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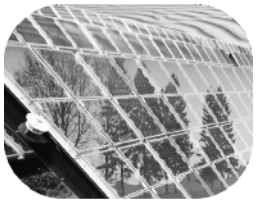
Pollution Charges, Fees, Taxes

Deposit-Refund Systems

Trading Programs



Subsidies for Pollution Control

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The United States Experience with Economic Incentives for Protecting the Environment

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EXECUTIVE SUMMARY

I. Purpose of This Report

Over its 30-year history the predominant tool used by the U.S. Environmental Protection Agency (EPA) to help achieve the nation's environmental goals has been uniform, nationally applicable regulations derived from environmental law. Those regulations, e.g., source-specific emissions limits, product specifications, and pollution-control guidelines, have been responsible for much of the improvement in air and water quality that is evident in the country today.

But over the past 20 years, and during the past decade in particular, EPA has begun to use a much broader array of tools to manage environmental quality. Among these relatively new tools, several kinds of economic incentives are being applied more and more widely. Once considered an academic abstraction or a revenue-raising adjunct to traditional regulatory mechanisms, market-based economic incentives are being used now as the principal instrument for controlling a growing number of environmental problems. To varying degrees, federal, state, and local governments are promoting the use of economic incentives as an environmental management tool because of the perceived advantages and effectiveness of these incentives.

Because of the wide—and growing—use of economic incentives at all levels of government in the United States, it is important to understand them more clearly. For example, what kinds of economic incentives are being used today to address what kinds of problems? Are particular incentives better suited for use at specific levels of government? Even more important are questions regarding relative effectiveness. How well have economic incentives performed in terms of improving environmental quality? How economically efficient and cost-effective have they been? To what extent have they stimulated technological change and innovation? How can past experience with economic incentives help improve their use today and in the future?

This report attempts to answer those questions by providing a broad overview and analysis of the current use of economic incentives as an environmental management tool in the United States. To that end, it makes use of, and builds on, related reports, surveys, and research. This report expands and updates the information contained in an earlier EPA report (1992) and a report to EPA in 1997 that documented the growing use of economic incentives in the United States and foreign countries. It also notes related research by the National Academy of Public Administration (NAPA).

At the same time, this report is not exhaustive. It does attempt to identify most of the incentives currently in use at the federal level for environmental pollution control. However, it limits its discussion of incentives at other levels of government to a representative sample of programs. A complete survey and assessment of the large number of incentives currently in use at the state and local levels would require a much broader study than this report. Likewise, the report only briefly summarizes a voluminous theoretical and applied literature on economic incentives.


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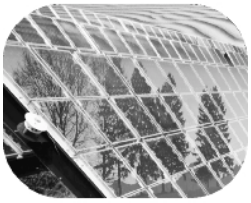
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II. Definition of Economic Incentives

For the purposes of this report, economic incentives are defined broadly as instruments that use financial means to motivate polluters to reduce the health and environmental risks posed by their facilities, processes, or products. These incentives provide monetary and near-monetary rewards for polluting less and impose costs of various types for polluting more, thus supplying the necessary motivation to polluters. This approach provides an opportunity to address sources of pollution that are not easily controlled with traditional forms of regulation as well as providing a reason for polluters to improve upon existing regulatory requirements. Under traditional regulatory approaches, polluters have little or no incentive to cut emissions further or to make their products less harmful once they have satisfied the regulatory requirements.

The definition of economic incentives used here is quite broad. As such, a great many instruments and programs could be included in this review. By necessity the report focuses on the most significant federal programs and a representative sampling of activities at the state and local level.

III. Value of Economic Incentives

Economic incentives have a singular advantage over traditional forms of regulation: they harness the force of the marketplace to reduce environmental and health risks. While this feature does not make economic incentives applicable to every source of pollution, market forces often can operate where traditional regulations would be ineffective. Sources of pollution include point sources such as discharge pipes and stacks; area sources such as factories and storage areas; and non-point sources such as streets, farms, and forests. In a traditional regulatory system, owners of many of these sources have an incentive to comply—i.e., avoidance of enforcement actions—but *releasing* pollution has no economic cost to the owner. Consequently, owners of these sources of pollution (hereafter referred to as "sources") normally have no incentive to do more than the regulations require, whether it is a limit on emissions or on the use of a specific technology.

With market incentives, sources of pollution can see an economic value in reducing pollution because doing so saves them money. Consequently, the difference between a traditional regulatory system and economic incentives can lead to several public health, environmental, and economic benefits.

First, economic incentives in some circumstances can be structured to achieve larger reductions in pollution than would result from traditional regulations. For example, a program that allows trading of pollution reduction obligations among sources may be able to require greater reductions in pollution than a similar program that does not use trading. Pollution charges or voluntary pollution prevention programs could encourage sources to reduce emissions below permitted amounts.

Second, economic incentives often can control pollution at lower costs than can traditional regulations. By setting standardized emissions, product, or technology requirements, traditional regulations do not usually take into consideration the different costs of compliance faced by different sources. But in an incentive system, the marginal costs of controlling pollution play an essential role. When emission allowances or credits can be bought and sold by the sources, the sources that have relatively low costs of pollution control will reduce more pollution than sources that have relatively high costs of pollution control. Thus, when economic incentives are

used, goals of reducing pollution—whether applied over a facility, an industry, or the nation as a whole—will be achieved at the lowest cost as determined by market forces. One study done for the EPA (Anderson. 1999) estimated that the potential savings from widespread use of economic incentives at the federal, state, and local level could be almost one-fourth of the approximately $200 billion per year currently spent on environment pollution control in the United States.

Third, the use of economic incentives, in contrast to that of traditional regulations, can control the pollution that is caused by a multitude of small and dispersed sources. A traditional regulatory system, which relies on reporting, inspections, and fines for noncompliance, becomes very cumbersome and expensive to administer when applied to thousands, or even millions, of sources. For many serious environmental concerns today, such as surface water quality and global warming, the sources of the problem can indeed number in the millions. Deposits on lead-acid batteries and variable charges for solid waste disposal are two good examples of how economic incentives can more effectively manage the quantity of pollution that is released from large numbers of small and dispersed sources.

Fourth, economic incentives can stimulate technological improvements and innovations in pollution control in situations where traditional regulatory mechanisms may not. In some cases, traditional regulatory mechanisms can stimulate technological change. For example, challenging numerical performance standards have prompted the development of cleaner technologies (e.g., catalytic converters). Also, when regulations require the use of the best available control technology (BACT), manufacturers of pollution control equipment have an incentive to improve the performance of the products they offer for sale. But traditional regulations that specify the approved pollution control technologies discourage sources from developing better pollution control technologies. Not only is there uncertainty that an improved pollution control technology would be approved, but greater pollution control normally is costly. What source would want to engage in greater control of pollution than is required by existing regulations? Economic incentives, on the other hand, attach a value to controlling pollution. In some cases the value is an explicit monetary amount, while in other cases the financial impact is indirect. Therefore, sources have an incentive to develop technologies that are more effective or less costly, particularly when pollution reduction obligations can be traded among sources like any other commodity in the marketplace.

Clearly, economic incentives have several advantages that make them attractive environmental management tools. When properly designed and used in appropriate circumstances, they can achieve environmental results beyond those of traditional regulations, they can achieve those results at lower costs, they often can do a better job of controlling large numbers of small sources, and they provide a valuable spur to technological innovation.

However, just as economic incentives have advantages, they also have limitations. One of the most significant disadvantages is that they are often inappropriate for dealing with environmental issues that revolve around equity concerns. Many types of environmental standards are designed to protect individuals around the site of a polluting facility; in some cases the specific purpose is to protect individuals exposed to the highest pollutant concentrations. In general, people are not willing to accept higher risks to their health because it is “more economical” to reduce risks to others. There are many such environmental and health standards, including toxicity standards for air, waste management standards, and cleanup standards. For example, risks cannot be traded between Superfund sites. To do so would mean that some people would live near an unsafe site

that doesn't meet federal standards because other people would live near another site that is twice as safe as required by federal standards.

IV. Types of Economic Incentives

This report examines several types of economic incentives that are currently in use in the United States at all levels of government, and it assesses their advantages and disadvantages. Although all these incentives give sources of pollution an impetus to minimize their emissions, the incentives take widely differing forms. In fact, the variety of economic incentives in use today is one of the most remarkable developments in environmental management over the past decade.

1. Fees, Charges, and Taxes

From the perspective of sources that are subject to environmental fees, charges, and taxes, these three terms are largely interchangeable in terms of their effects. They all require that the generator of a designated type of pollution pay a fee (or charge or tax) for each unit of pollution. These fees make attractive tools for managing the environment because they attach an explicit cost to polluting activities and because sources can easily quantify their savings if they reduce the amount of pollution they emit. One disadvantage is that fees do not guarantee the amount by which a source would reduce pollution.

Pollution-related fees, charges, and taxes are widely collected at all levels of government, and they are one of the most prevalent economic incentives in use today. For example, fees linked to air emissions are imposed in California, Texas, and several other states, while permit fees for water effluent discharge are based on the volume and toxicity of the discharge in Washington, New Jersey, and Wisconsin, among others. Per-bag fees on households that dispose of solid waste are in effect in more than 3,000 communities across the country. Fees that are tied to resources such as the use of grazing lands, water, and sewage systems are widely levied in the United States.

Similarly, environmental taxes are usually imposed on landfill operations and the disposal of hazardous wastes. Product charges are sometimes levied on products—e.g., chlorofluorocarbons, low-efficiency automobiles, fertilizer, motor oil, and packaging—that are believed to have harmful effects on the environment. Other fees are being charged on activities that are potentially damaging to the environment, for example, wetlands development and storm water runoff.

Although fees can generate substantial revenues for the government agency that imposes them, they tend to be set at rates too low to have a significant impact on pollution. Generally speaking, if pollution fees or taxes were set at rates equal to the incremental damage being caused by the pollution, or at a level that would force changes in business or personal behavior, they would be controversial. Concerns about the competitiveness of U.S. businesses would be raised if foreign companies were not subject to similar fees. Consequently, the rates of most of these environmental fees and taxes are not set high enough to achieve U.S. environmental goals, although in some specific cases fees and taxes are working well as a mechanism for controlling pollution.

2. Deposit-Refund Systems

Deposit-refund systems require a monetary deposit at the time of sale of a product. The deposit is returned when the item is returned at the end of its useful life. In the United States, deposit-

refund systems have been applied most widely to help control the disposal of lead-acid batteries, but they also are being applied in some states to products such as aluminum and glass cans, pesticide containers, and tires. When used products are valuable, as is currently the case for lead-acid batteries, the private sector often creates and manages a disposal system. Regardless of who manages the disposal of such products, the fees charged by this system help subsidize the return of recyclable products.

Deposit-refund systems appear to be most appropriate for discrete, solid commodities such as beverage containers, batteries, and car bodies that would cause environmental harm through their improper disposal. Government-mandated deposit systems for less discrete substances, like air and water pollutants, have not been attempted. One factor that limits the widespread use of deposit-refund systems is their high transaction cost. Collecting and refunding deposits on the sale of individual products such as beverage containers tends to be expensive, and additional costs are involved in collecting and returning used products for disposal.

3. Marketable Permits

There are two distinct types of trading systems: cap-and-trade systems and credit systems. Cap-and-trade systems seek a specific environmental result; trading allowances to release pollution is simply an option to minimize the cost of achieving the emission reductions specified in the regulatory cap on emissions. In the cap-and-trade approach, allowances for future emissions are sold or granted to existing sources. Uncapped credit systems, on the other hand, do not establish any fixed ceiling on total emissions. Total emissions can increase if new sources of pollution enter the market and as existing sources increase production. In uncapped systems, credits are earned for controlling pollution beyond a baseline specified in one's permit. Distinctions between cap-and-trade and credit systems are discussed in much more detail in chapter 6.Two well-known examples of cap-and-trade systems are EPA’s Acid Rain Trading Program and Southern California's RECLAIM. A wide variety of other federal, state and local programs feature some form of emission or effluent trading. For example, some of the high-mountain communities in Colorado require permits to use wood-burning appliances. Existing homeowners are given permits reflecting historic use but those who wish to install a new wood stove in a home are required to retire two existing permits, a rule that helps reduce air pollution. Certain classes of heavy-duty engines are subject to emissions averaging to meet an average performance standard, which is just the trading of pollution control obligations within a company, as well as emissions trading between companies. The rights to burn dry grass are subject to trading in Spokane County, Washington, and land development rights are traded in a few jurisdictions in Maryland, New Jersey, and Florida. In some areas, wetland mitigation credits can be created, banked, and sold to offset the adverse effects of development.

Trading programs have certain features that have made them increasingly popular in the United States. In a trading program, capital moves between companies involved in trades, and innovative, entrepreneurial companies can profit from low-cost reductions in emissions. In addition, cap-and-trade programs can provide great certainty about the magnitude of environmental improvement that will be achieved.

At the same time, trading programs may have several drawbacks, including the potential for high transaction costs and inactive markets, especially in credit or open-market systems. High costs can be attributed to the need to verify each reduction before authorizing the credit. Clearly, trading programs should not be applied to all environmental problems. The long-term effects of

trading programs on technical innovation vary from program to program. Some have spurred considerable innovation, such as the acid rain program, while others have not due to high transaction costs.

4. Subsidies

Subsidies to support reductions in pollution take many forms. Among the many subsidies that are used at all levels of government to help manage environmental pollution are grants, low-interest loans, favorable tax treatment, and preferential procurement policies for products believed to pose relatively low environmental risks. Subsidies are used to support private-sector pollution prevention and control activities, the cleanup of contaminated industrial sites, farming and land preservation, consumer product waste management, alternative automobile fuels, clean-running cars, and municipal wastewater treatment.

Subsidies for environmental management are sometimes criticized because the government entity providing the subsidy—and the taxpayer, ultimately—is helping to bear the costs that should be the responsibility of the polluter. Other environmentally related subsidies, such as federal support for timber harvesting in the national forests, are also criticized because they in fact have proven harmful to the environment. Nonetheless, subsidies have become a fairly common tool to manage the environment at every level of government.

5. Liability

Being held legally responsible for health or environmental damages is a potent incentive for sources to reduce or avoid pollution, since if found liable they can face extraordinarily large and unpredictable damage claims. The Clean Water Act, for example, requires the cleanup of oil and petroleum products spilled into the nation's waters, while the Superfund Act and the Oil Pollution Act impose liability for environmental damages caused by the release of hazardous substances and oil, respectively. Since 1990, awards and settlements for damages to natural resources under these and related state statutes total more than $700 million, with a number of cases that involve large sums still in varying stages of litigation. Liabilities associated with the cost of cleanup at Superfund sites total billions of dollars.

With potential costs of this magnitude, sources have a powerful incentive to minimize their legal exposure. Consequently, expensive technologies that control pollution or aggressive environmental management systems can seem very reasonable to sources. While liability has prodded sources to take significant actions to reduce pollution, such as managing hazardous wastes on site, it is sometimes difficult to quantify the environmental results of those actions or to establish a causal link between concerns over liability and reductions in pollution.

6. Information Disclosure

The collection and public availability of information on environmental performance has proven to be a strong incentive for sources to reduce their emissions of pollution. The incentive derives from a number of factors. For example, when companies collect emissions information, they learn about the nature and magnitude of their emissions. When such information is made easily accessible to the public, workers and local communities have a much better idea of the environmental risks they face, so they are more prone to support or demand actions to reduce emissions. When a source's emissions are shown to decline over time, the source often reaps the benefits of better relationships with its employees and with the local community. Finally, in

some cases a proven, long-term record of environmental stewardship makes a company's products more desirable to consumers.

The disclosure of environmental performance information is much more common today than a decade ago. Although some information is disclosed voluntarily, other information must be released to the public as required by statute. The two best-known laws mandating the public disclosure of environmental information are the Toxics Release Inventory provisions of the federal Community Right-to-Know Act and California's Proposition 65. Other forms of information reporting include environmental impact assessments, product labeling, environmental performance awards, Securities and Exchange Commission (SEC) environmental reporting requirements, and disclosure requirements for lead paint and radon when homes are sold.

Information disclosure has been a powerful tool for reducing pollution. Over the past decade, the Toxics Release Inventory, for example, shows that sources have substantially reduced the amount of substances listed in the inventory that they release into the environment. Because the TRI requires only the reporting of information, actions taken by sources to reduce pollution are voluntary and in all likelihood relatively low cost.

7. Voluntary Actions

Although government programs that encourage sources to reduce pollution on a voluntary basis were virtually unheard of 20 years ago, they have become one of the fastest growing environmental management tools in the country. At present, EPA and state governments have a variety of programs in place that encourage sources like private companies, schools, hospitals, and universities to reduce specific kinds of pollution. A 1999 EPA survey identified 54 such federal partnership programs, up from 28 just three years earlier. More than 7,000 organizations now participate in EPA's voluntary programs, and in 1998 those participants conserved 1.8 billion gallons of clean water, 7.8 million tons of solid waste, and prevented the release of air pollution in an amount equivalent to taking 13 million cars off the road. At t the same time, EPA estimates these organizations saved roughly $3.3 billion. Literally hundreds of similar programs are in operation at the state and local levels.

There are a number of reasons why voluntary reductions in pollution are proving more and more popular with sources, and they are related to the incentives associated with information disclosure. When sources voluntarily reduce pollution and their employees, neighboring communities, and customers learn about it, sources gain several benefits. Voluntary actions taken by sources often reduce employees' exposure to harmful pollutants, thus lessening sources' liability and improving their relationship with labor. Sources enjoy better relations with neighboring communities, and a reputation for good environmental stewardship may attract more customers for their products. In some cases, sources also save money by taking these actions. Moreover, sources that join voluntary partnership programs can be eligible for various kinds of technical assistance from sponsoring government agencies. For example, they can receive free information on the cost and availability of energy-efficient technologies.

V. Conclusions

1. Diversity of Economic Incentives at EPA

EPA is well known for its use of emissions trading as a key feature of its program to control acid rain. However, acid rain emissions trading is only one of the economic incentive programs managed by EPA.

Emissions trading, averaging, and banking are helping control major air pollution problems such as stratospheric ozone depletion and ozone-forming nitrogen oxide emissions. They are helping this country to achieve national goals for cleaner fuels, and they are built into virtually all EPA rules for motor vehicles and engines. New efforts to implement a Total Maximum Daily Load (TMDL) program in areas with impaired water quality are expected to substantially increase the use of water effluent trading in the years ahead.

EPA subsidies are helping to revitalize brownfields across the country. In addition, the Agency is rapidly expanding the kinds and extent of environmental information that it makes available to the public and that it requires sources of pollution to disclose to the public. The Toxic Release Inventory required by Superfund may be the public's most well known and most widely used EPA database, but over the past several years it has been augmented by many others. For example, beginning in 1998 drinking water suppliers have been required to provide households with information on the quality of their drinking water. Moreover, in 2000 EPA began publicizing the emission characteristics of motor vehicles to help consumers in their purchasing decision and to encourage vehicle manufacturers to further reduce emissions.

Voluntary programs have also become a major environmental management tool at EPA over the past decade. The Agency now manages dozens of such programs, many of which have led to measurable reductions in pollutant emissions. In some cases EPA's voluntary programs have given U.S. companies an incentive to develop less polluting products, like computers and household appliances, the sale of which reduces pollution in every part of the country.

EPA has incorporated nearly every type of economic incentive currently in use in the United States into its programs. And the growth of those incentives over the past decade suggests that the Agency is likely to increase its use of them in the decade ahead.

2. Wide Application at Other Levels of Government

The survey undertaken in this report demonstrates the extent to which economic incentives have been adopted as an environmental management tool at state and local levels in the United States. The report discusses dozens of such applications in detail, but there are hundreds more that are known but not included for analysis here.

Not only are the number of state and local economic incentives growing, but their diversity is remarkable. In fact, one of the most interesting aspects of economic incentives that are being tested in different states and communities in the 1990s is their rich variety. Several examples follow. Communities in California, Washington, Michigan, Wisconsin, Minnesota and many other states are charging fees to households for collecting and disposing of their solid waste based on the amount of waste generated. More and more states are imposing taxes on the generation of hazardous wastes. North Carolina imposed a disposal fee on "white goods" such as refrigerators and freezers in 1995, the same year that Minnesota levied a tax on the

"contamination value" of property. As an outgrowth of EPA's proposed Open Market Trading Rule, states like Illinois, Michigan, New Jersey, Texas, and Pennsylvania have developed trading programs for air emissions. In addition to EPA's subsidies for developing brownfields, states like New Jersey, Pennsylvania, Delaware, Minnesota, Ohio, Arizona, and Tennessee are offering similar subsidies. In addition, trading programs for water effluent are in various stages of development in Long Island Sound, the Boise River, Chesapeake Bay and many other locations.

The sheer numbers and variety of these programs make them a difficult topic for analysis within a single limited study. However, they do suggest that state and local governments will continue to be a major developer and user of economic incentives well into the future.

3. Unique Contributions to Environmental Management

In some instances it is difficult to quantify the reductions in pollutants or the improvements in human health and environmental quality that result from the use of specific economic incentives. However, there is little doubt that such incentives are providing a new and unique element to environmental management in the United States. In many cases, incentives are generating health and environmental benefits beyond what is possible with traditional regulations, and sometimes they can be applied in situations where regulations might not be possible at all. It is difficult to imagine, for example, the public supporting a regulatory system that mandated reductions in household waste, but household wastes are declining significantly in communities that charge for waste collection based on the amount generated.

The contributions to environmental management made by economic incentives are as varied as the incentives themselves. Deposit-refund systems are helping change the environmental behavior of individual consumers in ways that traditional regulations could not. Deposit-refund systems and taxes on products and outputs are reducing the pollution caused by a multitude of small and geographically dispersed sources that typically are difficult to control through traditional regulations.

Many economic incentives give an impetus to technological change and innovative pollution control because sources can generate profits by finding better, cheaper ways of reducing emissions. EPA's voluntary programs are a particularly good example of economic incentives acting as an incubator for technological improvements. When businesses take initiative on their own or work collaboratively with government to find ways to reduce pollution, instead of merely reacting to government regulations, they tend to apply the same inventiveness and cost-cutting skills used in other parts of the business. In this sense, voluntary programs, as well as other kinds of economic incentives, unleash the qualities of American entrepreneurs that make U.S. businesses such strong competitors in the marketplace and encourage these sources to use those skills to protect the environment.

4. Cost Savings

Economists have long understood that economic incentives have the potential to reduce pollution at a cost below that imposed by traditional regulations. The national experience of using economic incentives over the past decade reinforces this point of view. In some cases, it is difficult to quantify the costs imposed by a particular incentive. In other cases, the hoped-for cost reductions do not materialize to the extent expected. However, in general, it is clear that economic incentives do provide the opportunity to achieve any given level of pollution control with substantial cost savings.

Evidence supporting the lower costs of economic incentives is both theoretical (derived from models) and empirical (based on the results of operating programs). At least 40 studies based on computer modeling of different scenarios for controlling pollution show that economic incentives should be more cost-effective than traditional regulations. One study (ICF, 1989) estimated that allowance trading in EPA's acid rain program could result in savings to affected utilities of $700 to $800 million per year over the long term. The actual cost savings now are believed to be at least twice this amount. Other areas also offer potentially large savings. For example, effluent trading has the potential to save sources as much as $7.5 billion annually. Even if the cost savings from using market incentives are less than predicted as a result of regulatory, institutional, transactional, or legal restraints, or some combination of these factors, the actual savings undoubtedly are still significant.

5. Applicability to Specific Environmental Problems

The nation's recent—and growing—experience with economic incentives has helped improve our collective understanding of their relative usefulness and applicability to specific environmental problems. Experience to date suggests that, even though a wide variety of incentives are available, any particular one may be effective in managing only a fairly narrow range of problems (see Table ES-1).

Product taxes, for example, have been imposed on such diverse goods as fertilizer, tires, and chlorofluorocarbons. It is most useful to apply these taxes to products that have many consumers because administering these taxes is relatively simple and inexpensive. Product taxes have the added advantage of raising revenue for the taxing authority. For other environmental problems, however, raising revenue may be a less important, or even inconsequential, consideration.

Subsidies often are politically popular. In contrast to taxes, they transfer funds to specific targets within the private sector where incentives for conservation, recycling or pollution control currently are lacking. Consequently, subsidies may be most useful in situations in which targeted assistance is essential and other policy approaches would be politically unacceptable or ineffective.

Deposit-refund systems, like input or output taxes, appear to be most useful when applied to numerous, decentralized sources of pollution. However, these systems tend to have high administrative costs compared to alternative instruments such as taxes and fees. Clearly, the relative ability to administer the incentive would be a primary consideration when choosing among these alternatives.

In short, any government agency interested in using economic incentives has a range of options from which to choose. The environmental success of the incentive selected depends to a great extent on the characteristics of the specific environmental problem at hand.

Table ES-1. Uses of Economic Incentives

Incentive	Examples	Pros & Cons
Pollution Charges & Taxes	Emission charges Effluent charges Solid waste charges Sewage charges	Pros: stimulates new technology; useful when damage per unit of pollution varies little with the quantity of pollution Cons: potentially large distributional effects; uncertain environmental effects; generally requires monitoring data
Input or Output Taxes & Charges	Leaded gasoline tax Carbon tax Fertilizer tax Pesticide tax Virgin material tax Water user charges CFC taxes	Pros: administratively simple; does not require monitoring data; raises revenue; effective when sources are numerous and damage per unit of pollution varies little with the quantity of pollution Cons: often weak link to pollution; uncertain environmental effects
Subsidies	Municipal sewage plants Land use by farmers Industrial pollution	Pros: politically popular, targets specific activities Cons: financial impact on government budgets; may stimulate too much activity; uncertain effects
Deposit-Refund Systems	Lead-acid batteries Beverage containers Automobile bodies	Pros: deters littering; stimulates recycling Cons: potentially high transaction costs; product must be reusable or recyclable
Marketable Permits	Emissions Effluents Fisheries access	Pros: provides limits to pollution; effective when damage per unit of pollution varies with the amount of pollution; provides stimulus to technological change Cons: potentially high transaction costs; requires variation in marginal control costs
Reporting Requirements	Proposition 65 SARA Title III	Pros: flexible, low cost Cons: impacts may be hard to predict; applicable only when damage per unit of pollution does not depend on the quantity of pollution
Liability	Natural resource damage assessment Nuisance, trespass	Pros: provides strong incentive Cons: assessment and litigation costs can be high; burden of proof large; few applications
Voluntary Programs	Project XL 33/50 Energy Star	Pros: low cost; flexible; many possible applications; way to test new approaches Cons: uncertain participation

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ADF	Advance Disposal Fee
AEL	Acceptable Exposure Level
AF	Alternative Fuel
AFV	Alternative Fuel Vehicle
API	American Petroleum Institute
AQMP	Air Quality Management Plan
ATU	Allotment Trading Units
AUM	Animal Unit Months
BAAQMD	Bay Area Air Quality Management District
BAT	Best Available Technology Economically Achievable
BCRP	Beverage Container Recycling Program
BLM	Bureau of Land Management
BOD	Biochemical Oxygen Demand
BPT	Best Practicable Control Technology Currently Available
Btu	British Thermal Unit
CAA	Clean Air Act
CAFE	Corporate Average Fuel Economy
CalCAP	California Capital Access Program
CARB	California Air Resources Board
CBEP	Community-Based Environmental Protection
CCAP	Climate Change Action Plan
CCTI	Climate Change Technology Initiative
CDM	Clean Development Mechanism
CEM	Continuous Emission Monitoring
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
CFC	Chlorofluorocarbon
CH_4	Methane
CLEAN	California Loans for Environmental Assistance Now
CLI	Consumer Labeling Initiative
CMA	Chemical Manufacturers Association
CNG	Compressed Natural Gas
CO_2	Carbon Dioxide
CPCFA	California Pollution Control Financing Authority
CPTC	California Private Transportation Company
CRP	Conservation Reserve Program
CRS	Congressional Research Service
CSI	Common Sense Initiative
CWA	Clean Water Act
DACS	Department of Agriculture and Community Services (Florida)
DEM	Division of Environmental Management
DfE	Design for the Environment
DOE	Department of Energy
DOT	Department of Transportation
EAP	Environmental Accounting Project
EBI	Environmental Benefits Index
EER	Energy Efficiency Rating
EHS	Environmental Health and Safety
EIP	Economic Incentive Program

ELP	Environmental Leadership Program
EO	Executive Order
EPA	Environmental Protection Agency
EPCA	Energy Policy and Conservation Act
EPCRA	Emergency Planning and Community Right-to-Know Act
EQIP	Environmental Quality Incentive Program
ERC	Emission (or Effluent) Reduction Credits
ERMS	Emission Reduction Market System
EU	European Union
FGD	Flue Gas Desulfurization
FTC	Federal Trade Commission
FWPCA	Federal Water Pollution Control Act
FY	Fiscal Year
GEF	Global Environment Facility
GHG	Greenhouse Gas
GNP	Gross National Product
gpm	Grams Per Mile
HAP	Hazardous Air Pollutant
HEL	Highly Erodible Land
HFC	Hydrofluorocarbon
HON	Hazardous Organic Chemical NESHAP
IET	International Emissions Trading
IPTEP	Industrial Property Tax Exemption Program
IRR	Internal Rate of Return
ISO	International Organization for Standardization
JI	Joint Implementation
kWh	Kilowatt Hour
LAER	Lowest Achievable Emission Rate
MACT	Maximum Available Control Technology
MMBtu	Million Btus
MMTCE	Million Metric Tons of Carbon-Equivalent
MOU	Memorandum of Understanding
mpg	Miles Per Gallon
MSDS	Material Safety Data Sheet
N_2O	Nitrogen Oxide
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NFRC	National Fenestration Rating Council
NGO	Nongovernmental Organization
NLEV	National Low Emission Vehicle
NMOG	Non-Methane Organic Gas
NOAA	National Oceanic and Atmospheric Administration
NO_x	Nitrogen Oxide
NPDES	National Pollution Discharge Elimination System
NRDC	Natural Resources Defense Council
NSR	New Source Review
ODC	Ozone-Depleting Chemical
OMB	Office of Management and Budget
OPA	Oil Pollution Act
OSHA	Occupational Safety and Health Administration
OTC	Ozone Transport Commission
P2	Pollution Prevention

P3	Public-Private Partnership
PAH	Poly-Nuclear Aromatic Hydrocarbons
PDR	Purchase of Development Rights
PET	Polyethylene Terephthalate
PFC	Perfluorocarbon
POTW	Publicly Owned Treatment Work
ppm	Parts Per Million
PRIA	Public Rangelands Improvement Act
PSD	Prevention of Significant Deterioration
RACT	Reasonably Available Control Technology
RCRA	Resource Conservation and Recovery Act
RECLAIM	Regional Clean Air Incentives Market
RIA	Regulatory Impact Analysis
RFF	Resources for the Future
ROG	Reactive Organic Gases
RTC	RECLAIM Trading Credits
RVP	Reid Vapor Pressure
SARA	Superfund Amendments and Reauthorization Act
SCAQMD	South Coast Air Quality Management District
SCS	Scientific Certification Systems
SEC	Securities and Exchange Commission
SEP	Supplemental Environmental Project
SF_6	Sulfur Hexafluoride
SFI	Sustainable Forestry Initiative
SIC	Standard Industrial Classification
SIP	State Implementation Plan
SMCRA	Surface Mining Control and Reclamation Act
SOCMI	Synthetic Organic Chemical Manufacturing Industry
SO_2	Sulfur Dioxide
SRF	State Revolving Fund (Clean Water)
STEP	Strategies for Today's Environmental Partnership (API)
TSCA	Toxic Substances Control Act
TDR	Transferable Development Rights
TMDL	Total Maximum Daily Load
TNRCC	Texas Natural Resource Conservation Commission
TRI	Toxics Release Inventory
TSP	Total Suspended Particulates
UNFCCC	United Nations Framework Convention on Climate Change
URVs	Unit Risk Values
USAID	United States Agency for International Development
USDA	United States Department of Agriculture
USIJI	United States Initiative on Joint Implementation
VMT	Vehicle Miles Traveled
VOCs	Volatile Organic Compounds
VOM	Volatile Organic Matter
WAVE	Water Alliance for Voluntary Efficiency
WRAP	Waste Reduction Awards Program
WRP	Wetlands Reserve Program
WRI	World Resources Institute

1. Introduction


Pollution Charges, Fees, Taxes


Deposit-Refund Systems


Trading Programs


Subsidies for Pollution Control


Liability Approaches

Information Disclosure


Voluntary Programs

In recent years, economic instruments have achieved a prominent place among the tools used by governments to manage the environment. Once mainly an academic proposition, or a revenue-raising adjunct to traditional regulatory mechanisms, market-based economic incentives are now being used as the principal instrument of control on a number of environmental issues. Nowhere is this fact more evident than in the 1990 Clean Air Act Amendments, which created many programs that are underpinned by market-based mechanisms. The Clean Water Act Amendments of 1992, the Safe Drinking Water Act, and a host of state and local initiatives also contain important new incentive-based initiatives.

1.1 Purpose of the Report

This report expands upon and updates two earlier EPA surveys on the use of economic instruments for managing the environment. A 1992 EPA report documented the growing use of economic instruments to manage the environment in the United States and also characterized the experiences of many other countries.[1] A 1997 report to EPA reviewed many additional programs in the United States and in other nations.[2] Since these reports were issued, many new instruments have been implemented and existing instruments have been subjected to evaluation by academics and government agencies. Thus, an update is not only timely but also a good opportunity for offering new insights and perspectives. This is not the first such update. Particularly noteworthy are survey articles by Stavins and Hahn and recent research by the National Academy of Public Administration.[3] While the basic conclusions of the earlier EPA reports are still valid, the number of instruments that have been reviewed for their efficacy has grown substantially. A number of subtle and not so subtle differences in perspective also may be evident to the reader.

This report attempts to go well beyond simply enumerating existing market-based mechanisms for managing the environment by examining key issues. How well have these instruments performed? How economically efficient or cost-effective are these mechanisms in achieving the goals of environmental management? What are their effects upon the environment? Why are potential gains from economic instruments seldom observed in practice, and what can be done to improve this record? What can be learned in these cases that will assist in the formulation of new mechanisms?

1.2 Scope of the Report

For the purposes of this report, the term "economic incentives" will be defined broadly as instruments that provide continuous inducements, financial or otherwise, to sources of pollution, to reduce their releases of pollutants or make their products less polluting. In essence, with incentives, sources view each unit of pollution as having a cost, whereas under more traditional regulatory approaches pollution may be free or nearly so once regulations have been satisfied.

To achieve maximum cost effectiveness, each source should control pollution to the point where the last units of pollution cost the same amount to control at each source. To achieve efficiency, the situation that maximizes the difference between benefits and costs, pollution should be controlled until the per-unit costs of controlling pollution that are faced by each source are equal to the incremental value of damage to health and the environment caused by that pollution. This latter objective is much more difficult to achieve, so much so that it is of interest primarily as an academic or theoretical exercise; it does not have great regulatory significance.

The definition of economic incentives used here excludes mechanisms that use explicit or implicit price signals to control activities that have pollution as a by-product. While sometimes known as "environmental incentives," programs that provide ride sharing, bike paths, high-occupancy vehicle lanes, parking surcharges, and the like are beyond the scope of this report. However, there is a brief discussion of congestion pricing that addresses a problem not unlike (and quite likely linked directly to) pollution. While of interest because these mechanisms may lead to a reduction in pollution, they provide neither an explicit nor an implicit price on units of pollution. Excluding these mechanisms carries no particular implication regarding EPA's perspective regarding their present or future applications.

Payments per unit of pollution are perhaps the clearest example of an incentive, as the term is used in this report. Credits and allowances to reduce pollution also provide direct price signals. As such, sources receive rights that can be sold and used by another source. Subsidies for pollution control and deposit-refund systems also create continuous financial incentives. Finally, indirect financial incentives are created through reporting requirements, liability rules, and voluntary programs. All of these mechanisms provide financial incentives for sources to reduce their emissions and to make their products more environmentally friendly.

The principal contrast between incentive mechanisms and traditional regulatory approaches is that the latter do not provide incentives to reduce releases below permitted levels, or to make their products less harmful to the environment once regulatory requirements are satisfied. Under traditional regulatory approaches, sources are tempted to view releases within permitted amounts as having no cost and products that release less pollution than allowed by requirements s as having no incremental value. Sources operating within the limits of existing regulations have little reason to act until new regulations are issued.

In fact, if firms reduce pollution below permitted amounts or produce products with superior environmental performance, they may trigger actions by regulators to impose tougher requirements based on a source's past performance. Thus, under traditional forms of regulation there may be perverse incentives *not* to innovate and *not* to improve the technology to control pollution. Nonetheless, some incentives to exceed regulatory requirements do exist. Releasing less than permitted amounts of pollution provides a margin of safety to sources in the event of equipment malfunctioning; it often leads to fewer inspections; and it may trigger a tightening of regulations that would adversely affect competitors. Vendors of equipment that controls pollution also may have an incentive to design equipment and processes that exceed regulatory requirements. If they design technologies that exceed these requirements, EPA might adopt stricter pollution control requirements, thus creating a market for the vendors' products. Although this report attempts to make a careful distinction between traditional and market-based approaches, these distinctions are often blurred in practice. A range of pollution control measures does exist. They span the spectrum from such highly prescriptive traditional regulatory measures as technology requirements to such purely market-oriented measures as deposit-refund systems

or pay-per-bag methods for municipal waste disposal. Between these extremes exists a broad range of instruments, with no clear dividing line between traditional regulatory approaches and methods based on economic incentives. Many approaches to environmental management embody some features of incentive mechanisms along with a heavy dose of direct regulatory action. Most of the best known examples of economic incentive approaches, such as the acid rain trading program and the gasoline lead credit trading program, also have some features that are found in traditional regulatory approaches such as enforcement for noncompliance.

While many incentive programs are reviewed herein, including all that could be identified at the federal level, this report makes no pretense of being exhaustive. The literature on economic incentives is immense. Many levels of government have adopted such programs or are considering their use. Rather than being comprehensive, an attempt has been made to identify those mechanisms that are most likely to have significance in the long term. In doing so, many important initiatives have undoubtedly been omitted because of a lack of information or the need to create limits on the scope of this report. For example, economic mechanisms for allocating water are noted only briefly, despite the potential effect of this mechanism on the environment, because pollution control is not the primary objective of water allocation. Likewise, the brief discussion on highway pricing and congestion charges merely serves to introduce these incentives, since the effects of these fees on the environment—although they may be potentially significant—have yet to be documented.

1.3 Organization of the Report

This report is organized into eight additional chapters that are briefly summarized below.

Chapter 2 examines current and past U.S. government policies that incorporate incentive mechanisms, with an emphasis on policies initiated by the Clinton administration.

Chapter 3 provides an overview of the various types of incentive mechanisms in terms of their cost effectiveness and environmental effects, both in theory and in practice.

Chapter 4 discusses pollution-based fee, charge, and tax systems in place in the United States, and fees imposed on the quantity and quality of emissions, or both, that are released into the environment.

Chapter 5 considers deposit-refund systems to encourage recycling or the proper disposal of the product.

Chapter 6 covers trading systems, including credits for pollution reductions that have been achieved (open market programs) as well as emissions cap-and-trade (allowance) programs.

Chapter 7 discusses subsidy systems, including grants, low-interest loans, favorable tax treatment, and preferential procurement policies for products believed to be environmentally friendly. The chapter also considers the potential benefits that could be achieved by eliminating subsidies that harm the environment. Chapter 8 addresses the use of liability as a mechanism for compensating victims when sources release pollution that causes harm to human health and the environment and also as a mechanism for encouraging sources to comply with existing environmental regulations.

Chapter 9 discusses in some detail the potential effects that economic incentives may have on the information reporting requirements of two laws. They are the Emergency Planning and

Community Right-To-Know Act (EPCRA), which established the Toxics Release Inventory (TRI) reporting requirements, and California's Safe Drinking Water and Toxic Enforcement Act, commonly referred to as Proposition 65. Other forms of information reporting are also reviewed in this chapter, including environmental impact assessment reporting, product labeling, environmental performance awards, Securities and Exchange environmental reporting requirements, and lead paint and radon disclosure requirements.

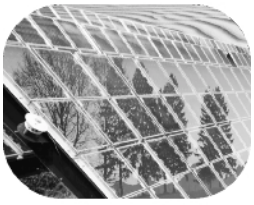
Chapter 10 looks at programs under which EPA and the states ask companies to voluntarily participate in activities to reduce pollution and protect the environment.

2. Government Policy on Economic Incentives


Pollution Charges, Fees, Taxes


Deposit-Refund Systems


Trading Programs


Subsidies for Pollution Control


Liability Approaches

Information Disclosure


Voluntary Programs

From the early days of the EPA, policy makers have recognized that economic instruments held the potential to improve the cost effectiveness of environmental management. The Nixon administration proposed to use emission fees to limit sulfur dioxide, however this initiative failed in Congress. Gradually, as allowed by its governing statutes, EPA began to experiment with the use of economic incentives, introducing emissions trading in the early 1980s. The Clean Air Act Amendments of 1990, a product of the Bush administration, greatly increased the use of economic incentives in environmental management. The Clinton administration has continued strong support for the use of economic incentives in environmental management. This chapter highlights some of the key reports, executive orders, environmental management innovations, and legislation that demonstrate the growing commitment to expanding the use of innovative, cost-effective approaches to environmental management.

2.1 Reports and Strategies

2.1.1 Project 88 Report

Sponsored by Senators Heinz and Wirth, a group of public policy scholars prepared the Project 88 Report in 1988.[4] It identified 36 proposals for "innovative solutions to major environmental and natural resource problems." Among the economic incentives included in these proposals were

- a national market for CO_2 offsets;
- internationally marketable permits for greenhouse gases;
- marketable permits for potential ozone-depleting substances, SO_2, NO_x, and point and non-point sources of water pollution;
- a deposit-refund system for hazardous wastes that can be placed in containers;
- taxes on fuel-inefficient vehicles with rebates for fuel-efficient vehicles;
- taxes on certain pesticides; and
- air emissions charges for mobile sources.

Round II of the *Project 88 Report* evaluates in detail implementation issues regarding three areas where incentives might be applied: global climate change, solid and hazardous waste management, and natural resource management. Many of the initiatives proposed in the *Project 88 Report* subsequently were enacted: solid waste management unit pricing, the Gas-Guzzler tax on fuel-inefficient vehicles, and marketable permits for SO_2, NO_x, and water effluents. The proposal for an international market in greenhouse gases that was contained within the Kyoto Protocol also flows directly from this report.

2.1.2 Report of the EPA Economic Incentives Task Force

The 1991 report by the EPA Economic Incentives Task Force, entitled *Economic Incentives: Options for Environmental Protection* studied existing and potential incentive mechanisms for the purpose of stimulating discussion on the role of such mechanisms in environmental policy.[5] The report focused on four areas where incentives might be applied: municipal solid waste management, global climate change, water resource management, and multi-media concerns. In the preface to the report, the EPA Administrator stated, "To maintain progress toward our environmental goals, we must move beyond a prescriptive approach by adding innovative policy instruments such as economic incentives. Properly employed, economic incentives can be a powerful force for environmental improvement."

2.1.3 President's Council on Sustainable Development

Created in May 1993, the Council on Sustainable Development includes of representatives from the Cabinet, industry, and environmental groups. The Council has the task of developing a strategy to achieve long-term economic growth without harming natural resources.

In its March 1996 final report, the Council recommended the use of performance targets in lieu of technology standards, commending Project XL for allowing companies to develop innovative methods to control pollution. It also recommended the adoption of incentives and the elimination of disincentives for environmental protection in a number of areas, as well as more cooperation between industry and government in controlling pollution. One example of cooperation that was endorsed by the report was the Common Sense Initiative, under which industry and environmental groups worked with EPA to study ways to improve environmental regulations affecting six specified industries.

2.1.4 Economic Report of the President

Under the terms of the Employment Act of 1946, the President's Council of Economic Advisors prepares an *Economic Report of the President* every year. Among the topics discussed in the 1996 report was regulatory reform and its application to environmental policy.

The report offers several ideas for "reinventing regulation," which it defines as "taking a new look at regulation and the regulatory process to ensure that regulations meet legitimate social needs, and where necessary changing both content and process to improve efficiency and effectiveness." Efforts to reinvent regulations take several forms, including the "better targeting of regulatory efforts to where the need is greatest," "a shift in emphasis from prescribing methods of compliance to specifying desired outcomes," and "harnessing economic incentives through market-based regulatory mechanisms."

A significant portion of the report is devoted to reinventing regulation of the environment and natural resources. "The Administration is improving the way we protect the environment," states the report, "making government a partner rather than an overseer." The report cites "cooperation with States and localities, partnerships with the private sector that engender creative solutions as well as set standards, and careful assessment of the advantages and disadvantages of alternative government action" as a means by which "environmental protection can be achieved at an affordable cost."

Stating that environmental rules should impose the least possible burden and that their benefits should justify their costs, the report discusses a number of incentive approaches that have been or

could be used to protect natural resources. The section entitled "Creating Cost-Effective Policies: Economic Incentives for Environmental Protection" includes liability for environmental damages, fees and charges, trading systems, conservation easements, and the provision of information. Trading systems for water pollution, air pollution, and fishing quotas are discussed at length. On the subject of water pollution, the report contains Administration estimates that several hundred million dollars to several billion dollars a year could be saved if effluent trading programs were expanded.

2.2 Executive Orders and Initiatives

2.2.1 Executive Order 12291

President Reagan's E.O. 12291 of February 17, 1981, required a Regulatory Impact Analysis (RIA) for proposed "major rules." The definition of "major rule" was similar to that of "significant regulatory action" in E.O. 12866, which replaced E.O. 12291. E.O. 12291 required that no regulatory action be taken "unless the potential benefits to society for the regulation outweigh the potential costs to society." Each RIA was required to contain a "description of alternative approaches that could substantially achieve the same regulatory goal at lower cost, together with an analysis of this potential benefit and costs and a brief explanation of the legal reasons why such alternatives, if proposed, could not be adopted."

After E.O. 12291 was adopted, EPA developed guidelines for conducting RIAs, according to which "each RIA should calculate the benefits and costs of a proposed regulation's full range of effects and should compare them with those of other regulatory and non-regulatory approaches." In the section entitled "Considering Alternative Approaches," the guidelines called for the consideration of "market-oriented regulatory alternatives (whether or not they are explicitly authorized in the Agency's legislative mandate)." Such alternatives "include using information or labeling to enable consumers or workers to evaluate hazards themselves and using economic incentives, such as fees or charges, marketable permits or offsets, changes in insurance provisions, or changes in property rights." EPA was required to submit all RIAs and proposed regulations to OMB for review. EPA's RIA guidelines were intended to increase the use of incentive mechanisms in environmental regulation.

E.O. 12291 built on a number of earlier Executive Orders and regulations dating back to President Nixon's "Quality of Life" reviews that required an assessment of alternatives and cost comparisons for proposed regulations. President Ford's E.O. 11821 of 1974 and E.O. 11949 of 1976 required inflation impact statements for major regulations. President Carter's E.O. 12044 of 1978 required Regulatory Analyses of the economic consequences of proposed regulations and alternatives under consideration, and the Executive Order instructed agencies to select the least burdensome alternative.

2.2.2 Executive Order 12866

A central idea of President Clinton's Executive Order (E.O.) 12866 of September 30, 1993 is that regulations should be adopted only after a reasoned determination concludes that quantified and nonquantified benefits justify the costs of the regulation. Further, E.O. 12866 states that, "in choosing among alternative regulatory approaches, agencies should select those approaches that maximize net benefits (including potential economic, environmental, public health and safety, and other advantages; distributive impacts; and equity), unless a statute requires another

regulatory approach." This order replaced President Reagan's E.O. 12291. Under E.O. 12866, agencies are required to assess the benefits and costs of any "significant regulatory action."

Actions deemed "significant" include those that "have an annual effect on the economy of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or State, local, or tribal governments, or communities" or that meet certain other criteria.

E.O. 12866 also requires that agencies consider the possibility of using incentive-based approaches for any significant regulatory action. Two specific "Principles of Regulation" in E.O. 12866 refer to incentive-based approaches:

> 1b3: "Each agency shall identify and assess available alternatives to direct regulation, including providing economic incentives to encourage the desired behavior, such as user fees or marketable permits, or providing information upon which choices can be made by the public."
>
> 1b8: "Each agency shall identify and assess alternative forms of regulation and shall, to the extent feasible, specify performance objectives, rather than specifying the behavior or manner of compliance that regulated entities must adopt."

