City area, residents of the South Bronx are playing a lead role in planning to revitalize their community.

Chattanooga is a particularly striking success story. Chattanooga's plight in the 1960s was similar to that of many other cities: suburban sprawl, loss of traditional manufacturing jobs, racial conflicts, poor schools, and a decaying urban infrastructure had all contributed to the city's decline. On top of that, Chattanooga in 1969 was dubbed the "worst polluted city" in America. Air pollution was so bad that drivers often had to switch on their headlights in the middle of the day.

Today, Chattanooga is widely recognized as one of the nation's best environmental turnaround stories. How did it happen? The city's business, political, and environmental leaders, along with the community as a whole, all played a role. Rather than an onerous burden, environmental improvements proved to be an economic opportunity for the city. The city's new electric buses are made by a new local firm that has also received orders from cities in several other states. Cleaning up the city's air spawned a new local manufacturer of air pollution "scrubbers." The city's leaders increasingly see environmental improvements as an opportunity to attract new businesses and new investments.

Community participation was another big part of Chattanooga's success. The 1984 Vision 2000 Project brought together some 1,700 members of the community to talk about their vision of the city in the year 2000. The project came up with 34 goals that generated some 223 city projects, including construction of the Tennessee River Park and the Tennessee Aquarium. By 1992, 85 percent of the goals had been met. Some $739 million has been invested in the city, about two thirds from private sources.

Chattanooga's vision of its future isn't unique. Other cities such as Portland, Oregon, and states like Minnesota have begun to use broad-based goal-setting and benchmarking projects. In Portland, communities are working together to plan for the region's rapid population growth. With the help of coordinated

decisonmaking and the use of urban growth boundaries, these communities are preserving open space and prime farmland to help maintain the area's quality of life.

Many other communities—including Charleston, South Carolina, and Savannah, Georgia—are using design control and making historic preservation a priority. Preservation of existing buildings provides a double benefit, saving both energy and materials and preserving a community's sense of continuity.

State, local, and community efforts to build new partnerships and look for innovative new solutions to community problems provide both a challenge and an opportunity at the federal level. Most federal agencies, including the Departments of Energy, Interior, Defense, Agriculture, and others, are pursuing these opportunities.

One such effort is EPA's new National Environmental Performance Partnership System (NEPPS). Under this program, a state performs a self-assessment of its environmental programs and negotiates an agreement with EPA on environmental and public health priorities and on how federal and state resources will be used to address them during the coming year. The program encourages local governments and the public to get involved in defining the way environmental protection works. This approach brings EPA, states, and the public together to evaluate public health and environmental problems in the state, set priorities, and develop a plan to address them. The program also provides states with increased flexibility to address local environmental conditions with the help of public information and public involvement.

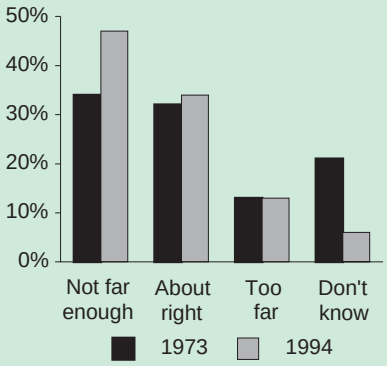
Public Support for Environmental Protection

In one important respect, the role of the public has not changed much since 1970. The American public has remained generally supportive of environmental protection and environmental protection laws and regulations.

Periodically since 1973, Roper Starch Worldwide Inc. has been asking this question: "There are different opinions about how far we've gone with environmental protection laws and regulations. At the present time, do you think environmental protection laws and regulations have gone too far, or not far enough, or have struck about the right balance?" In October 1973, 13 percent of respondents said laws and regulations had "gone too far," 34 percent said "not far enough," 32 percent said they had "struck about the right balance," and 21 percent said "don't know." In September 1994, 13 percent said "gone too far," 47 percent said "not far enough," 34 percent said "struck about the right balance," and 6 percent said "don't know" (Figure 1.17).

Cambridge Reports/Research International has asked a similar question since 1982: "In general, do you think there is too much, too little, or about the right amount of government regulation and involvement in the area of environmental protection?" Large majorities have responded that involvement is either too little or about right. About 10 percent of respondents said "too much" through the

Figure 1.17 Public Response to Surveys on "How Far Have Environmental Laws and Regulations Gone?"



Source: Roper Starch Worldwide Inc.

1980s, but recently that percentage has risen.

Support seems to be increasing for the view that both economic growth and a cleaner environment are simultaneously obtainable. Through the 1970s and 1980s, according to polls by Cambridge Reports/Research International, about half of all Americans thought we could have both; more recently, about two thirds agree with this view.

Forging a New Paradigm

Over the past 25 years a great deal has been learned about environmental problems and strategies to deal with them. Though a number of residual problems remain, the effort was generally successful and has almost certainly provided benefits well in excess of the costs.

Out of this experience, a new paradigm has emerged that can complement traditional approaches and help us build on proven means to protect human health and the environment. This new paradigm emphasizes goal-setting, economic incentives, pollution prevention, a more holistic approach to environmental problems, simplification of regulations, more flexible problem-solving, and a more interactive approach with stakeholders and the community at large. Some of these new approaches are the subject of the second chapter, which looks ahead to our environmental future over the next 25 years.

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