In January 1996, an interagency group convened by the Office of Management and Budget (OMB) issued a document entitled *Economic Analysis of Federal Regulations* that provided guidelines for performing economic analysis of proposed federal regulations under E.O. 12866.[6] Among the topics discussed in these guidelines were the importance of performance-based standards, alternative compliance methods, information approaches, and economic incentives.

On the first of these topics, the guidelines state, "Performance standards are generally to be preferred to engineering or design standards because performance standards provide the regulated parties the flexibility to achieve the regulatory objective in a more cost-effective way." "Performance standards," the guidelines continue, "should be applied with a scope appropriate to the problem the regulation seeks to address. For example, to create the greatest opportunities for the regulated parties to achieve cost savings while meeting the regulatory objective, compliance with air emission standards can be allowed on a plant-wide, firm-wide, or region-wide basis rather than vent by vent, provided this does not produce unacceptable air quality outcomes (such as 'hot spots' from local pollution concentration)."

On the subject of ensuring compliance, the guidelines state, "When alternative monitoring and reporting methods vary in their costs and benefits, promising alternatives should be considered in identifying the regulatory alternative that maximizes net benefits."

The guidelines mention various "informational measures," including "government establishment of a standardized testing and rating system (the use of which could be made mandatory or left voluntary), mandatory disclosure requirements (e.g., by advertising, labeling, or enclosures), and government provision of information (e.g., by government publications, telephone hotlines, or public interest broadcast announcements)."

The guidelines also call for consideration of economic incentives: "In general, alternatives that provide for more market-oriented approaches, with the use of economic incentives replacing traditional regulatory requirements, are more cost effective and should be explored." Incentives "that may be considered include fees, subsidies, penalties, marketable permits or offsets, changes

in liabilities or property rights (including policies that alter the incentive of insurers and insured parties), and required bonds, insurance or warranties."

In March 2000, OMB issued new *Guidelines to Standardize Measures of Costs and Benefits and the Format of Accounting Statements.*[7] OMB explains the relationship between this document and the *Best Practices Manual* as follows:

> *These Guidelines draw from the "Best Practices" document developed in 1994 and 1995 by an interagency group co-chaired by the Department of Transportation and the Council of Economic Advisers. That "Best Practices" document in turn revised the "Regulatory Impact Analysis Guidance" published by OMB in 1990 after a two-year notice and comment period. You should use this document in estimating and presenting the benefits and costs of regulations. While it does not represent OMB guidance, you may use the "Best Practices" (Q: shouldn't the document title here be surrounded with quotes as shown in other instances in this paragraph?) document as supplementary material to illustrate further specific issues or techniques. (page 2)*

2.2.3 Climate Change Initiative

The Climate Change Action Plan relies largely on voluntary incentives to achieve reductions in greenhouse gas emissions. Among its initiatives are Green Lights and Energy Star, Climate Wise, and at least four voluntary programs to promote methane recovery (Natural Gas Star, AgStar, Coalbed Methane Outreach, and Landfill Methane Outreach). Several of these programs are described in more detail in Chapter 10.

The more recent Climate Change Technology Initiative (CCTI) supplements these purely voluntary programs with targeted subsidies to improve technologies, so fewer greenhouse gases are produced. Shortly after the Kyoto agreement to reduce greenhouse gas emissions of December 1997, the Clinton administration proposed the CCTI and asked for congressional approval of $3.6 billion in tax credits as incentives and $2.7 billion for research and development.[8] Congress authorized $1.021 billion in R&D and $85 million in tax credits for FY 1999 and $1.095 in R&D for FY 2000. The 2001 budget proposed spending over $1.4 billion for R&D in FY 2001 and $4 billion in tax credits for the CCTI over the next five years.

2.2.4 Greening the Government

Executive Order 13148, issued by President Clinton on April 22, 2000, instructs the head of each federal agency to ensure that actions are taken to integrate environmental accountability into routine agency decision making and long-term planning. Many of the directives of the order could be classified as economic incentives because they help to provide information, take full costs into account in decision making, and reduce the use of toxic chemicals where cost-effective. Among other things, the order calls for federal agencies to develop and implement environmental management systems and to ensure compliance with environmental regulations by implementing audit programs and policies on environmental compliance that emphasize pollution prevention. The order also directs agency heads to keep the communities in which federal facilities are located informed as to possible sources of pollution, to make efforts to reduce the use of toxic chemicals by 10% per year, to engage in pollution prevention efforts, and to conduct life cycle cost analysis. The order is the latest of several issued by the Administration

on "greening the government," including E.O. 13101 of September 14, 1998, E.O. 13123 of June 3, 1999, and E.O. 13134 of August 12, 1999.

2.2.5 National Performance Review

Vice President Gore's National Performance Review released a report in 1993 entitled *Creating a Government That Works Better & Costs Less*.[9] Focused on reinventing government, the report included a number of recommendations for improving environmental protection, some of which advocated the use of economic incentives. The document's authors suggested that EPA work with Congress to encourage the use of incentives to reduce water pollution, including wastewater discharge fees. It also recommended that the conditions for accessing federal resources for activities such as grazing and mining be modified. The purpose of this suggestion was twofold: first, to ensure that the government obtains a fair return on its land, and, second, to provide incentives for improving federal land management.

2.2.6 Reinventing Environmental Regulations

On March 16, 1995, the President announced the first government-wide regulatory reforms designed to improve environmental regulation, so the nation achieves a better environment at lower cost. The President emphasized economic incentives in these reforms. For example, the document entitled *Reinventing Environmental Regulation* provides 10 principles for reinventing environmental protection. One of these principles is that environmental regulations must be "performance based" and must allow flexibility while requiring accountability in attaining goals. Another principle is that "market incentives should be used to achieve environmental goals, whenever appropriate." The document also includes "25 High Priority Actions," a section in which open-market air emissions, effluent trading in watersheds, and other topics are discussed.[10] (Subsequent initiatives by EPA to implement these recommendations are described in Chapter 6.)

In addition, the document describes actions that can improve compliance, accountability, and enforcement. EPA now coordinates these activities through its Environmental Leadership Program, a voluntary program that focuses on the role of compliance management systems in enforcement. It also provides incentives for auditing, disclosure, and correction. (This program is described in Chapter 10.) The document characterizes Project XL (another voluntary program discussed in Chapter 10) as one of the "Building Blocks for a New System" of environmental regulation.

2.2.7 National Environmental Technology Strategy

On March 18, 1995, the Vice President announced a National Environmental Technology Strategy to "create high-wage jobs and exports and stimulate overall economic growth; reduce the cost of cleaning up past pollution; and help prevent future damage to the environment." The strategies advocated the use of economic instruments to promote innovations in pollution control technologies that enhance the effectiveness of pollution control efforts or reduce cost, or both.

2.3 Recent Environmental Management Initiatives

2.3.1 Performance Track Approach at EPA

How to obtain more environmental protection more efficiently is the focus of recent EPA innovations in environmental management.[11] Noteworthy among the new innovative approaches are rewards for superior environmental performance. The current system of environmental regulation offers little incentive for firms to go beyond compliance. EPA now views this approach as a missed opportunity to encourage top environmental performers. Through a new "Performance Track" approach, firms would receive a standard package of incentives such as public recognition for meeting environmental criteria. Firms that routinely do much more than meet established requirements would be placed on a smaller second track and receive a higher level of recognition and incentives more closely tailored to their individual needs. EPA views this two-tiered reward structure as a significant step toward a more performance-based system that stimulates superior environmental achievement.

2.3.2 EPA Air and Water Policy Initiatives

Among the many initiatives within EPA that concern economic instruments, one on air quality and one on water quality are particularly noteworthy. Beginning in the late 1970s, EPA explored the ways in which flexibility could be integrated into air quality regulation, so cost effectiveness would be enhanced. These activities, which are described in Chapter 6, culminated in the Emission Trading Policy Statement and laid the groundwork for the broader use of economic incentive approaches in the Clean Air Act Amendments of 1990. Since then, EPA has provided trading opportunities in many air programs and rules to combat a variety of air pollution problems. In addition, the EPA Office of Water has actively promoted effluent trading as a means of improving the cost effectiveness of attaining its goals on water quality.

2.3.3 EPA Research Activities

Through the years, the Office of Research and Development (ORD), the EPA policy office, and several program offices have supported research on economic incentives for environmental management. Much of that research is available on the Economy and Environment home page at www.epa.gov/economics. At present, ORD is supporting a program in Market Mechanisms and Incentives Research.[12]

2.3.4 Promotion of Economic Instruments Abroad

On April 9, 1999, Vice President Gore and Premier Zhu Rongji announced a cooperative agreement designed to increase markets for U.S. environmental technology in China. The agreement will increase opportunities for U.S. investment in the Chinese energy-producing sector and promote the reduction of greenhouse gas emissions in China through a program to trade sulfur dioxide (SO_2) emissions. "In an agreement that will move China closer to a system of emissions trading, the EPA and China's State Environmental Protection Administration signed a Statement of Intent on development of a Sulfur Dioxide Emissions Trading Feasibility Study. The agreement calls for developing a study to test the effectiveness of emissions trading in China as a market-based approach to reducing greenhouse gas emissions."[13]

2.4 Legislation: Clean Air Act Amendments of 1990

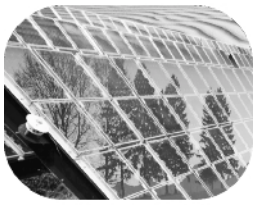
While other environmental legislation also creates programs based on economic incentives, the Clean Air Act Amendments of 1990, enacted during the Bush administration, are particularly noteworthy. With the passage of these amendments, the legislative branch of government showed strong support for economic incentives and expanded the regulatory toolbox beyond traditional regulatory requirements, which had dominated air pollution control policy in previous years. Among the incentive mechanisms authorized in these amendments are the Acid Rain Trading Program, provisions for offsets and other trading programs in ozone non-attainment areas, early reduction credits for hazardous pollutants, fees based on pollutant emissions, the possibility of marketable credits for certain fuel constituents, marketable production allowances for ozone-depleting substances, and labeling of ozone-depleting substances.

3. The Cost Effectiveness and Environmental Effects of Incentive Systems


Pollution Charges, Fees, Taxes


Deposit-Refund Systems


Trading Programs


Subsidies for Pollution Control


Liability Approaches

Information Disclosure


Voluntary Programs

3.1 Introduction

This chapter reviews several of the attributes of incentive-based strategies for managing the environment. From the perspective of economics, pollution is an output that occurs outside of normal market transactions. Termed an "externality," it has little or no cost to the source but may impose significant costs on other economic actors. How best to get sources to control their pollution is an issue that has been studied closely by economists and policy analysts.

One means of control is to rely on private negotiations between those who bear the costs of pollution and the sources of pollution. If several conditions are satisfied, such negotiations can lead to an optimal level of pollution control in which the full costs of pollution are taken into account in the decision process of the source.[14] One condition is that the sources and victims do not engage in strategic behavior. Another condition is that individuals who are harmed by pollution and sources can negotiate without any transaction costs (such as personal time or the need for third-party involvement). The final condition is that sources and victims are fully informed as to risks and harms that may occur. Although the assumption of no strategic behavior may be reasonable in many cases, costless transactions may never be a realistic assumption. The more parties who are harmed and the more geographically dispersed these parties are, the higher the transaction costs are likely to be. Likewise, it is unrealistic to assume that victims of pollution are as fully informed about risks as are the sources.

The existence of environmental legislation reflects the fact that negotiations between victims and sources of pollution cannot be relied upon as a means of control for most pollution problems. EPA's governing legislation uses various approaches to set environmental goals. Under some of the laws, the goal is to adequately protect public health and the environment without explicitly considering costs. In other cases, the governing statutes instruct EPA to take costs into account in protecting public health and the environment or to set goals that balance cost, health and environmental considerations.

The governing environmental statutes have varying opportunities and limitations with respect to the mechanisms that are available for achieving environmental goals. In the traditional regulatory approach, EPA often specifies requirements for different types of sources (factories, vehicles, fuels, etc). The regulations may impose limitations on the amount of discharge, the technology used to control pollution, the inputs that may be used, or characteristics of the outputs that are produced.

Market-based or incentive approaches, by contrast, provide rewards for reducing pollution (and, conversely, assign penalties for releasing pollution). The rewards may or may not be financial. In contrast to the traditional regulatory approach, an incentive-based regulatory strategy gives sources great flexibility in selecting both the type and

magnitude of their response and gives them incentives to develop new and cheaper strategies and technologies to control pollution.

Depending upon the characteristics of the sources of pollution and the damages (see Table 3-1), some tools of environmental management are likely to be more cost-effective than are others. Cost-effective tools achieve environmental goals for the least cost. Other criteria such as fairness, political acceptability, stimulus for innovation and technological improvement, and enforceability also could be used in place of, or in conjunction with, cost effectiveness.

Table 3-1. Considerations for Selecting Regulatory Instruments

CHARACTERISTICS OF THE SOURCES OF POLLUTION

- Are the costs of control known with certainty? If not, how great is the uncertainty?
- Is the technology of pollution control static, or is it likely to change over time?
- Can the quantity of pollution from each source be measured (or approximated) easily?
- How many sources are there for each pollutant?
- Are incremental control costs similar for different sources, or is there considerable variation?

CHARACTERISTICS OF THE DAMAGE CAUSED BY POLLUTION

- Does a unit of pollution from each source have the same impact on health and the environment, regardless of where it is released?
- Are the impacts on health and the environment known with certainty? If not, how great is the uncertainty?
- What are the major sources of uncertainty? What is known regarding the effect of pollution on environmental quality, exposures, physical effects, or the economic valuation of effects?
- How many parties are experiencing damage from pollution?
- Is it critical to control pollution within narrow limits to achieve environmental goals, or is the damage caused by pollution such that there is a continuum of effects from less serious to more serious, with no obvious unacceptable level and no obvious safe level of pollution?

The following sections describe alternative means for managing the environment and the circumstances under which one mechanism is likely to perform better than another tool.

3.2 Traditional Regulatory Approaches

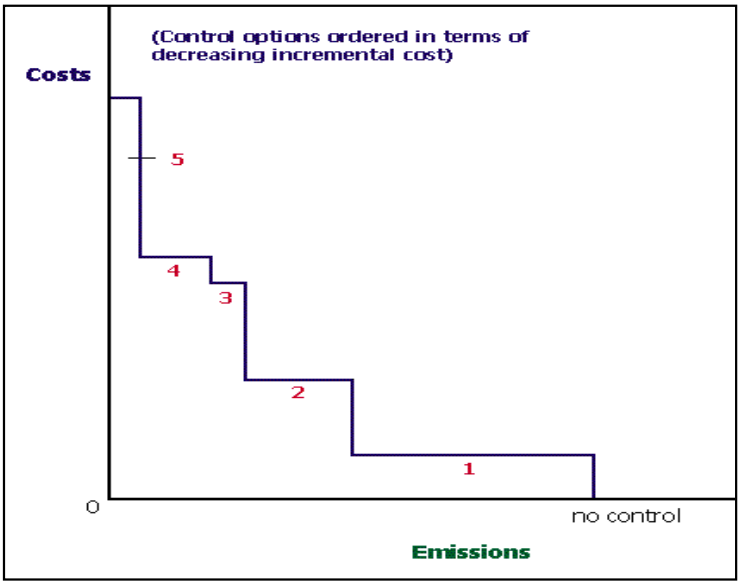
Traditional regulatory approaches normally operate through one of three means: source-specific emission limits, output specifications, or technology requirements. A brief description of each alternative illustrates both the strengths and weaknesses of traditional forms of regulation.

The first alternative applies emission (or effluent) limits to specific sources as a means of achieving health standards or environment-based ambient standards. The total amount of pollutants that are released could be limited by setting emissions standards for individual sources, such that total emissions just equaled the sum of the individual contributions from each source. Other pollution allocation formulas that do not treat new sources more harshly than existing sources could also be used. One such formula, for example, determines a set weight of pollution that can be released per unit of output.

Unless the authority responsible for controlling pollution is able to identify which sources have the lowest incremental costs for controlling pollution and insist that those sources implement their pollution controls first, this source-specific approach to emissions will not be cost-effective. As Figure 3-1 depicts, each source will usually have a number of options for controlling

emissions. The least cost option (#1 in the figure) will control some emissions. Other successively more expensive measures may be implemented until all emissions are controlled.

Figure 3-1. Control Options for a Source



It is very difficult in practice to identify the least cost strategy for controlling emissions from multiple sources. If all control measures and their costs are known, linear programming or other modeling techniques could be used to find the least cost strategy for every level of emission control for the sources taken as a whole. However, in most cases all potentially available control measures are not known, and, even if they were, pollution control laws typically do not allow an agency to impose strict controls at one source and relatively lenient control burdens on another, even if their control costs are quite different. Generally, similar sources must be treated the same. Furthermore, incremental control costs include more than simply the costs that sources must bear in order to comply with regulations, as noted earlier. It is likely to be difficult to predict in advance how emission limits would affect production technology, energy and other input use, and other cost elements. Economic instruments avoid the problems that a pollution control agency would have in identifying the least cost methods of meeting a pollution control objective by harnessing market forces to identify cost-effective solutions.

The second alternative specifies certain characteristics of outputs that are destined for the product market. Some examples include fuel efficiency requirements for automobiles, product specifications for gasoline, and regulations regarding the ability of products to be recycled and the recycled material content of consumer products. The regulatory strategy of imposing limitations on the polluting characteristics of products is affected by the same issues noted above that make it difficult to regulate emissions in a cost-effective manner. For example, the cost to individual refineries of meeting a sulfur limit in gasoline is likely to vary significantly. It would be more efficient to allow trading among sources to meet pollution reduction obligations than to apply uniform standards to each source.

The third alternative imposes technology requirements that specify the techniques or equipment that sources must use to control pollution. EPA prefers to use performance-based numerical limits rather than technology requirements whenever feasible, and, in fact, the Agency's programs rely heavily on numerical limits. Some standards that are performance-based demand a level of emission control that can be met only with one existing technology. Unless pollution control technologies improve, such performance standards have the same effect as technology standards. (For example, new source performance standards for SO_2 emissions at coal-fired electric power plants require a 90% reduction in these emissions from their uncontrolled state, a degree of control that can be met only by scrubbing.)

Technology standards (or more accurately de facto technology standards) are likely to be less cost-effective than emission or effluent standards, since the latter give sources the freedom to choose the least costly method of compliance. Further, technology standards tend to lock firms into one accepted method of compliance, which discourages technical change and innovation. However, when emissions cannot be measured or concerns exist about the feasibility of enforcing tax or trading systems or both, technology standards provide a practical way to reduce pollution.

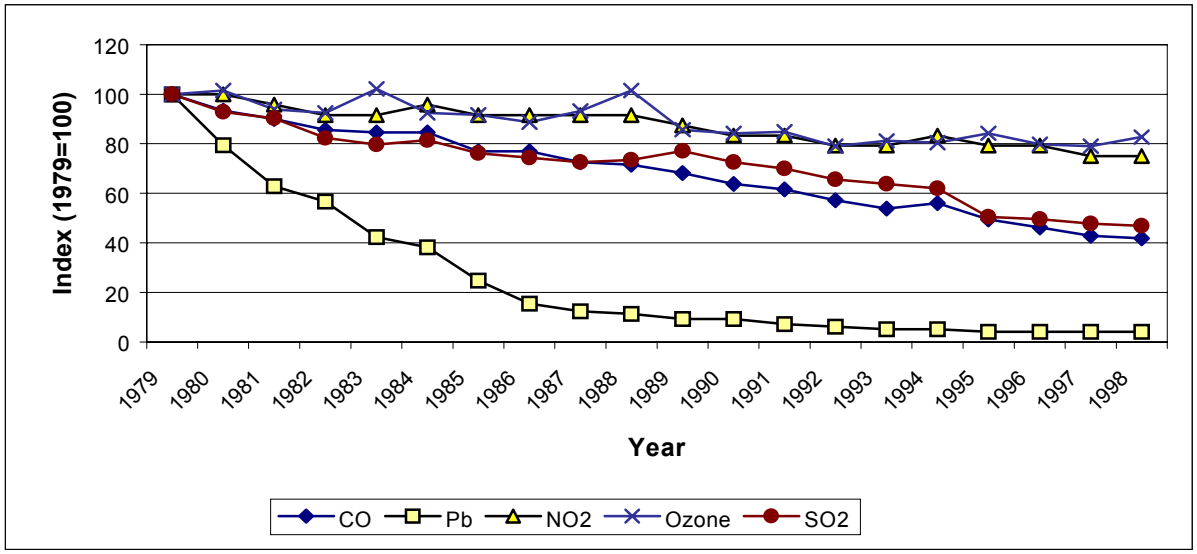
From a dynamic perspective, identifying the strategies that should be implemented to control pollution at the least cost is more problematic. Technology is not static. Over time, the number of possible options increases. Most of the options offer improvements over earlier technologies, in terms of cost, environmental performance or both. A traditional regulatory strategy to identify and mandate least cost controls can lock firms into technologies that become progressively less effective, and thus less attractive, over time.

These issues aside, traditional regulatory policies have achieved much in the United States. For the most part, traditional regulatory policies have resulted in ambient air and water quality that is demonstrably better now than it was 30 years ago when the EPA was established. The most recent *Emissions Trends Report* (EPA, 1998b) reveals that emissions of all criteria pollutants have declined since 1979: In the case of sulfur dioxide and carbon monoxide, emissions have been reduced by more than 50% and lead emissions by more than 95%. (See Figure 3-2.) Water quality is also improving. This achievement is significant given the economic growth and increasing populations that has occurred over the same period of time.

3.3 Incentive-Based Mechanisms

While incentive-based systems have existed in some form for decades as tools of environmental

Figure 3-2. National Long-Term Air Quality Trends, 1979-1998



Source: EPA 1998b

management, the federal government has aggressively sought their implementation for only the past 10 to 15 years. Economic incentives to protect the environment rely on decentralized

decision making by economic agents, all acting in their own self interest. In contrast, traditional regulatory approaches to environmental management are based on the regulations established by federal, state, or tribal governments that have been given the authority to make pollution control decisions. Actual compliance is the responsibility of the sources of pollution that are subject to the regulations. However, the flexibility that sources have to choose technology, as well as the extent of pollution control, tends to be quite limited under a traditional regulatory approach. Economic incentive methods generally allow sources to select how much they reduce pollution and the technology that helps them in this endeavor.

3.3.1 Pollution Charges, Fees, and Taxes

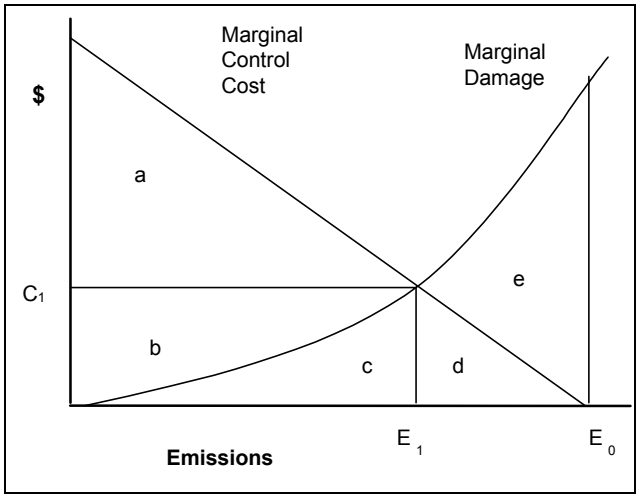
Pollution charges, fees, and taxes are payments required of sources for emitting pollution. (The three terms are used interchangeably here.) Ideally, sources would pay for each unit of pollution they emit. A source that is concerned with minimizing costs and is also faced with such a tax will control those emissions for which control costs are less than the tax and release the remainder. The source will then pay the tax on each of those units of pollution released into the environment.

A simplified analysis of charges, fees, and taxes from an economic perspective is illustrated in Figure 3-3. Prior to regulation, total uncontrolled emissions are equal in magnitude to E_0. Damage to the environment is equal to the area (c+d+e) and the source spends nothing on pollution control. If an emission fee of magnitude C_1 were imposed, cost-minimizing polluters would reduce total emissions to E_1. The total costs of pollution, which is equal to the sum of pollution control costs and environmental damage (c+d), are minimized with the fee at level C_1

Emission fees set at C_1 per unit of emissions cause cost-minimizing polluters to pay for all emissions up to E_1, an amount equal to the area (b+c) in Figure 3-3. Polluters subject to the fee spend an amount equal to area (d) to control emissions beyond E_1 and reduce environmental damage by an amount equal to the area (d+e) relative to uncontrolled emissions.

Emission fees that are high enough to change behavior significantly, like the one shown in this example, would typically result in large revenue transfers to the government. That is, payments the government, equal to area (b+c) in Figure 3-3, tend to be large, especially relative to the environmental damage that is mitigated, area (d). For this reason, polluters usually oppose pollution charges, taxes, and fees that would be high enough to act as an incentive for them to reduce pollution. They would prefer that their environmental expenditures be used to control pollution, not sent to the government.

Figure 3-3. Tax Per Unit of Emissions



From an economic perspective, charges, taxes and fees are basically interchangeable, although from a legislative and legal perspective some differences exist. The House Ways and Means Committee must review proposed taxes, since tax revenues are a part of general federal revenues. Fees and

charges, in contrast, are designed to recover some or all of EPA's administrative costs and need only be reviewed by environment committees and subcommittees. Fees and charges are imposed in two ways. First, an environmental statute may specify the activities that are subject to fees and charges. Second, EPA has additional general authority to collect and assess fees and charges under the Independent Offices Appropriations Act (31 U.S.C. §9701). Fees and charges assessed and collected under this Act must be deposited into the General Fund of the Treasury and cannot be retained by EPA.

Legislation authorizing pollution fees, taxes, and charges typically limits their magnitude to what is necessary to recover the costs of administering the program in question or related programs. Worldwide, the vast majority of emission tax, fee, and charge systems collect revenues that amount to only a few percent of pollution control costs.

Two exceptions are noted. The first is the tax on U.S. chlorofluorocarbon (CFC) production. This tax was designed to remove windfall profits that would otherwise accrue to CFC producers from increases in CFC prices due to reductions in the quantities of CFCs allowed in commerce. This tax is discussed in more detail later in this report. The second exception is the Swedish charge on NO_x emissions, which is set at a high level with the objective of changing behavior. Power plants pay the NO_x charge on emissions of NO_x and receive rebates in proportion to their energy output. The result is a mechanism that raises no revenue for the government yet produces significant incentives.[15] Relatively clean facilities receive rebates in excess of payments while relatively dirty facilities pay more in charges than they receive in rebates.

Designing pollution taxes that minimize the total costs of pollution (damage costs plus control costs) is difficult for a variety of reasons, including the lack of data on pollution damages, the inability to precisely measure emissions, and political opposition to large revenue transfers from pollution sources (companies) to the authority imposing the tax (government). The relationship between the quantity of emissions and the cost of the damages caused by those emissions (often called the “pollution damage function”) depicted in Figure 3-3 is highly simplified and glosses over a number of difficult measurement issues. In many situations, the function is not well known, so the ability of an agency to set charges to equate marginal control costs with marginal damages is questionable. Moreover, the damage function may differ from one localized area to another depending upon the population at risk, prevailing winds, sunshine, temperature, and other factors. If marginal control costs or marginal damages differ from one region to another, a single charge level may be inappropriate. Charges that differ by region may be required in order to achieve the efficient amount of pollution control. In addition, an emission tax provides the pollution control agency with limited control over the physical quantity of emissions dispersed into the environment because sources have the choice of controlling emissions or releasing emissions and paying the tax. If the magnitude of emissions is very important, as could be the case with toxic emissions that threaten public health, an emission tax may be viewed as an inadequate control over the actual quantity of emissions.

The implementation of emission fees, taxes, and charges also depends on the ability to measure emissions. The precision with which a pollution tax can be levied depends on the precision with which emissions can be measured. Political concerns may also be an issue in implementing emission taxes. Environmentalists sometimes oppose emissions fees because they seem to sanction the release of pollution.

3.3.2 Deposit-Refund Systems

A deposit-refund system operates like a tax on the purchase of a product with a subsidy for returning the used item to a designated collection site. The purpose of the subsidy or refund is to encourage individuals and firms to dispose of these items in an environmentally acceptable manner. The tax or deposit is made on the original purchase and yields sufficient revenue to pay future refunds. Some or all of the unclaimed deposits may be used to subsidize collection facilities. While the magnitudes of the deposit and the refund often are the same, there is no reason that this has to be the case.

Although most deposit-refund systems are created by legislation, deposit-refund systems sometimes are developed by the private sector when the used product has economic value. Thus, private-sector deposit-refund systems for beverage containers were widespread in the early part of the twentieth century before cheaper, non-returnable containers appeared. Mandatory deposit legislation for lead-acid automotive batteries has been enacted in about a dozen states, while the private sector has created deposit systems for lead-acid batteries in the remainder of the states, largely because of the economic value of used batteries. Ten states have enacted beverage container deposit-refund systems. Deposit systems exist for car bodies in four European nations, and for a wide variety of containers throughout most European nations. In a few nations of Europe, deposit systems help assure the recycling of used motor oil.

Administrative costs are an important consideration when determining whether to create deposit systems. Ackerman et al. (1995) estimate that administrative costs average about 2.3 cents per container—more than $300 per ton for steel containers and $1,300 per ton for aluminum cans—in states with traditional legislation on beverage container deposit systems. A full accounting of the desirability of deposit-refund systems would compare administrative costs and the costs imposed on consumers with the benefits of reduced disposal costs, energy savings, reduced litter, and other environmental benefits. Deposit-refund systems appear best suited for products whose disposal is difficult to monitor and potentially harmful to the environment. When the used product has economic value, the private sector may initiate the program.

3.3.3 Marketable Permit Systems

Two main forms of trading systems are observed: emission (or effluent) reduction credits (ERCs), and tradable allowances for future pollution. ERCs are earned by sources when they release less pollution than is authorized in their environmental permits. With either form of trading system, sources with high marginal control costs will try to buy credits or allowances from sources with low marginal control costs. Trading ERCs or allowances in such a situation is mutually beneficial.

For trading systems to function well, several requirements must be satisfied. First, there should be several potential participants (i.e., sellers and buyers of allowances or ERCs) so that a functioning market can develop. Exactly how small a universe of potential participants is sufficient for a functioning market is difficult to say, but simulation experiments suggest that 8 to 10 participants is a reasonable estimate.[16] Second, if sources are dispersed geographically, trading ratios other than one-to-one might have to be imposed to assure no degradation in environmental quality in particular locations.

Third, pollution control agencies must have the ability to monitor emissions (or measure a surrogate) reasonably well. The commodity to be traded needs to have constant or near-constant

impacts across the geographic area where trading is allowed. Fourth, the commodity to be traded must be quantifiable. The process of establishing emission baselines so that credits or allowances can be quantified is likely to require good historic data on emissions, input use, processes, etc.

Trading systems tend to be more popular with pollution sources than pollution charges because in many cases sources do not have to pay for emissions that are below permitted amounts. In fact, the right to emit pollutants up to permitted amounts and not pay for those emissions may have a considerable value once a trading system is created.

The literature that is cited later in this chapter predicts large, potential savings from trading systems. Available evidence on actual achievements, however, points to relatively modest savings from many of the programs. In searching for the reasons why such a wide gap exists between the potential savings and the actual savings, Stavins (2000) identifies transaction costs as the primary culprit. For example, the need to ensure that the credits claimed under the trading system represent real emissions reductions is one source of transaction costs.

With high transaction costs, the prices that sellers receive for pollution rights is depressed and the prices that buyers must pay for these rights remains high, which makes transactions less attractive for both buyers and sellers. With transaction costs acting as a barrier to trading, sources find it difficult to identify potential trading partners and to conclude trades. Transaction costs were especially high for some of the early emissions and effluent trading programs. Only a tiny fraction of the potentially beneficial trades actually took place.[17] Transaction costs were lower for programs such as lead credit trading and resulted in a far higher proportion of available credits actually being traded.

Price versus Quantity Instruments

The economics literature makes an important distinction between price and quantity instruments when a regulatory authority is uncertain regarding control costs and damage functions (Weitzman, 1974). Quantity instruments, such as cap and trade systems, provide the pollution control authority strict control over the quantity of emissions. Price instruments, such as pollution taxes and fees, provide strict limits on how much a firm must spend to control pollution but do not limit the release of emissions.

With uncertainty, the regulatory authority would not be able to predict costs well if it implements a quantity-based pollution control mechanism, or the environmental consequences if it implements a price-based approach. Which type of uncertainty is likely to be more serious? If important environmental threshold effects exist, a quantity approach would be preferred. But few pollutants have that characteristic; most exhibit relatively stable dose-response relationships. Because of difficulties in forecasting control technologies, it may be more important to limit the maximum amount that sources incur to control pollution. Thus, uncertainty may offer a reason to prefer price to quantity instruments for many types of pollution.

Transaction costs also feature prominently in the choice between making trades between sources within a firm (internal trades) and between firms (external trades). For all of the trading programs that have been studied, firms exhibit a strong preference for internal trading when it is feasible, often even when larger cost savings can be achieved by external trading.[18]

3.3.4 Subsidies for Reducing Pollution or Improving the Environment

Subsidies are the mirror image of emission taxes. Rather than taxing emissions to encourage firms to reduce their emissions, the subsidy approach offers cash payments to firms for reducing emissions. Polluters who release emissions forgo the cash payment. Under a subsidy system, polluters have an incentive to control all units of pollution whose marginal control cost is less

than the subsidy. Subsidy systems for pollution control are especially popular in two sectors: farming and municipal government.

Economists point out a major drawback of subsidy systems. Existing firms, farmers, and other entities that receive pollution control subsidies would have an incentive to reduce their pollution. However, the subsidies could attract new firms to enter the industry. In some extreme cases, pollution control subsidies could have the perverse effect of increasing total pollution.

Both federal and state governments have numerous subsidies already written into the tax code, a number of which are perceived as having harmful environmental consequences. Reducing environmentally harmful subsidies is another mechanism for improving the environment.

3.3.5 Liability for Harm Caused by Pollution

Another approach for resolving environmental issues is to make polluters liable for the damage their pollution causes. The purpose is twofold: First, to get polluters to make more careful decisions about the release of pollution; and second, to compensate victims of pollution. Liability rules control pollution through the decentralized decisions of polluters to act in their own best interest.

If polluters are liable (and must pay) for the damage they cause, they will control pollution to the point where the marginal pollution damage equals the marginal costs of control. At this point, their total payments for controlling pollution and compensating victims are minimized.

Liability can take two forms: civil law and common law. Civil liability is expressly written into law. Many environmental statutes worldwide have liability provisions. In the United States, the most important statutes are the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), which holds responsible parties liable for cleanup costs, and the Oil Pollution Act (OPA), which holds responsible parties liable for damage to natural resources caused by releases of hazardous substances and petroleum. Liability under CERCLA applies to historic as well as contemporary releases of pollutants. The form of liability is strict, joint, and several, meaning that a single contributor can be held responsible for all of the damage, even though many contributors caused the damage. Furthermore, liability is retroactive. Therefore, an individual or company can be held liable for actions that were perfectly legal at the time they occurred.

In an attempt to improve the incentive effects for cleaning up hazardous waste sites, EPA and the states have developed numerous so-called "Brownfields" initiatives, which are described in this report. The initiatives provide limited relief from strict and retroactive liability in exchange for promises to clean hazardous waste sites and turn them into productive assets. EPA recognized the need to address some of the concerns raised in the past regarding the fairness of enforcement in Superfund. As a result, EPA has taken significant steps to reduce litigation, to promote faster settlements, and to emphasize fairness in the application of Superfund's liability scheme. By streamlining the process by which claims are resolved at Superfund sites, EPA is accelerating the cleanups themselves and increasing the pace at which contaminated properties can be moved back into viable economic use, which is the critical first step in expediting many brownfields development projects.

Polluters respond to federal and state pollution liability statutes by taking precautionary actions that reduce the severity and frequency of spills. Alberini and Austin found this effect with respect to the imposition of strict liability laws by states.[19] The petroleum industry created the

Marine Spill Response Corporation, an emergency spill response effort, following the Exxon Valdez spill and the 1990 Oil Pollution Act.[20]

Common law, such as nuisance, trespass, and negligence, can be used to address harm to individuals and to private property that is caused by pollution. The effectiveness of these approaches in dealing with pollution is an open question. In selected applications, liability can be a strong deterrent, but a number of considerations limit the effectiveness of this approach as a general solution to pollution-related problems. One factor that restricts its widespread use is the time limit for filing claims, otherwise known as the "statute of limitations." In most jurisdictions, a case must be filed within two or three years of discovering a harm. In a few jurisdictions, a case must be filed within a two- or three-year period of when the harm occurred. This distinction is very important for individuals who develop cancer and other diseases of long latency possibly as a result of exposure to toxic substances, since observable effects may arise many years or even decades following the exposure.

A second limiting factor is the burden of proof required by law. The burden of proof required for a judgment against the defendant is usually the standard of "more likely than not," which usually is interpreted as having a probability greater than 50%. Epidemiological studies may suggest that exposure to a particular toxic substance is but one of many factors that could have caused a disease. Satisfying the more-likely-than-not standard can be difficult. Even if a substance is implicated, it may be difficult to determine which polluter is responsible for the harm. For example, doctors may determine that an auto mechanic's lung cancer likely was caused by inhaling dust from brake linings, but assigning responsibility to a particular manufacturer may be impossible. A few jurisdictions allow the assignment of proportional responsibility for both the harm-causing substance and for the determination of who is responsible.

A final limiting factor for liability systems are the transaction costs of pursuing a claim. These costs include the legal costs of obtaining evidence, reaching agreement among plaintiffs on how to pursue a case, presenting the case, and following up if the case is appealed. Liability works best when there is one party on each side of the case and an easily demonstrated harm. When the harm is large in magnitude, liability systems may perform reasonably well when transaction costs are small in proportion to the amounts awarded and if there are few defendants and clear causation, even if the number of plaintiffs is large.

3.3.6 Information Disclosure

By information disclosure programs, this report refers to mandatory disclosure requirements, such as those associated with California's Proposition 65 and the Emergency Planning and Community Right-to-Know Act (EPCRA), which also is referred to as Title III of the Superfund Amendments and Reauthorization Act of 1986. At the time these statutes were enacted, there was little evidence as to how companies would respond to information disclosure rules, other than that they strenuously objected to such requirements.

A number of retrospective studies found that EPCRA requirements gave a strong incentive for firms to identify and act upon opportunities for reducing accidental and routine releases of hazardous substances.[21] Information reporting requirements caused firms to behave as if all emissions were costly. Emissions that could be controlled relatively cheaply were reduced.

3.3.7 Voluntary Pollution Reduction Programs

At both the state and federal level, an enormous number of voluntary programs attempt to motivate firms and individuals to reduce pollution, promote conservation, and increase recycling. There are many reasons why voluntary programs are increasing in popularity. First, although the statutory authorities for creating programs and regulating sources through traditional regulatory mechanisms may be fully implemented, many less serious pollution and resource conservation problems remain. Second, voluntary programs are perceived to have low costs because firms and individuals undertake the measures on a purely voluntary basis. Unlike traditional regulatory measures, voluntary programs do not carry the threat of enforcement actions and penalties for noncompliance. Third, voluntary programs are sometimes used to experiment with new approaches to pollution control, approaches that may be adopted by law or regulation at a later date.

What incentive do firms and individuals have to participate in voluntary programs? In some cases, the reward is limited to the satisfaction of doing a good deed. Many recycling programs would be characterized as such. Participants in some voluntary programs receive free technical assistance regarding pollution control options. The permit approval process may be accelerated for firms that participate in some voluntary programs. Finally, many voluntary programs publicly acknowledge the participants that have successfully met program criteria. Being publicly recognized as an environmentally responsible firm could bring benefits such as increased product sales, improved access to talented workers, and a lower cost of capital to the firm.

3.4 Relative Cost Effectiveness

Economic analysis indicates that incentive mechanisms can often increase the cost effectiveness of pollution control relative to traditional regulatory approaches. Several reasons exist for this conclusion. First, some incentive-based mechanisms explicitly allow the trading of pollution allowances or pollution reduction credits. By trading credits or allowances, sources with high incremental costs of pollution control can have their obligations satisfied by sources with low incremental costs of pollution control. Other incentive-based mechanisms levy a charge or tax on each unit of pollution. Under such an approach sources would control pollution only to the point at which the incremental cost of control equaled the charge or tax. In an ideal world that did not have transaction costs and competitive markets, both permit/credit trading and pollution fee, charge and tax approaches should result in the same marginal cost of controlling pollution at each source. In such an idealized world of economic incentives, control costs should be lower than (or, at most, the same as) the costs associated with a traditional regulatory approach.

Being cost-effective, though, does not necessarily guarantee that the net benefits of pollution control are higher when an incentive-based approach is used. For example, the location of individual sources can matter. One source may be located upwind of a large population center while another is downwind. Equating marginal control costs per ton or equating the trading of allowances or pollution reduction credits among sources may well not maximize net benefits to society. Imagine the consequences if allowance trading resulted in greater emissions at a source upwind of a population center and lower emissions at a downwind source.

A number of other incentive-based mechanisms, such as information reporting requirements, liability rules, and voluntary programs, rely on implicit charges for pollution. The cost effectiveness of such mechanisms is more difficult to predict because sources are reducing

pollution for reasons that have only an indirect financial consequence. In some cases, a financial link to incentive-based approaches is very tenuous. The motive for participating in voluntary programs is largely one of improving corporate image to customers, to employees, and to regulators, although management's concern for the environment certainly could be a factor. With corporate image as the principal goal, the benefit to a firm of reducing emissions is difficult to express in financial terms. Perhaps the best that could be done is to examine what firms actually spend to participate in such programs to determine their willingness to pay for pollution reduction. One might find that firms respond in a systematic fashion to the various indirect incentives. Across a sample of firms, liability, for example, might generate a higher willingness to pay for a unit of pollution reduction than an information-reporting requirement, which in turn might exceed the willingness to pay for strictly voluntary activities.

An emerging literature has examined the impacts of existing taxes on the cost effectiveness of different approaches to environmental management (the so-called "tax-interaction" effect). If true, the tax interaction effect would raise the social cost of all environmental programs that control pollution. It appears that economic instruments fare better under these calculations than do traditional regulatory approaches. Goulder et al. (1998) used a general equilibrium model to demonstrate that preexisting taxes would make pollution control about 35% more costly than what was calculated with conventional methods. Relative to conventional calculations of cost, the general equilibrium method shows all forms of regulation as being more costly, however economic instruments maintain their cost advantages. Another observation is that the relative performance of economic instruments can be enhanced through careful design. For example, auctioning marketable permits can result in important efficiency gains relative to simply giving these permits to existing sources (so called "grandfathering").

Parry and Bento (1999) extended the results calculated by Goulder et al. with a simple numerical model that evaluated the effects of tax-favored consumption (e.g., employer- provided health insurance and the mortgage interest deduction). In this model, some economic instruments perform much better than traditional regulatory alternatives. In particular, the welfare gain from using revenue-neutral environmental taxes or the auctioning of emission permits can be greater than previously thought. Under certain conditions, the welfare costs of an environmental tax can be negative.

In a reexamination of the Goulder tax-interaction effect, Jaeger (2000) finds evidence of a double-dividend effect but not the alleged tax-interaction effect.[22] With the double-dividend effect, not only is pollution controlled with a tax or trading program, but revenues are also raised for other worthwhile programs.

Several studies that compare the theoretical cost effectiveness of incentive mechanisms to traditional regulatory approaches to managing the environment are summarized in Table 3-2 (air pollution); Table 3-3 (water pollution); Table 3-4 (solid waste); and Table 3-5 (other pollution-related issues). Many of these studies did not specify the precise nature of the market-based mechanism that would be used. Rather, the assumption was made that either pollution taxes or marketable permits would yield the least cost outcome that was identified through linear programming. One observes in every case that the ratio of costs comparing the traditional regulatory approach with the market-based approach exceeds 1, and sometimes it far exceeds 1.

Table 3-2. Potential Savings from Using Economic Incentives to Control Air Pollution

Pollutant Controlled	Study Year, Source	Geographic Area	Traditional Regulatory Approach	Ratio of Costs: Traditional Approach vs. Incentive Approach
Hydrocarbons	Maloney & Yandle (1984) T	DuPont facilities in United States	Uniform percent reduction	4.15
Nitrogen dioxide	Seskin et al. (1983) T	Chicago	Proposed Reasonably Available Control Technology (RACT) regulations	14.4
Nitrogen dioxide	Krupnick (1986) O	Baltimore	Proposed RACT regulations	5.9
Total Suspended Particulates (TSP)	Atkinson & Lewis (1974) T	St. Louis	State Implementation Plan (SIP) regulation	6.0
Particulates (TSP)	McGartland (1984) T	Baltimore	SIP regulations	4.18
Particulates (TSP)	Spofford (1984) T	Lower Delaware Valley	Uniform percent reduction	22.0
Particulates (TSP)	Oates et al. (1989) O	Baltimore	Equal proportional treatment	4.0 at 90 ug/m3
Reactive organic gases and NO_2	SCAQMD (1992) O	Southern California	Best Available Control Technology	1.5 in 1994 1.3 in 1997
Sulfur dioxide	Roach et al. (1981) T	Four Corners Area	SIP regulation	4.25
Sulfur dioxide	Atkinson (1983) A	Cleveland		
Sulfur dioxide	Spofford (1984) T	Lower Delaware Valley	Uniform percent reduction	1.78
Sulfur dioxide	ICF Resources (1989) O	United States	Uniform emission limit	5.0
Sulfates	Hahn and Noll (1982) T	Los Angeles	California emission standards	1.07
Six air pollutants	Kohn (1978) A	St. Louis		
Benzene	Nichols et al. (1983) A	United States		
Chlorofluorocarbons	Palmer et al. (1980); Shapiro and Warhit (1983) T	United States	Proposed emission standards	1.96
All regulated air pollutants	Bates et al. (1994) O	Poland	European Community and German standards	1.1 to 1.2
Sulfur dioxide	Haklos (1994) O	Europe	Uniform percent reduction	1.42
Ozone	Hahn (1995) O	United States	Vehicle mandate in CA and Northeastern United States	1.3 (NE only) 2.0 (CA + NE)
NO_x	Krupnick at al. (2000) O	Eastern United States	EPA SIP call provisions	1.83 (utilities) 2.0 (all sources)[23]

Note: T refers to original citation in Tietenberg (1990), A to original citation in Anderson et al. (1990), and O to original publication of paper.

Table 3-3. Potential Savings from Using Economic Incentives to Control Water Pollution

Substance Controlled	Source Year, Source	Geographic Area	Traditional Regulatory Approach	Ratio of Costs: Traditional Approach vs. Incentive Approach
Biochemical Oxygen Demand (BOD)	Johnson (1967) T	Delaware Estuary	Equal proportional treatment	3.13 at 2 mg/l 1.62 at 3 mg/l 1.43 at 4 mg/l
BOD	O'Neil (1980) T	Lower Fox River, WI	Equal proportional treatment	2.29 at 2 mg/l 1.71 at 4 mg/l 1.45 at 6.2 mg/l
BOD	Eheart et al. (1983) T	Willamette River, OR	Equal proportional treatment	1.12 at 4.8 mg/l 1.19 at 7.5 mg/l
BOD	Eheart, et al. (1983) T	Delaware Estuary	Equal proportional treatment	3.00 at 3 mg/l 2.92 at 3.6 mg/l
BOD	Eheart et al. (1983) T	Upper Hudson River, NY	Equal proportional treatment	1.54 at 5.1 mg/l 1.62 at 5.9 mg/l
BOD	Eheart et al. (1983) T	Mohawk River, NY	Equal proportional treatment	1.22 at 6.8 mg/l
Heavy metals	Opaluch & Kashmanian (1985) O	Rhode Island jewelry industry	Technology-based standards	1.8
Selenium	EDF (1994) O	Central Valley, CA	Best management practices	1.2
Nitrogen	Moore (2000) O	Long Island Sound	Equal treatment	1.46 at 3.5 mg/l
Nitrogen	Shabman and Stephenson (1998) O	Long Island Sound	Equal treatment	1.56 at 3.5 mg/l
Phosphorus	Faeth (2000) O	Minnesota River Valley	Equal treatment	2.7 at 1ppm/l
Phosphorus	Faeth (2000) O	Rock River, WI	Equal treatment	1.74 at 1 mg/l
Phosphorus	Faeth (2000) O	Saginaw Bay, MI	Equal treatment	5.9 at 1 mg/l

Note: T refers to original citation in Tietenberg (1990), A to original citation in Anderson, et al. (1990), and O to original publication of paper.

Table 3-4. Potential Savings from Using Economic Incentives to Control Solid Waste

Substance Controlled	Study Year, Source	Geographic Area	Traditional Regulatory Approach	Ratio of Costs: Traditional Approach vs. Incentive Approach
Municipal solid waste	Palmer, et al. (1995)	United States	Uniform percent reduction of 10%	2.0

Of course, these ratios are merely theoretical calculations of potential savings. Actual savings could be much less if sources face high transaction costs with trading regimes, a scenario that severs as the basis for comparison in most of the studies. A recent report to EPA (Anderson, 1999) used these studies and other inputs to calculate the potential savings from the widespread use of economic instruments in environmental management. The estimate is large—on the order of $45 billion a year, or almost one-fourth of current environmental expenditures of $200 billion a year at the federal, state, and local levels.

Table 3-5. Potential Savings from Using Economic Incentives for Other Pollution-Related Issues

Substance Controlled	Study Year, Source	Geographic Area	Traditional Regulatory Approach	Ratio of Costs: Traditional Approach vs. Incentive Approach
Fuel efficiency	Charles River Associates (1991)	United States	Corporate Average Fuel Economy standards	4.5
Agricultural chemicals	Rendleman et al. (1995)	United States	Uniform percent reduction	1.1
Traffic congestion	Hau (1990)	Hong Kong	Car ownership restraint	2.5

Examining the performance of trading systems in particular, one finds that existing applications fail to achieve anywhere near their theoretical potential cost savings.[24] Trades have been fewer and cost savings smaller, according to this analysis, than indicated by economic modeling. A number of explanations have been offered for why the predicted savings are not realized.[25] Regulatory and legal requirements of the actual programs may limit the trading opportunities to a greater extent than portrayed in the models, especially where the incentive programs operate in conjunction with traditional regulatory programs. Various models have not fully reflected all the aspects of real regulatory programs, including the transaction costs, restrictive trading rules, monitoring and reporting requirements, and the administrative burden placed on both emission sources and regulatory agencies.

In addition to the limitations imposed by the regulatory structure, potential participants in trading systems may be reluctant to trade emissions credits or allowances, preferring instead the greater certainty of installing pollution control equipment at their facilities. Moreover, pollution credits have a limited life whereas engineering controls, in principle, last for the life of a facility. In most trading systems, the vast majority of trades that take place occur within firms, not between firms. Furthermore, markets for permits that are available for sale tend to be thin, and it may be difficult to locate potential sellers.[26]

For tax, charge, and fee systems in the United States, the principal limitation to achieving the theoretical gains in cost effectiveness has been the generally low level of charges relative to the levels that would be required to have a significant impact on pollution. Typically, charges are set to recover the administrative costs of a program, not to affect pollution.

Even if the cost savings of trading systems are less than predicted, the actual savings are still impressive. In the appropriate circumstances, the wider use of incentive programs that are feasible in an actual policy setting will result in substantial cost savings while achieving equivalent environmental goals. In other circumstances, the cost differences between an incentive program and a well-designed traditional regulatory program will be less, although the incentive program will provide a stronger stimulus for innovation and technical change.[27]

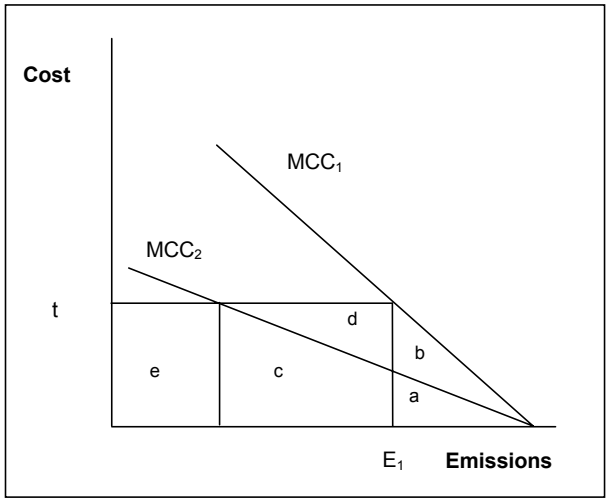
3.5 Economic Instruments and Technological Change

Market-based instruments should have significant advantages over traditional regulatory mechanisms in terms of stimulating technical change and innovation in pollution control. The reason is that each and every unit of pollution is costly to the source. In contrast, under a

traditional regulatory approach, once a source has satisfied the emission limits, all pollution within those limits has no cost. Why spend valuable resources instituting further controls when there is no offsetting cost savings? In fact, there generally is no incentive for a facility to reduce pollution much below permitted amounts because such an action would invite regulators to reduce the facility's permit limits. In many parts of the nation, pollution control agencies are constantly struggling to find ways of meeting ambient environmental quality goals. Facilities that demonstrate the possibility of making emission reductions below permitted amounts offer an easy target for obtaining some of the necessary emission reductions. These same innovative firms may be the catalysts for developing regulations that require other firms in the same industry to reduce their emissions to the amount shown to be feasible.

Figure 3-4 graphically depicts the difference in incentives produced by an emissions tax and by a traditional regulatory policy. A firm with marginal control costs (MCC) of MCC_1, facing an emission standard set at E_1 will control emissions to that level and incur costs equal to areas (a+b) for controlling all emissions beyond E_1. With an emissions tax set at t, the firm also would control emissions to E_1, but the firm would not only incur control costs of (a+b) but also would have to pay the tax on E_1 of emissions equal to (c+d+e).

Figure 3-4. Comparison of Emission Tax and Emission Limit



The incentive for sources to find improved methods of pollution control are much stronger under the emissions tax, since total pollution control costs are much higher. If the source finds a new, cheaper pollution control technology (represented by the shift in marginal control costs to MCC_2 in Figure 3-4), total abatement costs under the emissions standard approach would fall by an amount equal to area (b). Under the emissions tax approach, total pollution control outlays would equal (a+c+e), a decrease of (b+d).

It should not be surprising that the theoretical and empirical literature concludes that emission taxes provide the greatest stimulus for technical change and innovation, with marketable permits offering a lesser stimulus and traditional regulatory approaches the least. Among traditional regulatory approaches, it is safe to say that performance-based standards should provide a greater incentive to innovate than would pure technology requirements.

Long-run changes in behavior and technology are among the most difficult economic effects to document. For that reason, relatively little is known of the effects that take place as a consequence of different pollution control policies. Yet these effects are thought to be very important.

Outlays for research and development (R&D) in pollution control are between 2% and 3% of total pollution control expenditures. This percentage is about the same as the average R&D expenditure in all of U.S. manufacturing. Pollution control that is based more heavily on

economic instruments would be expected to stimulate greater R&D and, in turn, reduce the costs of improving the environment over the long run.

There is historical evidence that Clean Air Act requirements (some market-based, some not) have helped to provide impetus and market opportunities for technology innovation and performance improvements. Innovative companies have responded by producing breakthroughs such as alternatives to ozone-depleting chemicals and new super-performing catalysts for automobile emissions. There are many examples of technologies that were not commercially available a dozen years ago, but that are now important elements of pollution control programs. These examples include the following:

- Selective Catalytic Reduction (SCR) for NO_x emissions from power plants
- Advanced gas reburning technology for NO_x
- Scrubbers that achieve 95% SO_2 control on utility boilers
- Sophisticated new valve seals and detection equipment to control leaks
- Water-based and powder-based coatings to replace petroleum-based formulations
- Reformulated gasoline
- LEVs (Low-Emitting Vehicles) that are far cleaner than those believed possible in the late 1980s (an additional 95% reduction over the 1975 controls)
- Reformulated lower VOC paints and consumer products
- Safer, cleaner burning wood stoves
- Dry cleaning equipment that recycles perchlorethylene
- CFC-free air conditioners, refrigerators, and solvents

This pattern of technological progress is continuing today. In the regulatory impact statement for the 1997 ozone and PM National Ambient Air Quality Standards (NAAQS), EPA identified a number of emerging technologies—ranging from fuel cells to ozone-destroying catalysts to new coating technologies—that may hold promise for achieving further air pollution reductions. EPA can help foster additional demand for clean technologies by promoting strategies that create a market for the most efficient, best performing technologies.

3.6 Impacts on Environmental Quality

A full understanding of the desirability of incentive programs requires information on the actual environmental benefits that are achieved relative to command and control alternatives. The literature focuses almost exclusively on the cost side of the equation as opposed to the environmental effects because most studies assume that the same environmental goals are being sought in both approaches to environmental management. When comparing incentive-based policies with traditional regulatory approaches, or when comparing one incentive-based policy with another incentive-based policy, there may be impacts on environmental quality that would be of interest to regulators and other parties.

In general, incentive mechanisms based on trading are designed to produce environmental effects that closely approximate what would be achieved through a traditional regulatory approach. Some distinctions exist. For example, a cap-and-trade policy provides control over total emissions, while an open-market trading approach does not limit overall emissions. In an open-market approach, credits are generated at the sources' discretion. Open-market trading could reduce total emissions, however, if trading ratios of greater than 1:1 were applied. Some trading

programs described in this report have that feature (e.g., fireplace permit trading), but others do not.

In most cases, emission tax systems have not been designed to produce a specific environmental impact. Rather, the primary goal has been to raise modest revenues. (See, for example, Arnold 1995, chapter 11.) However, in the few examples for which emission fees have been set at a level intended to have environmental impacts, the benefits were greater than forecast (e.g., Swedish NO_x and SO_2 charges, and U.S. chlorofluorocarbon taxes).

Deposit systems appear to have achieved environmental results greater than could be achieved with a traditional regulatory approach. However, the refund must be large enough to induce consumers to bring back the used product. For example, deposits/refunds on automobile bodies (required in some European countries) function well in assuring the proper disposal of car hulks when set at a high enough level. A traditional regulatory approach works less well for car hulks. Thousands of abandoned cars are removed at city expense in New York each year, despite regulations prohibiting that type of disposal.

Variations in environmental effects can be important in evaluating the overall desirability of different approaches. Oates et al. provide an example in a comparison of regulatory approaches for of particulate matter control in the Baltimore, Maryland, region. The traditional regulatory approach of applying uniform emission limits to sources results in control of particulate matter to an extent greater than necessary to meet ambient air quality standards in some parts of the city. In contrast, an incentive-based approach achieves the air quality standard with more uniform ambient concentrations of particulate matter in all parts of the city. The extra reductions of particulate matter in some areas under the traditional regulatory approach yield a benefit that partially offsets the higher costs of the traditional approach.[28]

3.7 Finding the Right Instrument for the Problem

This chapter has described a wide range of instruments from the perspectives of cost effectiveness, distributional consequences, environmental effects, and incentives to develop new technologies to deal with pollution. An ideal tool would maximize the net benefits that accrue to society (all environmental and other benefits, less compliance costs, administrative costs, monitoring and enforcement costs) without creating major imbalances in the distribution of costs or benefits. The evidence accumulated from literally hundreds of applications of economic instruments that is reviewed in the following chapters suggests that the set of instruments that can deal effectively with individual classes of environmental problems is fairly narrow. Table 3-6 identifies the types of incentive-based instruments that have been applied to a variety of environmental problems. The relative effectiveness of the different mechanisms is also characterized. The interested reader is referred to Dower (1995) for other perspectives on selecting the best economic instrument for specific environmental problems.

Table 3-6. Uses of Economic Instruments

Instrument	Examples	Pros & Cons
Pollution Charges & Taxes	Emission charges Effluent charges Solid waste charges Sewage charges	Pros: stimulates new technology; useful when damage per unit of pollution varies little with the quantity of pollution Cons: potentially large distributional effects; uncertain environmental effects; generally requires monitoring data
Input or Output Taxes & Charges	Leaded gasoline tax Carbon tax Fertilizer tax Pesticide tax Virgin material tax Water user charges CFC taxes	Pros: administratively simple; does not require monitoring data; raises revenue; effective when sources are numerous and damage per unit of pollution varies little with the quantity of pollution Cons: often weak link to pollution; uncertain environmental effects
Subsidies	Municipal sewage plants Land use by farmers Industrial pollution	Pros: politically popular Cons: high budgetary cost; may stimulate too much of the activity; uncertain effects
Deposit- Refund Systems	Lead-acid batteries Beverage containers Automobile bodies	Pros: deters littering; stimulates recycling Cons: potentially high transaction costs; product must be reusable or recyclable
Marketable Permits	Emissions Effluents Fisheries access	Pros: provides limits to pollution; effective when damage per unit of pollution varies with the amount of pollution; provides stimulus to technological change Cons: potentially high transaction costs; requires variation in marginal control costs
Reporting Requirements	Proposition 65 SARA Title III	Pros: flexible, low cost Cons: impacts may be hard to predict; applicable only when damage per unit of pollution does not depend on the quantity of pollution
Liability	Natural resource damage assessment Nuisance, trespass	Pros: strong incentive effect Cons: assessment and litigation costs can be high; burden of proof large; few applications
Voluntary Programs	Project XL 33/50 Energy Star	Pros: low cost; flexible; many possible applications; way to test new approaches Cons: uncertain effectiveness

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Pollution Charges, Fees, Taxes


Deposit-Refund Systems


Trading Programs


Subsidies for Pollution Control


Liability Approaches

Information Disclosure


Voluntary Programs

4. Pollution Charges, Fees, and Taxes

4.1 Introduction

A *pollution charge* is a fee based on the quantity of pollutants that are discharged into the environment. A *user charge* is a fee paid in exchange for the use of natural resources or for the collection or disposal of pollutants. A *product charge* is a fee imposed on products that are believed to have environmentally harmful effects. Although the terms "fee," "charge," and "tax" are used interchangeably in this chapter, there are subtle differences. Under federal law, a tax is a purely revenue-raising instrument, whereas charges or fees are intended to offset costs to the government. Thus, tax receipts would be part of general revenues. While many charges and fees that are collected must be placed in the Treasury General Fund, some are allowed to be retained and could supplement agency budgets. The different types of fees, charges, and taxes discussed in this chapter can be classified in various ways. They are summarized in Table 4-1.

Table 4-1. Fees, Charges, and Taxes in Environmental Policy

Instrument	Description	Examples
Pollution fee	Charge based on the quantity of pollutants released into the environment	Air emissions permit fees in California, Maine, other states Effluent permit fees in Louisiana, California, Wisconsin, other states Solid waste disposal fees
User fee	Fee for the use of resources	Water use fees Congestion or time-based highway tolls Grazing fees
Product charge	Charge on a product believed to have environmentally harmful effects	Gas guzzler tax CFC tax State taxes on fertilizers State advance disposal fees on tires, motor oil, packaging, other goods
Other fees on environmentally damaging activities	Various mechanisms	Wetland development fees Stormwater runoff fees

Most environmental taxes are designed primarily to raise revenue, often to fund environmental protection activities. The economic rationale behind such taxes is that those who cause pollution should bear the costs. Such costs include both damages to the environment and the administrative costs incurred by the authorities that regulate polluters. To be economically efficient, environmental taxes should reflect both of these costs.

Although some charges, especially product charges, have been imposed at the federal level, the majority of them have been introduced at the state or local level. In the case of air and water pollution, the federal government has provided policy guidance on charges, but the states have developed and implemented a wide variety of charges as they have seen fit.

Given the multiplicity of environmental taxes—especially at the state and local levels—and the frequency with which they are adopted or modified, this chapter does not attempt to provide a comprehensive description of all the environmental taxes in place in the United States. Rather, its purpose is to describe some of the more important environmental taxes.

4.2 Water Fees

Water fees take various forms, including user fees (e.g., for groundwater, surface water, or drinking water supplied by waterworks) and fees for direct or indirect water discharges. Indirect discharges are sent to treatment works. The rationale for water user fees is that water is not a free resource but rather a scarce commodity that should be priced to avoid inefficient use and related environmental problems. The rationale for discharge fees follows from the polluter-pays principle described in the previous section. Most water fees are intended primarily to raise revenue to recover the costs of providing service rather than to allocate a scarce resource among competing interests.

4.2.1 Indirect Discharge and User Fees

Fees are imposed on households and businesses for discharges of wastewater into Publicly Owned Treatment Works (POTWs). Frequently, the water and wastewater utilities that service a household or business are one and the same. When a single invoice includes both services, users may be able to distinguish discharge fees from water user fees only by careful attention to line items. Wastewater discharges are not directly metered in most cases; rather they are assumed to be equal in volume to water consumption, which is measured. Some discharge fees for larger businesses are based not only on water use but also on discharge toxicity, which provides them with a separate incentive to reduce the toxicity of their discharges. Sims found that toxicity-based charges provided an incentive for large industrial facilities to reduce the volume of their discharge.[29]

With respect to water user fees, EPA's 1995 Community Water System Survey estimated that 95% of residential water customers and 98% of nonresidential water customers are metered. They pay water charges based directly on their usage.[30]

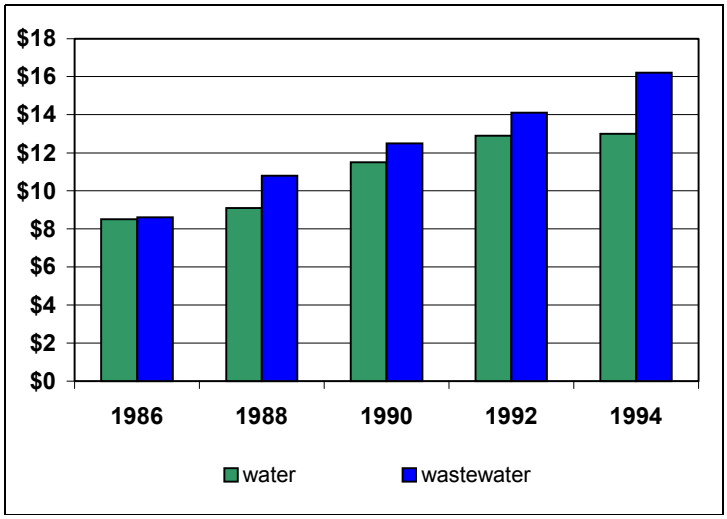
Whether a water user fee has a greater effect in terms of raising revenue or reducing a potentially polluting activity depends largely on the elasticity of the demand for water, that is whether demand is responsive to changes in price. If the demand is inelastic, an increase in user fees will raise revenue. User fees will not, however, affect consumption behavior in a significant way. If demand is elastic, however, consumption behavior is likely to be changed by a water fee, but the revenue-raising prospects are limited. Although water demand is often assumed to be inelastic, studies that separate water demand by season have found that household water demand is inelastic in winter but elastic in summer. Others have found that water demand by industrial and agricultural users is sensitive to price changes.[31]

To promote water conservation, many have suggested the use of rate schedules that impose higher rates per 1,000 cubic feet as use increases. Two periodic surveys give an indication as to the type of rates that water utilities use. The Ernst & Young survey focuses on only the largest urban utilities, while the EPA Community Water System Survey is a more comprehensive, random-sample survey that includes smaller utilities. The Ernst & Young survey of residential rates for about 130 utilities reported that 38% use decreasing rates, 37% use uniform rates, and

22% use increasing rates. It also shows two trends over time: a greater use of increasing rates and a lesser use of decreasing rates. EPA's Community Water System Survey obtained residential rates from more than 1,000 systems: 49% use uniform rates, 16% use decreasing rates, and 11% use increasing rates. Since utilities could report more than one type of rate per class of customer, the total for all rate types is more than 100%. Taken together, these two surveys suggest that smaller utilities in general are less likely to use increasing or decreasing rates than larger utilities.

As shown in Figure 4-1, periodic surveys of selected water utilities indicate that water and wastewater fees have risen significantly since 1986. These price increases have exceeded the rate of inflation. In addition, EPA's Community Water System Survey notes the tendency for large utilities to raise rates more frequently than small utilities. Smaller utilities raise rates by a greater amount when they do raise rates, but the differences are less dramatic when reported in annualized terms.

Figure 4-1. Water and Wastewater Charges (monthly average)



Source: Ernst & Young. 1994. p. 3

In addition to water and wastewater charges, stormwater charges have been imposed in a number of areas. Ernst & Young found that the number of utilities with such charges increased significantly from 1992 to 1994. Their use varies significantly across regions: They are used by over half of all utilities surveyed in the West but by none surveyed in the Northeast. In some areas, reduced storm-water fees are assessed in return for measures that promote stormwater management.

Finally, in some states, water user fees generate revenues for drinking water programs. New Jersey, for example, raises $2.8 million annually (out of a total drinking water program budget of $5 million) from a water use tax of $0.01 per 1,000 gallons.[32]

4.2.2 Direct Discharge Fees

The Federal Water Pollution Control Act of 1972 provides for the regulation of point- source discharges through a system of national effluent standards that are promulgated by EPA. All point sources must obtain National Pollution Discharge Elimination System (NPDES) permits in order to discharge effluent.[33] By August 2000, EPA had authorized 43 states to issue NPDES permits.[34] In two states, EPA regional offices issue the permits. As of July 1995, about 59,000 municipal and industrial facilities in the United States had received NPDES permits.[35]

A 1993 survey revealed that 39 states assessed NPDES permit fees as of December 1993. In 10 of the states, fees varied according to discharge volume and toxicity, while in 18 other states fees varied according to discharge volume alone (see Table 4-2). Other criteria sometimes used in setting fees include the purpose of the water use, the characteristics of the receiving water, and the type of facility releasing the discharge. Some states use point or class systems with various

criteria to determine the fee levels for different dischargers. Fees for Publicly Owned Treatment Works (POTWs) are sometimes based on the size of the population that is presumed to be connected to the local sewage system.

Table 4-2. State Effluent Permit Fee Structures

Fee Structure	States
Flat or varies only according to industry or size of permit holders.	Alabama, Alaska, Delaware, Hawaii, Kentucky, Maine, Massachusetts, Pennsylvania, Rhode Island, Utah, Virginia
Varies according to discharge volume	Arizona, Arkansas, Colorado, Connecticut, Florida, Kansas, Minnesota, Missouri, Nevada, New York, North Carolina, Ohio, Oregon, South Carolina, South Dakota, Tennessee, Vermont, Washington
Varies according to discharge volume and toxicity	California, Indiana, Louisiana, Maryland, Montana, New Jersey, Oklahoma, Texas, West Virginia, Wisconsin

Source: Duhl. 1993, p. 10.

The primary purpose of NPDES permit fees is to raise revenue, especially for the permitting program. This rationale explains why fees are often based on the complexity of the permit, a reflection of the administrative effort required to get the permit in place. In a number of states, fees are set to attain revenue targets.

A secondary purpose is to discourage water pollution. Although the incentive effect of water effluent fees in the United States has not been studied in a comprehensive way, several factors limit the likelihood of a strong impact. In some cases, fees are based not on measured discharge characteristics but rather on more easily measured parameters that are related to discharge characteristics. Moreover, some fee structures have broad classes for characterizing discharge volume, toxicity levels, or both. These structures impose the same fee within a given volume or toxicity class In such cases, polluters have no incentive to limit discharges unless they can move from one fee class to another. Finally, the charges are often modest relative to control costs. New Jersey has the highest effluent fees. In 1993, two facilities in New Jersey paid $702,812. In most states, however, the highest fees are less than $100,000. As a point of comparison, effluent control costs typically exceed $5 million each year at a large industrial facility.

4.2.3 Some State Effluent Permitting Fees

Although it is beyond the scope of this report to describe water effluent fees for all 50 states, examples from Louisiana, California, and Wisconsin should illustrate typical characteristics of these fees. Each of these states has NPDES permit fees (i.e., effluent fees) that vary with both the volume and toxicity of the discharge.

Louisiana uses water permit fees to fund not only the state permit program but also the activities of the Office of Water Resources of the Department of Environmental Quality. (The legislature no longer provides general revenues to the Office.) The annual permit fee is determined by a worksheet that assigns points on the basis of several factors: (1) facility complexity; (2) flow volume and type; (3) pollutants released; (4) heat load; (5) potential public health threat; and (6) the designation of a facility as major or minor, depending upon how many people it employs. The points are multiplied by a rate factor of $97.50 per point for municipal facilities and $170.63 per point for industrial facilities to determine total annual fees. The minimum annual fee is $227.50, and the maximum annual fee is $90,000. In addition to annual fees, Louisiana imposes

application fees for new, modified, or reissued permits. In most cases, these fees are 20% of the annual fee.[36]

In California, NPDES annual fees are based on the threat to water quality and the complexity of the permit. There are three categories for each characteristic: Categories I, II, and III for the level of threat to water quality; and Categories a, b, and c for the complexity of the permit. Permit holders with a I-a rating (the greatest threat to water quality and the most complex permits) pay the highest fees, $10,000 a year. III-c permit holders pay the lowest fees, $400 a year. These fees fund State Water Board programs.

In addition to the NPDES permit fees, California charges Bay Protection and Toxic Cleanup fees. This fee structure is similar to that of the NPDES permits except that it is also applied to other sources of pollution such as storm drains, boat construction and repair facilities, marinas, dredging operations, and beach replenishment activities. Another difference is that its revenues fund the Bay Protection and Toxic Cleanup Program, which is designed to identify hot spots, develop a water quality database, and help coordinate water policy. The Bay Protection Fee schedule ranges from $300 for III-c permittees (who pose the least threat to water quality and have the least complex permits) to $11,000 for I-a permittees. Dredging operations are charged an annual fee of up to $15,000.

The Wisconsin effluent fee system is believed to have potential incentive effects. The fee rate per pound of individual pollutants is inversely related to the permit limit in pounds for the pollutant. Thus, the most harmful pollutants are taxed at the highest rate per pound. Pollutant loadings are calculated on the basis of flow and concentration information contained in wastewater monitoring reports. Polluters are thereby encouraged to reduce both the quantity and the toxicity of pollutant releases.

4.2.4 Stormwater Runoff Fees

It is common practice for counties to impose fees on real estate developments based on surface area runoff (paved areas and areas under roof). Fee revenues are used for storm-water management in stream valleys. These fees differ from the utility stormwater fees described in Section 4.2.1 in that they apply to runoff into surface water.

4.3 Air Emission Fees

As is the case with water pollution, there are no national air emissions fees. However, the Clean Air Act Amendments of 1990 require that states impose fees for issuing emission permits. The Amendments also impose fees on VOC emissions that will come into force in 2005 and 2010 in areas that fall far short of attaining national ambient air quality standards for ozone. States have been more active in the use of emission fees as an air quality management tool.

4.3.1 Permit Fees

The 1990 Clean Air Act Amendments require that states impose permit fees to recover the administrative costs of their EPA-approved operating permit programs. The Amendments set the minimum presumptive level for such fees at $25 per ton of emissions of air toxics and criteria air pollutants (excluding carbon monoxide). They also specified that this amount should be adjusted for inflation. Each state is required to set fees that completely cover operating permit program costs. If the fees are greater than or equal to $25 per ton, adjusted for inflation—at present, about

$35 per ton—EPA assumes that the fees are adequately high. States with lower fees must present detailed evidence that fee revenues are sufficient to cover their operating permit program costs. Several state permit programs have been denied full EPA approval because they have submitted insufficient information on the adequacy of their fees. These states have received interim approval, pending their submission of evidence of fee adequacy.

Although states can meet the revenue-raising requirement through flat fees or other types of fees, most have chosen incremental per-ton fees. Some states base their fees on the pollutant's potential harm to the environment. New Mexico, for example, levies fees of $150 per ton for air toxics but only $10 per ton for criteria pollutants. Fee structures in Maine and California are discussed here for illustrative purposes.

4.3.1.1 Air Emission Permit Fees in Maine

In November 1993, Maine raised its air emission permit fees. Charges were raised from $2 per ton to $5 per ton for emissions up to 1,000 tons; from $4 per ton to $10 per ton for emissions between 1,001 and 4,000 tons; and from $8 per ton to $15 per ton for emissions in excess of 4,000 tons. The minimum charge rose from $100 to $250, and the maximum charge rose from $100,000 to $150,000. The fees apply to emissions of sulfur oxides (SO_x), NO_x, VOCs, and particulate matter. Having since been adjusted for inflation, their fee levels (as of 1997) are shown in Table 4-3. The fees applied to all permit holders.

Table 4-3. Air Emissions Permit Fees in Maine

Amount Emitted	Fee ($/ton)
Up to 1,000 tons	5.28
1,000-4,000 tons	10.57
More than 4,000 tons	15.85

Source: Limouze, Maine Air Quality Bureau.

Maine has also imposed an air quality surcharge based on the toxicity of emissions. The magnitude of the surcharge is determined on the basis of several criteria. Approximately 85 facilities are subject to the tax, which is capped at $50,000. Before the surcharge was adopted, the Director of Maine's Air Quality Bureau said that the state would give polluters an incentive to identify how they would reduce their emissions of the most toxic substances.[37] The same Air Quality Bureau official indicated that surcharge revenues have fallen and that the surcharge has had a slight incentive effect. The official also suggested that the impact on the environment is difficult to isolate from other potential factors, such as the Toxics Release Inventory. Permit fees produce approximately $1.8 million in revenues each year, and toxicity surcharges net $0.6 million in annual revenues. Revenues are used for the air permit program and other air quality activities.

4.3.1.2 Emission Permit Fees for South Coast Air Quality Management District

The South Coast Air Quality Management District (SCAQMD), located in Southern California) levies the highest fees per unit of air emissions in the United States. The fees shown in Tables 4-4 and 4-5 are adjusted for inflation and budgetary needs of the SCAQMD every May.

Facilities that temporarily exceed their allowable emissions levels must pay excess emissions fees. For most pollutants, the excess emissions fees are about the same as the regular fees. For

carbon monoxide, however, they are approximately twice as high. In addition, SCAQMD imposes fees for visible emissions and various administrative procedures.[38]

Table 4-4. Emission Fees in SCAQMD

FY 99–00, $ per ton

Annual Emissions	Organic Gases	Nitrogen Oxides	Carbon Monoxide	Sulfur Oxides	Particulate Matter
4–25 tons	$292.80	$171.30		$203.10	$223.90
25–75 tons	475.40	272.10		328.30	362.80
>75 tons	711.60	409.80		492.90	543.20
>100 tons			$3.50		

Source: SCAQMD Rule 301.

Fees for some air toxics have escalated rapidly, far faster than the fees for criteria air pollutants. Between 1996 and 2000, emission fees for asbestos; cadmium; hexavalent chromium; chlorinated dioxins; 1,3 butadiene; and lead rose by 50% to more than 100%.

Table 4-5. Air Toxics and Ozone-Depleting Chemicals Emission Fees in SCAQMD

Pollutant	$ Per Pound		
	FY96–97	FY98–99	FY99–00
Asbestos, cadmium	2.17	3.00	3.40
Benzene, carbon tetrachloride, ethylene di-bromide, ethylene dichloride, ethylene oxide	0.90	1.00	1.13
Methylene chloride	0.05	0.05	0.06
Hexavalent chromium	2.67	4.00	4.53
Chlorinated dioxins and dibenzofurans	3.17	5.00	5.66
Nickel	1.67	2.00	2.26
1,3-Butadiene, inorganic arsenic, beryllium, poly-nuclear aromatic hydrocarbons (PAH)	1.50	3.00	3.40
Lead, vinyl chloride	0.50	1.00	1.13
1,4-Dioxane	0.11	0.21	0.23
Formaldehyde, perchloroethylene	0.21	0.21	0.23
Chlorofluorocarbons	0.18	0.18	0.20
1,1,1-trichloroethane	0.038	0.04	0.04

Source: SCAQMD Rule 301

Given the presence of traditional forms of regulation and other factors that might influence air pollutant emissions, the incentive effect of the SCAQMD emissions fees is difficult to determine. In most cases, these fees are lower than the marginal costs for pollution abatement. The main purpose of these fees is to recover the administrative costs of SCAQMD's activities.

4.3.1.3 California "Hot Spots" Fees

The California Air Toxics "Hot Spots" Information and Assessment Act (AB 2588) requires facilities to report the type and quantity of certain substances they release into the air. The California Air Resources Board (CARB) administers the program. The law also requires CARB to develop and adopt fees to cover the administrative costs of the program that are incurred by CARB and local air districts. Districts can either set their own fees or request that CARB set fees

for them. Each district is responsible for billing and collecting the fees and remitting the district's share of state costs to CARB. The information component of this law is discussed in Chapter 9. The fees are discussed in this chapter.

CARB's Hot Spots fee structure, which is used in 12 of California's 34 air pollution control districts, is no longer based on tonnage of emissions. However, at least two of the 22 districts that set their own fees base them on the amounts and toxicity of pollutants. One district bases its fees on amount but not toxicity. The toxicity-based fee structure of the Bay Area Air Quality Management District (BAAQMD) is described here as an example.

BAAQMD bases fees on Unit Risk Values (URVs) for carcinogen emissions and Acceptable Exposure Levels (AELs) for other emissions. Fee amounts depend on the quantities of weighted emissions. For carcinogens, weighted emissions are determined by multiplying the amount of each substance by 100,000 times its URV. For other toxics, weighted emissions are determined by multiplying the amount of each substance by the reciprocal of its AEL (in m^3/micro-gram). The sum of the weighted emissions of all toxics is multiplied by a coefficient to calculate the fees charged to each source. The coefficient varies from year to year depending on the costs incurred by CARB and BAAQMD to manage the Hot Spots program.

Facilities with fewer than 50 weighted pounds pay nothing, while facilities with weighted emissions between 50 and 1,000 pounds pay a flat fee of $125. For gasoline dispensing facilities, the fee is simply $5 for each dispensing nozzle. For small businesses, which are defined as having no more than 50 employees and $5 million in annual receipts, fees are capped at $5,000. Government facilities are also subject to the fees. Although there is no maximum fee for larger businesses, no source has paid more than $60,000 in annual fees. In 1992, about 1,200 facilities paid $1.16 million in fees.

A total of 81 toxics are subject to the fees. In most cases, emissions are not measured but rather estimated on the basis of two factors: data on the use of toxics and emissions factors that depend on the abatement equipment. Although fee amounts appear relatively small for larger businesses, BAAQMD officials believe that the fees have contributed to a decrease in toxic emissions. Facilities have lowered emissions in various ways, including process changes and reductions in the use of toxics. When toxicity-based fees were adopted in 1992, for example, hospitals and metal plating facilities emitted relatively large amounts of ethylene oxide and hexavalent chromium. Since these substances have high URVs, emitting facilities faced high fees. Most of these facilities installed Best Available Control Technology soon after the BAAQMD fee structure was adopted.[39]

However, it is difficult to isolate the effects of these fees from other factors that could influence toxic emissions, including the information and reductions planning components of the Hot Spots program and federal Toxic Release Inventory requirements. In addition, refineries have made large investments to comply with the reformulated fuel and fugitive emissions standards.

4.3.2 Ozone Non-attainment Area Fees

The 1990 Clean Air Act Amendments impose fees on "excess" VOC emissions in ozone non-attainment areas designated as "Severe" or "Extreme." The fees are set at $5,000 per ton (adjusted for inflation since 1990) for each ton emitted in excess of 80% of a baseline quantity. The fees come into effect on the applicable attainment date for the area: 2005 for areas with the designation Severe and 2010 for areas designated as Extreme. (In 1990, California's South Coast

Air Quality Management District was the only non-attainment area rated as Extreme. At present, there are no areas that have that classification.)

4.4 Solid Waste Disposal Fees

This section briefly discusses variable rate programs (a relatively new trend in household waste collection), landfill taxes, and hazardous waste disposal taxes. The purpose of such disposal taxes is to discourage waste generation and encourage recycling. Unfortunately, they also create incentives to dispose of waste illegally or to transport waste to other locations where disposal is cheaper.

4.4.1 Variable Pricing Programs

Communities throughout the United States have traditionally levied fixed collection fees for household waste, or they have included collection and disposal costs in property taxes. Such pricing practices are inefficient in that the marginal price of solid waste disposal faced by the household is zero, whereas the marginal collection and disposal cost is positive.

However, a growing number of communities are now charging for solid waste collection based on the volume generated by the household. Such variable rate (or "pay-as-you-throw") programs have been implemented in more than 4,100 communities in 42 states, reaching an estimated 10% of the U.S. population. Four states have mandated the use of variable rate programs in some or all of their municipalities. Washington's law applies mostly to private collectors that operate in unincorporated areas of the state, but virtually all municipalities in the state use variable rates. Iowa and Wisconsin require variable rates only in communities that fail to attain a 25% waste recycling/diversion goal by certain deadlines. In Minnesota, variable rates are required in all communities.[40] EPA is also encouraging variable rates, and the Agency has held a series of workshops to explain their advantages and disadvantages and to provide information on how to implement them.

Variable rate programs can take several forms. Prepaid garbage bags or stickers that affix to bags can be required for collection, or collection fees can be based on the number of cans, the size of cans, or both of these characteristics. A small number of communities have weight-based systems. More common are mixed programs that combine a fixed rate—which in some programs entitles households to collect a pre-specified amount of waste—and incremental rates for amounts in excess of the maximum covered by the flat rate. Such mixed programs are growing in popularity, perhaps because they are relatively easy and inexpensive to implement, they provide a stable source of revenue for collection services, they have the potential to reduce illegal dumping, and they offer a pre-specified level of service at a fixed cost to many customers.[41] However, according to one source, collection systems that require periodic billing of customers are likely to be more expensive to administer than bag or sticker systems.[42] On the other hand, one disadvantage of using bags is that they can tear, especially if handled improperly or opened by animals. Table 4-6 describes variable rate structures in a number of U.S. communities studied by Miranda and Aldy and Bauer and Miranda.

Waste collection systems can be open systems or exclusive franchises. In open systems, the city may provide optional waste collection (e.g., Grand Rapids, Lansing), or it may leave collection completely in the hands of private firms (e.g., Colorado Springs). In exclusive franchises, collection can be done either by the city (e.g., Spokane, Tacoma) or by one or more contracted

Table 4-6. Variable Rate Structures

Community	Fee Structure
Glendale, CA	65-gallon cart: $6.45/month, 2¢/gallon 100-gallon cart: 10.10/month, 2¢/gallon
Pasadena, CA	60-gallon cart: $10.41/month, 4¢/gallon 100-gallon cart: 16.23/month, 4¢/gallon 2 60-gallon carts: 19.01/month, 4¢/gallon 60-gallon & 100-gallon carts: 22.40/month, 4¢/gallon 2 100-gallon carts: 28.62/month, 3¢/gallon
San Jose, CA	32-gallon cart: $13.95/month, 10¢/gallon 64-gallon cart: 24.95/month, 10¢/gallon 96-gallon cart: 37.50/month, 10¢/gallon 128-gallon cart: 55.80/month, 10¢/gallon
Santa Monica, CA	40-gallon cart: $14.85/month, 9¢/gallon 68-gallon cart: 17.76/month, 7¢/gallon 95-gallon cart: 21.07/month, 6¢/gallon 68-gallon & 95-gallon carts 37.28/month, 5¢/gallon
Oakland, CA	20-gallon can: $10.08/month, 13¢/gallon 1st 32-gallon can: 13.74/month, 11¢/gallon Each extra 32-gallon can: 16.49/month, 13¢/g
Portland, OR	20-gallon can: $14.60/month, 18¢/gallon 32-gallon can: 17.60/month, 14¢/gallon 35-gallon cart: 19.30/month, 14¢/gallon 60-gallon cart: 24.05/month, 10¢/gallon 90-gallon cart: 27.10/month, 8¢/gallon
Tacoma, WA	60-gallon can: $17/month, 7¢/gallon 90-gallon can: 25.50/month, 7¢/gallon
Spokane, WA	20-gallon can: $8.56/month, 11¢/gallon 1st 30-gallon can: 11.07/month, 9¢/gallon Each extra 30-gallon can: 6.01/month, 5¢/gallon
Colorado Springs, CO	1 34-gallon can + 1 30-gallon bag: $9.50/month, 4¢/g 2 cans and 2 bags: 11/month, 2¢/gallon 3 cans and 3 bags: 13/month, 2¢/gallon
Downers Grove, IL	30-gallon bag: $1.50, 5¢/gallon
Hoffman Estates, IL	30-gallon bag: $1.45, 5¢/gallon
Woodstock, IL	30-gallon bag: $1.56, 5¢/gallon
Grand Rapids, MI	30-gallon bag: $0.85, 3¢/gallon 30-gallon can: 44.20/year, 3¢/gallon
Grand Rapids, MI	64-gallon cart: $15/month, 6¢/gallon 104-gallon cart: 17/month, 4¢/gallon
Grand Rapids, MI	90-gallon cart: $17.35/month, 5¢/gallon
Lansing, MI	30-gallon bag: $1.50, 5¢/gallon
Lansing, MI	63-gallon cart: $12/month, 5¢/gallon 104-gallon cart: 15/month, 4¢/gallon
Lansing, MI	60-gallon cart: $11/month, 5¢/gallon 90-gallon cart + 3 30g bags: 13.40/month, 2¢/g

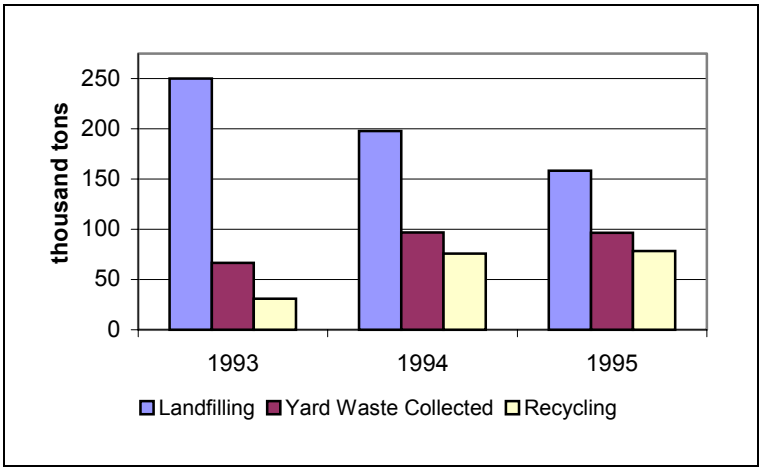
Sources: Miranda and Aldy. 1996; Bauer and Miranda. 1996.

haulers (e.g., Oakland). In both open and franchise systems, communities can set rules regarding collection fees. In St. Paul, Minnesota, for example, the city operates no collection program but requires that collectors charge variable rates, and Portland's open system has no city program but sets the collection fees that private haulers charge their customers.

Many communities with variable rates implement public education, curbside recycling, yard waste, white goods (e.g., refrigerators), and holiday greenery collection programs as well. Education has been found to be an important element in the success of variable rate programs. The collection frequency, fees, materials collected, and participation requirements for these programs, with the exception of public education, vary across communities. These complementary activities can have an important impact on the success of variable rate programs.

San Jose, California, began its variable rate program in 1993. The city contracts its waste collection and curbside recycling services to two different firms. One company serves the approximately 80,000 single-family households in the northern half of the city as well as all multi-family housing. The other business serves about 105,000 single-family households in the southern half of the city. A combination cart/sticker system is used to price household waste collection. Residents subscribe to specific cart sizes and pay the fees shown in Table 4-6 for weekly collection of the waste in these carts. When these households have too much garbage for their cart sizes, they can put the excess garbage in 32-gallon plastic bags, provided the bags each bear a sticker sold for $3.50 at local libraries, supermarkets, and convenience stores. Multi-family dwellings pay flat fees. One potential advantage of the stickers is that they give households the flexibility to exceed planned waste generation on occasion. San Jose also offers free curbside collection of recyclables and yard waste and collects white goods for a separate fee of $18 for up to three items. Figure 4-2 suggests that the variable rate program has significantly reduced the amount of waste sent to landfills and increased the amount of recycled waste. The amount of yard waste set aside for collection and subsequent composting also increased.

Figure 4-2. Solid Waste Flows in San Jose



Source: Miranda and Aldy. 1996

The variable rate systems described thus far base prices on waste volumes. Another, less common price basis is weight. Communities that have implemented weight-based pricing include Seattle, Milwaukee, Minneapolis, Durham (NC), Columbia (SC), and Farmington (MN). Such systems could have a stronger incentive effect by charging for every additional unit of weight and thereby eliminating the incentive given by volume-based systems to compact trash into containers. Seattle's weight-based scheme lowered the weight of garbage collected by 15%. One disadvantage of weight-based systems is that they tend to be technologically much more complicated, requiring that collection trucks carry specialized equipment and increasing the time haulers take to collect waste.

Seattle, for example, found that collection times were extended by 10% under the city's weight-based system. If the weight of garbage decreases enough, however, there is the potential to offset the increased implementation costs.[43]

In most areas where variable rate programs have been introduced, the amounts of waste collected have decreased significantly, a result of either increased recycling or decreased waste generation.

- A 1998 study of 114 variable rate cities and 845 traditional fixed rate communities estimated a 43.8% reduction in waste disposal after those cities and communities began to charge $1 for every 32-gallon bag.[44]
- A 1992 survey of 14 cities with variable rate programs found that the amount of waste destined for disposal decreased by an average of 44% during the first year following program initiation.[45]
- A study in Maine found that municipalities with variable rate systems disposed of less than half as much waste per capita as municipalities without such systems.[46]
- Surveys in Tompkins County, New York, and Dover, New Hampshire, found that variable rates led consumers to think of ways to reduce waste generation, including altering their purchasing habits.
- A 1996 study of four communities in California and five in the Midwest found that they achieved reductions in waste disposal of 6% to 50% after introducing variable rate systems. The higher the unit prices, the greater the reductions. Moreover, reductions were greater in those communities with relatively small minimum container sizes. If the minimum container size is too large, consumers often have little incentive to alter their behavior.[47]
- As shown in Table 4-7, another study found reductions in the tons of waste sent to landfill, reductions that ranged from 17% to 74% following the adoption of variable rates in 21 northern cities. The study reached two conclusions. First, the magnitude of the unit prices was positively correlated with the change in the amount of waste recycled. (That is, the higher the price per unit of waste, the more waste was recycled). Second, unit prices were negatively (not the right term) correlated with the change in the amount of waste landfilled. That is the higher the price per unit of waste, the less waste that was sent to landfills and the more waste that was recycled.

  The recycling increases shown in Table 4-7 were achieved in geographic areas that did not simultaneously implement recycling programs. In places where the adoption of variable rate programs has coincided with new public recycling activities, however, it is difficult to determine how much of the decline in waste disposal is due to the variable rates and how much is due to the new recycling alternatives. The Dover survey found that curbside recycling programs alone encouraged recycling but that variable rates provided additional incentive.[48] Another study estimates that a variable rate program will increase the amount of waste that is recovered under existing recycling programs by 4% to 13%. [49]
- Nestor and Podolsky (1998) reported on the results of an experiment in the city of Marietta, Georgia. In January 1994, the City of Marietta simultaneously introduced a bag/sticker program and a subscription can program in different parts of the city. After adjusting for seasonal effects, Nestor and Podolsky estimate that households participating

in the bag program reduced their garbage disposal by approximately 23% while households participating in the subscription can program decreased waste disposal by only about 8%. The explanation for this difference is that the bag/sticker program offers households more flexibility on a week-to-week basis regarding the amount of waste they are required to pay for. Households who are able to set out smaller-than-usual amounts of waste immediately benefit from it. The bag/sticker program gives households greater incentive to reduce waste because they are not committed to a specified number of containers each week.

Table 4-7. Responses to Variable Rate Pricing

Municipality	% Reduction in Tons of Waste Landfilled	% Increase in Tons of Waste Recycled
Antigo, WI	50	145
Charlemont, MA	37	N/A
Downers Grove, IL	52	N/A
Grundy Center, IA	32	N/A
Hancock, VT	33	N/A
Hartford, VT	17	29
Harvard, IL	33	113
High Bridge, NJ	18	N/A
Huntingburg, IN	74	N/A
Illion, NY	51	141
Ithaca, NY	31	63
Lisle, IL	53	N/A
Mt. Pleasant, IA	49	N/A
Mt. Pleasant, MI	44	141
Perkasie, PA	54	157
Plains, PA	49	88
Quincy, IL	41	45
River Forest, IL	19	N/A
St. Charles, IL	41	456
Weathersfield, VT	36	150
Woodstock, IL	31	N/A

Source: Miranda, as reprinted in Arner and Davis.

Despite the evidence cited in Figure 4-7, variable rate programs have some unresolved problems. Data on decreases in collection can be misleading if the programs result in significant illegal disposal of waste or the diversion of waste to cheaper disposal services. Illegal dumping includes direct discharge to the environment as well as placing waste in someone else's container or donating irreparable items to charitable organizations. Direct discharge to the environment is likely to be of more concern than other types of illegal disposal. The Maine study found that an increase in backyard burning and a slight increase in roadside dumping and illegal disposal in commercial containers coincided with variable rate systems. Of the 14 cities surveyed in Skumatz (1993), "six cities reported no problem with dumping, four reported minor problems, and four reported notable problems." Among the measures cited to limit illegal disposal are creation of viable recycling alternatives, public education, locking commercial dumpsters, high dumping fines, and flat collection fees that entitle households to a minimum level of service.[50]

Other problems need to be addressed in designing and managing variable rate programs. They can be difficult to implement in multi-family housing such as apartments, and they can have a regressive effect on large families. Variable rates are likely to be regressive because the amount of waste produced per thousand dollars of income is likely to be higher for a poor household than for a more affluent household. In addition, variable rate programs can lead to significant decreases in revenue for municipal waste collectors because households reduce the amount of solid waste that they generate.

Variable rate programs may not be appropriate for all communities. Analysts assert that variable rate pricing is unlikely to be successful in communities having the following characteristics: (1) those with affordable and environmentally acceptable landfills; (2) those with few or no nearby recycling facilities; (3) those with open spaces located nearby, which makes that land vulnerable to illegal dumping; and (4) those with consumers who oppose paying variable rates.[51] In some areas, however, variable rate programs appear to be beneficial. According to a World Resources Institute (WRI) study, "Where landfill costs are high, disposal charges would generate net economic savings of $0.17 for every dollar of revenue collected, even after the gross costs of curbside recycling programs were paid."[52]

4.4.2 Landfill Taxes

According to the National Recycling Coalition, surcharges on waste delivered to landfills have been imposed in over 20 states.[53] If operators are capable of passing on such taxes to their customers in their disposal fees, landfill taxes could have effects similar to variable rate programs.

New Jersey levies three different landfill taxes: a Solid Waste Services Tax of $1.05 per ton, a Landfill Closure and Contingency Tax of $0.50 per ton, and a Solid Waste Recycling Tax of $1.50 per ton. For waste in liquid form, rates for the Solid Waste Services Tax and the Landfill Closure and Contingency Tax are 0.002 cents per gallon, and rates for the Solid Waste Recycling Tax are 0.00225 cents per gallon.

In Pennsylvania, counties are required to create trust funds to finance the costs associated with closing landfills and to finance these trust funds with disposal fees. The per ton disposal fee is calculated by dividing the estimated cost of closing the landfill by the estimated weight of the garbage that will be sent to the landfill before it is closed.

Texas levies a fee of $1.50 per ton on the disposal of all municipal solid waste. In part, fee revenues are used to fund the state's efforts to control solid waste. They are also used to provide grants to local governments and other organizations for recovering resources, minimizing the amount of waste, and developing programs that help enhance the efficiency of solid waste management facilities.[54]

It is unclear whether these landfill taxes have produced a significant incentive effect. Moreover, as is the case with variable rate programs, increasing the price of waste disposal creates incentives to use alternative disposal options. The District of Columbia's experiences with its nearby Lorton, Virginia, landfill is a case in point. Of the $64.39 per ton tipping fee at Lorton, $28.39 per ton was reserved for the District's residential recycling program. Private trash haulers have reportedly trucked waste to landfills located elsewhere in Virginia and southern Pennsylvania, where tipping fees are lower. The resulting loss in revenue from tipping fees led the District to suspend its recycling program in 1995. It subsequently reestablished the program

but with reduced service. Because of the instability of these tipping fee revenues, the District now relies on general revenues to fund its recycling program.

4.4.3 Hazardous Waste Taxes

A 1998 survey identified 30 states that impose taxes on the generation or management of hazardous wastes.[55] Some of these states have higher tax rates for landfilling than for incineration, and several states impose no tax on incineration. In some states, taxes vary according to the type of waste or whether the waste was generated outside the state, or both of these factors. In addition, on-site disposal of hazardous waste is exempt from taxes in some states. Vermont and California each levied taxes of more than $100 per ton for land disposal of hazardous waste, and six other states levied taxes of more than $50 per ton. The mean tax level for all states, including those with no tax, was $21 per ton. To put these taxes into perspective, in the late 1980s a middle-of-the-range estimate of the costs associated with the disposal of hazardous waste was $132 per ton.

California levies fees on both the generation and disposal of hazardous waste. As shown in Table 4-8, California imposes taxes on hazardous waste disposal that range up to $220 per ton. Generation fees vary by quantity generated, with rates fixed within a given range of tons per year. (See Table 4-9.)

Table 4-8. Hazardous Waste Landfill Fees in California

Waste Category	Rate ($/ton)
Non-RCRA cleanup wastes	$7.50
Other non-RCRA wastes	17.94
Ores and minerals	14.30
Extremely hazardous waste	220.00
Restricted hazardous waste	220.00
Hazardous waste (RCRA)	44.44

Source: California Department of Toxic Substances Control.

Table 4-9. California Hazardous Waste Generation Fees

Weight of Waste Generated (tons/year)	Fee ($)	Middle Range of Rates Charged ($/ton)
Less than 5	$0	$0
5 to 25	169	11.3
25 to 50	1,348	35.9
50 to 250	3,371	22.5
250 to 500	16,855	44.9
500 to 1,000	33,710	44.9
1,000 to 2,000	50,565	33.7
More than 2,000	67,240	<33.7

Source: California Department of Toxic Substances Control.

According to the California Department of Toxic Substances Control, the two fees are intended to raise revenue and to encourage waste minimization. The tonnage of hazardous waste sent to landfills has declined in the last 10 years. It is difficult, however, to determine to what extent this

decline is due to the fees, as many other factors could influence generation and disposal practices.

Hazardous waste is also subject to numerous other administrative fees in California. Efforts are currently being made to simplify the existing fee structure, which is widely viewed as too complicated.[56]

The findings of several studies suggest that taxes on hazardous waste have had an impact on disposal. Two engineering studies, one by the Congressional Budget Office (1985) and the other by EPA (1984), concluded that such taxes significantly reduced the disposal of hazardous waste in landfills. By 1987, 10 states had taxes exceeding the level at which EPA predicted a 60% reduction in landfill disposal. Another study examined empirical evidence on the effects of a twofold rise in hazardous waste taxes in New York in 1985. It found that the quantity of hazardous waste disposed of in the state decreased significantly. Because taxes on incineration remained constant in this case, the amount of waste incinerated rose, but it did not increase as much as the amount of waste sent to landfills declined.[57]

Sigman (1996) studied the impact of landfill and incineration taxes on the generation of four types of chlorinated solvent wastes from metal cleaning. Using data from the 1987–1990 Toxics Release Inventories, the study included a cross-section analysis of generation across states and used a number of independent variables, including disposal taxes in the state of generation and in neighboring states. It also studied the impact of disposal taxes and other factors on the choice of disposal method. The study reached two conclusions. First, elasticities of waste generation with respect to these taxes on disposal were in the range of -7 to -22, meaning that the quantity of hazardous waste sent to landfills or incinerators was very sensitive to the tax. Second, the taxes encouraged generators to choose incineration or other treatment options as their waste management method, instead of landfilling. However, the estimated impact of these taxes was minor because the fees were low in comparison to the total costs of waste management.

Although "[s]tates' experience suggests that taxes may provide an alternative to the standard-based policies now used for most hazardous waste regulation," Sigman found, the design and implementation of such taxes pose several potential problems, including the determination of tax levels. To maximize the efficiency of these taxes, they should reflect the social cost of hazardous waste generation. This cost, however, depends on the type of waste, the method of disposal, the geographic location, and various other factors that are difficult to assess and incorporate into tax structures. If, on the other hand, taxes are too high, they could encourage illegal dumping, of which even a small amount could cause enough environmental damage to offset the increased efficiency achieved by taxes. "In the presence of illegal dumping," the study states, "a deposit/refund program may be substantially less costly than a waste-end tax."

Because current federal regulations impose high costs on generators of hazardous waste, there may already exist sufficient incentives to reduce the generation of hazardous waste. If existing regulatory incentives are sufficient, taxes could raise the costs of waste disposal to a level that is higher than what is socially desirable.

4.5 Product Charges

Product charges are imposed on either a product or some characteristic of that product. Economic theory suggests that products whose disposal causes environmental pollution should

be taxed to reflect the added social costs they impose. To date, the theoretically ideal product charge has not been imposed. Although some product charges may be large enough to have a significant effect on behavior, most of them are intended primarily to raise revenue. Product charges typically take the form of advance disposal fees (ADFs) or of taxes on a product designed to fund its proper disposal after use.

A traditional regulatory mechanism that competes with the product charge is termed "extended producer responsibility;" it relies on take-back requirements placed on the manufacturers of certain products. Producers bear the responsibility for ensuring the proper disposal of post-consumer waste. Although some states have implemented extended producer responsibility for selected products, the federal government has never endorsed such an approach.[58] Several European nations have also enacted rules regarding extended producer responsibility.

4.5.1 Federal Product Charges

A number of federal product charges have been imposed, including charges on fuels, transportation, transport equipment, and chemicals. Most of these taxes are intended to raise revenue. Consequently, they have minimal effect on incentives. For a list of federal environmental excise taxes, see Barthold (1994). The following subsections in this chapter discuss the Superfund taxes, taxes on fuel-inefficient automobiles, and taxes on chlorofluorocarbons (CFCs).

4.5.1.1 Superfund Taxes

Until the end of 1995, the federal government imposed taxes on oil, chemicals, and business profits to fund the cleanup of inactive hazardous wastes designated under Superfund. This activity was financed by taxes on crude oil (9.7 cents per barrel), chemicals ($0.22-$4.87 per ton), and gross business profits (0.12% of amounts over $2 million).[59] Congress did not extend the tax after its scheduled expiration. The oil and chemical taxes could be regarded as product charges or raw material input taxes. Their primary purpose, however, was to raise revenue, rather than to prevent pollution.

4.5.1.2 Taxes on Gas Guzzlers

Introduced in 1978, the gas-guzzler tax is imposed on the sale of new automobiles with a fuel efficiency of less than 22.5 miles per gallon. Sports utility vehicles (SUVs), minivans, and trucks are not subject to the tax. The magnitude of the tax ranges from $1,000 to $7,700 per automobile, depending on fuel efficiency. Revenues, which amounted to $144.2 million in 1992, contribute to the Highway Trust Fund.[60] Most gas-guzzler tax payments have been made by buyers of foreign luxury cars.

Two measures that could have effects similar to gas-guzzler taxes are fines for the failure to meet corporate average fuel efficiency (CAFE) standards and taxes on luxury cars. CAFE fines, which could be regarded as non-compliance fees, are based on the extent to which an auto manufacturer violates CAFE standards. These fees could provide an incentive for manufacturers to invest in the design of fuel-efficient cars. Luxury taxes are set at 10% of the sales price of a car in excess of a base level, which was originally set at $30,000 but has since increased. Since many luxury cars are relatively fuel-inefficient, luxury car taxes could encourage the use of more fuel-efficient vehicles.

4.5.1.3 Ozone-Depleting Chemicals

In accordance with the 1987 Montreal Protocol on Substances that Deplete the Ozone Layer and subsequent amendments, the production of ozone-depleting chemicals (ODCs) such as chlorofluorocarbons (CFCs) for most uses in the United States was phased out by January 1, 1996. To facilitate the phaseout, the United States imposed a tax on selected ODCs on January 1, 1990; the government expanded that tax to other ODCs the following year. The magnitude of the tax was determined by multiplying a base rate per pound of ozone-depleting chemicals produced or imported by an ozone depletion factor that varied according to the type of chemical. Initially set at $1.37 per pound, the base tax amount increased to $3.35 in 1993, $4.35 per pound in 1994, and $5.35 in 1995. Since 1996, the annual increase in the base tax amount has been $0.45 per pound per year. The ozone depletion factors, which are intended to indicate each chemical's damage to the ozone layer, were set by the Montreal Protocol.[61] For example, methyl chloroform had a factor of 0.1, whereas Halon-1301 had a factor of 10.0, which meant that methyl chloroform was taxed at $0.53 per pound in 1995 while Halon-1301 was taxed at $53.50 per pound that year. The tax was imposed on producers and importers of these chemicals as well as on the importers of products that contained these chemicals or that used them in their production processes.

Unlike most product charges, this tax is widely credited with a significant incentive impact. ODC consumption (expressed in CFC-11 equivalents using the above-mentioned ozone depletion factors) fell from 318,000 metric tons in 1989 to 200,000 metric tons in 1990, the year the tax was introduced.[62] A Congressional Research Service (CRS) study concluded, "the CFC tax has clearly accelerated the rate at which CFC uses are being substituted for and the rate at which CFCs are being recovered for reuse." CRS adds that the tax was also intended to raise revenue for the federal government and to capture a portion of the windfall revenues experienced by ODC producers as a result of the tightened supply of ODCs.[63]

According to the World Resources Institute (WRI), the tax raised $2.9 billion in its first five years. WRI adds that the phaseout cost less than EPA's original projection.[64] In 1988, EPA predicted that the average cost of reducing the use of CFCs by 50% would be $3.50 per kg. In 1992, EPA revised its cost estimate to only $2.45 per kilogram.

The tax is believed to have contributed significantly to the reduction in ODC use. Several other factors, however, also had an impact, including the establishment of an ODC trading system (described in Chapter 6); the well-publicized intentions of the federal government to phaseout ODC use; and EPA's work with the private sector on ODC recycling and the use of substitutes. As a result of the multiplicity of these policy measures, it is difficult to isolate the effects of the CFC tax.

4.5.2 State Product Charges

States have imposed charges on a number of products, including beverage containers, fertilizers, furniture, motor oil, pesticides, refrigerators, solvents, and tires. Some of these have taken the form of advance disposal fees (ADFs). Hoerner (1998) identified approximately 400 environmental taxes that are imposed at the state level. Some taxes, such as those on the sale of tires, are found in well over one-half of the states. Litter taxes, which are imposed on the sale of products that commonly are found in litter, are found in a handful of states. Many states impose severance taxes on the removal of minerals from the ground. This section highlights a few of the charges that states impose on different products.

4.5.2.1 Tire Charges

Fees are imposed on automobile tires in at least 34 states. The fees generally range from $0.25 to $2.00, but Texas has a fee of $3.50 on truck tires. Some of the fees are assessed as a percentage of the price of the tires. Given the low magnitude of the charge levels relative to the price of tires and the lack of substitutes for tires, the incentive effect of state tire charges on the buyers of tires is likely to be minimal; however, the system does encourage the proper disposal of tires. Most fees were instituted as part of a scrap tire program, which included restrictions or bans on the disposal of used tires in landfills.[65] States use their tire fee revenues to subsidize the development of markets for end uses of used tires, such as rubberized surfaces, noise barriers, blasting mats, and rubberized asphalt pavement. Fee revenue also may be used to pay for the cleanup of tire disposal sites and for the enforcement of laws designed to prevent illegal disposal. The effect is that tire buyers pay for the proper disposal of used tires through these tax/subsidy schemes.

As shown in Table 4-10, the federal government also imposes product charges on tires, charges that range from $0.15 to $0.50 per pound. Revenues from these charges are allocated to the Highway Trust Fund.[66]

Table 4-10. Federal and State Tire Charges

Taxing Authority	Fee Structure	Uses of Revenues
Federal Government	Tires 40–70 lbs: $0.15/lb x weight exceeding 40 lbs Tires 70–90 lbs: $4.50 + $0.30 x weight exceeding 70 lbs >90 lbs: $10.50 + $0.50 x weight exceeding 90 lbs	Highway Trust Fund
State Governments (34)	$0.25 to $2.00 for passenger car tires	Tire recycling, tire disposal site cleanup, other similar activities

Source: Fullerton. 1995, p. A7; *Scrap Tire News Legislative Report,* pp. 18–19.

4.5.2.2 Fertilizer Charges

At least 46 states impose charges on the sale of fertilizers. Nebraska's fee of $4 per ton is one of the highest; most are below $1 per ton. Assuming fertilizer prices of $150–$200 per ton, the charges are too low to significantly influence the use of fertilizer. The most common use of these charge revenues is the inspection of fertilizers and fertilizer storage by state agencies.

4.5.2.3 Rhode Island Hard-to-Dispose Material Tax

Rhode Island imposes charges on "hard-to-dispose material," such as lubricating oil, antifreeze, organic solvents, and tires. The fees are 5 cents per quart of lubricating oil, 10 cents per gallon of antifreeze, 0.25 cents per gallon of organic solvents, and 50 cents per tire. Although the incentive effects are assumed to be minimal, the charge incorporates at least some of the disposal costs of these various materials into their prices. Charge revenues are deposited in a "hard-to-dispose material account" that funds educational and technical assistance programs, grants, research, and collection centers for hard-to-dispose material.

4.5.2.4 Florida Advance Disposal Fee (ADF)

In a two-year experiment with ADFs, on October 1, 1993, Florida instituted a fee of one cent on a variety of containers. Exempted from the tax were containers made of plastic, plastic-coated paper, and glass that had average recycling rates of at least 50%; glass containers having 35% recycled content; and plastic containers having 25% recycled content. Paper and plastic

packaging were also subject to the ADF, with exemption possibilities similar to those for glass and plastic containers. Since the Florida Department of Environmental Protection determined that aluminum and steel cans had already fulfilled the 50% recycled content requirement, they were exempt from the tax.[67] To further encourage recycling, the tax was doubled the second year it was in effect.

Despite the low-fee level, manufacturers reportedly went to considerable trouble to obtain exemptions. Their efforts appear to have been due more to the public relations value of being exempted than to the ADF itself.[68]

One interesting aspect of this ADF is the wide range of options that it gave manufacturers to obtain exemptions. These options included working with other firms in the same sector to raise recycling rates, increasing the recycled content of packaging, averaging the amount of recycled content over various containers, and recycling equivalent amounts of previously discarded waste into other products. In theory, the variety of options should have allowed each firm to select a relatively cost-effective way to promote recycling. Most firms sought exemption based on use of recycled content. However, at least two companies, Piper Plastics and Anheuser-Busch, have built, or plan to build, recycling facilities. Both companies cited the ADF as the decisive factor in their decisions to build these facilities in Florida.[69]

One disadvantage of including various exemption possibilities in the ADF was the potential administrative burden of assessing requests for exemptions. At least one industry group criticized the ADF as deceptive, burdensome, and administratively costly.[70] The ADF expired in October 1995.

4.5.2.5 North Carolina ADF

North Carolina imposes a fee on "white goods," such as refrigerators and freezers. Beginning in 1995, the ADF was $10 for products containing CFCs and $5 for those without CFCs. Effective July 1998, the tax was reduced to a flat $3 per item and extended to July 2001.[71]

Although the ADF probably does not have a significant incentive effect, it generates revenues to manage the disposal of white goods. With the introduction of the ADF, county landfills were required to accept old white goods for disposal, free of charge. Counties received 75% of the ADF revenue on a per capita basis to fund the removal of CFCs and programs that recycle white goods and metal products. Additional ADF revenues were available for those counties whose disposal costs exceeded their per capita allocations of ADF funds from the state. In July 2001, local governments will be authorized to impose disposal fees for white goods.

4.5.2.6 Texas Clean Fuel Incentive Surcharge

In 1989, Texas introduced a 20-cent-per MMBtu-surcharge on boiler fuel oil. The surcharge applies only to industrial and utility boilers that are capable of using natural gas, that are in use between April 15 and October 15 of each year, and that are located in ozone non-attainment areas having populations of 350,000 or more. As part of a larger state effort to encourage the use of natural gas, the surcharge specifically addresses ozone problems that occur in the summer months and that caused by NOx emissions. Used oil and fuels derived from hazardous waste are exempt from this fee. Surcharge receipts are deposited in the State General Revenue Fund.[72] According to one official on the Texas Natural Resource Conservation Commission (TNRCC), the surcharge has had little if any incentive effect because few facilities used fuel oil before the surcharge was introduced.

4.6 Road User Fees

Tolls are the most common type of road user fee for financing road construction in the United States. Because these fees are purely revenue-raising mechanisms that are unrelated to environmental protection, they are not discussed in this report. However, another type of road user fee, congesting pricing—the tolls that vary by time of day or how heavily the road is being used—is intended to reflect some of the social costs of traffic congestion. One of these costs is increased emissions per mile traveled. One study estimated that if the current level of vehicular traffic in southern California flowed smoothly, emissions from motor vehicles would decrease by approximately 13%.[73] For this reason, congestion pricing is of considerable interest as an environmental management tool. Moreover, economic analysis indicates that the economic gains from congestion pricing can be large, much greater than any other traffic management tool.[74] Congestion pricing makes users aware of the impact their use of a highway has in terms of increasing the travel time of others. By making users pay the full social cost of travel and not just their private cost, highway use declines and traffic flows more smoothly.

In December 1995 in southern California, a congestion-based 4-lane toll road opened in the median of the existing eight-lane Riverside Freeway (SR-91). The road was built by private funds from the California Private Transportation Company (CPTC), and the same firm operates the toll system. CPTC is free to determine toll levels, but it is subject to a cap on the rate of return on its investment. Five different toll levels range from $0.25 to $2.50 per 10-mile trip, depending on the time of day. Toll prices are announced in advance, so motorists can plan their trips accordingly. Windshield-mounted transponders allow motorists to pay for toll-lane use without stopping at toll booths. High-occupancy vehicles (HOV) having three occupants, public transit vehicles, zero-emission vehicles, and vehicles with a disabled-person license plate are exempt from paying the tolls.

By March 1996, over 30,000 transponders were in use, a level the project had not expected to reach until late June. In interviews with the *Los Angeles Times,* express lane users have reported time savings of more than 30 minutes. CPTC adds that the toll lanes have not only reduced travel times for their users but also diminished congestion on the adjacent freeway.[75]

As part of its Value Pricing Pilot Program, the Federal Highway Administration is studying the experiences of SR-91 and is funding several other projects. Some of the pilot projects are highlighted below.[76]

- In March 1998, San Diego began a pilot project that charged for the use of lanes in the I-15 freeway based on the time of day and the level of congestion. In the first four months of the project, almost 4,000 transponders had been distributed.
- Houston began a pilot project in January 1998 that allowed a limited number of users of HOV-2 carpools into HOV-3 carpool lanes for a fee of $2 during peak travel periods.
- Beginning in August 1998, variable pricing is being used to manage traffic flows on two bridges in Ft. Myers, Florida. The program offers drivers a 50% reduction in the usual toll if they travel on either side of peak travel periods.

4.7 Wetland Compensation Fees

Wetland compensation fee systems are programs in which a regulatory agency collects fees in lieu of requiring a developer to compensate for wetland losses through their on-site mitigation or through their acquiring of credits generated by a mitigation bank. (This system is discussed in greater detail in Chapter 6.) The fees are used for mitigation projects undertaken by an agency or non-profit organization. Wetland compensation fees offer the flexibility to mitigate wetland loss in a cost-effective manner. Instead of doing mitigation at the project site, a developer pays a fee to another organization to perform mitigation activities in more suitable locations.

Fee-based mitigation mechanisms have been used in Arkansas, Florida, Illinois, Louisiana, Maryland, Mississippi, Texas, and Virginia. The magnitude of the fees is usually set to cover costs such as mitigation, land acquisition, project planning, and site management.

Initiated in 1986, Florida's Mitigation Park Program is the oldest fee-based wetland mitigation system in the United States. Fees paid by wetlands developers in lieu of on-site mitigation are deposited in the Florida Game and Fresh Water Fish Commission's Fish and Wildlife Habitat Trust Fund. These charges finance the purchase and subsequent management of large, biologically defensible Mitigation Parks. These parks, which range in size from 400 to 1,500 acres, are publicly owned but may be managed by either government entities or non-profit organizations.

To participate in the program, developers need approval from the regulatory agency with which they are working. Fees depend on the amount of wetlands developed, the type of habitat impacted, and the species present at the site of the development. The developer pays one fee to finance land acquisition; a second fee (15% of the first fee) to fund site management; and a third fee (7% of the sum of the first two charges) to their state's tax department. Interest accrued on the second fee is used to fund site management. As of 1999, the Mitigation Park Program had received more than $17 million in deposits and had purchased in excess of 7,000 acres.[77]

In Maryland, the mitigation fees paid by developers into the Nontidal Wetlands Compensation Fund depend on the number of acres and type of wetlands impacted and the costs of wetland restoration and construction. The mitigation ratio (the number of acres that must be enhanced, restored, or created for every acre impacted) is 1:1, 2:1, or 3:1, depending on the type of wetland impacted. The 3:1 ratio applies to wetlands of special concern to the state. Land acquisition costs are assessed on the basis of the prevailing market prices for agriculturally zoned or low-density land that has little potential for development. Restoration and construction costs are assessed at $10,000 per acre in low-cost counties and $50,000 per acre in high-cost counties. Counties with a relatively large amount of farmed hydric soils, which indicates the former presence of wetlands, are placed in the low-cost category. Losses of less than 5,000 square feet of wetlands do not require mitigation.

In Louisiana, companies are required to offset their damage to coastal wetlands by performing a mitigation project on their own property or by contributing mitigation fees to the Louisiana Wetlands Conservation and Restoration Fund. Mitigation fees range from $1,500 to $12,000 per acre, depending on the environmental quality of the wetland that is lost to development.

The costs, benefits, and incentive effects of wetlands compensation fees have not been comprehensively studied, and it would be difficult to determine those effects given the varied functions that wetlands perform. Some evidence suggests, however, that such fees have been

beneficial. Clustering individual mitigation activities into selected areas increases the viability of the wetlands. Moreover, the fact that developers have participated in fee-based schemes suggests that paying fees is more economical for them than conducting on-site mitigation activities on their own.

4.8 Grazing Fees

Federal and state governments charge fees for animal grazing on public lands. Federal fees date back to 1906 and are currently charged for grazing on about 167 million acres of Bureau of Land Management (BLM) land and 94 million acres of Forest Service land. About 10% of the livestock producers in the 16 Western states participate in the program. Grazing on BLM land accounts for approximately 2% of total beef-cattle feed in the 48 contiguous states. Fees are charged based on a formula that was established by the 1978 Public Rangelands Improvement Act (PRIA).[78] The PRIA formula is based on private grazing rates, beef cattle prices, and the cost of livestock production. The fee is expressed in animal unit months (AUM), where one AUM is the amount of forage required to sustain one cow and her calf, one horse, or five sheep or goats for a month. The fee in 2000 is a minimum of $1.35 per AUM, the same minimum fee imposed by President Reagan in 1986.[79]

The theory behind such fees is that animal owners should pay fair market value for the use of the land and that they should bear the costs of the damage inflicted by their animals on that land. However, current fee levels are widely believed to be lower than what would be charged if the grazing rights were being sold by a private owner. That belief is supported by the fact that properties with attached federal grazing rates command higher market prices than properties without such grazing rights. Moreover, the fees may not adequately compensate the federal government for the environmental destruction caused by the movement of privately owned animals on public lands. To the extent that the fees are too low, they amount to a form of subsidization. Therefore, they are included in the discussion of environmentally harmful subsidies in Chapter 7.

4.9 Minnesota Contamination Tax

The Minnesota Contaminated Property Tax, which entered into effect in fiscal year 1995, is levied on the "contamination value" of property, i.e., the difference in the value of the property before and after contamination. Owners of contaminated property who do not have approved cleanup plans pay this fee at the full property tax rate. The contamination tax is halved for owners who have filed an approved cleanup plan. Owners who purchase contaminated land without being notified by the seller of the contamination pay 25% of the full property tax rate until they file a cleanup plan, after which the tax rate decreases to 12.5%. According to a local tax official, the tax gives property owners "a strong impetus to clean up."[80]

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5. Deposit-Refund Systems

5.1 Introduction

Deposit-refund systems (hereafter referred to as "deposit systems") are a combination of a product charge (the deposit) and a subsidy for recycling or proper disposal (the refund). Manufacturers or vendors of products that are subject to deposits incur additional costs in handling returned products, but these costs are often partially offset by the interest earned on deposits, unclaimed deposits, and sales of collected, used products.

One of the objectives of a deposit system is to discourage illegal or improper disposal. Waste products that are discarded improperly have higher social costs than those disposed of properly, since such discards can become an eyesore or even an environmental or health threat. Improperly discarded waste is also quite expensive to redirect to the legal waste stream. Deposit systems are commonly applied to beverage containers, in part because these containers make up a large proportion of roadside litter. Another important objective of a deposit system is to divert recyclable items from the waste stream.

In addition to being used for beverage containers, deposit systems have also been used for other products such as pesticide containers, lead-acid batteries, and tires. Some of these systems are voluntarily implemented by industry, whereas others are implemented by state or local authorities. While federal legislation on deposits has been considered, none of these proposals has been enacted.

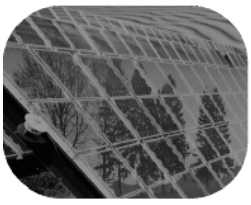
Several studies have concluded that deposit systems are more cost-effective than other methods of reducing waste disposal, such as traditional forms of regulations, recycling subsidies, or advance disposal fees (ADF) alone. A recent study by Palmer et al. (1995) concluded that a 10% reduction in waste disposal would cost $45 per ton of waste reduced under a deposit system, compared to $85 per ton under advance disposal fees and $98 per ton under recycling subsidies. However, the study noted that the relatively high administrative costs of a deposit system could outweigh these cost savings.

Administrative costs are an important consideration when determining whether to create deposit systems. Ackerman et al. (1995) estimate that administrative costs average about 2.3¢ per container—more than $300 per ton for steel containers and $1,300 per ton for aluminum cans—in states with traditional legislation on beverage container deposit systems. A full accounting of the desirability of deposit-refund systems would compare administrative costs and the costs imposed on consumers with the benefits of reduced disposal costs, energy savings, reduced litter, and other environmental benefits. Deposit-refund systems appear best suited for products whose disposal is difficult to monitor and potentially harmful to the environment. When the used product has economic value, the private sector may initiate the program.


Pollution Charges, Fees, Taxes

Deposit-Refund Systems


Trading Programs


Subsidies for Pollution Control


Liability Approaches

Information Disclosure


Voluntary Programs

Fullerton and Kinnaman (1995) conclude that fees for waste collection should be priced as if disposal and recycling are the only two disposal options. If illicit burning or dumping is also an option, the optimal policy is "a tax on output plus a rebate on proper disposal," in other words, a deposit system. While variable pricing programs for waste collection have the potential to give waste generators an incentive to improperly dispose of waste, deposit schemes give them an incentive to return waste for proper disposal or for recycling. For example, with beverage containers, roadside litter is an important issue, so a deposit system is a good policy choice.

As noted in this chapter, studies have found that deposit systems result in higher recovery rates of used products and less contamination of recyclables than curbside recycling programs. However, deposit schemes are also believed to cost more to administer than curbside programs.

5.2 Beverage Containers

Beverage containers have been subject to both voluntary and mandatory deposit schemes. In the past, the beverage industry made extensive use of voluntary schemes to recover refillable bottles. However, this practice nearly disappeared following the introduction of cheaper "disposable" containers.

As shown in Table 5-1, 10 states have passed "bottle bills" that mandate beverage container deposits ranging from 2.5¢ to 15¢ per container, the most common amount being 5¢ per container. Beer and soft drink containers are subject to deposits in all 10 states; mineral water containers in six states; malt containers in four states; and wine coolers, liquor, and carbonated mineral water containers in three states. Michigan includes containers of canned cocktails, New York includes containers of soda water, and Maine includes containers of juices and tea. In most states, deposit requirements apply to the full range of container types, including glass, plastic, aluminum, and steel. The State of Delaware, however, has exempted aluminum from its requirement.

Most states require retailers to take back containers that are in their product line, even if the container was purchased elsewhere. In Maine, however, retailers located within a certain distance of a certified redemption center are not obligated to take back containers. In addition to retail outlets, "redemption centers" accept containers in most states. Any organization may operate such centers, although certification of the center may be required. Some redemption centers and retailers could earn profits from mandatory handling fees of 1.5¢ to 3¢ per container, fees that are paid by distributors. As shown in Table 5-1, distributors usually keep unclaimed deposits.

Not included in this table is a deposit system that has been in effect in Columbia, Missouri, since 1982. Under this system, consumers pay deposits of 5¢ on containers of beer, soft drinks, malt, and carbonated mineral water. Although retail stores are required to take back containers, no handling fees are mandated. The overall rate of redemption is estimated to be 85% to 95%.

Although it is beyond the scope of this report to describe in detail every deposit system that is listed in Table 5-1, systems in Maine and California are discussed below as illustrative examples.

Table 5-1. State Beverage Container Deposit-Refund Systems

State	Since	Containers Covered	Deposit, Refund Amounts	% Returned	Redemption Sites	Unclaimed Deposits	Handling Fees
California	1987	Beer, soft drinks, wine coolers, mineral water	<24 oz, 2.5¢ >24 oz, 5¢	Aluminum 88% Glass 76% PET 50% Overall 84%	State-certified centers	Program administration grants	Per container processing fee
Connecticut	1980	Beer, malt, soft drinks, mineral water	Minimum 5¢	Cans 88% Bottles 94% Plastic 70-90%	Retail stores and redemption centers	Kept by distributor or bottler	Beer, 1.5¢; Soft drinks, 2¢
Delaware	1982	Non-aluminum beer, malt, soft drink, mineral water <2qt	5¢	Insufficient data	Retail stores and redemption centers	Kept by distributor or bottler	20% of deposit
Iowa	1979	Beer, soft drinks, wine, liquor	5¢	Aluminum 95% Glass 85% Plastic 70-90%	Retail stores and redemption centers	Kept by distributor or bottler	1¢
Maine	1978	Beer, soft drinks, wine, wine coolers, liquor, juice, water, tea	Beer, soft drinks, juice: 5¢. Wine, liquor: 15¢	Beer, soft drink 92% Spirits 80% Wine 80% Juices, non-carbonated 75%	Retail stores and redemption centers	Kept by distributor or bottler	3¢
Mass.	1983	Beer, soft drinks, carbonated water	5¢	Overall 85%	Retail stores and redemption centers	State	2.25¢
Michigan	1978	Beer, soft drinks, canned cocktails, carbonated and mineral water	Refillables: 5¢; Nonrefillables: 10¢	Overall 93%	Retail stores	75% environmental programs, 25% handling fees	25% of unclaimed deposits
New York	1983	Beer, soft drinks, wine coolers, carbonated mineral water, soda water	5¢	Wine cooler 63% Soft drink 72% Beer 81%	Retail stores and redemption centers	Kept by distributor or bottler	1.5¢
Oregon	1972	Beer, malt, soft drinks, carbonated mineral water	Standard refillables: 3¢; Others: 5¢	Overall 85%	Retail stores	Kept by distributor or bottler	None
Vermont	1973	Soft drinks, beer, malt, mineral water, liquor	Soft drinks, beer: 5¢ Liquor: 15¢	Overall 85%	Certified redemption centers and retail stores	Kept by distributor or bottler	3¢

5.2.1 Maine Bottle Deposit System

Maine introduced a deposit system for beer and soft drink containers on January 1, 1978.[81] In distributing beer and soft drinks to retailers, distributors (or manufacturers) levy a 5¢ deposit. Retailers in turn include this amount in their sales prices. The customer can obtain a 5¢ refund by returning the container to any retailer that sells the product or to a redemption center.

Distributors (or manufacturers) return the 5¢ deposit to retailers for every returned container. In addition, retailers are reimbursed a 3¢ handling fee, which provides a strong incentive for retailers to promote the return of containers. At times, demand by retailers for used containers is so high that customers can obtain refunds 10% to 20% higher than the deposit amount. In some places, reverse vending machines also offer refunds for returned containers.

Distributors typically pick up used containers while distributing new products. Distributors (or manufacturers) have at least three sources of revenue to offset the costs of handling containers. First, they can sell the collected containers to processors and keep unclaimed refunds and handling fees. Second, in the past distributors had to share one-half of their unclaimed refunds

with the state government. Distributors then complained about their costs. As a result of their efforts, distributors were allowed to retain all unclaimed refunds, effective January 1, 1996.[82] Third, distributors earn revenue by the interest earned on deposits and handling fees before redemption.

The deposit system was expanded to include liquor and wine containers on September 1, 1990, and bottled water, iced tea, and juice on December 31, 1990. This action resulted in new (and perhaps less cost-effective) types of deposit-refund arrangements. Unlike soft drinks and beer, several companies in the same geographic area often distribute juice. Consequently, each one often has difficulty determining which containers it is responsible for collecting. As a result, some distributors may pay more in refunds than they receive in deposits, while for others, deposits may exceed refunds. Because distributors fear that they will lose money in collecting deposits and paying refunds, manufacturers have had to collect deposits themselves and contract independent collectors to redeem containers. This method may be less cost-effective than collection by distributors who already travel to collection sites when they distribute new products.

Two redemption problems have been identified. One, the in-state distribution of containers can take place without deposit fees being imposed. Second, the in-state redemption of containers that were originally purchased outside the state also occurs. These errors have resulted in redemption rates in excess of 100% for certain products. For example, Coca-Cola reported redemption rates for Minute Maid Juices® and Hi-C® of 142% in 1993, 281% in 1994, and 126% in 1995. The same type of bottle deposit fraud is estimated to cost the state of Michigan more than $16 million per year.[83] Nearly one-third of the cans returned for recycling in southeast Michigan were purchased outside the state.

Retailers have complained that the deposit system (especially the expanded one) requires more storage space and more time for recordkeeping, receiving bottles and sorting bottles. In addition, traces of beverages in containers have attracted pests. The administrative burden probably became more severe following the expansion of the system because significant variations in the types of juice containers make them more difficult to sort and store.

The deposit system in Maine is reported to have significantly reduced litter. A 1979 study by the Maine Department of Transportation found that total litter declined by 10% and that container litter declined by 56%.[84] Since completion of the study, the redemption rate rose. Thus, it is likely that container litter has decreased further. In addition to reducing the incidence of litter, the deposit system also gave incentives to scavenge bottle and can litter to obtain refunds. The deposit also may have increased recycling capacity by creating a reliable supply of recyclable materials. Three container-processing facilities were established in Maine as a result of the

deposit system. These facilities can, in turn, stimulate demand for recyclables that are collected outside the deposit system.

Criner et al. (1991) estimate that the costs of Maine's deposit system exceed those of curbside collection programs, but the system also results in higher collection rates. They surveyed retailers, redemption centers, distributors, and manufacturers to develop cost estimates for the deposit system. Using a computerized waste management model, Criner et al. estimated that retailers incurred costs of 2.4¢ to 3.1¢ per container under the original deposit system and virtually the same costs under the expanded system. The high end of this range applies to smaller retailers. Based on these estimates, the handling fee of 3¢ per container appears to be set at a level that covers retailers' costs. The handling fee was originally one cent, but it rose to 2¢ in 1980 and to 3¢ in 1990.

Criner et al. estimated the costs incurred by distributors at 5.7¢ per container for beer and soda and 7.5¢ for juice products. (These estimates do not include the costs incurred by consumers in returning containers for refunds.) Collection costs, storage facilities, and labor can be more expensive for containers of juice than for other beverage containers. Two reasons for this difference are suggested: (1) significant Variations in the types of juice containers make them more expensive than other containers to sort and store; and (2) manufacturers hire companies specifically to collect used juice containers, which raises costs.

Table 5-2 presents cost estimates for collecting recyclables under curbside programs and deposit systems for a hypothetical Maine community of 25,000 inhabitants. The estimates are based on the assumption that curbside collection is present. They suggest that the costs of deposit systems are not only significantly higher than curbside programs but that they also raise the costs of curbside collection when the two activities are implemented at the same time. This latter effect is probably caused by the diversion of recyclable containers away from curbside programs, which reduces the economies of scale that were present in these programs.

Table 5-2. Beverage Containers: Estimated Tons Recycled and Costs of Collection in Maine

.Collection Method	No Deposit System	Original Deposit System	Expanded Deposit System
Curbside Programs: tons recycled (cost per ton)	2,538 ($41)	1,917 ($80)	1,378 ($100)
Deposit Schemes: tons recycled (cost per ton)	0	1,138 (567)	2,037 (402)
Total: Tons Recycled (weighted average cost per ton)	2,538 (41)	3,055 (261)	3,413 (280)

Source: Criner et al. 1991, p. 50.

A significant portion of the costs of Maine's deposit system appears to be passed on to consumers. Criner et al. compared beverage prices in Maine with those of neighboring New Hampshire, Rhode Island, and Massachusetts. Prices were very similar for juices, which were not subject to deposits at the time, but they were higher in Maine for soda and beer. As noted in Table 5-1, Massachusetts has a 5-cent deposit, as does Maine. Criner et al. speculate that the deposit system in Massachusetts has not resulted in beverage prices that are higher than those of New Hampshire and Rhode Island. Two reasons may explain this theory. First, distributors in Massachusetts face more competition than they do in Maine. Second, the state's population density limits the cost of handling and transporting used containers.

Criner et al. also found that the prices of most juices sold at two Maine supermarkets increased during the fall of 1990 to late February 1991. During the same period, the prices of orange juice in large plastic containers (64–96 oz.)—which was subject to deposit requirements—fell significantly. These findings suggest that expanding the deposit system to include juice containers an impact on the prices of these beverages. However, the price increases at the two stores were not compared with price changes elsewhere.

5.2.2 California Beverage Container Recycling Program

The 1986 California Beverage Container Recycling and Litter Reduction Act (AB2020) led to the creation of the Beverage Container Recycling Program (BCRP) in 1987. The program was originally intended to achieve an overall beverage container-recycling rate of 80%.

California's deposit system removes some of the constraints on vendors associated with other deposit systems. It introduces flexibility through simplification and leaves intact the incentive to consumers to return containers for proper disposal or recycling. California's system differs significantly from that of other states in two ways. First, retailers in the state are not responsible, for the most part, for collecting deposits and offering refunds to consumers. Second, used containers are not returned to their original distributors. Instead, manufacturers of most beverage containers pay a fee of 2¢ per container to a state recycling fund. When containers are returned, the fund pays 2.5¢ per container to the individual or organization that collected it. The beauty of this system is that anyone can be a collector: businesses or consumers. For containers of more than 24 ounces, the fee is 4¢, and the payment is 5¢. The payment may be passed on to consumers to entice them to return containers.

This system resembles an advance disposal fee, with fee revenues used to provide collection incentives. It is the result of compromise between various interests, including grocers (who did not want to manage used containers in their stores) and environmentalists (who wanted incentives to stimulate recycling).

Retailers with annual revenues of less than $2 million are not required to accept used containers, and larger retailers can be exempted if there is a recycling center located within a half-mile radius of their store. In areas where there are no centers, retailers usually hire a recycling business to establish a collection site or to install a reverse vending machine.

The state also assesses handling fees each year for each type of container. Manufacturers are required to either pay these fees or to guarantee a price for recyclable containers that is equal to the cost of collection. These requirements have increased the prices of recyclable containers in the state to the point at which incentives are provided to import these containers from other states. The law bans redemption for such imports.

In 1994 and 1995 the BCRP received about $333 million in revenues. However, this figure fell in the next few years because reductions in processing fees were required by 1995 legislation and container redemption increased. Unclaimed deposits and fees finance grants for private, non-profit programs and public-sector activities that help reduce litter and promote recycling.

Like all other states with deposit systems, California has specific labeling requirements for its beverage containers. All containers must bear the label "CA Redemption Value" or "California Redemption Value." To increase the public's awareness of the deposit system, the redemption value must be posted separately on store shelves, in advertising, and on retailer invoices.

The BCRP required that a government structure be created to manage the program. Initially, the program generated relatively low return rates. By the early 1990s, however, after the initial one-cent container fee had been more than doubled, the program had achieved return rates comparable to those of other states with deposit systems. As shown in Table 5-1, the overall recycling rate for beverage containers has risen to 84%.

Ackerman et al. (1995) observe that California's redemption system results in lower costs per redeemed container than systems in which redemption is managed through vendors. Containers are not sorted by brand and returned to their distributors as in other states. As a result, administrative costs are estimated at 0.2¢ per container in California and 2.3¢ in other states with deposit-refund laws.

5.2.3 Summary of Beverage Deposit/Refund Systems

Although data are incomplete, anecdotal evidence suggests that beverage container deposit laws have significantly reduced litter in several states, as would be expected. Maine reported decreases in litter following the introduction of its deposit scheme. Oregon reported a 75% to 85% decrease in roadside litter just two years after enacting deposit legislation.

Another probable impact has been an increase in the percentage of containers recycled, although this is difficult to confirm due to a lack of historical data on recycling. Wellman, Inc. (1994) estimate that the percentage of PET containers recycled in 1993 was about 80% in states with deposit systems (excluding California), 70% in California, but only 53% nationally. A 1990 GAO study found that almost two-thirds of the glass recycled in the United States. came from the deposit states, excluding California, even though these states made up only 18% of the U.S. population. If California is included, the 10 states accounted for more than 80% of this country's recycled glass. All deposit states also report return rates on aluminum cans that exceed the national average.

A related phenomenon is the relatively high market share for refillable containers in states with deposit schemes. In the case of beer containers, for example, all nine deposit states (excluding California) exceed the national average for market share of refillables. McCarthey (1993) calculated that the unweighted average for these nine states was 15% in 1990, which was three times the national average.

A comparison of deposit systems and curbside recycling programs by McCarthey (1993) found that deposits generally resulted in higher percentages of materials returned and less contamination of collected materials. Among states with large curbside programs but no deposit systems, the study found that none had attained a recovery rate equal to that of states with deposit schemes. Moreover, glass collected through curbside programs is much more likely to break before it can be sorted by color. Such breakage makes it difficult to recycle not only glass bottles but also other recyclables that may be contaminated with glass. The largest user of recycled polyethylene terephthalate reported that more than 90% of the PET it purchased came from states with deposit schemes because of its concerns over contamination.

The costs of deposit systems may be substantial for manufacturers, distributors, vendors, consumers, and regulatory authorities. One study found California's system to be more cost-effective than those in which retailers accept redeemed containers. Deposit systems could also divert revenues from, and lower the cost effectiveness of, curbside recycling programs. However, McCarthey (1993) found evidence suggesting that "local governments would achieve a greater

diversion of solid waste from disposal at a lower cost per ton if both a bottle bill and a curbside collection program were in place." One difference between the two approaches is that the costs of deposits are borne by manufacturers and distributors, who in turn pass on some costs to consumers, whereas the curbside programs are often funded by general revenues or waste tipping fees. Lack of information on the costs and benefits of litter reduction and recycling and on the costs incurred by consumers in returning containers makes it difficult to thoroughly evaluate beverage container deposit systems.

5.3 Lead-Acid Batteries

Lead-acid batteries are subject to mandatory deposit systems in several states and voluntary deposit systems in most other areas. The lead in used batteries has positive economic value for battery makers. Deposit amounts are typically $5 to $10 per battery. Consumers can obtain refunds by returning a used battery and proof of the deposit to the same retailer, typically within 7 to 30 days after the purchase of a new battery.

Despite the presence of numerous voluntary schemes, 11 states have required deposit systems. As shown in Table 5-3, state laws have addressed such questions as the refund period and what portion of unclaimed refunds should go to different parties.

Table 5-3. States with Mandatory Lead-Acid Battery Deposit Systems

State	Deposit/Refund ($)	Unclaimed Refunds	Refund Period (days)
Arizona	$5	Retailer	30
Arkansas	10	Retailer	30
Connecticut	5	Retailer	30
Idaho	5	Retailer	30
Maine	10	Retailer	30
Minnesota	5	Retailer	30
New York	5	Retailer	30
Rhode Island	5	State: 80%, Retailer: 20%	7
South Carolina	5	Retailer	30
Washington	Minimum of 5	Retailer	30

Source: Weinberg, Bergeson & Neuman. 1996.

As with beverage containers, deposit systems for lead-acid batteries appear likely to have a significant incentive effect because they offer motorists money in return for a used product. As shown in Figure 5-1, the percentage of battery lead that has been recycled nationwide has exceeded 90% since 1988. Lead prices appear to affect the recycling rate to a minor extent; the dip in the recovery rate in 1992–1993 coincided with a period of low prices for primary and secondary lead. (Scrap lead prices can be found at several sites on the Internet.[85])

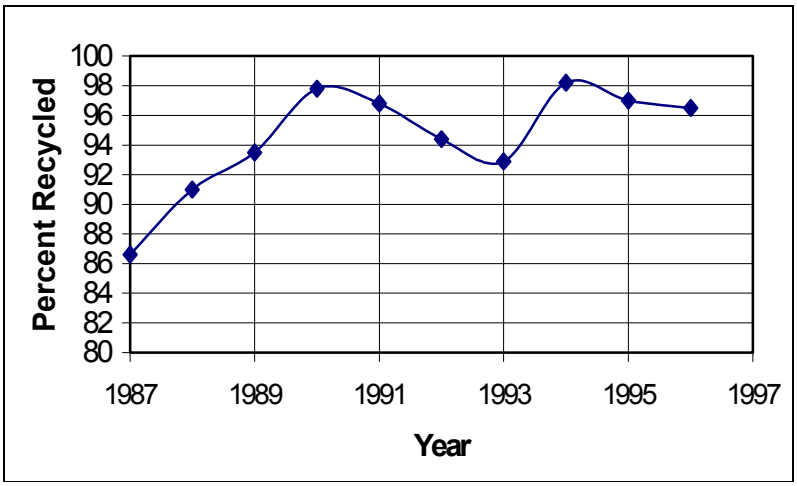
5.4 Maine Pesticide Container Deposit System

The discovery of more than 400 illegal disposal sites in Maine led state authorities to initiate a deposit system for pesticide containers in 1985. The rule applies to all limited-use and restricted-use pesticides sold in glass, metal, or plastic containers, a category that consists mainly of conventional agricultural and forestry applications. Deposit amounts are $5 for containers with less than a 30-gallon capacity and $10 for larger containers.

Farmers must rinse containers three times before returning them for refunds. Containers found to have significant traces of pesticides are not accepted for refunds. Collections are made at designated points once a year according to publicized schedules. Pesticide dealers arrange to have container-shredding equipment at the collection sites. According to the Maine Board of Pesticides Control, the deposit system has played a significant role in reducing the incidence of improper container disposal.[86]

In 1985, the first year that the deposit system operated in Maine, Board of Pesticides Control staff inspected all 7,055 containers that were turned in. Had these containers simply been drained rather than properly rinsed, 429 pounds of active ingredient would have been deposited into landfills. Since the containers were triple-rinsed and therefore were 99.998% clean, only 0.05 pounds of active ingredient was sent to landfills that year.[87] Published reports on the Maine pesticide container deposit system do not discuss the consequences of transferring pesticide residues to wastewater systems. It is possible that pesticide residues are managed in a more environmentally sound manner when they move through wastewater management systems than when they are sent to landfills.

Figure 5-1. Lead Recovery from Lead Acid Batteries



Source: Smith, Bucklin and Associates.

One problem with the deposit system is that it does not apply to general-use pesticide containers, which are far more numerous than containers for restricted-use and limited- use pesticides. One reason why general-use products are not included in the system is that inspecting them would require significantly more resources than are available at present. For a similar reason, a few larger states have considered a program similar to Maine's, but they have concluded that they would not be able to inspect a large number of containers.

5.5 Other Products

Since 1988, Rhode Island has required $5 deposits on all types of replacement vehicle tires. Customers can recover their deposits by returning old tires within 10 to 14 days after they purchase new tires. Their refund payments are limited to one tire for every tire purchased, and the refunds can be obtained only at the point-of-sale of the new tire. In addition to the deposit, Rhode Island—along with most other states—imposes product charges on tires to finance the cleanup of piles of old tires.

Outside the United States, deposit systems have been applied to car hulks, light bulbs, lubricating oil, and other products. An earlier EPA report by Anderson and Lohof (1997) describes several of these systems.

5.6 Voluntary Deposit Systems

In addition to lead-acid batteries, a few other products are subject to deposit schemes that are voluntarily operated by industry. Among such products are large paper drums, beer kegs, propane gas containers, and, in some areas, beer bottles and pesticide containers.

5.7 Performance Bonds

Performance bonds are fees levied upon companies that extract certain natural resources, such as timber, coal, oil, and gas. Amounts deposited with the performance bond can be refunded when the payer fulfills certain obligations. In that sense, a performance bond acts like a deposit-refund system.

An example of an environmental issue that has been addressed with the use of performance bonds follows. The Surface Mining Control and Reclamation Act (SMCRA) of 1977 requires the purchase of performance bonds before surface coal mining and reclamation permits can be obtained.[88] The amounts are determined by the regulatory authority, which can be either the state authority or the U.S. Department of the Interior. The fee amount depends on the reclamation requirements that are specified in the permit; the anticipated difficulty of reclamation due to factors such as topography, geology, hydrology; and the revegetation potential of the site. SMCRA requires that the amount charged be sufficient to finance reclamation by the regulatory authority in case the company forfeits its deposit. The minimum amount is $10,000 per permit area. Deposit amounts are adjusted as mined areas increase or decrease and as estimates of reclamation costs change.

Although such performance bonds give companies an economic incentive to reclaim mining sites, they are backed up by a regulatory requirement that is specified in a permit. The reclamation requirement may have more of an incentive effect than the deposit, since a firm's ability to obtain leases in the future is dependent in part on satisfying today's regulatory requirements.

Federal and state governments also use performance bonds to influence environmental management by the timber industry and oil and gas operators.

6. Trading Programs

Crocker and Dales generally are credited with first proposing that marketable emission permits be used as an incentive mechanism for achieving environmental goals.[89] The basic approach outlined by Crocker and Dales and later refined by Dewees and Harrison is that the environmental authority can issue a fixed number of marketable permits to release emissions.[90] Through trading, low-cost sources will sell some of their permits and abate more than they would under a traditional regulatory approach, while high-cost sources will buy permits and abate less. The end result, according to the academic design, is the same amount of pollution reduction that would be achieved through traditional regulatory approaches, but it is achieved at lower cost.

EPA first applied the concept of marketable emission permits in the mid-1970s as a means for new sources of emissions to locate in non-attainment areas without causing air quality to worsen. New sources and existing sources that wanted to expand their facilities were required to offset their emissions by acquiring emission reduction credits from existing sources. This important but modest beginning was based on an interpretation of the Clean Air Act, rather than on a specific statutory authority. EPA's Offset Policy was included in the 1977 amendments to the Clean Air Act statute. In 1980, then-Administrator Hawkins signed a memo that allowed emission averaging between can-coating lines.[91]

On August 7, 1980, EPA promulgated New Source Review (NSR) and Prevention of Significant Deterioration (PSD) rules that allowed netting, a means for sources to avoid PSD and NSR requirements for emission increases due to facility expansion, if emissions were decreased contemporaneously elsewhere at the facility.[92] Under the PSD mandate, this rule included facilities within a plant as a source of emissions as well as an entire plant as a source of emissions, in what was termed a "dual-source definition." Chevron and others challenged this rule, claiming it made modernization too difficult. Eventually the U.S. Supreme Court agreed that states did not need to include the dual-source definition in their non-attainment rules. This opened the door to many of the emission trading programs that exist today.

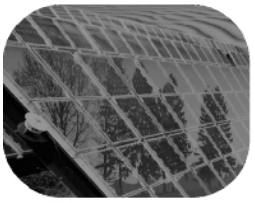
The 1990 Clean Air Act Amendments authorized a variety of emission trading systems. While similar statutory authority to establish effluent permit trading systems does not exist, EPA believes that the Clean Water Act allows effluent trading. Programs of this sort have been operational for several years without legal controversy. Pollution permit trading systems now come in a wide variety of forms, and they apply to a large and growing number of sources of pollution that affect the quality of air, water, and land.

Insofar as trading between economic entities is concerned, two main forms of trading systems are observed: (1) uncapped emission (or effluent) reductions credit (ERC) systems, and (2) capped allowance systems (also referred to as cap-and-trade systems). In the case of uncapped systems, pollution limits are rate-based (e.g., grams per mile for motor vehicles), and sources earn credits by releasing less pollution than their legal limit or other defined baseline. Under these systems,


Pollution Charges, Fees, Taxes


Deposit-Refund Systems


Trading Programs


Subsidies for Pollution Control


Liability Approaches

Information Disclosure


Voluntary Programs

emissions can increase with economic growth. By contrast, with capped systems, total emissions are limited by an overall ceiling that is designed to achieve health or environmental goals, and allowances are allocated to sources in quantities consistent with this ceiling. The formula for making such allocations will vary from one situation to the next.

A number of the programs described in this chapter involve the right to average emission characteristics of a slate of similar products that are manufactured by one economic entity. Emission averaging is an important mechanism for improving the cost effectiveness of environmental regulation. It can be characterized as intra-firm trading across the product lines where it is allowed.

Trading systems, properly designed and applied in appropriate circumstances, can cut compliance costs, encourage technological development, and create incentives for achieving environmental benefits beyond minimum requirements. For trading systems to function well, a number of requirements must be satisfied. There should be several potential participants in trades if a functioning market is to be created. Exactly how small a universe of potential participants there can be and still have a functioning market is difficult to say, but simulation experiments suggest that 8–10 participants is a reasonable estimate.[93] If sources are dispersed geographically, trading ratios other than one-to-one might have to be imposed to account for wind direction or the distance between sources to ensure no degradation in environmental quality.

Some pollutants are seasonal in their impact, implying that trades might be allowed only during a portion of the year. Trading might be limited because of a desire to avoid "hot spots" where pollution concentrations increase. Trading requires that pollution control agencies have the ability to monitor emissions (or measure a surrogate to those emissions) reasonably well. The need to ensure accountability of trades must not pose unacceptably high transaction costs. The commodity to be traded needs to be defined. In general, a well-defined commodity requires a baseline from which to calculate the emission reduction credits (or allowances) that may be traded. Establishing baselines is likely to require good historic data on emissions, input use, etc. In the case of allowance systems, the political will must exist to achieve an allocation of allowances among competing interests.

Cap-and-trade systems to date have allocated most or all of the allowable emissions under the cap to existing sources, providing allowance set-asides for new sources or using auctions as a safeguard to ensure access to allowances. Initially, environmentalists opposed marketable permit trading because the existence of trading was evidence that sources could make greater reductions in pollution than were being achieved. In addition, there has been a lingering concern that trading could result in localized "hot spots" that had undesirably high levels of pollution. With the success of the Regional Clean Air Incentives Market (RECLAIM) and the Acid Rain Program described later in this chapter, marketable permit trading has become more accepted as a cost-effective means of achieving many environmental goals.

On the other hand, attempts to establish new trading programs often encounter controversy. For example, some citizen groups have opposed trading programs for ozone-forming volatile organic compounds (VOCs). They based their opposition on two basic concerns: (1) the possibility of localized toxic pollution "hot spots," or (2) the ability of the source (or EPA for that matter) to reliably measure emissions to ensure that participants would be held accountable. EPA, in consultation with environmental justice groups and other stakeholders, is working on guidance for addressing these environmental justice concerns with trading.

The scope of trading systems is considerable. An emission trading proposal is a centerpiece of the Kyoto Protocol for controlling greenhouse gas emissions. Certain Colorado communities have created programs to trade the right to own and operate a wood burning stove or fireplace. For a number of years, there was an active program under which refiners could trade lead that was used as an additive in gasoline. Heavy-duty truck manufacturers can meet engine emission standards by averaging together the emissions performance of all the engines they produce. Programs to trade effluents are operating in selected locations. These particular programs are likely to be expanded significantly in coming years as a result of a new EPA initiative to improve water quality in polluted rivers and lakes. Developers whose activities would cause the loss of wetlands can satisfy mitigation requirements in some areas by purchasing credits from a wetland mitigation bank.

These and other trading systems for air, water, and land are described in this chapter. The discussion begins with a review of trading programs in air emissions, followed by sections on water effluent trading, land development, and, finally, international trading programs in which the United States is involved.

A few basic parameters may be used to characterize trading systems:

1. *Scope.* Is trading restricted to averaging within a single facility, allowed among facilities owned by the same firm, or allowed among firms or facilities under different ownership?
2. *Cap.* Is there a limit on total emissions or on effluents?
3. *Commodity Being Traded.* How will the commodity be defined: As allowances for future pollution, as credits for quantifiable reductions in pollution, as emission characteristics of products, as rights to own and operate products themselves, or as some other definition?
4. *Distribution of Tradable Permits.* Are the tradable certificates auctioned to the highest bidder, or are they grandfathered to existing sources?
5. *Trading Ratio.* Is the required trading ratio 1:1 or some greater ratio? Does the trading ratio depend on the respective location of the sources, season of the year, or other factors?
6. *Banking.* Can tradable certificates be banked or otherwise reserved for future use?
7. *Monitoring.* How is credit generation and trading monitored?
8. *Environmental Benefit.* Is a "set-aside" for the benefit of the environment built into the trading system? For example, each trade could be debited by 10% to yield an environmental benefit.

6.1 Trading in Clean Air Act Programs: An Overview

Since 1990, EPA has significantly expanded the use of trading in Clean Air Act programs. Today, emissions trading is a standard tool of EPA's air quality program. Although not a panacea for every situation, trading is being used by EPA and states to help solve a variety of air pollution problems. A broad overview of these programs follows. (Some of these programs are discussed in detail later in this chapter.)

Acid Rain: Perhaps the best-known example of trading is the Acid Rain Program's system of marketable pollution allowances for sulfur dioxide emissions for electric utilities. Enacted as part of the Clean Air Act Amendments of 1990, this cap-and-trade program has been highly successful at achieving cost-effective emissions reductions. The first phase of the program,

which took effect in 1995, reduced annual emissions by 4 million tons. Since then, measurements have shown that rainfall in the eastern United States is as much as 25% less acidic, some ecosystems in New England are showing signs of recovery, and ambient sulfate concentrations have been reduced, thus benefiting public health. The second phase of the program, beginning in 2000, will more than double the annual emissions reductions achieved by the first phase over time. The annual cost of the program, once it is fully implemented, is expected now to be approximately $2 billion, which is about one-half the cost that EPA had originally estimated.

Smog and Other Common Pollutants: EPA is working with states to promote trading and other market-based approaches to help achieve national air quality standards for smog, particulates, and other common pollutants that are regulated through national air quality standards. In addition, EPA has provided trading opportunities in virtually all federal rules that are aimed at cutting emissions from motor vehicles and fuels. These federal measures are essential to helping states meet federal air quality goals.

Under the Clean Air Act, states have primary responsibility for devising pollution control strategies for local areas, so states can meet national air quality standards. EPA has issued guidance to assist states in designing trading and other economic incentive programs, including economic incentives rules and guidance in 1994 (which, at present, are being revised); general guidance on State Implementation Plans (SIPs) in 1992; and the 1986 emissions trading policy statement. EPA also has assisted states in setting up trading programs, such as California's RECLAIM cap-and-trade program for sulfur dioxide and nitrogen oxides and the Ozone Transport Commission's (OTC) program for controlling nitrogen oxide emissions among states in the Northeast. Through a unique partnership, EPA and the OTC states are jointly implementing this NO_x budget system for the Northeast, which draws on the experience of the acid rain program.

In 1998, EPA issued a rule that established NO_x budgets for many states (the "NO_x SIP call") to combat the problem of transported ozone pollution in the eastern United States on a broader scale. To encourage an efficient market-based approach to reducing NO_x on a regional basis, EPA simultaneously provided states with a model cap-and-trade rule for utilities and large industrial sources. The experiences of the acid rain program and the OTC effort show that this approach holds the potential to achieve regional NO_x reductions in an efficient and highly cost-effective manner.

In the 1990 Clean Air Act Amendments, Congress called for EPA to help states meet their air quality goals by issuing federal standards to cut emissions from cars, trucks, buses, many types of non-road engines, and fuels. These rules cut toxic air pollution as well as reduced the amount of air pollutants, which were regulated through air quality standards.

EPA has provided trading opportunities in virtually all of these new standards, building on the early success of trading in the phased reduction of lead in leaded gasoline during the 1980s. These standards include rules for cleaner burning reformulated gasoline, which now accounts for approximately 30% of the nation's gasoline, and the national low-emission vehicle standards for cars and light-duty trucks that will be met nationwide by 2001. Opportunities for averaging, trading, and banking also are provided by new national emissions standards for heavy-duty trucks and buses, locomotives, heavy-duty off-road engines such as bulldozers, and small gasoline engines (e.g., those used in lawn and garden equipment).

Another recent example is the landmark Tier II/gasoline sulfur rule that President Clinton announced in December 1999. This rule would provide compliance flexibility to both vehicle manufacturers and fuel refiners by allowing them to use averaging, banking, and trading. to In the case of automakers, EPA created different "bins" of emissions levels, rather than require a single NO_x emissions standard for each vehicle model. EPA required automakers to achieve a fleet average emissions rate of 0.07 grams of NO_x per mile (gpm). Automakers whose fleet average is below 0.07 gpm could generate credits that they could either use in a later model year or sell to another auto manufacturer. This rule does allow the production of certain higher polluting vehicles that consumers desire. However, it also provides a strong incentive for the industry to develop technology well beyond the 0.07 gpm standard, since any higher polluting vehicle will have to be offset by a lower polluting one.

Industrial Air Toxics: The 1990 Clean Air Act Amendments called on EPA to establish national emissions standards to control major industrial sources of toxic air pollution. EPA has used emissions averaging as one of several ways to provide compliance flexibility in these industry-by-industry standards. For example, emissions averaging is permitted by national air toxics emissions standards for petroleum refining, synthetic organic chemical manufacturing, polymers and resins manufacturing, aluminum production, wood furniture manufacturing, printing and publishing, and a number of other sectors. To avoid shifting risks from one area to another, toxics averaging is allowed only within individual facilities. With appropriate safeguards, EPA also has used other methods, including multiple compliance options, to help provide flexibility in complying with air toxics rules.

Ozone Layer Depletion: In gradually phasing out the production of chemicals that harm the stratospheric ozone layer, EPA is giving producers and importers the flexibility to trade allowances. Under the Montreal Protocol, the United States and other developed countries agreed to stop producing and importing CFCs (chlorofluorocarbons) and other chemicals that are destructive to the ozone layer. By 1996, production of the most harmful ozone-depleting chemicals, including CFCs, virtually ceased in the United States and other developed countries. Additional chemicals are to be phased out in the future. Provided the United States and the world community maintain their commitment to planned protection efforts, the stratospheric ozone layer is projected to recover by the middle of the 21st century.

The phase-out of these chemicals is being achieved by using trading rules developed by EPA, rules that have served as a model for programs in other countries. In part because of the flexible market-based approach, the phase-out of CFCs was much less expensive than predicted. In 1988, EPA estimated that a 50% reduction of CFCs by 1998 would cost $3.55 per kilogram. In 1993, the cost for a 100% phase-out by 1996 was reduced to $2.45 per kilogram.

6.2 Foundations of Air Emissions Trading

The first trading of permitted rights to release any type of pollutant in the United States began in the 1970s as a mechanism to allow economic development in areas that failed to meet ambient air quality standards. EPA gradually broadened the offset policy to include emission bubbles, banking, and netting. These programs are described in the following paragraphs. While many of the achievements are modest, EPA's early efforts in emissions trading are important because they provided a foundation and valuable practical experience for the development of more effective and cost-effective trading programs such as the Acid Rain Program.

6.2.1 Offset Program

In the mid-1970s, the EPA proposed the "offset" policy that permitted growth in non-attainment areas, provided that new sources install air pollution control equipment which met Lowest Achievable Emission Rate (LAER) standards. These sources also had to offset any excess emissions by acquiring greater emission reductions from other sources in the area. Through this process, growth could be accommodated while maintaining progress toward attaining national ambient air quality standards.

Of more than 10,000 offset trades (a few of which are described later in this section), over 90% have been in California. Nationwide, about 10% of offset trades are between firms; the remainder are between sources owned by the same firm. Most offset credits are created as a result of all or part of a facility being closed.

The offset policy, which was included in the 1977 amendments to the Clean Air Act, spawned three related programs: bubbles, banking, and netting. The common element in these programs is the Emission Reduction Credit (ERC), which is generated when sources reduce actual emissions below their permitted emissions and apply to the state for certification of the reduction. To be certified as an ERC, the state must determine that the reduction meets the following criteria: (1) that the reduction is surplus in the sense of not being required by current regulations in the State Implementation Plan (SIP); (2) that it is enforceable; (3) that it is permanent; and (4) that it is quantifiable. ERCs are normally denominated in terms of the quantity of pollutant in tons released over 1 year. By far the most common method of generating ERCs is closing the source or reducing its production. However, ERCs also can be earned by modifying production processes and installing pollution control equipment. Trades of ERCs most often involve stationary sources, although trades involving mobile sources are permitted. States have approved a variety of activities that sources may use to generate offset credits. The South Coast Air Quality Management District (SCAQMD) in California, for example, accepts the scrapping of older vehicles and lawn mowers as a means of generating credits. It then applies a formula to determine the magnitude of air pollution credits for each old car that is scrapped.[94]

The offset, banking, and netting programs and bubble policy were subject to numerous revisions before being incorporated into EPA's Final Emission Trading Policy Statement, which was issued in 1986.[95] The Policy Statement addresses trading of ERCs for criteria pollutants such as sulfur dioxide, nitrogen oxides, particulate matter, carbon monoxide, and volatile organic compounds (VOCs) that contribute to the formation of ground-level ozone. The final policy statement responded to public comments that pollutant trading could cause environmental damage unless accompanied by safeguards, such as trading ratios greater than 1:1and the use of air quality modeling in some cases).

6.2.2 Bubble Policy

The bubble policy, established in 1979, allows sources to meet emission limits by treating multiple emission points within a facility as if they face a single aggregate emission limit. The term *bubble* was used to connote an imaginary bubble over a source such as a refinery or a steel mill that had several emission points, each with its own emission limit. Within the "bubble," a source could propose to meet all of its emission control requirements for a criteria pollutant with a mix of controls that is different from those mandated by regulations—as long as total emissions within the bubble met the limit for all sources within the bubble. A bubble can include more than

one facility owned by one firm, or it can include facilities owned by different firms. However, all of the emission points must be within the same attainment or non-attainment area.

Bubbles must be approved as a revision to an applicable State Implementation Plan (SIP), a factor that has discouraged their use. Prior to the 1986 final policy, EPA approved or proposed to approve approximately 50 source-specific bubbles. EPA approved 34 additional bubbles under EPA-authorized generic bubble rules. The EPA-approved, pre-1986 bubbles were estimated to save $300 million over conventional control approaches. State-approved, pre-1986 bubbles saved an estimated $135 million.[96] No estimates are reported for the number of, or savings from, post-1986 bubbles. By design, bubbles are neutral in terms of environmental impact.

6.2.3 Banking

EPA's initial offset policy did not allow the banking of emission reduction credits for future use or sale. EPA contended that banking would be inconsistent with the basic policy of the Clean Air Act. But without a provision for storing or banking ERCs, the policy encouraged sources to continue operating dirty facilities until they needed credits for internal use. New and expanding firms without internal sources of ERCs had to engage in lengthy searches for other firms that were willing to create and supply credits.

The offset policy in the 1977 amendments to the Clean Air Act included provisions for the banking of emission reduction credits for future use or sale. Although the EPA approved several banks, there was limited use of the provision, most likely because of the uncertain nature of the banked ERC. In 1980, EPA determined that an ERC is not an absolute property right and that communities must have the option of modifying the use of ERCs, including the debiting of part or all of the banked ERCs.[97] A 1994 report identified 24 emission banks; some limited ERCs to a life of as little as 5 years.[98] Since that date, the number of banks has remained stable. Most of the banks provided a registry to help buyers of ERCs find potential sellers. Some states debit a percentage of each ERC deposit for use by the state to attract new industry or to meet anticipated SIP requirements.

6.2.4 Netting

Netting, the final component of EPA's 1986 emission trading policy statement, dates from 1980. Netting allows sources undergoing modification to avoid new source review if they can demonstrate that plant-wide emissions do not increase significantly. Netting is the most widely used of these early emission trading programs. Hahn and Hester (1989) estimate that between 5,000 and 12,000 sources have used netting.

In each application, netting is designed to have no significant impacts on environmental quality. However, with a large number of netting transactions, a modest adverse impact might ensue. The total savings in control costs from netting are difficult to estimate because the number of transactions is not known precisely, and the cost savings from individual transactions can be highly variable.

Cost savings can arise in three ways. First, netting may allow a firm to avoid being classified as a major source, under which it would be subject to more stringent emission limits. Reductions in control costs in such a case would depend upon the control costs and emission limits that the firm must satisfy after netting. One source estimated that netting typically results in savings between $100,000 and $1 million per application (indicating aggregate savings of $500 million

to as much as $12 billion).[99] Second, the aggregate cost savings from avoiding the cost of going through the major source permitting process could range from $25 million to $300 million. Third, additional savings could arise from avoiding construction delays that are caused by the permitting process.

On April 3, 1996, EPA's Office of Air and Radiation announced a series of proposed revisions to new source regulations. These revisions were expected to reduce the number of permitting actions that new sources and sources undergoing changes must take by more than one-half. Because the proposal shares many of the features of netting, it is described here. The proposed regulations would allow sources to use plant-wide limits. They would also provide exemptions for pollution prevention activities and so-called "clean" emission sources in a facility.

Under the proposal, sources making changes could avoid new source review requirements by establishing a plant-wide cap on emissions. (In general, this cap would be the source's maximum potential emissions.) Process changes could be made as long as the changes did not result in an increase in emissions beyond the cap.

6.2.5 Evaluation of Early Emission Trading Activities

With data from offset transactions in the Los Angeles area, Foster and Hahn (1995) provide the most comprehensive evaluation of the original emissions trading program. The South Coast Air Quality Management District (SCAQMD) provided data on trading activity, some of which are reproduced in Table 6-1. The large increase in offset transactions in 1991 and 1992 reflects activity at two special funds created by the SCAQMD in 1991: the Community Bank, which serves small sources producing less than 2 tons per year; and the Priority Reserve, which secures credits for essential public services.

Table 6-1. Emission Trading Activity in the Los Angeles Area

YEAR	OFFSETS	NETTING	TOTAL
pre-1977	...	5	5
1977	...	30	30
1978	...	34	34
1979	...	72	72
1980	...	129	129
1981	...	238	238
1982	...	210	210
1983	...	258	258
1984	...	256	256
1985	7	235	242
1986	27	432	459
1987	24	329	353
1988	55	358	413
1989	30	352	382
1990	53	394	447
1991	2,208	155	2,363
1992	3,678	77	3,755

Note: Trading activity is based on the number of trades reported to SCAQMD.
Source: Foster and Hahn (1995).

During the period 1985–1992, over 10,000 tons of pollutants were traded in the offset program, with total expenditure on ERCs estimated to be on the order of $2 billion. (This figure indicates an average price for traded pollutants of about $200 per ton.) Nearly three-quarters of the trades involved reactive organic gases (SCAQMD terminology for a subset of volatile organic compounds), but there also were trades in CO, NO_x, PM, and SO_2.

AER*X, a broker in the Los Angeles offset market, supplied data for prices for over 40 of the trades from 1985 to 1992. The minimum price per ton in trades of reactive organic gases (ROG) fluctuated in the $40-per-ton range over this period, while the minimum value for NO_x trades was about $120 per ton. High prices for ROG increased steadily over the period, from $135 per ton to $711 per ton; and high NO_x prices increased from about $320 per ton to $655 per ton over the same period.

For a variety of reasons, one would not expect all tons of ROG or NO_x to be valued identically. First, the markets are imperfect, and information on historic trades is not widely disseminated. Second, credits that have been banked involve additional costs to the selling party. Third, offset ratios vary with the distance and location of parties to the transaction. The low end of prices could be determined largely by transaction costs to the seller (thought to be a minimum of $10,000 per transaction). In a few cases, transaction costs apparently exceeded the market value of the credits that were exchanged. Although the highest and average prices increased over the period, most of the change in 1991 can be attributed to a change in SCAQMD rules in the prior year. None of the observed prices remotely approach the typical incremental control costs for ROG and NO_x in the Los Angeles area over that period: on the order of $5,000 per ton for ROG and $8,000 per ton for NO_x.

ERC emission trading has not lived up to expectations; trades have been fewer and offset prices lower than many had expected. Several factors seem to have limited the appeal of the emissions trading policy. In order to assure that air quality did not deteriorate, state environmental administrators often required expensive air quality modeling prior to accepting proposed trades between geographically separated parties. Deposits to emission banks typically were “taxed” by the air quality management authority to meet state SIP requirements or to generate a surplus that the area could offer to attract new firms. Offset ratios greater than unity further depressed the value of ERCs. In many areas, it appears that ERCs had an economic value less than the transaction costs of completing a sale to another party.

In other respects, the emission trading program revealed the myriad possibilities for emission trading and many of the features that would be necessary to make trading viable. It served as the foundation for the enormously successful lead credit trading program and for many of the emission trading features of the 1990 Clean Air Act Amendments. States also have learned from the experience.

A number of states have redesigned their offset programs as trading programs without emission caps. (Examples include Delaware, Massachusetts, Michigan, New Jersey, Texas, and Wisconsin.) The Los Angeles area has developed a much more significant trading initiative known as “RECLAIM,” with an emissions cap and phased reductions in the allowable emissions of SO_2 and NO_x. (The RECLAIM initiative is described in more detail later in this chapter.) Illinois recently developed a similar program with an emissions cap.

6.3 Acid Rain Allowance Trading[100]

An early solution to mitigate local air pollution that was caused by sulfur dioxide (SO_2) and nitrogen oxide (NO_x) emissions from power plants was to build tall stacks to disperse pollutants away from populated areas. This strategy led to large increases in regional pollution concentrations and concerns about potential ecological damage. Coal-burning electric generating units built after 1970 were limited to 1.2 pounds of SO_2 per million Btu (British Thermal Units). By 1977, new plants were forced to meet a percent-reduction requirement in addition to the 1.2-pound limit. However, older coal-burning units continued to emit pollutants at much higher rates—up to 7 pounds of SO_2 per million Btus—and to operate far beyond their original design lives because of the high cost of building new units.

By the 1980s, studies began to demonstrate probable harm to lakes and forests, agricultural crops, materials, and visibility from the long-range transport of sulfates and nitrates formed from SO_2 and nitrogen oxide emissions. Studies also revealed that the acidification of soils and waters could release heavy metals and aluminum that were previously bound in soils. Further, increased atmospheric levels of sulfate and nitrate pose a risk to human health.

In Title IV of the Clean Air Act Amendments of 1990, Congress created the Acid Rain Program to address both wet and dry acidic deposition by cutting national SO_2 emissions from power plants by approximately 50%. Costs of compliance were estimated in the range of $5 billion per year. At that time, quantifiable economic benefits were believed to be lower—in the range of $1 billion per year.[101] Actual costs have been far less and associated benefits have been far greater, as further explained in this last paragraph of this subsection.

Title IV also sets allowable limits on NO_x emissions from utility boilers by placing limits on emission rates. An owner of two or more power plants may comply with the NO_x requirement by averaging emissions across all its power plants, a rudimentary form of emissions trading.

The Acid Rain Program set a cap of 8.95 million tons of SO_2 per year, to be achieved in two phases. During Phase I, which ran from 1995 through 1999, the 110 highest emitting coal-fired power plants (with a total of 263 coal-burning units) were required to reduce emissions to satisfy a tonnage cap. These so-called "Table 1" units were targeted for the first phase because their emissions exceeded 2.5 pounds of SO_2 per million Btu, and their capacity exceeded 100 megawatts. Between 125 and 182 additional units each year joined Phase I as substitution or compensating units. Although not required to participate until Phase II, these units elected to participate early to help fulfill the compliance obligations of a Table 1 unit. Furthermore, several units not required to participate in the Acid Rain Program opted to join the program during these years. In the second phase, which began in 2000, all power plants producing more than 25 megawatts and all new facilities must meet a lower emission cap. Phase II reductions will total an additional 5 million tons and will reach the overall 8.95 million-ton cap.

A major innovation of the program is the acceptance of emissions trading as a means of achieving compliance. Prior to the drafting of Title IV of the Clean Air Act, a number of studies had identified potential cost savings of as much as $1 billion per year through emissions trading due to significant differences among utility sources in the marginal cost of abatement.[102] Actual experiences with emission trading have exceeded expectations. A recent study estimates that emissions trading reduces the cost of complying with Title IV by 50%, or $2.5 billion annually.[103]

6.3.1 Allowances

Emission caps are enforced through a system of tradable emission allowances. Title IV specifies fixed numbers of allowances, each of which represents a limited authorization to emit one ton of SO_2, to be given each year to each of the affected units. Political considerations dictated that allowances be given rather than auctioned. SO_2 allowances issued in any particular year do not expire, meaning allowances issued in 1 year may be "banked" for use in subsequent years. The banking provision has been widely utilized in the Acid Rain Program. Emissions each year have been well below allocated levels, resulting in an increasing amount of banked allowances that can be used for compliance in later years. For example, 1999 emissions were almost 30% below the level allowed. Sources benefit from the flexibility that allows them to conserve allowances for use in later years.

The basic formula for computing Phase I allowances is 2.5 pounds of SO_2 per million Btu, multiplied by each unit's average 1985–1987 Btu consumption. For Phase II, 1.2 pounds of SO_2 per million Btu are multiplied by each unit's 1985–1987 Btu consumption. There are a number of departures from the basic formula, particularly in Phase II. Sources that fail to hold sufficient allowances to cover their emissions following a compliance period are subject to a penalty for each ton of excess emissions. Initially set at $2,000 per ton, the penalty is indexed for inflation and is currently more than $2,600 per ton. The Acid Rain Program has reported 100% compliance for its first 5 years, primarily because noncompliance carries such a high price.

As in Table 6-2, Table 1 units received 6.9 million allowances in 1999. Several other provisions of Title IV also create allowances, and the number of allowances created under these other provisions can vary from year to year. These other provisions varied from year to year during

Table 6-2. Origin of 1999 Allowable Emissions

TYPE OF ALLOWANCE	NUMBER OF ALLOWANCES	EXPLANATION OF ALLOCATION
Initial allocation	5,550,820	Granted to units based on baseline Btu output and emission rates, as specified in the Clean Air Act Amendments of 1990
Phase I extension	171,710	Given to Phase I units that reduce emissions by 90% or reassign obligations to units that reduce emissions by 90% (i.e., scrubbers)
Substitution allocation	909,455	These are the initial allocations of Phase II units that enter Phase I as substitution units
Auctions	150,000	Provided in the Clean Air Act Amendments in a Special Allowance Reserve when initial allocations were made
Compensation allocation	85,138	These are the initial allocations of Phase II units that enter Phase I as compensating units
Opt-in allowances	97,392	Provided to units that enter the program voluntarily
Small diesel allowances	25,617	Allocated to small diesel refineries that produced desulfurized diesel fuel in the previous year
Total (1997)	**6,990,132**	

Source: Exhibit 2 at http://www.epa.gov/airmarkets/cmprpt/arp99/index.html#so2compliance

Phase I. Owners of "extension" units that propose to reduce emissions with flue gas desulfurization (FGD)/scrubbing receive allowances, as do owners of "substitution" and "compensation" units. The substitution provision allows owners of units to substitute cheaper reductions from other units for the reductions required of Table 1 units. The compensation

provision lets a utility reduce electricity generation of a Table 1 unit below its baseline level, provided the source of any compensating generation is designated. If the compensating unit emits SO_2, EPA provides an allocation of allowances to that unit, so the compensating unit in essence becomes part of Table 1. Phase I initially included 263 units. An additional 125–182 combustion units joined Phase I as compensation or substitution units (the totals varied by year). Several opt-in sources joined as well, raising the total of Phase I units to between 398 and 445 units.

Beginning January 1, 1995, EPA could allocate up to 300,000 bonus allowances from its Conservation and Renewable Energy Reserve to utilities that undertake energy efficiency and renewable energy measures. The full accounting of provisions for allocating 1999 allowances are identified in Table 6-2 to illustrate the many sources of allowances.

In order to maintain the emissions cap, new sources receive no allowances. Instead, they must buy them from existing allowance holders or in EPA auctions. New sources are also required to satisfy New Source Performance Standards.

In March 1995, EPA expanded the Acid Rain Program to include industrial facilities that burn fossil fuels.[104] The rule establishes an "opt-in" program that allows industrial sources and other sources to participate in the existing SO_2 program, which previously included only utilities. Industrial sources that participate in the program will have an allocation of allowances that they can use for compliance or for selling or trading to other sources. These provisions allowing industrial sources to opt-in have been little used, partially due to high transaction costs and lower-than-expected allowance prices.[105] Ten units had joined the program as opt-in units by 1999.

6.3.2 Monitoring and Compliance

Utilities whose units are included in Phase I and Phase II must install continuous emission monitoring (CEM) systems to verify compliance with emission limits, and they must file quarterly reports of their hourly emissions data with EPA. Initially, sources mailed these data to EPA on computer disks, but most sources now transmit the information over the Internet. Continuous emission monitoring systems—the accepted industry standard for measuring SO_2, NO_x, and CO_2—provide an accurate accounting of emissions, assuring those buying and selling allowances that the commodity they are trading is real and assuring EPA that emission limits have been met.

CEMs for coal-fired electric power plants have an initial capital cost of just over $700,000, and annual operating costs of just under $50,000. On an annualized basis that spreads the capital costs over a capital recovery period, the cost of operating a CEM is approximately $125,000 each year. This amount is equivalent to about $0.16 per kilowatt of installed capacity.[106]

The cost of monitoring with CEMS represents approximately 7% of the observed cost of compliance. More than 2,100 units are now required to have CEMS for Phase II of the program. This requirement helps ensure low transaction costs and confidence that each allowance represents one ton of SO_2 emissions, regardless of where or when it is generated. That confidence is an important underpinning of trading.

At the end of each quarter, EPA receives more than 1,700 reports containing hourly emissions data and heat input for affected units. More than 90% of this data is received electronically.

Using these data and the allowance record for each unit, EPA tracks compliance. CEMS provide some of the most accurate and complete data ever collected by EPA. In 1999, SO_2 monitors on sources in the Acid Rain Program achieved a median relative accuracy of 3% and a median availability of 99.5%.

Under the authority of Title IV, EPA developed an allowance tracking system that serves as the official record of ownership and transfers. The system currently requires a paper form with the signature of the seller, but it will allow transactions to be completed on the Internet by the end of this year. With just two staff members, EPA processes most allowance transactions within one day of receipt.

6.3.3 Allowance Auction

In addition to private transactions in allowances, Title IV directed EPA to offer allowances at an annual auction, beginning in 1993. This auction offers the equivalent of roughly 2.8% of total allowances. Private parties may also offer allowances at the auction. Each offer includes the quantity for sale and a minimum acceptable price. The auctions helped to provide a price signal to the allowance market in the early stages of the program and currently provide an additional source of allowances for utilities. The auctions have only involved allowances that can be used in the current year and 6 and 7 years into the future. From now on, each auction will involve current-year and 7-year allowances.

Before discussing the specifics of the auction, it is worth noting that it has largely served its purpose now that (1) the market under the Acid Rain Program is flourishing and (2) the auction activity is dwarfed by the allowance exchanges occurring every day all over the country. Economists have criticized the mechanics of the auction, suggesting that it may also contribute to lower prices than otherwise would occur.[107] The Act requires a discriminating price auction, which ranks bids from highest to lowest. EPA has interpreted this statement as requiring that each seller receive the bid price of a specific buyer. The auction first awards allowances offered by the seller with the lowest asking price to the bidder with the highest bid price. Incrementally, the allocation mechanism moves up the supply list and moves down the bid list until no bidder is willing to offer what the remaining sellers are asking. The idea of having a discriminating price auction came from staff members of the U.S. House of Representatives, who were convinced that such an auction maximized revenue to sellers.[108]

This unusual auction mechanism may cause sellers to misrepresent and under-reveal their true costs of emission control.[109] By lowering the reservation price, a seller increases the probability of sale and the expected price, if buyers are offering different prices. Therefore, sellers would set lower reservation prices in such a discriminating price auction than in a single-price auction. Joskow (1998) concludes that EPA auctions became a sideshow to the much larger private market, after just the first two auctions. (These two auctions provided useful indications early in the process that allowance prices would be lower than first anticipated.)–The evidence from a detailed analysis of the auction records is that private sellers in the EPA auction have tended to set prices above market-clearing levels rather than too low, as initially hypothesized by Cason and others.

6.3.4 Transaction Costs

Many observers of the Acid Rain Program have noted the low transaction costs of the allowance market. The allowance market operates on a very narrow bid—to-ask spread. Recently, this

spread has been less than $2 per ton, or about 1% of allowance prices. Most allowance transfers are processed within 24 hours of receipt, as program requirements eliminate the need for review of submissions beyond electronic verification that the allowances being transferred are indeed in the seller's account. In addition, program design eliminates the need for source-specific emission limits or reviews of compliance strategies, causing the costs of oversight to drop dramatically.

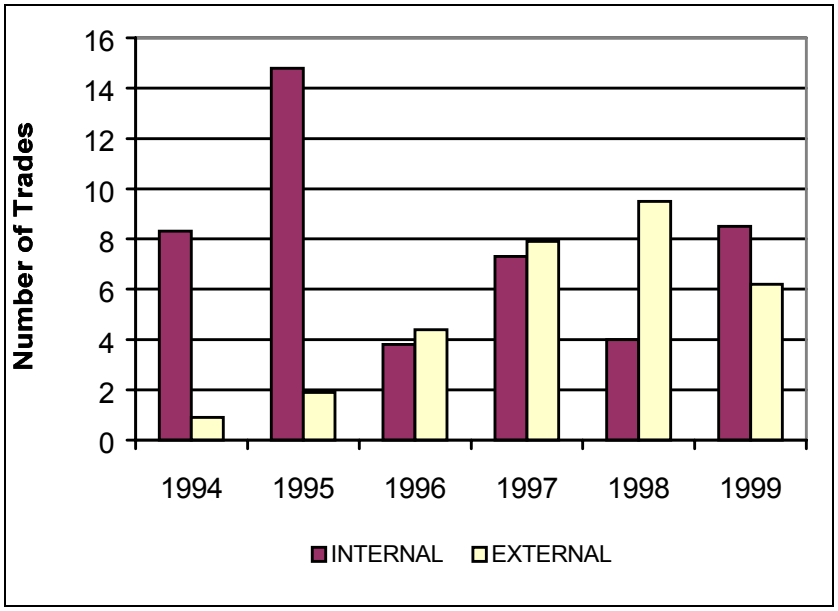
During the 5 years following the Clean Air Act Amendments, EPA spent $44 million to implement the Acid Rain Program and allocated an additional $18.9 million to state and local governments to implement the program. These costs may be compared with the $1.09 billion that EPA spent to implement the Clean Air Act in the same period and the $833 million EPA distributed to state and local governments for this purpose.[110]

6.3.5 Results

From 1995 through 1999, the Acid Rain Program has exceeded expectations, with firms exceeding the reduction target at less than one-half the forecast cost. These results follow from the very flexible structure of the program, one key component of which was the trading provision.[111]

While there was considerable trading activity from the start, little of that activity initially was between economically distinct entities. (See Figure 6-1.) In searching for explanations for the relatively low level of trading between economically distinct entities (labeled "external" in Figure 6-1), analysts have cited relatively high transaction costs at first, the behavior of public utility commissions, and legislation in some states that promoted the use of locally produced coal.

Figure 6-1. Internal and External Trading



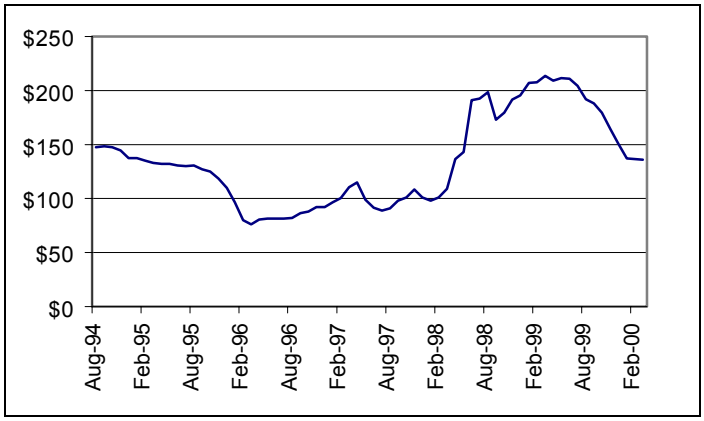
Source: Exhibit 6 at http://www.epa.gov/airmarkets/cmprpt/arp99/index.html#so2compliance

Emissions data compiled by EPA show at least 9,300 transfers involving 81.5 million allowances through the end of 1999. About 62% of the allowances or 50.4 million tons were transferred within organizations, and 38% or 31 million tons were transferred between organizations. Another 40 million tons reflect movements of allowances from EPA to the market through auctions, Phase I extension allowances, substitution allowances, and other mechanisms. SO_2 emissions control is ahead of schedule. The excess emissions reductions—unused allowances—in Phase I are being banked by utilities for use during Phase II, when the performance standard tightens significantly.

The price of allowances has been far below initial forecasts, an issue that has attracted considerable attention. Prior to passage of the Clean Air Act Amendments of 1990, industry estimates of abatement costs were $1,000 per ton, and EPA forecast allowance prices were in the $750-per-ton range. As an ultimate backstop for compliance, Congress authorized direct allowance sales by EPA at a price of $1,500 per ton. The direct sale provisions were eliminated several years ago when it became clear that allowance prices were far lower than anticipated, and the direct sale option would not be utilized.

Some early allowance transactions occurred at prices as high as $300 per ton in 1992. By 1993, the price had fallen to a range of $150 per ton to $200 per ton. Allowance prices—from EPA auctions, transactions through the Emissions Exchange, and through brokers—gradually fell to a low of $66 per ton through mid-1995 and, in general, remained below $120 per ton through 1997. (See Figure 6-2.) In 1998, allowance prices began to increase and exceeded $200 per ton by early 1999, peaking at $217 per ton in March. Prices then declined to about $130 ton by March 2000.[112]

Figure 6-2. Acid Rain Allowance Prices



Source: Exhibit 5 at http://www.epa.gov/airmarkets/cmprpt/arp99/index.html#so2compliance

Lower-than-forecast allowance prices have several explanations. Prices for virtually every form of compliance are well below anticipated levels. The price of low-sulfur western coal delivered to Mid-West and Eastern markets has declined due to productivity improvements in extraction and transport, and deregulation of rail rates. Engineers have found ways to blend low-sulfur Western coal with high-sulfur Eastern coal to meet emission limits in boilers that had been designed to burn high-sulfur coal. In addition, innovations in the scrubber market have cut the cost of scrubbing by approximately one-half. Many utilities committed themselves to scrubbers and other relatively expensive control measures, based on early engineering cost studies. If utilities had anticipated SO_2 control costs better, fewer scrubbers would have been placed in service. The consequence of greater-than- expected compliance is downward pressure on allowance prices in Phase I.

Analysts debate the role that allowance trading plays in stimulating cost effectiveness in SO_2 control from power plants. There is no doubt that SO_2 control has experienced tremendous technological and productivity improvement over a very short period of time, leading to approximately 50% lower costs for controlling emissions than had been anticipated. The issue is the extent to which allowance trading should be credited with these gains. Burtraw (1995) reached two conclusions. First, it is the flexible, performance-based design of the program that has stimulated the development of low-cost compliance measures seen in Phase I. Second, within that framework, allowance trading played an important, positive role. Ellerman (2000) attributes all of the cost savings to trading provisions. The difference in the two points of view is considerable. Ellerman gives credit to emissions trading for a dramatic fall in the cost of scrubbing emissions and for the growing use of low-sulfur Western coal. In contrast, Burtraw

credits performance standards and flexible program design, not emissions trading directly, for much of the cost savings.

Phase II of the Acid Rain Program is likely to see much greater reliance on allowance trading. Phase II will involve 700 additional sources, many of which are likely to select scrubbing as their method of compliance. More scrubbing should result in greater variation in the marginal costs of control across sources. Consequently, there should be greater incentives to trade allowances to achieve compliance in Phase II.

A 1995 EPA assessment of the Acid Rain Program put the costs at $1.2 billion annually in Phase I and $2.2 billion annually in Phase II.[113] The same EPA report estimated the mean value of annual health benefits at $10.6 billion in Phase I and $40 billion in Phase II. These health benefits are limited to benefits from reduced sulfates; total health benefits would be even higher. Interestingly, health benefits were not a major concern in the legislative decision to control acid rain, yet they now appear to be the dominant benefit component, dwarfing earlier estimates of environmental effects. Recall that early estimates of the costs of controlling acid rain put the costs at $4.5 billion to $6 billion annually with a traditional regulatory approach and benefits at $1 billion to $2 billion. An independent assessment reached a similar conclusion: Benefits will be much greater than costs.[114] More recent studies have estimated Phase II costs at $1.0 billion (Carlson et al., 2000) and $1.4 billion (Ellerman, 2000, p. 282).

To estimate the savings attributable to tradable allowances, Carlson et al. (2000) estimated marginal abatement cost functions for thermal power plants that were affected by Title IV. For plants that use low-sulfur coal as a means of compliance, they found that the main sources of cost reductions are technological improvements and the fall in low-sulfur coal prices, not allowance trading. Over the long run, the authors estimate that allowance trading could result in savings of $700 million to $800 million per year, relative to an "enlightened" regulatory approach with a uniform emission standard.

6.4 NO_x Regional Ozone Programs

The federal SO_2 control program shows that acid rain poses a number of difficult problems for policy makers, regulators, environmentalists, and industry. Experiences with the SO_2 program were instrumental in designing and implementing the recent NO_x control program.

Along with SO_2, NO_x contributes to the acid rain problem nationwide. NO_x also contributes to ground-level ozone and fine particulate problems in the East and in certain densely populated areas elsewhere. With respect to acid rain, both SO_2 and NO_x have cumulative and long-range impacts on the environment. With respect to ground-level ozone and fine particulate matter, the primary concern is ambient concentrations over short periods of time during the summer months.

NO_x trading is designed to account for these complex time and space dimensions in the need to control NO_x. Electric power generation peaks in summer months in the Northeast to meet air conditioning demands. Periods of peak power production are periods of peak NO_x emissions and tend to be periods of time when ambient ground-level ozone concentrations are most likely to exceed federal standards.

6.4.1 OTC NO_x Budget Program

In the 1990 Clean Air Act Amendments, Congress established the Ozone Transport Commission (OTC), a working group consisting of 12 Northeast states and the District of Columbia. OTC's mandate was to develop plans to meet national ambient air quality goals for ozone in the Eastern United States. With the help of EPA, the OTC developed a NO_x Budget Program to address regional ozone problems. Critical program elements, such as monitoring and reporting provisions, compliance determination, and penalties, were required to be uniform across states. A 1994 memorandum of understanding with EPA was signed by all of the OTC states, except Virginia. It put in place a NO_x cap-and-trade system within the OTC states. The intent of the agreement is to institute a cooperative effort to solve a common problem.

The agreement caps NO_x emissions at 219,000 tons during the May through September compliance period for the years 1999–2000 and at 143,000 tons starting in 2003. Both amounts are less than one-half the 1990 baseline of 490,000 tons. The cap affects 465 sources of NO_x in the participating OTC states, including utilities, industrial plants, and independent power producers.

The OTC NO_x trading program is implemented by states, as are many programs under Title I of the Clean Air Act. States are free to establish rules of their own choosing, including allocation provisions. (See Table 6-3.) The OTC made efforts to ensure that the rules were compatible across states to facilitate regional emissions trading. Some provisions, such as initial emission allocation formulas, differ across participating states. The program establishes that one allowance is good for one ton of NO_x emissions emitted during the compliance months. EPA administers the Allowance Tracking System and the Emissions Tracking System, but the states maintain all responsibility for compliance and enforcement.

Table 6-3. OTC's NO_x Budget Program Allocations and Emissions (1999)

STATE	BASELINE EMISSIONS (in tons)	1999 ALLOCATIONS[115] (in tons)	1999 EMISSIONS (in tons)
Connecticut	11,130	6,312	5,830
Delaware	13,510	6,142	6,160
Massachusetts	41,331	19,680	17,293
New Hampshire	14,589	6,788	3,463
New Jersey	46,963	21,292	15,390
New York	85,632	54,276	47,267
Pennsylvania	203,181	103,668	79,166
Rhode Island	1,099	580	274
TOTAL	**417,435**	**218,738**	**174,843**

Source: 1999 OTC NO_x Budget Program Compliance Report.

Unlimited banking of allowances is allowed, but sources are restricted in how they may use them for compliance. The constraints on banking address seasonal and spatial concerns regarding ozone formation. Eight states participated in the 1999 OTC NO_x Budget Program: Connecticut, Delaware, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, and Rhode Island. A total of 912 affected combustion units underwent reconciliation for 1999 to determine whether they held sufficient allowances to cover their emissions. The affected sources released

emissions at a level nearly 20% below their allocations for 1999, banking the remainder for future use when emission limits will be stricter.[116]

The market is showing signs of maturing. Trades for future year allowances have higher prices, which reflect the anticipated difficulty of meeting a shrinking cap on emissions. Similar price spreads also exist in the SO_2 allowance market.

6.4.2 NO_x Budget Trading Program

EPA promulgated the call for State Implementation Plans (SIPs) on NO_x, (the NO_x SIP call) pursuant to the requirements of Section 110 of the Clean Air Act (CAA). Section 110 requires a SIP to contain adequate provisions that prohibit any source or type of source or other types of emissions within a state from emitting any air pollutants in amounts that will contribute significantly to non-attainment in, or interfere with maintenance of attainment of a standard by, any other State with respect to any National Ambient Air Quality Standard (NAAQS). Section 110 authorizes EPA to find that a SIP is substantially inadequate to meet any CAA requirement when appropriate, and, based on such finding, to then require the state to submit a SIP revision within a specified time to correct such inadequacies.

The final rule required 22 states and the District of Columbia to submit State Implementation Plans that address the regional transport of ground-level ozone. The rule will reduce total summertime emissions of nitrogen oxides by about 28% (1.2 million tons) in the affected states and the District of Columbia. The final rule includes a model NO_x Budget Trading Program that will allow states to achieve over 90% of the required emissions reductions from large electric generating sources and large industrial boilers in a highly cost-effective way.

The NO_x SIP call was challenged by representatives of both industry and affected states. In May 1999, the U.S. Court of Appeals for the District of Columbia Circuit stayed the submittal deadline of the NO_x SIP call indefinitely. In November 1999, oral arguments were heard and, in March 2000, the Appeals Court ruled in favor of EPA on all major issues, remanding to EPA only a few minor issues.

As a result of its ruling, three states were no longer required to comply with the NO_x SIP call (Wisconsin, Georgia, and Missouri), and EPA was required to take further notice and comment on a portion of its electric generation unit (EGU) definition. Sources in several states will be subject to this action: Alabama, Connecticut, District of Columbia, Delaware, Illinois, Indiana, Kentucky, Massachusetts, Maryland, Michigan, North Carolina, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, South Carolina, Tennessee, Virginia, and West Virginia. In June 2000, the Appeals Court lifted the stay and ruled that affected states must submit SIPs to EPA by the end of October 2000. In August 2000, the court made another ruling. This ruling moved the compliance date to submit SIPs to May 31, 2004, from its original date of May 1, 2003. As of September 2000, EPA had not yet decided whether to appeal this ruling.

The petitioners have asked the Supreme Court to review the Appeals Court's decision. As of August 2000, the Supreme Court had not decided to hear the case.

Section 126 of the Clean Air Act allows states that are adversely affected by interstate transport of pollution to petition EPA to set pollution limits on specific sources of pollution in other states. In a December 17, 1999 rule, EPA granted petitions filed by Connecticut, Massachusetts, New York, and Pennsylvania that sought to reduce ozone in these states through the control of NO_x

emissions from other states.[117] These states had petitioned that they could not attain the federal 1-hour ozone standard because of the interstate transport of ozone and its precursors.

Under its Section 126 authority, EPA published a final rule that affects 392 electric utilities and industrial boilers with rated output greater than 25 megawatts or a maximum heat input capacity greater than 250 MMBtu/hr. The Federal NO_x Budget Trading Program establishes emission limits for affected sources in the form of tradable NO_x allowances. One allowance authorizes the emission of one ton of NO_x. Sources in the program are located in Delaware, the District of Columbia, Indiana, Kentucky, Maryland, Michigan, North Carolina, New Jersey, New York, Ohio, Pennsylvania, Virginia, and West Virginia. Collectively, they must reduce NO_x emissions by nearly 530,000 tons per year by 2007 from levels had been allowed that year.

Both the NO_x SIP call and the Section 126 action require sources to reduce emissions of NO_x. However, the SIP call allows states the flexibility to choose how reductions will be made; under the 126 action, EPA directly regulates sources. Furthermore, the SIP call covers a larger geographic area. EPA is continuing to work with the states to determine how to integrate these two programs.

6.5 Chlorofluorocarbon (CFC) Production Allowance Trading

The Montreal Protocol on Substances that Deplete the Ozone Layer called for a cap on chlorofluorocarbon (CFC) and halon consumption at 1986 levels, with reductions in the cap scheduled for 1993 and 1998. At a second meeting in 1990, the parties to the Montreal Protocol agreed to a full phaseout of the already-regulated CFCs and halons, as well as a phaseout of "other CFCs," by 2000.[118]

The Montreal Protocol defined consumption as production plus imports, minus exports. Consequently, in implementing the agreement, EPA distributed allowances to companies that produced or imported CFCs and halons. Based on 1986 market shares, EPA distributed allowances to 5 CFC producers, 3 halon producers, 14 CFC importers, and 6 halon importers.

The marketable permit system for producers and importers resulted in a number of savings relative to a program that directly controlled end uses. EPA needed just 4 staffers to oversee the program, rather than the 33 staffers and $23 million in administrative costs it anticipated would be required to regulate end uses. Industry estimated that a traditional regulatory approach to end uses would cost more than $300 million for recordkeeping and reporting, versus only $2.4 million for the allowance trading approach.

Title VI of the Clean Air Act Amendments of 1990 modified the trading system to allow producers and importers to trade allowances within groups of regulated chemicals that were segregated by their ozone-depleting potential. As an example, EPA assigned producers and importers allowances for five types of CFCs (CFC-11, CFC-12, CFC-113, CFC-114, and CFC-115). Producers and importers could trade allowances within this group. For example, 14 million kilograms of CFC-11 and CFC-113 were traded for CFC-12 in 1992 as air conditioner makers and foam producers reduced their use of these substances. At the same time, CFC-12 users maintained their demand. By 1994, the quantity of CFC-11 and CFC-113 swapped for CFC-12 grew to 26 million kilograms. EPA rules implementing Title VI specify that, each time a production allowance is traded, 1% of the allocation is "retired" to assure further improvement in the environment.

Congress coupled the marketable allowance trading system with excise taxes on CFC production, which are discussed in Chapter 4, Pollution Charges, Fees, and Taxes. The rationale for the excise taxes was that the restrictions on the quantity of CFCs and halons could be sold would lead to rapidly escalating prices. The excise taxes were designed to capture "windfall profits." In contrast, the allowance trading system was designed to assure that the production and import of the CFCs was cost-effective. The excise tax has the effect of making CFCs much more expensive in the United States than they are in developing countries where production is still allowed. Smuggling of these chemicals has become a serious problem.

6.6 Lead Credit Trading

As early as the 1920s, tetra-ethyl lead was added to gasoline by refiners to increase octane levels and reduce premature combustion in engines, which allowed more powerful engines to be built. Lead additives in gasoline were the least expensive of several ways of raising octane levels. The additives also prevented premature recession of soft-valve seats, a feature of most automobile engines that were manufactured prior to 1975 (but not after).

By the 1970s, virtually all gasoline contained lead at an average of almost 2.4 grams per gallon. EPA acted to curtail lead use in gasoline for two reasons. One, by 1975 new production vehicles were equipped with exhaust system catalysts, so these vehicles could meet the tailpipe emission standards for hydrocarbons, carbon monoxide, and nitrogen oxides that were mandated by the 1970 Clean Air Act. Unleaded fuel was required for vehicles manufactured after model year 1975, since exhaust system catalysts would be fouled and not function properly if vehicles were run on leaded gasoline. As catalyst-equipped vehicles began to dominate the fleet, sales of unleaded gasoline reached about 80% of all gasoline sales by the mid-1980s.

Two, concerns about the role of airborne lead in adult hypertension and cognitive development in children motivated EPA to limit the overall use of lead in gasoline. EPA required that the average lead content of all gasoline sold be reduced from 1.7 grams per gallon after January 1, 1975, to 0.5 grams per gallon by January 1, 1979. Initially, these limits were applicable as quarterly averages for the production of individual refineries, implicitly allowing trading across batches of gasoline at individual refineries. Later, EPA broadened definition of averaging to allow refiners who owned more than one refinery to average or "trade" among refineries to satisfy their lead limits each quarter.

During the late 1970s, the demand for unleaded gasoline grew steadily as more catalyst-equipped vehicles were sold. By the early 1980s, the market share of leaded gasoline had shrunk to the point that EPA's limits on the average lead content of all gasoline ceased to have an impact on the lead content in leaded gasoline. Meanwhile, evidence on the magnitude and severity of the health effects attributable to lead mounted.

EPA acted to curtail sharply the remaining use of lead in gasoline, initially setting a limit of an average level of 1.1 gm/gal beginning on November 1, 1982. EPA lowered the average to 0.5 gm/gal by July 1, 1985, and then to 0.1 gm/gal by January 1, 1986. To facilitate the phasedown, EPA allowed two forms of trading: inter-refinery averaging during each quarter and banking for future use or sale.

Inter-refinery averaging, which operated from November 1, 1982, to December 31, 1985, allowed refineries to "constructively allocate" lead. To take an example, suppose refiner A produced 200 million gallons of gasoline in the first quarter of 1983 with an average lead content

of 1.4 gm/gal. Refiner A could buy 60 million grams of lead credits from Refiner B, who produced an equal quantity of gasoline with lead content of 0.8 gm/gal. In 1985, EPA permitted refiners to bank credits for use until the end of 1987, which in effect extended the life of lead credits to that date.

Lead credits were created by refiners, importers, and ethanol blenders (who reduced the lead content of gasoline by adding ethanol). For example, when the average lead content was limited to 1.0 gm/gal, a refiner producing 1 million gallons of gasoline with an average lead content 0.5 gm/gal would earn 500,000 lead credits. EPA enforcement relied on reporting requirements and the random testing of gasoline samples. Reporting rules were simple. Each refiner or importer was obligated to provide the names of entities with whom it traded, the volumes for each trade, and the physical transfer of lead additives. The data allowed EPA to compare reported lead additive purchases and sales for each transaction to assure compliance. Discrepancies in reported figures could trigger investigations and enforcement actions. Well over 99% of all transactions were reported accurately; however, several dozen fraudulent transactions occurred.[119] In one quarter alone, the now-defunct Good Hope refinery in Louisiana accounted for over one-half of all reported lead credits sold during one quarter. Subsequent investigation uncovered the fraud.

Judged by market activity, lead credit trading was quite successful. Lead credit trading as a percentage of lead use rose above 40% by 1987. Some 20% of refineries participated in trading early in the program; by the end of the program, 60% participated.[120] Early in the program, 60% of refineries participated in banking, rising to 90% by the end. Trading allowed the EPA to phase out the use of lead in gasoline much more rapidly than otherwise would have been feasible. Given that refiners faced very different opportunities for reducing the lead content of gasoline, a rapid phase-down without trading would have rewarded refiners collectively, since the market price of gasoline would have been determined by the high-cost producers.

During the period of time when lead credits were traded, the price increased from about 3/4 cent/gm to 4 cents/gm.[121] Nearly one-half of all lead traded was between refineries owned by the same firm.[122] With external transactions, refiners revealed a preference to deal with normal trading partners, even though they could obtain a better price elsewhere. This preference indicates that trading did not produce the least cost outcomes, even though there was an active market in lead credits. In part, this result occurred because internal trades have lower transaction and information costs than inter-refinery trades. However, it also reflects strong preferences in the industry to avoid revealing potentially valuable information to competitors.

EPA estimated that the banking provisions alone would involve 9.1 billion grams of lead credits and save refiners $226 million. Subsequently, the amount of lead banked was placed at just over 10 billion grams. Lead credit trading may be viewed in retrospect as a considerable success. The use of lead in leaded gasoline was sharply reduced over a short period of time, without spikes in the price of gasoline that otherwise might have occurred. The market in lead credits was quite active, although, as noted in the previous paragraph, refiners did not maximize their gains from trade. In addition, some small refiners and ethanol blenders nonetheless sold many more credits than they had earned, despite seemingly foolproof procedures for catching fraudulent trades.

6.7 Gasoline Constituents

Title II of the Clean Air Act Amendments of 1990 imposes substantially tightened mobile source emission standards by requiring automobile manufacturers to reduce tailpipe emissions and by

requiring refiners to develop reformulated fuels. The Amendments require reductions in tailpipe emissions of 35% for hydrocarbons and 60% for NO_x, starting with 40% of the vehicles sold in 1994 and increasing to all vehicles sold in 1996. Light-duty trucks are subject to similar requirements. EPA is required to impose further reductions of 50% below these standards by 2003 if it finds such reductions are necessary, technologically feasible, and cost-effective. EPA recently issued Tier 2 gasoline sulfur standards that implement this further reduction.

Title II requires that states having CO non-attainment areas with design values of 9.5 parts per million (ppm) or higher must implement a program to supply oxygenated fuels to motorists in winter months. (The term "design values" is defined as the second highest ambient reading measured over the most recent two years.) Gasoline sold in the 41 cities affected by this requirement must have an oxygen content of 2.7% starting in 1992. To meet the percent oxygen requirement, states are "strongly encouraged" to create a program for marketable oxygen credits to provide flexibility to gasoline suppliers.

In October 1992, EPA issued guidance for trading programs in oxygenates under the wintertime oxygenated gasoline program; however, participation is optional for the affected states.[123] In areas where trading is permitted, credits in oxygenates can be exchanged between parties that the state has designated as responsible for satisfying fuel requirements, also known as the Control Area Responsible Party or CAR. Normally the CAR is the party who owns gasoline at a terminal. The CAR receives data on the volume and oxygen content of all gasoline shipped to the terminal and assures that the average oxygen content is 2.7% by weight. Where trading is allowed, the CAR would be free to sell excess oxygenate credits to other CARs or buy oxygenate credits from a CAR to meet the 2.7% requirement. While trading in oxygenates theoretically offers a cost-effective means of meeting wintertime oxygenate requirements, in fact, the trading programs have been moribund. Only the Pennsylvania part of the Philadelphia ozone non-attainment area (which also includes parts of New Jersey) adopted trading rules. Within that area, no trades have been reported. Other areas have declined to allow trading, citing the costs of monitoring such a program as prohibitive.

Title II also requires that the 9 worst ozone non-attainment areas offer reformulated gasoline during the summer months. It also specifies several performance characteristics for reformulated gasoline as well as certain fuel properties, including a minimum oxygen content of 2% by weight beginning in 1995. Under so-called "opt in" provisions, an additional 31 areas applied to EPA, so they could participate in the reformulated gasoline program.

Title II requires that EPA establish trading systems for three constituents of reformulated fuels: oxygen, aromatics, and benzene. Under a trading system, refiners could meet reformulated content requirements by producing gasoline that met the specifications or by trading credits in these constituents with other refiners, so collectively the standards were satisfied. EPA's rules for reformulated gasoline set up an averaging-and-trading system as well as an averaging-and-trading system for meeting EPA's performance standards for VOCs and toxic air chemicals.

There has been considerable trading and averaging of reformulated gasoline requirements, mainly from the Midwest to the East Coast. That trading has led to some regional failures to meet oxygenate retail averages, and it has resulted in a tightening of the oxygenate standards for reformulated gasoline.

6.8 Tier 2 Emission Standards

On February 10, 2000, EPA promulgated new standards for tailpipe emissions of NO_x from passenger cars and light-duty trucks and for the sulfur content of gasoline.[124] The tailpipe emission action was taken under EPA's authority to set tailpipe emission standards for new vehicles (Section 202 of the Clean Air Act). The fuel standard action was based on EPA's determination that motor vehicle fuels contribute to air pollution and adversely affect the performance of emission control systems (an authority under Section 211 (c)(1) of the Clean Air Act).

Manufacturers will be able to average their Tier 2 vehicles to comply with the corporate average NO_x tailpipe standard of 0.07 grams per mile (gpm), which is more than a 75% reduction from the current 0.30 gpm. standard.[125] When a manufacturer's corporate average NO_x emissions fall below the standard, it will earn credits that may be banked for later use or sold to another manufacturer. These credits will be very similar to those currently in place for non-methane organic gas (NMOG) emissions under California and the federal National Low Emission Vehicle (NLEV) regulations. The NO_x credits will have unlimited life. Manufacturers would be permitted to run a credit deficit for 1 year and carry forward that deficit. If the manufacturer has a credit deficit in the second year, the manufacturer would be subject to an enforcement action.

Refiners and gasoline importers must satisfy a corporate average gasoline standard of 120 ppm and a cap of 300 ppm sulfur beginning in 2004. In 2005, this corporate average standard drops to 90 ppm sulfur, with the cap remaining at 300 ppm. The format of the program changes in 2006 from a corporate average to a per-refinery requirement. At that time, the cap will be 80 ppm sulfur, and most refiners will have to produce gasoline that averages no more than 30 ppm sulfur. Refiners who produce gasoline with a corporate average sulfur content lower than the standard will be allowed to bank credits for future use or for sale to other refiners that are unable to meet the standard. Credits produced under the phase-in years have a limited life. Those credits produced beginning in 2006 have an unlimited life. The program runs until 2010. However, refiners will be able to carry forward a deficit for 1 additional year, providing that the average is below 80 ppm sulfur.

The standards concern hydrocarbon emissions, which was termed "NMOG" in the rulemaking. Manufacturers would have to satisfy a corporate average standard, but they could meet this standard through the trading of credits earned by manufacturers that exceeded the corporate average standard. Banking also would be allowed. Banked credits, however, would be subject to discounting over time.

6.9 Heavy-Duty Truck Engine Emission Averaging

Title II of the Clean Air Act Amendments of 1990 authorizes EPA to set standards for particulate matter, NO_x, and other emissions from heavy-duty truck engines. The standards must represent the maximum degree of reductions achievable, taking cost and other factors into consideration. EPA has interpreted this provision to authorize the use of averaging, banking, and trading as part of the process of realizing the maximum degree of reductions achievable.

Under this program, there has been a great deal of averaging and banking but only one trade between firms, a 1996 exchange of rights to 5 tons of particulate matter from Navistar to Detroit Diesel. The averaging of emissions facilitates compliance, since not every class of engines has to

meet the 75% reduction standard. How much engine manufacturers actually save is unknown. However, a recent paper examined a similar type of engine performance averaging program that was proposed in California for light-duty trucks. It concluded that the cost savings of the program were likely to be modest.[126]

6.10 Corporate Average Fuel Economy (CAFE) Standards

The Energy Policy and Conservation Act of 1975 established corporate average fuel economy (CAFE) standards for all manufacturers that sell vehicles in the United States. The standards were first imposed in 1978 and are now 27.5 miles per gallon (mpg) for production passenger cars and 20.7 mpg for production light-duty vehicles. (Light-duty vehicles include sport utility vehicles, minivans, and pickup trucks with gross vehicle weight ratings less than 8500 pounds.)

Corporate average fuel economy and compliance with the CAFE standard is determined as the harmonic mean of the fuel economy of automobiles produced by each manufacturer.[127] Harmonic average fuel economy is more difficult to achieve than is simple averaging. For example, to achieve a CAFE standard of 27.5 mpg, two 35-mpg vehicles must be sold for every 20-mpg vehicle sold. The penalty for failing to meet the CAFE standard is $5.50 per automobile for every 0.1-mpg shortfall. Carry back and carry forward provisions akin to banking do exist, and they allow shortfalls in one year to be met with credits from another year.

CAFE standards have been the primary national policy instrument for improving personal vehicle fuel economy and for reducing gasoline and oil consumption in the transportation sector. From the late 1970s through the mid-1980s, CAFE standards—working in concert with higher gasoline prices through most of that period—nearly doubled the average fuel economy of new personal vehicles. Throughout the 1990s, with oil and gasoline prices recording historic lows on an inflation-adjusted basis, CAFE standards provided a floor for automotive fuel economy. Fuel economy was higher than it would have been absent the standards. Therefore, compliance with these standards reduced gasoline consumption.

Since fuel economy is inversely proportional to carbon dioxide emissions, the primary greenhouse gas from motor vehicles, CAFE has yielded reductions in carbon dioxide emissions and overall greenhouse gas emissions. (Fuel economy is largely unrelated to emissions of criteria pollutants such as particulate matter, CO, and NO_x). In this regard, CAFE can be viewed as an intra-firm trading system to meet a de facto standard to reduce the carbon dioxide emissions from personal vehicles.

As a policy instrument, CAFE has both advantages and disadvantages. Some of CAFE's advantages follow.

- CAFE is in place, it has proven to be a workable program, and lessons have been learned about how it could be improved.
- CAFE has yielded significant reductions in gasoline consumption and carbon dioxide emissions, which would not have been the case without these standards.
- The general public strongly supports CAFE relative to other alternatives to increase fuel economy and reduce carbon dioxide emissions, such as higher gasoline taxes.
- CAFE includes many market elements, such as

- sales-weighted averaging (as opposed to a floor that every vehicle must meet),
- a 7-year rolling average for compliance (and credits can be carried back or forward for 3 years), and
- the option of paying monetary fines in lieu of meeting the standard, a choice that is left to the discretion of the manufacturer. (Several non-U.S. firms pay these fines. All U.S. automakers have chosen to meet CAFE standards in the past.)

Like any policy instrument, CAFE also has disadvantages. Some of them follow.

- CAFE is inconsistent with low fuel prices. That is, when gasoline prices are relatively low, there is less demand for high-fuel economy cars, and manufacturers must sell higher fuel economy than the market demands.[128]
- CAFE does nothing to reduce vehicle miles traveled (VMT). (Some analysts argue that CAFE increases VMT and emissions by lowering the cost of driving, i.e., raising the fuel economy of vehicles means, in theory, that less gasoline is needed to travel a certain number of miles. Other analysts assert that these effects are negligible.)
- CAFE does have a cost, either in terms of the higher prices of vehicles or the tradeoffs that must be made with other vehicle attributes such as utility, weight, or acceleration.
- CAFE is strongly opposed by automakers, whose objections include higher vehicle cost and the potential reduction in safety for passengers in these lighter weight vehicles.

Alternatives to CAFE standards would include higher gasoline taxes and "feebates," which would assess fees to the sale of vehicles with low-fuel economy and rebates for the purchase of high-fuel economy vehicles. Like CAFE, each of these options has advantages and disadvantages. The relative merits of these options relative to CAFE are debated, as is the magnitude required for such policies to provide the same benefits as CAFE.

6.11 Hazardous Air Pollutant (HAP) Early Reduction

In December 1992, EPA issued final rules for the early reduction of hazardous air pollutants.[129] If a facility qualifies for inclusion in the program by reducing hazardous air pollutants by 90%—95% in the case of hazardous particulate emissions—prior to EPA proposing maximum available control technology (MACT) regulations on the source category, the facility may defer compliance with the new MACT for as long as 6 years. Because participation in the program is voluntary, a source must anticipate cost savings, or it would not have an incentive to participate. Once a source is accepted into the program, it becomes legally obligated to meet the 90% (or 95%) reduction in emissions. Trading exists intertemporally across time in that sources exchange their early reductions for their later reductions. (The example in the next paragraph illustrates how this program works.)

EPA has shown that such a program can benefit the environment. Assume a source emits 100 tons per year. Under the early reduction program, it would emit 10 tons per year. Further assume that MACT would have the source reduce emissions to 2 tons per year in year 5 and thereafter. The source has reduced emissions by 360 tons in years 1 through—4 in exchange for 48 tons of emissions in years 5 through10. Total emissions are reduced by 312 tons. Table 6-4 illustrates the time profile of emissions.

By mid-1993, over 60 chemical plants had asked to participate in the program, so they could avoid the synthetic organic chemical MACT standard for 6 years. Other types of facilities also had applied to join the program.[130]

Table 6-4. Benefits of Achieving Early Emission Reductions

YEAR	MACT EMISSIONS (in tons)	EARLY REDUCTION EMISSIONS (in tons)
1	100	10
2	100	10
3	100	10
4	100	10
5	2	10
6	2	10
7	2	10
8	2	10
9	2	10
10	2	10
TOTAL	**412**	**100**

Source: 57 FR 61970

6.11.1 The Petroleum Industry NESHAP

EPA's National Emission Standard for Hazardous Air Pollutants (NESHAP) rule, promulgated on August 18, 1995, establishes Maximum Available Control Technology (MACT) requirements for process vents, storage vessels, wastewater streams, and equipment leaks at refineries. The rule specifically includes marine tank vessel-loading activities and gasoline loading racks.

The rule excludes distillation units at pipeline pumping stations and certain process vents that EPA determined would be subject to future NESHAP rules: catalyst regeneration on cracking units, vents on sulfur recovery units, and vents on catalytic reforming units.

On September 19, 1995, EPA issued a final NESHAP rule for marine vessel tank-loading operations. The rule affects new and existing marine bulk loading and unloading facilities that emit 10 tons or more of a single hazardous air pollutant (HAP) or 25 tons of any aggregate HAPs. Affected facilities must install a vapor collection system to collect volatile organic compounds (VOCs) that are displaced from marine tank vessels during loading. The vapor recovery system must achieve a 95% reduction in emissions, 98% if combustion is used.

Both of these NESHAP rules permit the use of emissions averaging among marine tank vessel-loading operations, bulk gasoline terminal or pipeline breakout station storage vessels and bulk gasoline loading racks, and petroleum refineries. Emissions averaging gives the owner the opportunity to find the most cost-effective control strategies for a particular situation. The owner may over-control at some emission points and under-control at others to achieve the overall level of emissions control that is required.

6.11.2 Hazardous Organic Chemical NESHAP

The Hazardous Organic Chemical NESHAP (or "HON") affects more than 400 facilities of the Synthetic Organic Chemical Manufacturing Industry (SOCMI). The final rule requires sources to limit emissions of organic hazardous air pollutants (HAPs) and to apply "reference control" or

equivalent maximum available control technology (MACT). In recognition of the high costs of some MACT controls in this industry, the rule allows emissions averaging. Under this alternative method of compliance, sources engaging in pollution prevention measures that over-control at some points earn emissions credits that can be used to offset the debits they accrue when measures under-control at other points.

6.12 Regional Clean Air Incentives Market (RECLAIM)

Some of the highest ozone levels in the nation are recorded in the Los Angeles area. The South Coast Air Quality Management District (SCAQMD or District) also fails to meet the particulate matter and CO NAAQS, although not by such a large margin. Historically, the SCAQMD has relied on source-specific emissions regulations to limit the emissions of ground-level ozone precursors (as well as other pollutants).

Substantial progress has been made over the past three decades in improving the air quality in the Los Angeles Basin. However, it was apparent to SCAQMD officials that further progress toward attaining federal standards would be prohibitively expensive if they used traditional regulatory methods. By 1990, the marginal costs of NO_x control in the District had reached $10,000 per ton to $25,000 per ton at electric power plants, versus $500 per ton to $2000 per ton elsewhere in the United States. Proposed SO_x controls on catalytic cracking units at refineries would have cost $32,000 per ton, versus the national costs of less than $500 per ton for other methods of controlling SO_2 emissions. (See Section 6.3, Acid Rain Allowance Trading. Consequently, the District began to investigate the feasibility of creating a marketable permit in reactive organic gases (ROG) and NO_x as well as SO_x—the latter for its role in the formation of small particulate matter—as a means of accomplishing air quality goals at lower cost.

The District initially proposed a marketable permits program termed "RECLAIM" (for Regional Clean Air Incentives Market). The program would include about 2,000 sources of reactive organic gases (sources that represent about 85% of permitted stationary source emissions); 700 NO_x sources (sources that represent 95% of permitted NO_x emissions); and about 50 sources of SO_x (sources that represent about two-thirds of permitted stationary source emissions). Each market would start with an allocation of emissions to sources equal to the 1994 emissions target in the District's Air Quality Management Plan (AQMP). Each marketable permit program would be designed to reduce emissions annually by the amounts necessary to achieve the AQMP targets: Meeting air quality standards for SO_x and NO_x emissions by 2003 and meeting the goals for reducing ROG emissions by 2010.

For the NO_x and SO_x programs, emissions originated at combustion sources with well-defined exit points to the environment. Emission monitoring would be based on stack gas measurement using continuous emission monitors (CEM). For ROG, the market was based largely on evaporative emissions, which are inherently more difficult to measure. Prospective ROG trading also was complicated by the fact that ROG are not homogeneous; some react much more readily to form ozone than others do. Furthermore, some ROG are classified as toxic pollutants and regulated separately. After about 1 year of analysis and discussion, RECLAIM officials decided to defer including ROG in its program and to concentrate on the program's design for NO_x and SO_x.

A basic issue for both programs was which facilities would be included. Despite the prospect for lower control costs that would accompany participation in a marketable permit program, a

number of sources argued for exemptions. These sources were concerned about the future price and availability of marketable permits. District officials eventually exempted sewage treatment plants, landfills, and three small municipally owned power plants.

Baseline emission allocations proved contentious. According to the basic design features for RECLAIM, emission allocations would be based on the 1994 emission target for each source. This target was computed in the AQMP by taking reported 1987 emissions and deducting projected reductions that were mandated by air quality regulations. Due to a recession in the early 1990s, emissions in 1991, 1992, and 1993 were lower for many sources than what the AQMP required. Many interest groups, including the affected sources, argued that baseline allocations should be based on the AQMP. Environmental groups argued that actual 1993 emissions should serve as the baseline for emission allocations, not the AQMP. The compromise that was struck defines the emission cap for each source as the highest year of reported emissions between 1989 and 1991, less any reductions required by regulations that were implemented through 1993.

Monitoring and reporting issues also proved controversial, with lengthy debates over how emissions would be measured and how often reports would be filed. Industry sought to file one report per year, while public health agencies and environmentalists wanted daily or weekly reporting. The EPA sought assurance that the hourly NO_x standard would not be violated.

In an attempt to allay industry concerns that frequent monitoring would be too expensive, the AQMD developed a central computer that would accept data directly from the facilities participating in RECLAIM. Sources installed continuous emission monitors, or CEMS, which cost $100,000 to $150,000 each, on every boiler emitting 10 tons annually or more. These CEMs recorded pollutant readings minute by minute and sent the readings to a remote terminal that averaged the readings over 15-minute periods. The remote terminal then forwarded the number to the AQMD central computer. An artificial intelligence system analyzed the data and verified compliance by each boiler. When the system detected a potential problem, inspectors were dispatched to investigate further.

The District projected that the one-time costs of installing monitoring equipment would be approximately $13 million, with negligible annual operating costs. The District projected that annual savings in compliance costs relative to traditional forms of regulation would be an average of $58 million annually for each of the next 10 years. These calculations effectively muted the industry's complaints about the costs of monitoring equipment.

The actual trading works as follows. Each source has a declining allocation of RECLAIM Trading Credits (RTC) for each year from 1994 to 2003. After 2003, the balance remains constant. The RTC are denominated in pounds: one RTC equals one pound of emissions. Sources are free to trade RTC for the current year or for future years; however, all RTC are good only for the year for which they are issued. Trades in RTC are limited by geographical factors; for a potential buyer, the number of credits required to offset a pound of emissions varies with the location of the seller. The District maintains records of all transactions in RTC and shares that information with market participants.

Under RECLAIM rules, the District may impose penalties for net emissions (including trades) in excess of the permitted amounts. One such penalty would reduce next year's emission allocation by the amount that emissions exceeded the allowable limit. Other possible actions include civil penalties and the loss of the facility's operating permit.

In 1994, the NO_x and SO_x markets began with 370 sources and 40 sources, respectively. Both markets represented approximately 70% of stationary source emissions. Analysis shows that the program should reduce NO_x emissions by an average of 8.3% per year, which amounts to a cumulative reduction of 80 tons per day by 2003. It should also reduce SO_x emissions by 6.8% per year, which amounts to a cumulative reduction of 15 tons per day by 2003. The District projects that RECLAIM will lower compliance costs by $57.9 million a year when compared to a traditional regulatory approach: $80.8 million versus $138.7 million.

As a means of jump-starting the market, the SCAQMD held an auction of RTC on July 29, 1994. Utilities, which had by then installed new emission control equipment and did not need their full allocation, were large sellers of NO_x credits. A total of 114,676 NO_x credits and 9,400 SO_x credits changed hands at the auction. Prices for RTC were low for near years and much higher for more distant years. In all cases, though, the cost for a ton of credits was far lower than the marginal control costs incurred from recently enacted or proposed regulations. The per-ton price ranged from less than $20 to $2000, depending upon the credit's year of validity, prices that are very much in line with the 1994 auction. (See Table 6-5 for the prices of these credits.)

Table 6-5. Reclaim Trading Credit Prices

VINTAGE*	NO_x ($ per ton)**		SO_x ($ per ton)**	
	1994	1997	1994	1997
1994	2			
1995	334		1,500	
1996	574		1,900	
1997		227		64
1998				
1999	1,480			
2000	1,580			
2001	1,700			
2002	1,830			
2003	2,090			2,393
2010		1,880		2,385

Notes: * The term "Vintage" refers to the year in which the credit could be used. ** These figures are based on prices at a July 1994 auction and 1997 market prices.

Source: *BNA Daily Environment Report,* Aug. 10, 1994; SCAQMD 1998.

In June 1995, the SCAQMD proposed adding VOC emissions to RECLAIM; the initiative included almost 1,000 facilities in 14 industrial categories that generated 4 tons or more of VOC annually. In contrast to the NO_x and SO_2 programs that were scheduled to last for 7 years, the VOC program would last 14 years. Officials estimated that the program would reduce emissions from these sources from 53 tons a day, the projected level for 1996, to 15 tons a day by 2010.

The proposal to include the trading of VOCs within RECLAIM met with fierce opposition from environmentalists. They charged that the 1989 baseline selected for emissions by SCAQMD could result in a huge increase in emissions over 1993 levels when the program is fully implemented. Regulators sought the 1989 baseline to avoid locking industry into emission levels that were associated with the recessionary conditions that occurred in 1991, 1992, and 1993. Industry representatives note that the AQMP has a schedule for orderly reductions over time toward the 2010 goals. In their view, emissions increases that occur from 1993 to 1996 as the

economy pulls out of a recession are not relevant so long as emissions remain below the target levels in the AQMP.

Unable to resolve the baseline issue, the 12-member governing board of SCAQMD set aside the proposed rule to include trading of VOCs within RECLAIM in January 1996. The board then directed its staff to develop a program to trade VOC emissions separately. Due to strong opposition in some quarters and to difficulties in accurately measuring these emissions, a subsequent VOC initiative ultimately was shelved.

RECLAIM has won praise for its progress to date. A state-mandated performance review found that the District has a state-of-the-art air quality program that is performing efficiently and effectively. According to the report, RECLAIM demonstration projects have helped stimulate technological development. Furthermore, its outreach and compliance programs have helped save or create more than 10,000 jobs, while, at the same time, these programs have improved air quality.

Trading in the program has been active, expanding from $2.1 million worth of credits in 1994 to $21 million worth of credits in 1997.[131] The largest buyers of credits have been large refineries and utilities, while the sellers were smaller refiners, glass container manufacturers and facilities that ceased operations. Of the sources that went out of business or left the area, only a handful cited environmental regulations as a factor in their decision.

RECLAIM credit prices have remained far below the prices that were projected at the time of program adoption. The average price in 1997 for NO_x credits of the same vintage was just $227 per ton, while 2010 vintage credits were $1,880 per ton. Average 1997 prices for SO_x credits were as low as $64 for 1997 vintage credits and as much as $2,393 per ton for 2003 vintage credits. According to Cantor Fitzgerald, a broker in emission reduction credits, the average price for SO_x RTC in early 2000 was about $1500 per ton for 2000 vintage credits and $2,300 per ton for 2005 to 2010 vintage credits.[132]

6.13 Other State Programs

In addition to RECLAIM, emission-trading programs are in various stages of development in several states. This section reviews activities in Illinois, Michigan, New Jersey, Texas, Pennsylvania, Colorado, and Washington. The state programs are an outgrowth of EPA's proposed 1995 Open Market Trading Rule.[133] While the 1995 proposal was never finalized, it was incorporated into Draft Economic Incentive Program (EIP) Guidelines in September 1999. The Open Market Trading Rule and the subsequent EIP Guidelines provided guidance for states that wish to institute emissions trading as part of their State Implementation Plans (SIP). As is the case with all draft guidance documents, the guidelines are subject to change. The advantage of EPA's generic emission trading rules over offsets, bubbles, netting, and banking is that individual trades do not require a SIP revision or EPA review. By following the generic rules, the transaction costs of emission trading can be reduced substantially.

6.13.1 Illinois Emission Reduction Market System

The Illinois Emission Reduction Market System (ERMS) allows the trading of VOC emission credits between firms in the Chicago non-attainment area. Like RECLAIM and the Acid Rain Program, the Illinois ERMS is an allowance program designed with an overall emissions cap and phased reductions to meet air quality goals. By 2007, when the market is scheduled to end, the

Chicago area must be in attainment for the national ambient air quality standard for ozone. Air quality modeling revealed that controlling emissions of volatile organic matter would be far more effective in reducing ozone than controlling NO_x emissions.

The ERMS is applicable to sources in the Chicago ozone non-attainment area that emit more than 10 tons per year of volatile organic matter (VOM) during the ozone season and that are subject to the Clean Air Act Permit Program. Sources receive an allocation of allotment trading units (ATU), each of which represents the right to release 200 pounds of VOM during the May 1-to-September 30 allotment period. Sources may receive a program exemption if they accept a 15-ton per season cap on emissions or if they agree to limit emissions to 82% of baseline emissions. Sources in the program receive an allocation that is 12% lower than their baseline emissions, defined as the two highest emission years during the 1994–1996 period.

6.13.2 Michigan Emissions Trading Program

The Michigan Air Emission Trading Program began in 1996.[134] It provides for the banking and trading of emission reduction credits (ERCs) in NO_x, VOCs, and all criteria pollutants except ozone. ERCs, which are denominated in tons per year, may be generated in the following ways: (1) through a facility shutdown; (2) through a permanent reduction in operations that results in reduced emissions; (3) through the use of new technologies, equipment, or inputs that result in reduced emissions; and (4) through the installation of pollution control equipment that decreases actual emissions. Various methods may be used to measure emissions: CEM; stack gas sampling; measuring surrogates (e.g., some VOC, but not all VOC); inputs; process conditions; etc. In general, credits obtained through a facility shutdown cannot be traded within a non-attainment area to satisfy a source's obligations.

6.13.3 New Jersey Emission Trading Program

The New Jersey Emission Trading Program is similar to Michigan's program, except that it applies only to NO_x and VOC.[135] The New Jersey Department of Environmental Protection maintains a registry of discrete emission reduction (DER) credits that are transferred. Average prices for 2000 are reported in Table 6-6.

Table 6-6. Open Market Emissions Trading Registry Report (2000)

POLLUTANT	OZONE SEASON	YEAR-TO-DATE AVERAGE PRICE PER DER
NO_x	No	$43.91
NO_x	Yes	48.40
VOC	No	127.50
VOC	Yes	127.50

Source: http://www.omet.com/scripts/omet/OMET_Report_Month_Selector.idc

6.13.4 Texas Emissions Trading Program

The Texas Natural Resource Conservation Commission (TNRCC) Emission Credit Banking and Trading Program provides a market-based framework for trading emission reductions of volatile organic compounds (VOC), nitrogen oxides (NO_x), and certain other criteria pollutants from stationary, area, and mobile sources. The program was designed to provide additional flexibility for complying with the Texas Clean Air Act while creating a net reduction in total air emissions

with each transaction. At present, the TNRCC is developing a NO_x cap-and-trade for certain ozone non-attainment areas.

6.13.5 Pennsylvania Emission Trading Program

The Pennsylvania program is similar to the Michigan program, with some exceptions. ERCs may be generated only for VOCs and NO_x. ERCs can be transferred from dirtier areas—the five Philadelphia counties—to cleaner areas, but not from the cleaner areas to the dirtier ones.[136] ERCs may be transferred within the five-county Philadelphia area with some limitations. The Pennsylvania Department of Environmental Protection (DEP) maintains a registry of ERCs that are available for trade or future use. Buyers and sellers of ERCs are encouraged to contact DEP for assistance.

6.13.6 Wood Stove and Fireplace Permit Trading (Colorado)

During the 1970s and 1980s, a number of mountain communities in Colorado experienced unacceptably high levels of particulate pollution during winter months due to the use of wood-burning stoves and fireplaces. The growing popularity of skiing and other winter activities has exacerbated the problem in some of these areas.

Telluride tried to combat the problem through traditional forms of regulation. In 1977, the city passed an ordinance limiting new residential construction to one stove or fireplace per unit. This rule might have slowed the deterioration in air quality. However, new construction continued, which virtually guaranteed that air quality would continue to worsen, which it did into the 1980s.

In 1987, the city adopted a program that was part traditional and part modeled on air pollution offsets that would guarantee improvements in air quality. Owners of existing wood stoves and fireplaces were grandfathered with operating permits, but they were required to meet stringent performance standards within 3 years: 6 grams of particulate matter and 200 grams of CO per hour. During the first 2 years of the program, those individuals who converted their fireplaces and wood stoves to natural gas could earn a rebate of $750, which would partially defray their costs. For new construction, no new permits would be issued for wood-burning stoves or fireplaces. To install such an appliance in a newly constructed building, the owner must produce permits to operate two fireplaces or stoves. These permits could only be acquired from existing permit owners.

In a matter of months, a lively market in second-hand permits developed, with potential buyers and sellers making contact through classified advertisements. By the mid-1990s, permit prices were in the $2,000 range. In the years after Telluride adopted the program, it has reported no violations of the ambient air quality standard for particulate matter.

Other communities in Colorado soon implemented similar programs, which combined performance-based standards that encouraged the retirement of older inefficient fireplaces and wood stoves. All these programs focused on reducing the burning of wood, but some offered no rebates for converting these fireplaces and stoves to natural gas. From the available evidence, the programs appear to have been a success, achieving air quality goals quickly and at a relatively modest cost. A project for future research would compare and contrast the approaches taken by different communities in limiting the use of heavily polluting wood stoves and fireplaces, as well as assess the effectiveness of the programs.

6.13.7 Grass-Burning Permit Trading (Washington)

The City of Spokane, Washington, is nestled in the Spokane River Basin about 400 feet below the surrounding Columbia River Plateau. The basin forms a natural trap for air pollution during temperature inversions. The area exceeds the federal 24-hour standard for particulate matter several times each year, due to a combination of unpaved roads, wind-blown dust, grass burning, and wood-burning stoves.

Spokane is a major growing region for turf grass seed, with between 15,000 and 30,000 acres planted for seed production each year. After harvest each year, the fields are burned in August or September to control weeds and pests and to stimulate the grass to produce seed rather than concentrate its energy on vegetative growth. In 1990, air pollution authorities in Spokane County implemented an innovative program to reduce grass burning as a source of particulate matter.[137]

Grass burning had been subject to permitting for years. The program superimposes a countywide cap of 35,000 acres that may be burned each year onto the existing permit process. Growers are allocated permits to burn grass based on burning permits they held during the base period, 1985 to 1989. The overall cap does not appear to be binding; it exceeds the actual acreage burned in every year since 1971. However, some grass growers found themselves short of desired permits because they had planted other crops during the base period or because they had rented their land to tenants (who held the permits) during the base period.

The program allows transfers of grass-burning permits in three situations: permanent land transfers; temporary land transfers by lease; and transfer through an auction held by the Air Pollution District. When permits are transferred through the auction, 10% of the burnable acreage is deducted from the buyer's account, resulting in a small decrease over time in the total number of burnable acres. The auction mechanism is patterned after the acid rain allowance auction. Parties submit sealed bids and offers prior to the auction. The party with the highest bid is matched with the party with the lowest offer, with the actual transaction occurring at a price midway between the bid and offer. If the entire quantity offered was not purchased by that bidder, the bidder with the next lower price is then matched with the remaining offer. The process continues until all potential transactions are completed.

6.14 Effluent Trading

Despite many academic studies showing the potential benefit of effluent trading and considerable effort by EPA and the states to implement the concept, effluent trading has yet to live up to its full promise. While conceptually very similar to emission trading (which deals with emissions to the air), effluent discharge and its regulation also differ significantly from emission trading because effluent trading deals with emissions to the water.

Water pollution is caused by both point and non-point sources. *Point sources* discharge pollutants into surface waters through a conveyance such as a pipe or ditch. Primary point sources include publicly owned treatment works (POTWs) and industries. *Non-point sources* add pollutants from diffuse locations such as surface agricultural runoff or unchannelized urban runoff. The most important non-point source of water pollution is agriculture. The differences between emission trading and effluent trading have made it difficult to design practical programs that can capture the potential benefits of effluent trading. New efforts by EPA to implement its Total Maximum Daily Load (TMDL) program in areas with impaired water quality are expected

to vastly increase the use of effluent trading. For current EPA efforts to promote effluent trading, see http://www.epa.gov/owow/watershed/trading.htm.

6.14.1 Effluent Bubble

In concept, a water effluent bubble operates identically to the air emission bubble described in Section 6.2.2, Bubble Policy. A facility with multiple discharge points is wrapped in an imaginary bubble, with a facility-wide discharge limit rather than separate limits at the individual points of discharge. In contrast to the 100-some bubbles approved under the air emission trading program, only a handful of facilities within the iron and steel industry have received the authority to bubble effluents. The historical development of that program is described in the following paragraphs.

Asked by EPA to evaluate the potential for water effluent bubbling, a contractor ventured in 1981 that bubbling would not produce cost savings for most industrial facilities.[138] The reasons include the fact that most industrial facilities already have centralized wastewater treatment plants with a single point of discharge, trades between outfalls may be circumscribed due to water quality concerns, and some facilities already operated under permits that allowed all technologically feasible tradeoffs to be made.

Despite the acknowledged limitations, a subsequent study identified four plants in the iron and steel industry that would, potentially, benefit from water bubbling as they went from BPT (best practicable control technology currently available) to BAT (best available technology economically achievable).[139] The projected savings were less than $1 million annually. A retrospective study estimated the savings from effluent bubbles in the iron and steel industry were far larger: in excess of $122 million, as shown in Table 6-7.

Table 6-7. Estimated Cost Savings from Iron and Steel Intraplant Trades

FACILITY	OUTFALLS IN TRADE	TRADING PERIOD FOR ANALYSIS	PRESENT VALUE OF REDUCED CAPITAL COSTS (in millions of 1993 dollars)	PRESENT VALUE OF REDUCED OPERATING & MAINTENANCE COSTS (in millions of 1993 dollars)	PRESENT VALUE OF ALL REDUCED COSTS (in millions of 1993 dollars
A	5	1987–1993	$3.9	$2.4	$6.3
B	2	1983–1986	No Data	No Data	No Data
C	2	1985–1993	2.4	2.5	4.9
D	3	1984–1993	2.1	1.2	3.3
E	4	1986–1993	No Data	No Data	No Data
F	2	1983–1988	10.3	3.9	14.2
G	2	1984–1993	5.5	3.1	8.6
H	2	1984–1989	8.9	6.8	15.7
I	3	1983–1985	57.7	12.1	69.8
J	3	1984–mid-1980s	No Data	No Data	No Data
TOTALS			**$90.8**	**$32.0**	**$122.8**

Source: Kashmanian et al. 1995.

EPA's implementation of the effluent bubble for the iron and steel industry was dictated by a 1983 settlement agreement among EPA, the Natural Resources Defense Council (NRDC), and the American Iron and Steel Institute. The agreement supports the use of bubbling under the

Clean Water Act, but it imposes constraints on the approach. Bubbling of effluents from iron and steel plants is acceptable, provided that net reductions are achieved in each pollutant that is bubbled. Relative to the BAT limits that are in effect, bubbling must involve a reduction of at least 15% of the amount of both suspended solids and oil and grease and 10% of the amount of other pollutants. The NRDC reserved the right to challenge bubbles that might be proposed for other industries.

Complying with the steel effluent bubble has produced considerable cost savings for the industry. According to a former EPA employee who is now a consultant to the industry, however, the bubble has not resulted in any pollution control innovations.[140] EPA will soon propose revisions to the iron and steel regulations that would make the effluent bubble unnecessary.

6.14.2 Effluent Trading: Point-to-Point

Effluent trading dates to the early 1980s. At that time, the State of Wisconsin created a state-wide program to give sources such as wastewater treatment plants and pulp and paper mills added flexibility to meet the state's water quality standards through the trading of effluent rights. The first application of this authority was on the heavily industrialized lower Fox River.

The Fox River program applies to the last 35miles of the river, allowing trading between point sources with permits to discharge wastes that increase biochemical oxygen demand (BOD). Sources that control more waste than their discharge permit requires can sell those incremental rights to sources that control less waste than is required. Strict conditions are imposed on would-be buyers of rights: Trading of rights is allowed only if the buyer is a new facility, is increasing production, or is unable to meet required discharge limits despite optimal operation of its treatment facilities. Traded rights must have a life of at least 1 year, but they may not run past the expiration date of the seller's discharge permit, which is, at most, a 5-year period. Since effluent discharge limits may change with each permit renewal, there can be no guarantee that rights that were traded-in during one permit period would be available during subsequent permit periods. Analysis predicted that the potential gains from effluent trading among sources on the lower Fox River was significant: $7 million annually or roughly one-half of anticipated compliance costs for BOD regulations.[141]

Later, the state initiated BOD trading programs on 500 miles of the Wisconsin River. For administrative reasons, the Fox River was divided into three segments and the Wisconsin River into five segments. The Fox River program included 21 parties: five mills and two towns in each of the three administrative segments. Twenty-six parties are included in the Wisconsin River program. To date, trading under these programs has been disappointing, involving a single trade on the Fox River between a municipal wastewater plant and a paper mill. One reason for the limited activity is that dischargers developed a variety of compliance alternatives not contemplated when the regulations were drafted. Second, there were questions about the vulnerability of the program to legal challenge, and these questions remain since the Clean Water Act does not explicitly authorize trading. Furthermore, there is a requirement that all facilities meet minimum technology-based effluent limits. Finally, as noted in a previous paragraph, the state imposed severe restrictions on the ability of sources to trade.

6.14.3 Effluent Trading: Point-to-Non-point Sources

A number of programs allow the trading of nutrient discharges between point and non-point sources. Three such programs are described here; others are included in Table 6-8.

6.14.3.1 Dillon Reservoir

Dillon Reservoir, which supplies Denver with more than one-half of its water supply, is situated in the midst of a popular recreational area. Four municipal wastewater treatment plants discharge into the reservoir: the Frisco Sanitation District, Copper Mountain, the Breckenridge Sanitation District, and the Snake River treatment plant of the Keystone area.

Due to concerns that future population growth in the region could lead to eutrophic conditions in Dillon Reservoir, as well as the discovery that Copper Mountain was exceeding its discharge limits, EPA launched a study of the Dillon Reservoir in 1982 under its Clean Lakes program. The study indicated that phosphorus discharges would have to be reduced to maintain water quality and accommodate future growth. Point source controls alone were unlikely to be sufficient; runoff from lawns and streets and seepage from septic tanks also would have to be reduced.

A coalition of government and private interests developed a plan to reduce phosphorus releases to the reservoir. The plan established a cap on total phosphorus loadings, allocated loadings to the four wastewater treatment plants, and provided for the first-ever trading of phosphorus loadings with non-point sources.

The plan relies on 1982 phosphorus discharges as the baseline; that year represented a near worst-case scenario due to high rainfall and water levels that led to high non-point loadings. Discharges from new non-point sources are restricted through regulations that require developers to show a 50% reduction of phosphorus from pre-1984 norms. New non-point sources must offset all of their discharges by using a trading ratio of 1:1 with existing non-point sources. For point sources, the plan established a trading ratio of 2:1, whereby point sources that are above their allocation must obtain credits from point or non-point sources for twice the amount of the excess from sources that are below their allocation. The system would be monitored through existing NPDES (National Pollution Discharge Elimination System) permits for point sources.

Trading has been very slow. Not only has the region experienced a recession for a number of years that limited population growth, but the wastewater treatment plants have found cheaper means of controlling phosphorus than were previously envisioned. In the future, though, opportunities for further control at the wastewater treatment plants are thought to be limited. Population growth is once again evident, leading to the conclusion that more trading activity is likely.

6.14.3.2 Cherry Creek Reservoir

Like the Dillon Reservoir, Cherry Creek Reservoir also is a source of water for the Denver region and an important recreation area. The 800-acre reservoir attracts more than 1.5 million visitors annually. To protect recreational and water supply uses, the Cherry Creek Basin Authority developed a total phosphorus standard to limit algae concentrations and assigned wasteload allocations to the 12 wastewater treatment facilities in the watershed (a total maximum daily load for the reservoir). Source trading between point sources and non-point sources is authorized as an option for addressing the fact that 80% of the phosphorus load originates with non-point sources. To date, there has been no compelling need to trade at Cherry Creek since

phosphorus effluent at municipal wastewater treatment facilities remain below the limits set by the Colorado Water Quality Commission. The Cherry Creek Basin Authority has designed a number of non-point pollution control projects that will generate phosphorus reduction credits. When regional economic growth compels wastewater treatment facilities to achieve greater phosphorus reductions, the credits will be available.

6.14.3.3 Tar Pamlico Basin

The North Carolina Environmental Management Commission designated the Tar-Pamlico Basin as nutrient-sensitive waters in 1989, in response to findings that algae blooms and low-dissolved oxygen threatened fisheries in the estuary. Upon designating an area as nutrient-sensitive, North Carolina law requires that the Division of Environmental Management (DEM) must identify the nutrient sources, set nutrient limitation objectives, and develop a nutrient control plan.

DEM prepared analysis showing that most of the nutrient loadings (nitrogen as the limiting factor but also phosphorus) came from non-point sources, principally agricultural runoff. Other identified sources included municipal wastewater treatment plants and industrial and mining operations. DEM proposed a solution to control both nitrogen and phosphorus discharge from wastewater treatment plants: nitrogen at 4 mg/l in the summer and 8 mg/l in the winter and phosphorus at 2 mg/l year-round.

Concerned about the potential costs of this regulation, municipal wastewater dischargers worked with state agencies and the North Carolina Environmental Defense Fund to design an alternative approach. Ultimately accepted by the DEM, the plan requires the parties to the accord to develop a model of the estuary, identify engineering control options, and implement a trading program for nutrient reductions. The trading program allows each of the 12 point source dischargers the opportunity to offset any discharges above their permitted limits. They may trade with feedlot operators on a 2:1 basis or with cropland managers on a 3:1 basis. To date, point source dischargers have found ways to meet new and stricter discharge limits without resorting to trading. In the future, trading may become more attractive as a compliance option. Hoag and Hughes-Popp (1997) provide a useful discussion of the program.

6.14.3.4 Other Effluent Trading Initiatives

EPA and the states are actively involved in a number of other effluent trading projects. These projects are summarized in Table 6-8 and in more detail in a recent EPA report entitled "A Summary of U.S. Effluent Trading and Offset Projects."[142] Many of these projects also are discussed on the Nutrientnet web site: http://www.nutrientnet.org.

6.14.4 Future Prospects for Effluent Trading

The Federal Water Pollution Control Act (FWPCA) of 1972 developed the basic framework for federal water pollution control. After amendments in 1977, the FWPCA has been known as the Clean Water Act (CWA). The FWPCA controls water pollution by regulating discharges of pollutants from point sources—such as industrial facilities, sewage treatment plants, and concentrated animal feeding operations—with a system of national effluent standards and permits for each class of point source discharge (the NPDES system). EPA sets effluent discharge standards based on the cost of control and the availability of control technology. By using this basic approach, many of the nation's streams and rivers are demonstrably cleaner than they were in 1972.

Table 6-8. Effluent Trading Projects

PROJECT	WATER BODY	STATE	ACTIVITY DESCRIPTION	STAGE	TRADES/ OFFSETS APPROVED?	SAVINGS ESTIMATE AVAILABLE?
Grassland Area Tradable Loads	San Joaquin River	CA	Watershed trading program	Implementation	Y	N
San Francisco Bay Mercury Offset	San Francisco Bay	CA	Regional offset program	Under development	N	N
Bear Creek Trading Program	Bear Creek Reservoir	CO	Watershed trading program	Approved	N	N
Boulder Creek Trading Program	Boulder Creek	CO	Watershed trading program	Implementation	Y	Y
Chatfield Reservoir Trading Program	Chatfield Reservoir	CO	Watershed trading program	Approved	N	N
Cherry Creek Basin Trading Program	Cherry Creek Reservoir	CO	Watershed trading program	Implementation	Y	N
Dillon Reservoir Trading Program	Dillon Reservoir	CO	Watershed trading program	Implementation	Y	N
Long Island Sound Trading Program	Long Island Sound	CT	Large watershed trading program	Under development	N	Y
Blue Plains WWTP Credit Creation	Chesapeake Bay	DC	Single trade	Under development	N	N
Tampa Bay Cooperative Nitrogen Management	Tampa Bay	FL	Regional cooperation	Implementation	Y	N
Cargill and Ajinomoto Plants Permit Flexibility	Des Moines	IA	NPDES permit flexibility	Implementation	Y	N
Lower Boise River Effluent Trading Demonstration Project	Boise River	ID	Watershed trading program	Under development	N	Y
Specialty Minerals Inc.	Hoosic River	MA	Offset for one discharger	Implementation	N	Some
Town of Acton POTW	Assabet River	MA	Offset for one discharger	Under development	N	Some
Wayland Business Center Treatment Plant Permit	Sudbury River	MA	Offset for one discharger	Implementation	Y	Y
Maryland Nutrient Trading Policy	Chesapeake Bay, other MD waters	MD	Statewide trading program	Under development	N	N
Kalamazoo River Water Quality Trading Demonstration	Kalamazoo River, Lake Allegan	MI	Watershed pilot program	Implementation	Y	N
Michigan Water Quality Trade Rule Development	MI Waters	MI	Statewide trading program	Nearing completion	N	Y

PROJECT	WATER BODY	STATE	ACTIVITY DESCRIPTION	STAGE	TRADES/ OFFSETS APPROVED?	SAVINGS ESTIMATE AVAILABLE?
Minnesota River Nutrient Trading Study	Minnesota River	MN	Watershed trading study	Completed	N/A	Y
Rahr Malting Plant	Minnesota River	MN	Offset for one discharger	Implementation	Y	N
Southern Minnesota Beet Sugar Plant	Minnesota River	MN	Offset for one discharger	Implementation	Y	N
Chesapeake Bay Nutrient Trading	Chesapeake Bay	multi	Large watershed trading program	Under development	N	N
Neuse River Nutrient Strategy	Neuse River Estuary	NC	Watershed trading program	Approved	N	Y
Tar Pamlico Nutrient Program	Pamlico River Estuary	NC	Watershed trading program	Implementation	Y	Y
Passaic Valley Sewerage Com. Effluent Trading	Hudson River	NJ	Pretreatment program	Implementation	Y	N
Truckee River Water Rights and Offset Program	Truckee River	NV	Offset for one discharger	Implementation	Y	N
New York Watershed Phosphorus Offset Pilot Programs	Hudson River	NY	Offset pilot programs	Implementation	Y	N
Claremont County Project	Little Miami River, Harsha Reservoir	OH	Potential regional trading project	Under development	N	N
Delaware River Basin Trading Simulation	Delaware River	PA	Watershed pilot program	Early discussion	N	N
Henry Co. Public Service Auth. and City of Martinsville	Smith River	VA	Single trade	Implementation	Y	N
Virginia Water Quality Improvement Act and Tributary Strategy	Chesapeake Bay, other VA waters	VA	Statewide trading program	Approved	N	N
Wisconsin Effluent Trading Rule Development	WI waters	WI	Statewide trading program	Pilots active	N	N
Fox-Wolf Basin Watershed Pilot	Green Bay	WI	Watershed pilot program	Approved	N	Y
Red Cedar River Pilot Trading Program	Tainter Lake	WI	Watershed pilot program	Approved	N	Y
Rock River Basin Pilot Trading Program	Rock River Basin	WI	Watershed pilot program	Under development	N	N

Source: EPA. Reinvention Activity Fact Sheets. Effluent Trading in Watersheds

According to data submitted by states in 1998, about 40% of the nation's streams and rivers do not meet the water quality goals set forth by states, Indian tribes, and territories.[143] For these water bodies, a little-known provision in Section 303 of the Clean Water Act will soon be used to achieve further improvements in water quality. Recently, EPA published final rules, which have not yet taken effect, concerning the Total Maximum Daily Load (TMDL) Program.

A TMDL is a calculation of the maximum quantity of pollution that a water body can accept and still meet designated water quality standards. The TMDL is then allocated to point and non-point sources. Effluent trading will be encouraged as a means of lowering compliance costs for affected sources.

Of concern is the CWA requirement that existing, expanding, and new facilities—including publicly owned treatment works, industrial dischargers, stormwater programs, and coastal zone measures—meet all applicable technology-based requirements. This requirement appears to represent a severe obstacle to trading.

The potential cost savings from effluent trading are impressive. Analysis by EPA suggests that trading among indirect dischargers could produce compliance cost savings of $658 million to $7.5 billion. Trading just among point sources could achieve cost savings of $8.4 million to $1.9 billion, while trading among point and non-point sources could yield compliance cost savings of $611 million to $5.6 billion.[144]

6.15 Wetland Mitigation Banking

Wetlands (also sometimes termed "swamps," "bogs," or "floodplain") were long considered unproductive wastelands. Over time, hundreds of thousands of acres of wetlands were drained by farmers, filled by developers, and otherwise converted to "productive" uses. From the 1780 to 1980, the contiguous 48 states lost over one-half of their original wetland acreage. [145]

In recent years, scientists pointed out the ecological importance of wetlands. Government policies at the federal, state, and local level have since come to emphasize wetland preservation, not development. Developers whose proposed actions would destroy wetlands are increasingly being forced to minimize damage to wetlands and to offset what damage occurs through wetland protection or enhancement offsite. Sometimes, the offset takes the form of compensation. That approach is described more fully in Chapter 4, Pollution Charges, Fees, and Taxes. This section describes wetland mitigation banking, a procedure for offsetting the adverse impacts of development on wetlands.

Wetland mitigation banks are created through a memorandum of understanding (MOU) among federal and state officials and a bank administrator. In most cases, the MOU would describe the responsibilities of each party, the physical boundaries of the bank, how mitigation credits will be calculated, and who is responsible for long-term management of the bank. Credits, which are usually denominated in terms of acres of habitat values, may only be used to mitigate development within the same watershed. State regulations would cover issues such as where mitigation credits can be used (e.g., statewide or within a watershed) and the compensation ratios that would be required for various types of development. Existing banks vary from a few acres to over 7,000 acres.

Among established wetland mitigation banks, most MOUs allow the bank operator to sell credits only after the bank has actually accomplished wetland enhancement or preservation. A few states

allow the bank operator to sell credits concurrently as preservation or enhancement actions are undertaken.

The land for a mitigation bank could have any number of origins. Some of the more common sources of mitigation bank lands include existing natural wetland areas, enhanced natural wetland areas, pits created by the removal of landfill material, and lands that previously had been drained for agricultural use. State highway departments established approximately one-half of existing wetland mitigation banks to provide a means for mitigating losses due to highway construction. Conservation organizations and for-profit entities have set up mitigation banks that offer mitigation credits for sale.

Mitigation banking offers several advantages over more traditional on-site mitigation activities.

- Environmental values are better protected in large-scale developments.
- Economies of scale in wetland preservation and enhancement can be realized.
- The cost of wetland mitigation actions can be made known to developers very early in the development process.
- Mitigation banking offers greater assurance of long-term management of the protected area.

About 100 wetland mitigation banks in at least 34 states are currently in operation, and more are in advanced stages of planning. Wetland mitigation banking was featured in the 1996 Farm Bill as part of the Wetlands Reserve Program. Wetland mitigation banking has been endorsed by EPA, the Army Corps of Engineers (which oversees most development in wetlands under Section 404 of the Clean Water Act), and by the authors of leading legislative initiatives to reauthorize the Clean Water Act. All of these facts suggest that wetland mitigation banking will grow in importance as a means of protecting and enhancing the nation's wetlands.

6.16 Greenhouse Gas Emissions

The Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC) establishes quantified emission limitations and reduction targets for greenhouse gases (GHG) that are to be achieved by the end of the first commitment period (2008–2012). On average, these commitments call for a 5.2% reduction from 1990 emission levels. (However, these commitments vary from one Party to the Convention to another.) To date, the Protocol has been signed by 38 industrialized countries and the European Community—the so-called Annex I Parties—but it has not been ratified by a sufficient number of Parties to come into effect.

Among other things, the Protocol includes basic provisions for the monitoring, reporting, and verification of greenhouse gas emissions (Articles 5, 7, and 8), and it outlines the need for effective procedures and mechanisms to address non-compliance (Article 18). Most remarkably, the Kyoto Protocol allows for the use of economic-incentive mechanisms, the so-called "flexible mechanisms," that enable the emission reduction targets to be met at least cost. These mechanisms, described in the following paragraphs, consist of Joint Implementation (Art. 6); the Clean Development Mechanism (Art. 12); and International Emissions Trading (Art. 17). They also include the use of Article 4 (the "bubble") by a group of Parties to fulfill their commitments jointly. At present, many of the rules and guidelines related to these provisions are in the process of being negotiated. How the issues are resolved will have an effect on the number of countries

that will ratify the Kyoto Protocol and the cost of achieving these emission reduction targets. In November 2000, delegates met in The Hague, The Netherlands but were unable to resolve many of the issues concerning GHG trading. They have scheduled a resumed session for May 2001 in Bonn.[146]

Joint Implementation (JI): JI allows Annex I Parties to transfer and acquire "Emission Reduction Units" that are generated from project-level activities that reduce emissions by sources or that enhance removals by sinks in other Annex I countries. That is, a country or designated legal entity within a country can invest in a greenhouse gas (GHG) reduction project in another Annex I country and receive credits for the emissions reductions that the project generates. Project participants must show that the emissions reductions or removals are real, measurable, and additional to what would have occurred in the absence of the project activity.

Clean Development Mechanism (CDM): The CDM enables Annex I Parties or legal entities within these countries to invest in GHG emission reduction or removal projects in non-Annex I countries (i.e., developing countries), in exchange for "certified emissions reduction" units. The CDM would promote sustainable development in developing countries and help Annex I countries meet their GHG targets. Similar to JI, project participants must show that the emissions reductions or removals are real, long-term, measurable, and additional to what would have occurred in the absence of the project activity.

International Emissions Trading (IET): Under Article 17, Annex I Parties are able to participate in international emissions trading to meet their GHG targets. That is, countries with high costs of emissions abatement can provide funding for additional reductions in other Annex I countries that have low costs of emissions abatement, in exchange for the acquisition of assigned amount units. This ruling, in effect, enables Annex I Parties to reach their emission reduction targets at minimum cost.

The Article 4 Joint Fulfillment: Article 4 would allow a group of Parties in Annex I to choose to satisfy their emission reduction commitments jointly and to reallocate the commitments among the Parties within the group. The provision was designed to allow the European Union (EU) to change the distribution of reduction and limitation commitments set out in Annex B of the Kyoto Protocol for its members, with the absolute EU target remaining unchanged. The provision also enables other groups of Annex I Parties to enter into such an agreement, if they choose.

Activities Implemented Jointly (AIJ): At the first conference of the Parties to the UN Framework Convention on Climate Change, which was held at the 1990 Rio Earth Summit, the Parties agreed to a pilot program called "Activities Implemented Jointly." Under this program, government entities in one country could jointly undertake projects with similar entities in another country.

The United States Initiative on Joint Implementation (USIJI) was the first national program to adopt a formal set of criteria and an evaluation process for activities that could be implemented jointly (AIJ). An Evaluation Panel with representatives from U.S. government agencies determined the acceptability of proposed projects. The first United States AIJ projects were accepted in January 1995, and others followed soon thereafter. Central America hosted most of the early U.S. projects, but Russia and other nations also hosted AIJ projects. Projects involved energy end uses; energy production; biomass, geothermal, hydroelectric, and wind energy technologies; and forestry management. Through the end of July 1998, the USIJI panel had

approved 32 projects out of 110 that had been submitted. (See Table 6-9.) The other projects were withdrawn or rejected.

Table 6-9. Accepted USIJI Projects

(As of October 25, 2000)

PROJECT NAME	COUNTRY	PROJECT TYPE
CAPEX, SA Electric Generation Project	Argentina	Energy production
Landfill Gas Management in Greater Buenos Aires	Argentina	Energy production
Rio Bermejo Carbon Sequestration Project	Argentina	GHG sink
Bel/Maya Biomass Power Generation Project	Belize	Energy production
Rio Bravo Conservation and Forest Management	Belize	GHG sink
Noel Kempff M. Climate Action Project	Bolivia	GHG sink
Rural Solar Electrification Project	Bolivia	Energy production
The Taquesi River Hydroelectric Power Project	Bolivia	Energy production
SIF Carbon Sequestration Project	Chile	GHG sink
The Rio Condor Carbon Sequestration Project	Chile	GHG sink
Wind Energy Project	Chile	Energy production
La Sierra Electricity Efficiency in Colombia	Colombia	Energy end use
Aeroenergia S.A. Wind Facility	Costa Rica	Energy production
Consolidation of National Parks & Biological Reserves as Carbon Deposit	Costa Rica	GHG sink
Dona Julia Hydroelectric Project	Costa Rica	Energy production
ECOLOAND: Piedras Blancas National Park	Costa Rica	GHG sink
Esquinas National Park	Costa Rica	GHG sink
Klinki Forestry Project	Costa Rica	GHG sink
Plantas Eolicas S.R.L. Wind Facility	Costa Rica	Energy production
Territorial and Financial Consolidation of Costa Rican National Parks and Biological Reserves	Costa Rica	GHG sink
Tierras Morenas Windfarm Project	Costa Rica	Energy production
City of Cecin: Fuel Switching, District Heating System	Czech Rep.	Energy end use
Bilsa Biological Reserve	Ecuador	GHG sink
Cemento de El Salvador, S.A. de C.V.	El Salvador	Energy end use
Matanzas Hydroelectric Project	Guatemala	Energy production
Rio Hondo II Hydroelectric Project	Guatemala	Energy production
Santa Teresa Hydroelectric Project	Guatemala	Energy production
Bio-Gen Biomass Power Generation Project, Phase I	Honduras	Energy production
Bio-Gen Biomass Power Generation Project, Phase II	Honduras	Energy production
Solar-Based Rural Electrification	Honduras	Energy production
The Bagepalli Project: Community-Based Fruit Tree Orchards for CO_2 Sequestration	India	GHG sink
Reduced Impact Logging for Carbon Sequestration in East Kalimantan	Indonesia	GHG sink
Energy Centers for Mali	Mali	Energy production
Solar Electric Generation for the Island of Rodrigues	Mauritius	Energy production
APS/CRD Renewable Energy Mini-Grid Project	Mexico	Energy production
Community Silviculture in the Siera Norte of Oaxaca	Mexico	GHG sink
Project Salicornia: Halophyte Cultivation in Sonora	Mexico	GHG sink
Scolel Té: Carbon Sequestration and Sustainable Forest Management in Chiapas	Mexico	GHG sink
El Hoyo-Monte Galan Geothermal Project	Nicaragua	Energy production

Continued on the next page

PROJECT NAME	COUNTRY	PROJECT TYPE
Commercial Reforestation in the Chiriqui Province	Panama	GHG sink
The Central Selva Climate Action Project	Peru	GHG sink
Energy Efficient Street Lighting Project in the Philippines	Philippines	Energy end use
District Heating Renovation in Lytkarino	Russian Fed.	Energy end use
Improving District Heating Efficiency in Metallurguichesky District of Cheliabinsk	Russian Fed.	Energy end use
Reforestation in Vologda	Russian Fed.	GHG sink
RUSAFOR--Saratov Afforestation Project	Russian Fed.	GHG sink
RUSAGAS: Fugitive Gas Capture Project	Russian Fed.	Energy end use
Zelenagrad District Heating System Improvements	Russian Fed.	Energy end use
Guguletu Eco-Homes Project	South Africa	Energy end use
SELCO—Sri Lanka Rural Solar Electrification Project	Sri Lanka	Energy production
Energy Center for Uganda	Uganda	Energy end use
Solar Light for the Churches of Africa	Uganda	Energy end use

Source: USIJI Secretariat, 2000.

Financing remains a major obstacle; just 13 of the 32 projects that were approved through July 1998 had obtained funding by sponsors. Participants in these projects assert that they faced large transaction costs in dealing with host governments and experienced significant delays in getting project approvals from the USIJI Evaluation Board and from host governments. Sponsors identified development of new contacts in the host country, early entry into a potentially profitable business, the possibility of influencing future AIJ criteria, and favorable publicity as motivating factors.

The record of the early AIJ projects offers important lessons regarding the CDM and how it should be structured. After-the-fact assessments of a large number of U.S. AIJ projects reveal difficulties in determining whether project activities truly are additional to activities that would have been undertaken without the AIJ program. Furthermore, monitoring progress and measuring the success of JI activities in reducing GHG emissions have proven to be a challenge, particularly for projects designed to create or enhance carbon sinks. Since pre-Kyoto AIJ was largely an experimental activity, the consequences of a shortfall were not large. If credits had been sold or traded to other parties, the consequences would have been more serious.

Implementation of the Kyoto Protocol will have major financial implications. EPA-sponsored studies by Koomey et al. (1998) and Laitner et al. (1999) suggest that market-based policies, including expanding EPA's own voluntary programs, could reduce domestic energy-related carbon emissions by as much as 300 million metric tons at a net positive benefit to the economy by 2010. Estimates of the potential savings from the use of trading to satisfy U.S. obligations, versus traditional alternatives, are as high as $100 billion per year.[147] Clearly, details regarding how the program will be designed and implemented are likely to have considerable financial implications.

7. Subsidies for Pollution Control

7.1 Introduction

For the purposes of this report, subsidies of interest involve financial support by the government of activities believed to be environmentally friendly. The types of subsidies described in this report include grants, low-interest loans, favorable tax treatment, and procurement mandates for products believed to have environmental advantages. Research and development, information dissemination, and other services provided by the government that are below their true cost could also be considered subsidies. However, such services are too varied and numerous to be included in this report.

Subsidies are often funded by the fees charged on environmentally harmful products or activities. Advance disposal fees, for example, provide revenues to subsidize the proper disposal of products after their use. Although it could be argued that such disposal activities are not truly subsidized by the government if they are funded entirely by the fees on the product that are paid by industry or consumers, this chapter includes such mechanisms for the purposes of discussion.

Given the variety of subsidies used in environmental management at all levels of government, this chapter does not attempt to cover the topic in a comprehensive way. Its purpose is, instead, to provide an overview, with illustrative examples of the types of subsidies and how they have been used to address specific environmental problems.

The following areas are considered: pollution prevention and control, cleanup of contaminated industrial sites, farming and land preservation, consumer product waste management, citizen monitoring of environmental regulations, alternative fuels and low-emitting vehicles, and municipal wastewater treatment. The chapter concludes with a discussion of subsidies that have had the unintended effect of promoting environmentally harmful activities.

Table 7-1 summarizes various subsidy instruments, most of which are discussed in this chapter. Column 2 shows who pays for the various subsidies. The issue of whether the costs of subsidies are passed on to other businesses or consumers in some way is not addressed. Information on funding sources other than general revenues is also included in parentheses, where available. Column 3 lists the recipients of these subsidies. Whether these parties pass on the benefits of subsidies to their customers or others is also not assessed.

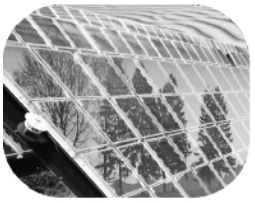
7.2 Pollution Prevention and Control

This section discusses the use of tax benefits and loans to promote pollution prevention and control. It also discusses an EPA program under which fines for environmental violations are reduced in exchange for pollution prevention and control activities.


Pollution Charges, Fees, Taxes


Deposit-Refund Systems


Trading Programs


Subsidies for Pollution Control


Liability Approaches

Information Disclosure


Voluntary Programs

Table 7-1. The Use of Subsidies in Environmental Management

SUBSIDY INSTRUMENT	WHO PAYS?	RECIPIENTS
Grants	.	
Brownfields development grants	EPA, states	Communities, property owners
Cost sharing for land conservation	Federal government	Property owners
Conservation easements	Federal, state, and local governments (Land transfer taxes)	Property owners
Environmental violation reporting rewards	States of New Jersey, California	Individuals and organizations
Waste management and recycling grants	Federal, state, and local governments (advance disposal fees (ADFs), waste taxes)	Public and private organizations
Unit-based waste collection or reuse payments	State governments (ADFs, waste taxes)	Businesses
Unit-based payments for the use of alternative fuel vehicles (AFVs)	Federal government	Public bus systems and small businesses
Municipal sewage treatment plant construction grants (replaced by loans)	Federal and state governments	Communities
Loans	.	.
Pollution control loans	State governments	Small businesses
Brownfields development loans	State governments (waste taxes)	Property owners
Recycling business loans	State governments (ADFs, waste taxes)	Businesses
Municipal sewage treatment plant construction loans (replaced previous grant program)	Federal and state governments	Communities
Tax Benefits	.	.
Pollution control property	State governments	Private organizations
Louisiana environmental score-card deduction	State of Louisiana	Businesses
Brownfields development	State governments	Property owners
Land use credits	State governments	Property owners
Recycling benefits	State governments	Businesses
Credits for ethanol and compressed natural gas	Federal and state governments	Alternative fuel vehicle manufacturers
Credits for alternative fuel vehicles and equipment	Federal and state governments	Alternative fuel vehicle purchasers
Renewable electricity generation credits	Federal government	Businesses
Electric vehicle credits	Federal government	Businesses or organizations
Interest exemption of pollution control investment debt	Federal government	Businesses or organizations
Procurement Mandates	.	.
Public procurement of recycled products	Federal, state, and local governments	Recycled products manufacturers
Public procurement of alternative fuel vehicles	Federal, state, and local governments	Alternative fuel vehicle manufacturers
Recycled content requirements	Private organizations	Recycled products manufacturers
Mandates for the use of alternative fuel vehicles	Private organizations	Alternative fuel vehicle manufacturers

SUBSIDY INSTRUMENT	WHO PAYS?	RECIPIENTS
Miscellaneous		
Reduced fines in return for supplemental environmental projects	Federal and state governments	Businesses
Accelerated review of applications for new pesticides	Federal government	Pesticide manufacturers
Relaxed regulatory requirements (e.g., ethanol Ried Vapor Pressure (RVP) waiver)	Federal, state, and local governments	Various organizations
Research & development; public education (technical assistance to participants in voluntary programs)	Federal, state, and local governments	Various organizations

7.2.1 Tax Benefits

Numerous states offer favorable tax treatment for the construction and installation of pollution control equipment. In most states that have such tax incentives, the equipment must have pollution control as its primary purpose. In some states, equipment with other purposes receives tax benefits on a prorated basis. Some states also require environmental regulators to certify equipment that is eligible for tax breaks.

The benefits usually apply to property or sales/use taxes but can apply to income tax in a smaller number of states. Air and water pollution equipment is commonly given tax benefits. However, New York offers a property tax exemption for industrial waste treatment facilities, and Ohio offers benefits for noise abatement equipment. Tax exemptions for production machinery and products used directly in manufacturing also apply to pollution control equipment in many cases.[148]

In Texas, for example, a constitutional amendment approved by voters in 1993 provided for exemptions of certain pollution control property from property taxes. The purpose of the amendment was to ensure that investments made to comply with environmental mandates did not raise the property tax payments of businesses. The exemptions applied only to "devices, equipment, methods, or land used to prevent, monitor, control, or reduce air, water, or land pollution" purchased in 1994 to "meet or exceed state, federal, or local laws, rules, and regulations." The vast majority of exemption requests were made for equipment that was used to comply with Clean Air Act requirements. The total value of the property for which businesses applied for exemptions was $1.2 billion. A state official estimated that the applications would lead to a loss of $26.6 million in tax revenue.[149]

One problem with such tax benefits is that they can erode state or local tax bases. In Texas, for example, the $26.6-million revenue shortfall is expected to affect mainly school districts, but also cities and counties. One tax district appraiser predicted that homeowners would make up the shortfall.[150]

The incentive effect of such preferential tax treatment is difficult to assess, in part because of the simultaneous presence of other policies that affect behavior. If the benefits are offered merely to subsidize compliance with regulations, the regulations themselves probably have a stronger incentive effect than the benefits. However, the favorable tax treatment could provide an incentive to exceed requirements.

7.2.2 Louisiana Environmental Scorecard

Louisiana's environmental scorecard program, which was in effect from October 1990 to January 1992, linked tax exemptions for companies to their environmental performance. The state's Departments of Economic Development and Environmental Quality built the scoring system into an existing 10-Year Industrial Property Tax Exemption Program (IPTEP). In contrast to the previous practice of awarding 100% exemptions for 20 years from local property taxes for new equipment and other capital expenditures, the scoring system determined that companies would receive a base exemption of 50% and then rated their environmental behavior to determine how much of the remaining 50% they could obtain.

Companies earned points based on their environmental violation record and the amount of emissions they generated per employee. Table 7-2 shows how these factors influenced point totals. Points for environmental violation records were calculated by adjusting the values in Column 2 of Table 7-2 for the age of the violation, i.e., how many years ago the violation occurred. Next, the number of years was multiplied by coefficients ranging from 1 for violations in the past year to 0 for violations 6 years or older. The results were then subtracted from 25. Points for emissions per employee were calculated by dividing total payroll by $25,000; then points were awarded as shown in Column 4. After the Department of Environmental Quality had assigned a preliminary score to an exemption request, a company that received fewer than 100 points could raise its score by developing an emissions reduction plan. Other criteria, such as recycling activities and creating jobs for high unemployment areas, could also increase point totals.

Table 7-2. Points Under Louisiana Scorecard System

VIOLATION FINE	POINTS AWARDED (25 minus the value in this column, adjusted for the age of the violation)	POUNDS OF EMISSIONS PER EMPLOYEE	POINTS AWARDED
$0–$3,000	1	0–500	25
$3,001–$10,000	5	501–1,000	20
$10,001–$25,000	10	1,001–2,500	15
Over $25,000	15	2,501–5,000	10
Criminal or felony violations	20	5,001–10,000	5

Source: Environmental Law Institute. 1993a, p. 119.

Data suggest that this program had a significant incentive effect. Final scores during the 15-month program averaged 94.9, which was significantly higher than preliminary scores. Twelve companies submitted emission reduction plans for bonus points worth $7,030,249 in tax exemptions. This amount is slightly greater than the $5.2 million of exemptions recovered by the state through the scorecard system. Since the system was built into an existing exemption, administrative costs were reasonably low. It also gave the state the opportunity to use the exemption "carrot" to promote not only economic but also environmental health.

Industry, however, opposed the program, perhaps in part because it attached conditions to what had previously been an unconditional tax exemption (the IPTEP). It was industry's opposition that led the Governor of Louisiana to terminate the program in 1992.

7.2.3 Supplemental Environmental Projects

Supplemental environmental projects (SEPs) are "settlements negotiated by EPA and an environmental law violator in which the company agrees to do an alternative environmental project in return for an agency agreement to lower the proposed penalty." Although such projects have existed since the early 1980s, their numbers have increased in the 1990s and they are now included in as many as 1-in-10 enforcement actions. More than 200 were approved in 1992. In the first six months of 1992, one EPA official estimated that EPA negotiated 164 SEPs worth approximately $23 million. In 1995, EPA negotiated 348 SEPs valued at $104 million.

Most SEPs have been pollution prevention activities that involve violations in the Toxic Substances Control Act (TCSA) or in the Emergency Planning and Community Right-To-Know Act (EPCRA). However, SEPs have also been negotiated for violations of other laws. In New England, for example, a sand blasting and paint company had its EPCRA fines reduced from $50,000 to $14,000 by agreeing to hire an environmental auditor and launch a five-year pollution reduction program. In Nebraska, a $5,000 fine for supplying restricted-use pesticide to an uncertified user in violation of the Federal Insecticide, Fungicide, and Rodenticide Act was reduced to $2,000 when the violating company agreed to install concrete containment dikes around its pesticide storage tanks and a shower/eye wash. The measures under the SEP were estimated to cost this company $7,496.

In a RCRA case involving the improper characterization of waste streams, leakage of hazardous wastes from a sewer, and operation of an unpermitted incinerator, Eastman Kodak had its penalty reduced by approximately $3 million in return for investing $12 million in six SEPs. These SEPs were expected to reduce hazardous wastes at its Kodak Park facility by 2.3 million pounds by the year 2001. In a Clean Water Act (CWA) case, the City and County of Honolulu agreed to spend $30 million on SEPs to treat and reuse wastewater and sludge. The Kodak and Honolulu SEPs are described in an EPA report.[151] Fines have also been reduced in cases in which businesses complied with existing environmental laws soon after being charged with a violation.

The advantage of SEPs for EPA is twofold: First, fines that would be paid to the Treasury are instead used for environmental protection activities; and second, the cost of these activities usually exceeds the negotiated reduction in the fine. Estimates place the cost of the SEP at one-half to one-sixth of the reduction in the fine. At the state level, on the other hand, SEPs have proven much less popular, in part because many states rely on the revenues from these fines to fund environmental activities.

Despite the high SEP-to-fine reduction ratio, SEPs can offer violators a number of potential advantages that are associated with improved environmental performance, including positive publicity, reductions in waste management costs, and early preparedness for increasingly stringent regulations. Another advantage is that, unlike fines, SEPs involve business expenditures that lower taxes. Since all SEPs represent voluntary agreements made by violators, the SEP mechanism appears to have a significant incentive effect.

7.2.4 Loans and Tax Exempt Bonds

The federal government exempts from taxation the interest on debt that is issued by state or local governments to finance pollution control or waste disposal facilities. This exemption cost the government an estimated $625 million in 1995.[152]

Although it is beyond the scope of this report to describe all state financing programs, several mechanisms used in California are discussed here. The California Pollution Control Financing Authority (CPCFA) issues tax-exempt bonds to provide low-interest loans of $1 million to $20 million to small businesses for pollution control and solid waste recovery projects. Loans in excess of $20 million are provided under a similar program for larger businesses. Repayment periods are usually longer than those of conventional bank loans. Proceeds from bonds issued by CPCFA on behalf of businesses are deposited into a fund held by the bond trustee. The borrower uses these funds for the project, making periodic repayments according to the terms of the loan agreement.

For example, about $1 million in tax-exempt bonds were issued to finance a dry ash waste recovery investment at an electricity generating facility at the Eel River Sawmills. The equipment purchased through this financing arrangement reprocesses ash waste through the electrical generating facility. This reprocessing reduces the amount of ash waste sent to landfills by 60%, from 24 tons per day to 10 tons per day.

In addition to these tax-exempt bond programs, CPCFA offered loans for pollution control investments under the California Loans for Environmental Assistance Now (CLEAN) program. Under this program, CPCFA issued bonds and lent proceeds at interest rates that were roughly 2% higher than bond rates. CPCFA hoped to repackage and sell these loans to raise more capital but was unable to do so. In three years, 38 loans ranging from $30,000 to $500,000 were issued, totaling approximately $3 million. Since CLEAN's subsidized interest rates attracted a number of businesses that could have obtained loans from commercial banks, it ended up financing many pollution control investments that would have been made without the CLEAN program. Moreover, CPCFA's loan disbursing process was slow, its loan marketing poor, and its administrative costs high. The program cost about $1.40 for every $1 lent.[153]

To address these problems, CLEAN was replaced by the California Capital Access Program (CalCAP), under which CPCFA sets up loan portfolio "insurance" to encourage banks to lend to small businesses. CPCFA matches the sum of premiums that are paid by the borrower and the lender and then puts that money into a loss reserve account for the lender. In case of default, the CPCFA account covers losses. The maximum individual loan is $2.5 million. As a result of improved marketing and loan disbursing procedures and the leveraging of reserve funds under CalCAP, $160 million has been lent in two years, as compared with only $3 million in 3 years under CLEAN. Under CalCAP, every dollar contributed by CPCFA has resulted in $23 in lending.

7.3 Brownfields Programs

Various measures have been taken to subsidize the development of brownfields, which are contaminated industrial sites that pose a relatively low risk to the environment as compared to the most heavily polluted Superfund sites. The number of brownfields programs has grown at the federal and state level because they deal successfully with an unintended consequence of hazardous waste cleanup laws, that is, laws that discourage developers from reusing contaminated property. Brownfields programs have included a variety of incentives, including grants, loans, and tax benefits. Liability incentives are another important aspect of brownfields programs; they are discussed in Chapter 8.

7.3.1 EPA Pilot Grant Projects

Under the Brownfields Initiative, EPA has funded several types of pilot projects to states, tribes, and local governments to encourage the assessment, cleanup, and reuse of brownfields. EPA has awarded 362 grants of as much as $200,000 each to assist communities in assessing contamination at brownfields; 104 grants of up to $500,000 to establish revolving loan funds for cleanup; and 37 grants of as much as $200,000 each to train local workers to assess and clean up brownfields. Through the Brownfields Initiative, communities report assessing almost 2,000 properties, leveraging more than $2.3 billion in economic development funds and generating more than 7,000 jobs. For more information on the Brownfields Initiative, see EPA's brownfields Internet site at www.epa.gov/brownfields.

7.3.2 Tax Incentives and Loans

New Jersey offers both tax benefits and loans to encourage brownfields development. Under the Environmental Opportunity Zone Act, which became effective in January 1996, developers of contaminated sites could receive a 10-year property tax exemption if they remediate the site in accordance with state standards and return it to commercial or industrial use. In 1998, the period of tax exemption was extended to 15 years. Loans for cleanups are funded by a dedicated 5% portion of the state's Hazardous Discharge Site Remediation Fund.

To qualify for tax benefits and loans, the contaminated land must be on the state's list of hazardous discharge sites, be vacant or underused, and need cleanup because of an actual or potential pollution discharge. The sites must also be located in environmental opportunity zones designated by state municipalities. The property tax exemption gradually decreases from 100% in the first year of development to 0% in the tenth year.[154]

Pennsylvania's Land Recycling and Environmental Remediation Standards Act established an Industrial Sites Cleanup Fund of up to $15 million to provide low-interest loans to help property owners clean up pollution that they did not cause.[155] Grants are available to finance activities by local governments and economic development agencies. These funds can cover up to 75% of cleanup costs. The Industrial Sites Environmental Assessment Act allows the U.S. Department of Commerce to make grants to municipalities and other local authorities, nonprofit economic development agencies, and similar organizations to fund environmental assessments of industrial sites in distressed communities. Up to $2 million is provided annually for such funding.[156] A key feature of the program is its reliance on risk assessments to dictate remediation strategies at individual sites.

A January 2000 legislative report assessed the program's effectiveness.[157] After approximately $20 million in expenditures, more than 650 sites have been cleaned up and over 300 additional sites are in the process of being cleaned. The program has received an award from the Ford Foundation as one of the 10 most innovative programs in government.

In 1995, Delaware added credits for brownfields development to its Blue Collar Jobs Tax Credit program.[158] Minnesota and Ohio offer loans to fund cleanups, and Ohio also provides tax incentives. Arizona and Tennessee pay for the cleanup of wastes that cannot be identified as to source or for which sources are no longer financially able to shoulder the cleanup cost burden.[159]

The Brownfields Tax Incentive was passed as part of the U.S. Taxpayer Relief Act of 1997. This federal tax incentive encourages the cleanup and redevelopment of brownfields by allowing the cleanup costs in certain areas to be fully deductible in the year expended, rather than capitalized

over time. The U.S. Treasury Department estimates that the $1.5-billion incentive will leverage as much as $6 billion in private investment and return as many as 14,000 brownfields to productive use.

7.4 Farming and Land Preservation

Subsidies used in farming and land preservation include grants, loans, and tax benefits that are offered in exchange for improved conservation practices. Multi-year contracts pay landowners to either take land out of cultivation or to manage it in a certain way. In addition, benefits that support farm programs have, since 1985, been linked to environmental performance in a program called "Conservation Compliance." Table 7-3 shows the federal subsidy programs and the respective funding levels implemented expressly for conservation purposes. The conservation provisions achieved through cross-compliance are also described.

Table 7-3. Funding for Conservation Subsidy Programs of the U.S. Department of Agriculture (FY 1998) in millions of dollars

PROGRAM	AGENCY WITHIN USDA	CONSERVATION	WATER RESOURCES	RECREATIONAL RESOURCES	POLLUTION CONTROL	TOTAL NATURAL RESOURCES AND ENVIRONMENT
Conservation Reserve	FSA	2,096				2,096
Agricultural Conservation	FSA	44				44
Conservation Operations	NRCS	644				644
Wetlands Reserve	NRCS	38				38
Resource Conservation	NRCS	33				33
Water Bank	NRCS	8				8
Wildlife Habitat Incentives	NRCS	8				8
Forestry Incentives	NRCS	6				6
Colorado River Salinity	NRCS	4				4
Great Plains Conservation	NRCS	4				4
Resource Conservation	NRCS	1				1
Rural Clean Water	NRCS		279	1		280
Watershed and Flood	NRCS		57			57
Conservation Operations	NRCS		11			11
State and Private Forestry	FS	59				59
Other	USDA	2,462		125	20	2,607
TOTAL		**5,407**	**347**	**126**	**20**	**5,900**

Source: USDA. 2000. FSA is the Farm Service Agency, NRCS is the Natural Resources Conservation Service, and FS is the Forest Service.

This section concludes with a discussion of selected state subsidy schemes, including programs that allow the purchase of development rights to prevent the conversion of agricultural lands to alternative uses.

7.4.1 Conservation Reserve Program

The Conservation Reserve Program (CRP) was established by the U.S. Food Security Act of 1985 (also known as the "1985 Farm Bill") and modified by the 1990 and 1996 Farm Bills. The CRP seeks to protect soil and water resources and wildlife habitat by taking land out of cultivation. Participating farmers receive annual payments of as much as $50,000 per person to put land in the Conservation Reserve for 10 to 15 years. Applications to participate in this program must include conservation plans, which usually require the planting of grass cover). The federal government pays not only annual rents, so the land is not cultivated, but also one-half the cost of the required conservation measures.

Since landowners have offered more acres than the CRP can afford, they bid for enrollment. For the first nine opportunities to enroll through August 1989, bids had to be at or below the "maximum acceptable rental rate" for a given area. However, this approach did not actively target environmentally sensitive cropland. Consequently, farmers gradually increased their awareness of maximum rates and set their bids accordingly, often resulting in rental payments that were in excess of market value.[160]

The 1990 and 1990 Farm Bills shifted the emphasis of the CRP to protecting lands that were not only highly erodible but also important to water quality and wildlife habitat. The bidding system, as a result, has been changed several times, beginning with the 10th signup in May 1991. An Environmental Benefits Index (EBI) is used to evaluate bids at or below the market rental rate for comparable land. The EBI includes numerous factors relating to soil erosion, water quality, and the value of the land for wildlife habitat. Lands located in special Conservation Priority Areas are given additional preference, particularly if structural or land management practices proposed for the lands maximize environmental benefits per dollar expended. The EBI is compared with the bid amount to determine whether the parcel should be enrolled in the CRP.

Since August 1992, some 36.4 million acres, the maximum acreage allowed under the program, had been placed in the CRP. This figure is nearly 10% of the total U.S. cropland, an estimated 395 million acres. (See Table 7-4.) The first nine enrollments consisted mostly of land located in the Great Plains and Mountains states. Changing the program's emphasis to water quality and wildlife goals has led to increased concentrations of land in the Midwest and Great Lakes regions being enrolled in the program.

In 1990, when 33.9 million acres were enrolled, USDA estimated the net social benefits of CRP at $4.2 billion–$9.0 billion over the life of the program. Table 7-5 shows the estimated dollar value of different types of social costs and benefits.

Statistics on the first nine enrollments indicate annual reductions in soil erosion of 700,000 tons, an average of 19 tons per acre. This figure represents a 22% reduction in cropland erosion since the program was established.

Table 7-4. Conservation Reserve Acreage and Rental Payments

REGION	NUMBER OF ACRES	ANNUAL RENTAL PAYMENTS (in millions of dollars)	RENTAL PAYMENTS PER ACRE ($)
Appalachia	1,158,124	$62.5	$53.97
Corn Belt	5,603,333	416.1	74.26
Delta	1,248,403	55.3	44.31
Great Lakes	3,008,337	176.5	58.68
Mountain	6,687,264	265.3	39.67
Northeast	226,411	13.4	59.29
Northern Plains	9,664,110	444.5	46.00
Pacific	1,791,182	88.8	42.71
Southeast	1,692,580	72.3	42.71
Southern Plains	5,342,989	214.7	40.18
TOTAL	**36,422,733**	**$1,809.4**	**$49.70 on average**

Source: GAO. 1995b, p. 13.

The CRP could be more cost-effective by concentrating enrollment on land that is more environmentally sensitive, some critics claim. By concentrating on enrolling buffer zones alongside streams, rivers and lakes instead of entire fields, a GAO study claimed, only about 6 million acres would need to be enrolled in order to protect surface water, groundwater, air, and soil. However, protecting wildlife habitat would require significantly more acreage.[161] The buffers along streams can reduce sediment loadings by 50%[162] and nitrate concentrations[163] and herbicide concentrations[164] by 90%.

Table 7-5. Estimated Social Benefits and Costs of CRP

SOCIAL BENEFITS	RANGE OF VALUES ($billion)
Increases in net farm income	$2.1–6.3
Value of future timber	3.3
Preservation of soil productivity	0.6–1.7
Improved surface water quality	1.3–4.2
Lower damages caused by windblown dust	0.3–0.9
Wildlife enhancements	1.9–3.1
TOTAL BENEFITS	**$9.5–19.5**
SOCIAL COSTS	.
Higher food costs for consumers	$2.9–7.8
Existence of vegetative cover on CRP land	2.4
USDA technical assistance	0.1
TOTAL COSTS	**$5.4–10.3**
NET BENEFIT	**$4.1–9.2**

Source: USDA.1994a, pp. 180-1.

The 1996 Farm Bill and subsequent rules developed by USDA addressed this criticism in reauthorizing the CRP through 2002. While maintaining the maximum number of acres to be enrolled at 36.4 million, the new bill also allows contract holders to terminate contracts entered into prior to 1995, provided the contract has been in effect for at least 5 years and the land in question is not of high environmental value. The USDA Secretary was given the authority to

agree to future early terminations. The possibility that such terminations may be invoked will give USDA the opportunity to refocus enrollment in the program on land that is more environmentally sensitive.

Substantial bonus payments—including a 20% rental bonus, a $100 per acre up-front payment, and other incentives—now encourage the enrollment of these stream buffers as well as certain other practices that are of high priority. More than a million acres of these buffer areas have been enrolled since farmers were offered the new incentives for buffer zones.

7.4.2 Conservation Reserve Enhancement Program

Part of the 1996 Farm Bill, the Conservation Reserve Enhancement Program is an enhancement of the Conservation Reserve Program that creates federal–state partnerships for conserving environmentally sensitive farmland. This program uses financial incentives to encourage farmers and ranchers to participate in removing lands from agricultural production for periods of 10 to 15 years. The status of this program in each state is shown in Table 7-6.

Payments in the Conservation Reserve Program average about $50 per acre per year. The amount that farmers will be paid to participate in CREP is quite variable because it is tied closely to the rental rates of local land. The formula for calculating the amount to be paid to farmers includes base rental rates, the cost of installing conservation practices, annual maintenance costs, and any special incentives.

Table 7-6. Status of Conservation Reserve Enhancement Programs

STATE	STATUS	ACRES	TOTAL COST (in millions of dollars)	INCENTIVES	EASEMENT TERM	TARGET AREA	ENVIRONMENTAL OBJECTIVE
IL	Agreement signed March 30, 1998.	100,000	$250	30% for buffers, wetland restoration, wildlife food plots, & shallow water areas; 20% all other practices	100,000 acres, 15 yr. or permanent	Middle Illinois River	Reduction of sedimentation and soil erosion – 85,000 acres riparian buffers, wetland restoration, emphasis on native species; 15,000 acres Highly Erodible Land (HEL).
MD	Agreement signed October 20, 1997.	100,000	195	70% for riparian buffers; 50% for filter strips and HEL	25,000 acres, permanent	Chesapeake Bay	Reduction of nutrient loading -- 70,000 acres riparian buffers; 20,000 acres HEL; 10,000 acres wetland restoration
MN	Agreement signed February 19, 1998.	100,000	223	20% for all practices	100,000 acres, >20 yr. To perpetuity	Minnesota River	Water quality benefits from sediment and nutrient reduction and mitigation of flood damage. Native grasses and hardwoods, wetland restoration, and filter strips.
NY	Agreement signed August 26, 1998.	5,000	10	150%	N/A	New York City watershed/ Catskill/ Delaware system	Risk reduction of nutrient, pathogen, and sediment inputs to streams/reservoirs that supply drinking water to NYC – riparian buffers, filter strips, and erosion control on HEL

Continued on the next page.

STATE	STATUS	ACRES	TOTAL COST (in millions of dollars)	INCENTIVES	EASEMENT TERM	TARGET AREA	ENVIRONMENTAL OBJECTIVE
OR	Agreement signed October 17, 1998.	100,000	250	25% for filterstrips; 35% for riparian buffers; 50% for wetland restoration; Cumulative impact bonus equal to four times base rental rate	N/A	Streams providing habitat for endangered salmon and trout statewide	Restoration of salmon habitat through enhancement of riparian areas and wetland restoration.
WA	Agreement signed October 19, 1998.	100,000	250	50%, plus an additional 10% if designated under State growth management law	N/A	Salmon spawning streams statewide	Restore habitat for native anadromous fish species using riparian buffer conservation practice.
NC	Agreement signed March 1, 1999	.	.	.	.	.	.
DE	Agreement signed June 2, 1999	.	.	.	.	.	.
WY,ID WI,KY MO,ND	Proposals received						

Source: USDA/FAS. CRP State CREP Information.

Maryland recently sweetened its CREP program by adding a one-time signing bonus of $250 per acre in an attempt to increase enrollments to the program's goal of 100,000 acres. Under the Maryland program, participating farmers would plant trees and grasses along Maryland waterways to act as natural filters that absorb nutrients and chemicals before they entered the waters. When the Maryland program was launched in 1997, it was the first in the nation. In three years of operation, the program had enrolled only 20,000 acres, largely because farmers considered the rules complex and the reimbursement rate too low.[165]

7.4.3 Wetlands Reserve Program

Under the Wetlands Reserve Program (WRP), which was created by the 1990 Food, Agriculture, Conservation and Trade Act (a.k.a. the 1990 Farm Bill), farmed wetlands and agricultural land converted from wetlands as well as buffer zones and some riparian areas are eligible for 30-year easements or permanent easements. Participants in this program are required to implement conservation plans approved by the Natural Resources Conservation Service and the Fish and Wildlife Service. Agricultural activities on enrolled land must be compatible with wetlands protection. Participants receive a lump sum for permanent easements or 10 equal payments for 30-year easements. Payment amounts are limited to the loss of market value of the land as a result of the easement. In addition to paying for the easements, the government shares in the cost of approved conservation measures.

As shown in Table 7-7, the number of acres for which bids were made was roughly five times the acreage enrolled in WRP during its first enrollment. In 1994, WRP was expanded to several other states.

Table 7-7. Wetland Reserve Program's First Enrollment (1992)

STATE	BID OFFERS (in 1,000 acres)	ENROLLED LAND (in 1,000 acres)	TOTAL COST (in thousands of dollars)	COST PER ACRE ($)
California	34.3	6.0	10,768	1,787
Iowa	27.9	5.1	5,951	1,168
Louisiana	69.9	14.1	9,882	702
Minnesota	13.1	0.7	764	1,082
Mississippi	65.0	14.9	10,764	723
Missouri	14.6	2.7	2,753	1,032
New York	0.5	0.1	212	2,934
North Carolina	15.3	4.7	3,675	780
Wisconsin	8.5	1.6	1,287	782
TOTAL	249.1	49.9	46,056	923

Source: USDA. 1994a, p. 194.

The 1996 Federal Agriculture Improvement and Reform Act (a.k.a. the 1996 Farm Bill) reauthorized WRP through 2002 while capping total enrollment at 975,000 acres. Beginning October 1996, land enrolled in this program was to be divided in the following way: one-third (33%) will be given permanent easements; one-third, 30-year easements or less; and one-third, wetland restoration agreements with cost sharing. Seventy-five thousand acres of land in less-than-permanent easements must be placed in the program before additional permanent easements are placed. The Act provides cost-sharing assistance to landowners of 75%–100% for permanent easements and 50%–75% for 30-year easements and restoration cost-share agreements.

7.4.4 Compliance Provisions

Under the 1985 Farm Bill, farmers must adhere to two compliance provisions before they become eligible for farm support programs such as price support loans and technical assistance. First, they must implement approved conservation plans on highly erodible land (HEL). Second, they must refrain from draining wetlands. Considering the large amounts of financial support at stake—some $24 billion in support payments in 1999—compliance provisions have had a strong incentive effect.

7.4.5 Highly Erodible Land Conservation and Sodbuster Provisions

To ensure farmers' eligibility for receiving support under the highly erodible land conservation compliance provision, farmers are required to develop and implement approved conservation plans for designated "highly erodible" land that was farmed between 1981 and 1985. The plans typically entail adjustments in farming practices and rotations and could include measures such as the maintenance of crop residues on fields in winter, contour plowing, minimum tillage, and shelterbelts. The sodbuster provision is similar to the highly erodible land conservation compliance provision, except in two respects. One, it applies to highly erodible land that was *not* farmed between 1981 and 1985. Two, it is more stringent in that it requires the adoption of a

conservation system that reduces erosion to a level above which long-term soil productivity may be depleted.[166]

This cross-compliance rule appears to have a strong incentive effect. Implementation costs for the conservation compliance provisions are estimated at $7–$17 per acre depending on the region, whereas a loss in farm support benefits would cost farmers between $37 and $62 per acre.[167]

As shown in Table 7-8, the estimated net benefit of the conservation compliance provision varies substantially across regions. The air quality benefits listed in the table are limited to household wind damage. Although the estimates show costs exceeding benefits in the Northern Plains, the benefits might exceed costs if air quality benefits were more broadly defined.

Table 7-8. Economic Benefits and Costs of Conservation Compliance

.REGION	PER-ACRE BENEFIT (in $) FROM:			PER-ACRE COST (in $) TO:		NET ECONOMIC BENEFITS (in $)	.BENEFIT/ COST RATIO
	Water Quality	Air Quality	Productivity	Producers	Federal Government		
Northeast	35.63	0	0.16	3.57	3.43	28.80	5.12
Lake States	21.99	0	0.12	0.32	3.43	18.37	5.90
Corn Belt	15.61	0	0.25	8.90	3.43	3.53	1.29
Northern Plains	3.47	3.00	0.19	3.35	3.43	-0.11	0.96
Appalachia	23.58	0	0.24	3.51	3.43	16.89	3.43
Southeast	25.63	0	0.12	8.18	3.43	14.15	2.22
Delta	35.50	0	0.12	1.97	3.43	30.22	6.60
Southern Plains	5.26	4.63	0.33	2.34	3.43	4.45	1.77
Mountain	5.10	4.01	0.15	0.20	3.43	5.63	2.55
Pacific	31.83	1.09	0.14	2.23	3.43	27.40	5.85
Entire United States	13.81	1.93	0.21	3.78	3.43	8.74	2.21

Source: USDA. 1994a. p. 186.

7.4.6 Swampbuster Program

Under the Swampbuster Program, program benefits are denied to farmers who plant crops on wetlands that were converted after 1985 or who drain or otherwise convert designated wetlands. Conversion is allowed if its impact on the hydrological and biological value of the wetland is limited or if the farmer restores wetlands of equivalent value.

The 1996 Farm Bill made several changes to provisions in the Swampbuster Program. According to USDA, these modifications "will give farmers more flexibility in complying with wetland conservation requirements while protecting natural resources."[168] The bill expands wetland mitigation areas and options, allowing mitigation through restoration, enhancement, or creation, provided that wetland functions and values are maintained. In addition, the bill also stipulates that conversion activities authorized by a Clean Water Act permit will be accepted for Farm Bill purposes if the conversions are adequately mitigated. The bill also establishes a pilot program for mitigation banking. (See Chapter 6 for information on mitigation banking.)

7.4.7 Subsidies Created Under the 1996 Farm Bill

In addition to modifying several existing programs in ways that USDA believes will simplify them and enhance their efficiency and flexibility, the 1996 Farm Bill created a number of new programs. The largest of these programs in terms of funding is the Environmental Quality Incentives Program. Others include the Farmland Protection Program, the Conservation Farm Option, and the Wildlife Habitat Incentives Program.

As shown in Table 7-3, Conservation Subsidy Programs of the U.S. Department of Agriculture (FY 1998), USDA has implemented a large number of conservation programs. A 1995 GAO study stressed the need to consolidate these programs, stating that "they frequently promote identical resource conservation purposes, use similar financial incentives, serve the same population, and finance the application of the same set of technical practices." The study asserted that program overlap made it more difficult for farmers to identify and apply for financial and technical assistance and increased the administrative burden on USDA.[169]

Environmental Quality Incentive Program (EQIP): This program replaced several programs, all of which were phased out in 1996: the Agricultural Conservation Program, the Colorado River Basin Salinity Control Program, the Water Quality Incentives Program, and the Great Plains Conservation Program. EQIP assists farmers and livestock producers with making environmental and conservation improvements. Participating landowners agree to establish conservation plans and implement them for periods of 5 to 10 years. In doing so, they receive cost-share or incentive payments for as much as 75% of their costs for adopting these conservation practices. Payments are limited to $10,000 per person per year or a total of $50,000 for any multi-year agreement.

The legislation and rules developed by USDA requires the Department to select projects that maximize the environmental benefits per dollar spent under EQIP. Priority areas must be targeted. Plans must be developed that identify both the main problems being addressed and the practices capable of solving these problems with available resources. These provisions effectively make watershed planning a major activity for the Natural Resource Conservation Service.

EQIP has placed added emphasis on livestock as a pollution problem. One-half of the program's funding is reserved for livestock-related conservation problems, and one-half for other conservation problems. The program was funded at $130 million in FY 1996 and $200 million annually from 1997 to 2002, although Congress subsequently reduced funding levels to $170 million a year. Most farmers attempting to enter the EQIP program are turned away due to the targeting process described in the previous paragraph and current budgetary limitations.

Farmland Protection Program: Under this $35 million program, USDA will work with state and local governments to purchase conservation easements on 170,000 to 340,000 acres of farmland of special interest. To be included in this program, land must be subject to a pending offer from a state or local government for the purpose of protecting topsoil by limiting nonagricultural uses.

Conservation Farm Option: Under this pilot program for producers of cotton, rice, feed grains, and wheat, producers may consolidate payments from three programs— CRP, WRP, and EQIP—into one annual payment. They can do so only in exchange for entering into 10-year contracts and implementing conservation plans that address water, soil and related resources as

well as wildlife habitat. The incentive effect of being able to consolidate program payments is unknown. A total of $197.5 million will be provided for this program through 2002.

Wildlife Habitat Incentives Program: This program is intended to offer cost-sharing assistance to landowners to encourage them to plan and adopt approved management practices that ameliorate wildlife habitat. Total funding from FY 1996 to FY 2002 is $50 million.

7.4.8 Impacts of Conservation Programs

Table 7-9 presents some of the effects of USDA conservation programs. Activities of the Water Quality Program consist mostly of educational and technical assistance, but they also include some financial assistance. Monetary values of some of these impacts have been estimated. For example, the benefits of reducing salt loads under the Colorado River Salinity Control Program have been estimated at $61 per ton a year.[170]

Table 7-9. Impacts of Conservation Programs

PROGRAM AND IMPACTS	IMPACTS							
	1988	1989	1990	1991	1992	1993	1994	1995
	Reductions of Erosion (in 1,000,000 tons)							
Conservation Reserve Program	514	596	644	654	672	692	692	692
Conservation Compliance Provisions	0	0	0	NA	236	458	465	527
Agricultural Conservation Program	40	34	33	34	30	29	9	18
Conservation Technical Assistance and Great Plains Conservation Program	463	353	353	282	298	321	325	284
Annual Acreage Reduction Program	107	62	55	60	39	46	29	40
	Reductions (in 1,000,000 pounds)							
Water Quality Program: Reduction in Nitrogen Application	NA	NA	NA	10.7	53.3	NA	NA	NA
Water Quality Program: Reduction in Phosphorus Application	NA	NA	NA	6.1	70.5	NA	NA	NA
	Reductions of Active Ingredients (in 1,000 pounds)							
Water Quality Program: Reduction in Pesticide Load	NA	NA	NA	239	528	NA	NA	NA
	Reductions (in 1,000 Tons)							
Colorado River Salinity Control Program: Reduction in Salt Load	62	75	92	105	127	163	191	212

Source: USDA, ERS: Agricultural Resources and Environmental Indicators, Ch. 6.1

7.4.9 State Initiatives

In addition to the federal programs described in this chapter, various types of subsidies have been used to promote land preservation on the state level. A 1994 USDA report found that, as of 1990, 25 states had cost-sharing programs, 6 offered tax credits, and 5 offered low-interest loans to encourage the preservation of land.[171]

In Lake Okeechobee, Florida, phosphorus contained in the waste of dairy cattle has posed a threat to water quality. The "Dairy Rule" that entered into effect in June 1987 required Florida dairy farmers to use specific techniques to prevent discharges from barn wash water. The Florida State Legislature provided the Florida Department of Agriculture and Consumer Services

(DACS) with cost-share funds to facilitate the implementation of this policy. Of the 49 dairy operations in the state that were affected by the Dairy Rule, 18 chose to participate in a buyout program under which they received $602 for every cow they permanently removed from the basin. The buyout program took 14,039 cows out of the basin.

A survey of wildlife management programs in the 20-state region of the Northeast found that 5 states had cost-sharing programs, 5 offered equipment loans, 4 offered property tax incentives, 1 offered state income tax benefits, and 8 had tie-ins with federal programs. In Indiana, the Wildlife Habitat Cost-Share Project pays up to 90% of the cost of establishing permanent wildlife habitat, windbreaks, brush piles, vegetation management, and wetland improvement. Property tax assessments are lowered for landowners who adopt measures that enhance or preserve existing wildlife habitat.[172]

Minnesota has a property tax exemption for undisturbed wetlands and ungrazed prairie.[173] The state also has a Pheasant Habitat Improvement Program under which landowners can receiving cost-sharing assistance of up to 75% of their costs as well as technical assistance in return for improvements such as food plots, nesting cover, and woody cover.[174] In Texas, the Galveston Bay Comprehensive Conservation and Management Plan approved by the EPA in April 1995 called for economic incentives, such as tax breaks, for private landowners. The tax incentives are intended to encourage owners to preserve wetlands.[175]

In November 1995, voters in Texas approved a constitutional amendment to allow open-space land that is used for wildlife management to be taxed in the same manner as open-space agricultural land. Consequently, taxes will be based on the land's productive capacity rather than its higher market value. The Sierra Club lauded the measure, which it said "will allow landowners to take lands out of traditional agricultural production without penalizing them for protecting their property for wildlife."[176]

7.4.10 Purchase of Development Rights Programs

A number of states (11 as of April 1996) and several counties and local governments have purchase of development rights (PDR) programs in place under which landowners are paid *not* to convert farmland to commercial or residential uses. (Such rights are also known as "conservation easements.") As shown in Table 7-10, such programs are especially common in the Northeast and have covered more than 400,000 acres at a cost of almost $730 million. In addition to objectives of food security and agricultural production, PDR programs have several environmental objectives, including the maintenance of habitat and resting places for wildlife and the aesthetic value of open space. Among the advantages of PDRs are their voluntary nature, which helps avoid the legal conflicts that can arise from zoning laws, and the low cost of this form of land protection for state and local governments as compared to outright land purchase.

The funding mechanisms for PDR programs vary from state to state and include general revenues, land transfer taxes, property taxes, and bonds. Criteria used to select the land parcels that are to be purchased include cost, threat of conversion, and location. Many programs prefer to purchase development rights on parcels that are near each other.

Table 7-10. Purchase of Development Rights Programs in States

STATE	YEAR STARTED	NO. OF FARMS IN PROGRAM	NO. OF ACRES AFFECTED	STATE FUNDS SPENT (in thousands of dollars)	STATE FUNDS AVAILABLE (in thousands of dollars)
California*	1980	72	47,992	$46,515	$23,100
Connecticut	1978	164	25,042	73,430	8,800
Colorado*	1986	6	1,904	3,254	2,800
Delaware	1995	31	8,561	12,000	0
Maine	1990	1	307	380	0
Maryland	1977	809	117,319	125,099	8,100
Massachusetts	1977	398	35,907	86,109	6,000
Michigan	1993	2	79	709	10,000
New Hampshire	1979	57	9,148	no data	0
New Jersey	1981	189	27,924	88,463	107,000
New York*	1976	154	6,941	46,000	4,950
North Carolina*	1987	21	1,255	1,785	0
Pennsylvania	1989	596	74,500	148,000	31,000
Rhode Island	1982	30	2,428	14,000	0
Vermont	1987	140	45,511	26,304	2,000
Washington*	1979	187	12,600	58,000	1,500
TOTAL			417,418	730,048	205,250

*Denotes county or other local programs

Source: American Farmland Trust.

7.5 Consumer Product Waste Management

Managing the waste from consumer products is one area in which traditional regulatory measures may be *less* likely than incentives to protect the environment. It is difficult, if not impossible, to monitor the behavior of millions of consumers. For example, bans on the disposal of used motor oil or containers in landfills are hard to enforce. Consumers are more likely to respond positively to factors such as more convenient collection service—which subsidies make possible—or refunds.

Various types of subsidies, including grants, loans, payments, and tax incentives, have been used extensively in consumer product waste management. Also included in the following discussion are preferential procurement and recycled content policies, both of which encourage recycling by stimulating demand for recycled products. Most of these measures have been implemented at state and local levels. Table 7-11 identifies the various state subsidies that help manage the disposal of one consumer product, used tires.

7.5.1 Advance Disposal Fees

As noted in Chapter 4, advance disposal fees (ADFs) on consumer products generate revenues that subsidize the otherwise unprofitable activity of disposing of specific products after they have been used. In Rhode Island, for example, fees on "hard-to-dispose material," such as motor oil, tires, antifreeze, and solvents, are used to fund centers that collect these products after their use as well as research and public education on the disposal and reuse of these products.

Table 7-11. State Subsidies for Used Tire Management

TYPE OF SUBSIDY	NUMBER OF STATES
Tax benefits	13
Payments based on the number of tires recycled	7
Public procurement	28
Grants and loans	34

Source: *Scrap Tire News*, January 1996, p. 18.

In Virginia, an ADF of $0.50 per tire that has been in effect since January 1990 generates revenues for the state's Waste Tire Trust Fund. The fund finances several efforts: cleanup of used tire disposal sites, activities in several regions that manage the current flow of used tires, and subsidies of $22.50 per ton for the conversion of waste tires to other end uses such as blasting mats, fuel and rubberized surfaces. By 2000, the program had processed about 27 million tires at a cost of $11.6 million.[177] Similar programs are in effect in several other states.

7.5.2 Deposit Handling Fees

In most states that have mandatory bottle deposits, distributors are required to pay handling fees to retail outlets and other used bottle collection centers. In California and Maine, for example, handling fees are 3 cents per bottle. Such handling fees have encouraged the collection of used bottles to such a degree that many redemption centers have been created voluntarily by the private sector to earn profits. Chapter 5 has further details on deposit-refund systems in California, Maine, and other parts of the United States.

7.5.3 Recycling Loans and Grants

At least 24 states have grant or loan programs that promote the recycling industry.[178] Under Washington State's Model Litter Control and Recycling Act, grants are awarded to individuals who develop recycling programs. Under a state Litter Control and Recycling Act, Rhode Island provides grants to communities and organizations for creating litter and recycling initiatives.[179]

As shown in Table 7-12, Wisconsin offers both loans and grants to promote recycling. The largest program provides grants to municipalities and counties to fund various recycling activities. Recycling rebates can be of two types. One, they can be general rebates that are offered for as long as five years in order to offset the increased cost of making or processing recyclable materials that are generated in the state. Two, they can be property rebates that cover 5%–25% of the cost of qualified property. In 1993–94, 17 qualified property rebates worth $1,136,805 and 10 general rebates worth $4,599,334 were awarded.

Under the Waste Tire Reimbursement Grant Program, Wisconsin businesses receive payments of $20 per ton for using waste tires in any of the following ways: in energy recovery, including the production of combustible byproducts; as road base in highway improvement projects; in recycling to make a new product; and in other uses that are approved by the state's Department of Natural Resources (DNR). Other uses must be approved in advance by DNR. Businesses receive payments that are based on documented tire use over the course of a given calendar year. Wisconsin's expenditures under this program for 1990–94 totaled approximately $5.5 million.[180]

Table 7-12. Financial Assistance Programs in Wisconsin that Promote Recycling (1994–95)

STATE PROGRAMS	REBATES (in thousands of dollars)
Municipal and County Recycling Grants	$29,200
Waste Reduction and Recycling Demonstration Grants	1,750
Recycling Loans	2,519
Minority Business Recycling Grants and Loans	400
Recycling Rebates	5,100
Recycling Market Development Board Assistance	2,892
Waste Tire Reimbursement Grants	750
Waste Tire Management or Recovery Grants	250
TOTAL	$42,861

Source: Bonderud and Shanovich, p. 11.

As shown in Table 7-13, at least 16 states had loan funds in 1995 for businesses that recycle used products. In Iowa, for example, loans have included $485,000 for a project that converts waste gypsum into new wallboard; $145,000 for efforts to convert used electrical wire into padding for use in the dairy cattle industry; and $245,000 for a project to make rubber mats from used tires.

Table 7-13. State Loan Funds for Recycling Enterprises

STATE	MAXIMUM LOAN AMOUNT (in $)	INTEREST RATE	FUND SIZE (in $)	FUNDING SOURCE
California	$1 million	5.8%	$25 million by 1996	Landfill tipping fees
Colorado	150,000 initially	Prime Rate	1-1.5 million per year	1 tire fee
Florida	Unknown	<Prime Rate	3.5 million	ADFs
Illinois	750,000	5%	1-3 million per year	Landfill tipping fees
Indiana	500,000	<Prime Rate	3-4 million per year	Landfill tipping fees
Iowa	2 million	0%	4 million per year	Landfill tipping fees
Kentucky	None for cities	3.4%	4 million	General revenues
Louisiana	600,000	Unknown	2 million	Tire fees
Maine	100,000	4%-8%	About 100,000 per year	Brown goods disposal fee
Michigan	500,000	0%	4 million	Landfill tipping fees
Minnesota	500,000	2% below Prime Rate	4 million	General revenues
Mississippi	200,000	2% below Prime Rate	Unknown	Unknown
New Jersey	500,000	3% below Prime Rate	21 million	Landfill tipping fees
New York	500,000	<Prime Rate	5 million	Petroleum overcharge funds
Pennsylvania	300,000	3%	5 million	Landfill tipping fees
Vermont	To be determined	To be determined	To be determined	To be determined
Wisconsin	750,000	4%	5.6 million	Business tax

Sources: Trombly. 1995, p. 38; Louisiana Department of Environmental Quality; California Environmental Protection Agency.

The California Integrated Waste Management Board offers loans to organizations located in the state's 40 Recycling Market Development Zones. Zones range in size from a portion of a city to

areas encompassing several counties. Loans are repayable within 10 years with a 5.8% interest rate and can be used to cover as much as 50% of the cost of a project, up to $1 million. In the three years leading up to March 1996, 67 loans totaling $28 million were approved, of which 42 totaling over $16 million have closed. The California Environmental Protection Agency has stated that these 42 loans have diverted nearly 1.4 million tons of waste from landfills annually. Recent loans include $1 million to finance the production of custom packaging out of shipping boxes and $475,000 to finance equipment for producing fire logs out of paraffin-saturated cardboard from grocery stores and sawdust from a local sawmill.[181]

Louisiana's used tire subsidy program combines a loan program with rebate payments that are based on the number of tires recycled. Loans of up to $600,000 are available for efforts to process waste tires. Each loan is limited to 25% of the value of the processing facility. The loan is repayable to the state, with interest, at a rate of $0.15 per tire processed. The state also offers rebates of $0.85 per tire processed.

7.5.4 Tax Incentives

Twenty-eight states have offered tax incentives for businesses that recycle used products. Idaho, for example, enacted a tax credit in 1994 for the purchase of equipment needed to manufacture post-consumer paper.[182] "An Act Concerning Solid Waste Management" in Kansas allows "up to $100,000 of income tax deductions determined at a rate of 20% of purchase price of new equipment that uses recycled materials to produce products or energy and expands the taxpayer's ability to use recycled goods."[183]

7.5.5 Preferential Procurement of Recycled Products

One type of policy measure that could be considered a subsidy is the preferential procurement of recycled products. By stimulating demand for recycled products, such policies are intended to promote recycling. This section of the chapter considers only government procurement practices as opposed to private-sector procurement practices. Mandates governing the private-sector use of recycled materials are discussed in the next section, Section 7.5.6, Recycled Content Policies.

Preferential procurement can take one of at least two forms: one, price preferences and two, set-asides and goals. In this context, price preferences refer to the public sector's willingness to pay a higher price for recycled products. Set-asides and goals refer to the rules or targets established by the public sector regarding the total percentage of products they purchase that must contain recycled materials.

Paper is the product most commonly subject to procurement policies on recycled goods. A 1993 survey conducted by the Northeast Maryland Waste Disposal Authority found that all 50 states and the District of Columbia (DC) favored recycled products, compared to only 13 states in 1986.

In the 38 states (including DC) that had price preference policies, 15 states were willing to pay 5% more for products that had recycled content than for comparable products that did not contain recycled materials, and 20 states had preferences that were 10%. Oregon had a preference of 12%, and two other states had preferences between 5% and 10%. In 21 of these states, the preferences applied not only to paper but also to other recyclable products. Vermont used life-cycle costing in deciding what to purchase, buying recycled products "where the added

cost of using waste materials rather than virgin materials is less than the cost avoided by not having (that waste) in the waste stream."

The same survey found that 30 states had set-asides or goals, mostly for paper. Iowa, Montana, and Nebraska had the most stringent set-asides. By January 1, 2000, 90% of the printing and writing paper purchased by Iowa's public sector had to have recycled content, and two years later all the tissue paper products it purchased had to have recycled content. Montana had a set-aside of 95% by 1996. Nebraska bought only recycled paper and was considering similar purchasing policies for plastic bags, motor oil, and carpets. North Carolina required the use of recycled paper for all state government reports, memoranda, and other documents, unless written authorization was obtained from the head of the agency.

The 1993 survey also identified 186 local governments that favored recycled products, with some cities adopting price preferences as high as 20% and some having set-asides. The City of Newark, New Jersey, required its agencies to use recycled products if available, regardless of price.

In Florida, for example, prison industries reprocess tires for sale to state, county, and local governments, and state grants to counties are used to purchase products made from waste tires. The Florida State Department of Transportation uses 10,000 tons of crumb rubber (made from two million waste tires) annually in rubber-modified asphalt for roads. As a result of these initiatives and other market development activities, the percentage of tires dumped in Florida landfills has decreased since 1989.

7.5.6 Recycled Content Policies

Recycled content policies as defined here refer only to requirements that private-sector organizations use a percentage of recycled products. Recycled content rules applied to government purchases, such as the aforementioned executive order on paper purchases, have been placed under the heading of public procurement policies. Consequently, they have been discussed in the previous section, Section 7.5.5, Preferential Procurement of Recycled Products.

Although there is a large element of traditional regulation in policies that require a minimum recycled content for certain products or containers, such policies also create incentive effects by stimulating demand for recycled products. If manufacturers are forced to use a certain amount of recycled product, they or their suppliers are more likely to offer consumers better access to recycling services.

At least 13 states have passed laws mandating the use of recycled content in newspapers, and 15 states have created voluntary agreements for the same. (The voluntary agreement in Massachusetts is described in Chapter 10.) A typical example is the 1990 Wisconsin Recycling Law, which requires newspapers to use recycled content in newsprint. The minimum content requirements increased from 10% in 1992 to 45% in 2000. Publishers failing to meet these requirements are subject to fees that are based on the extent of non-compliance. In this respect, the law could be considered to act as a product charge on non-recycled newsprint. However, the Wisconsin Department of Natural Resources sometimes exempts publishers from these fees if they can show that they could not obtain recycled newsprint at a reasonable cost.

In 1992 and 1993, more than 90% of the 78 newspaper publishers in Wisconsin exceeded the state's minimum content requirement of 10%. Only one failed to meet the requirement. In 1994,

however, when the minimum content standard was increased to 25%, 14 of the publishers in the state failed to meet the standard. Five of them paid the fee and the others were exempted.

7.6 New Jersey's Information Awards Program

Under this program, which became effective in 1990, New Jersey citizens who report illegal dumping to environmental authorities receive 10% of any civil penalty or $250, whichever amount is larger. Information leading to criminal convictions is rewarded by 50% of the collected penalty. The identity of those seeking rewards is protected.

Four other New Jersey statutes also contain provisions for monetary awards that are given to individuals who report violations.

1. The Major Hazardous Waste Facilities Siting Act awards 50% of any criminal penalty collected for the illegal treatment, storage, or disposal of hazardous waste.
2. The Regional Low Level Radioactive Waste Disposal Facility Siting Commission awards 50% of any penalty collected for the illegal treatment, storage, or disposal of low-level radioactive waste.
3. The Comprehensive Regulated Medical Waste Management Act awards 10% of any civil or criminal penalty collected for violations or $250, whichever amount is larger.
4. The Ocean Dumping Enforcement Act awards 10% of any criminal penalty collected for violations.

This scheme differs from most subsidies and other incentive mechanisms featured in this report. These programs seek to affect the behavior of citizens and businesses by making monetary awards to those individuals or organizations that notify authorities of acts of noncompliance, thus allowing those who report violations to benefit from the successful efforts of law enforcement. As of May 1996, three penalties had been collected as a result of information provided by citizens. One payment of $50,000 and two payments of $250 were awarded in these three cases. (The payments equaled 10% of the penalties collected in each case.) Other rewards are pending.[184]

A similar source of monetary support for environmental organizations is the fees awarded to attorneys who have won citizen suits against environmental violators. As noted in Chapter 8, these fees appear to create stronger incentives for private parties to initiate lawsuits under California's Proposition 65 than the so-called "bounty hunter provision." Under the bounty hunter provision, the person who brought the lawsuit can receive 25% of any fines collected.

It is possible for citizens or organizations to obtain rewards for reporting potential environmental violations or initiating lawsuits under other state and federal laws. However, it is beyond the scope of this report to determine their extent or their effects on environmental behavior.

7.7 Alternative Fuels and Low-Emitting Vehicles

Various levels of government subsidize alternative fuels (AF) and alternative fuel vehicles (AFV) through measures such as tax incentives, rebates, and preferential procurement. The annual costs of federal programs alone have been estimated at more than $1 billion. Some of these subsidies result in environmental improvements, but, as noted in the following section, alternative fuels are also subsidized for other reasons.

7.7.1 Federal Subsidies

As shown in Table 7-14, the largest subsidy in the area of cleaner fuels is the exemption of ethanol blends from $0.054 of the $0.184-per-gallon gasoline tax. Since ethanol blends of 10% receive this deduction, the exemption for ethanol is the equivalent of $0.54 per gallon.

The category of "other direct subsidies" shown in Table 7-14 includes preferential taxation of compressed natural gas (CNG) and payments to subsidize purchases of AFVs and AFV infrastructure. The CNG tax deduction is equivalent to $0.128 per gallon. Although this subsidy is small compared to ethanol tax deductions, it is expected to increase in importance by the year 2000 as the number of CNG vehicles increases. The federal government also subsidizes the purchase of alternative fuel mass transit buses and school buses, state AFV planning, and the purchase of alternative fuel vehicles by small businesses.

Table 7-14. Alternative Fuel and Vehicle Subisdies

TYPE OF SUBSIDY	1994 (in millions of dollars)	2000 (PROJECTED) (in millions of 1994 dollars)
Research & Development	$348	$350
Ethanol credit	573	914
Other direct subsidies	53	76
Preferential procurement	6	614
Tax credits for AFVs and equipment	20	100
Reid vapor pressure waiver for ethanol blends	95	120
TOTAL	$1,095	2,174

Source: Anderson. 1994, pp. 18-21.

At present, tax credits for AFVs and refueling stations amount to roughly $20 million each year. However, they are predicted to rise to $100 million annually by the year 2000. The federal government also subsidizes a number of research and development activities.

The RVP (Reid vapor pressure) waiver entitles ethanol blends to an extra pound of vapor pressure beyond the limits imposed on conventional gasoline. (Adding ethanol to gasoline raises vapor pressure about 1 lb. in a 10% ethanol blend.) This waiver is worth approximately $0.09 per gallon of ethanol, based on the additional costs incurred by refiners to produce an ethanol blend stock with lower vapor pressure.

Table 7-14 also shows that another type of subsidy, preferential procurement, is expected to rise significantly in value by the year 2000. This trend is due to the fact that many procurement requirements are only now entering into effect, and they are scheduled to become more stringent over time. Table 7-15 shows these requirements, many of which will eventually be applied to privately owned fleets of vehicles.

The federal government also provides income tax deductions of $2,000 to $50,000 to businesses, organizations, and citizens who purchase clean-fuel vehicles. Electric vehicle purchases are eligible for income tax credits of 10%, or up to $4,000. The cost to the government in 1995 of the electric vehicle credits has been estimated at $65 million. [185]

Table 7-15. Federal Procurement Requirements for Alternative Fuel Vehicles by Model Year

(percent of all vehicle purchases, except as noted)

MODEL YEAR	FEDERAL AGENCIES	STATE AGENCIES	SUPPLIERS OF ALTERNATIVE FUELS	OWNERS OF PRIVATE FLEETS
1993	5,000 vehicles			
1994	7,500 vehicles			
1995	10,000 vehicles			
1996	25%	10%	30%	
1997	33%	15%	50%	
1998	50%	25%	70%	
1999	75%	50%	90%	
2000	75%	75%	90%	
2001	75%	75%	90%	
2002	75%	75%	90%	20%
2003	75%	75%	90%	40%
2004	75%	75%	90%	60%
2005	75%	75%	90%	70%
2006 and beyond	75%	75%	90%	70%

Source: Anderson. 1994, p. 10.

7.7.2 State Subsidies

In addition to the federal purchasing requirements for AFVs that are imposed on state governments—shown in Table 7-15—several states, including New York and Massachusetts, have their own vehicle purchasing requirements. Furthermore, most states offer tax benefits or grants for AF or the purchase of AFVs.[186]

In Connecticut, for example, vehicles powered by natural gas, propane, or electricity; vehicle conversion equipment; and equipment for AF refueling stations are exempt from the state's 6% sales and use taxes. In addition, businesses are entitled to 50% tax credits for the investments they make in vehicle conversions and refueling stations. Companies that derive at least 75% of their income from alternative energy sources are exempt from income tax, and natural gas sales are exempt from gross earnings taxes of 4%–5%.

The California Air Resources Board (CARB) requires that vehicle sales by the seven largest vehicle manufacturers in the state include at least 5% alternative fuel vehicles in 2001 and 10% in 2003. The direct incremental and infrastructure costs of this mandate have been projected at $19.5 billion through 2010. This figure accounts for almost 80% of the expected costs of all the state's activities to promote the purchase and use of alternative fuel.[187]

A number of cities use AFVs in their mass transit systems. In Los Angeles, for example, the Board of Directors of the Metropolitan Transit Area has adopted a policy that requires all buses purchased by the transit agency in the future to be AFVs.

Table 7-16 focuses on the Ozone Transport Region (OTR), which consists of 12 Mid-Atlantic and Northeastern states as well as the District of Columbia. The table shows that state subsidies for AF and AFVs are expected to rise significantly over the next 15 years.

Table 7-16. Alternative Fuel and Vehicle Subsidies in the Ozone Transport Region

TYPE OF SUBSIDY (excluding federal mandates)	1995 (in millions of dollars)	2000 (in millions of dollars)	2005 (in millions of dollars)
AFV procurement requirements	$0	$153.3-930.5	$719.0-5,875.5
State and local tax incentives	4.3-4.8	(44.8)-12.0	Unknown
Other state and local incentives	2.9-10.5	0.0-4.0	Unknown
TOTAL	$7.2-15.3	$108.5-946.5	$719.0-5,875.5

Source: Perkins. September 1995, p. 9.

Some of the subsidies actually involve net costs. State and local tax incentives could range from a net cost of $44.8 million in 2000 to a positive subsidy of $12.0 million. The incentive effect of some of the AF and AFV subsidies is likely to be significant. Preferential tax treatment has played a large role in the rise in ethanol production in recent years. A 1995 GAO report found that without the partial excise tax exemption for ethanol, its use would fall by 50%-90%.[188] The purchase of AFVs has also stimulated demand for methanol and CNG.

The environmental impact of such incentive effects is unclear. Some alternative fuels are cleaner than gasoline. Alternative fuels are promoted for several reasons: to improve the environment, to help increase U.S. energy security, and (in the case of ethanol) to provide a market for part of the country's large agricultural surpluses.

7.7.3 Car Buyback Schemes

In a number of states, programs have been implemented that offer cash payments to motorists if they turn in old, high-emitting automobiles. In the RECLAIM program described in Chapter 6, the South Coast Air Quality Management District (SCAQMD) allows emission reduction credits to be generated if citizens scrap old vehicles and lawnmowers, both of which are blamed for significant quantities of air pollution.

In 1990, Unocal Corporation in Los Angeles purchased and scrapped 8,376 vehicles that were manufactured before 1971 for $700 per vehicle. SCAQMD estimated the per-ton cost of the combined reductions in oxides of nitrogen (NO_x) and reactive organic gas (ROG) emissions at $4,900 through the scrapping of pre-1972 vehicles. This figure is much less than the $10,000 to $20,000 per-ton cost for traditional control methods. The SCAQMD concluded that its vehicle-scrapping program was relatively cost-effective.[189]

7.8 Renewable Energy and Conservation

Renewable energy and conservation are subsidized by tax benefits. Renewable electricity generation earns income tax credits of 1.5 cents per kWh, adjusted for inflation. For 1995, the credit was 1.6 cents per kWh. It applies to closed-loop biomass and wind energy sources. The estimated cost of these credits to the government was approximately $970 million in 1995.

Conservation subsidies paid by utilities are also partly or fully excluded from income tax. Since 1992, subsidies to residential consumers have been fully deductible, and 65% of subsidies to non-residential consumers have been deductible. The annual cost to the government of this exclusion has been estimated at approximately $100 million.

In cooperation with the U.S. Department of Energy, the U.S. Department of Housing and Urban Development created the Energy Efficient Mortgages (EEM) Program to help homebuyers and homeowners finance new homes or the cost of adding energy-efficiency features to an existing home as part of their Federal Housing Administration-insured home purchase.[190] EEM makes mortgage credit available to borrowers who otherwise would not qualify for conventional loans or for affordable loan terms and to residents of disadvantaged neighborhoods. In FY 1996, 3,500 loans were approved under this program. In FY 1997, 4,700 additional loans were approved.

7.9 Municipal Sewage Treatment Plant Construction

The federal government has subsidized the construction of municipal sewage treatment plants since the 1956 Water Pollution Control Act Amendments. The subsidies took the form of cost-sharing grants in which the federal government's contribution was limited to 55% in 1956, raised to 75% by the Federal Water Pollution Control Act of 1972, then decreased back to 55% by the 1981 Municipal Wastewater Treatment Construction Grant Amendments.

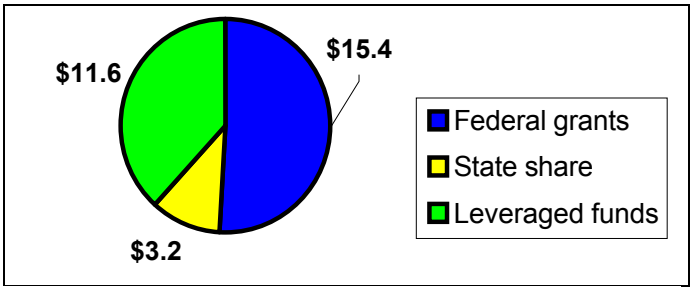
During the 1970s and 1980s, the Construction Grants Program provided more than $60 billion for the construction of public wastewater treatment projects: sewage treatment plants, pumping stations, and collection and intercept sewers; rehabilitation of sewer systems; and the control of combined sewer overflows.[191]

The 1987 Water Quality Act (commonly referred to as the "Clean Water Act") established 1990 as the last year for appropriating construction grant funds. With the phaseout of the Construction Grants Program and the initiation of the State Revolving Fund (SRF), Congress significantly reduced the amounts of funding available. They also provided for a transition from grants to loans.[192]

The grants undoubtedly encouraged construction activities that increased public access to sewage treatment. However, these grants have been criticized for giving municipalities "only weak incentives to hold the line on capital costs by seeking cost-effective design and technologies or by matching more carefully the designed capacity of the plant to projected need." This effect was compounded by state grants that covered part of the non-federal share, which effectively lowered communities' share of construction costs to 10%–25%.[193]

Under the Clean Water Act, grants were phased out by 1991 and replaced by federal contributions to state-managed revolving loan funds in what is known as the Clean Water State Revolving Fund (SRF) program.[194] SRFs in all 50 states and in Puerto Rico are capitalized by federal government grants. States are required to provide 20% matching funds for all federal grants, effectively making the state share 16.6% and the federal share 83.3%. By 1998, the SRF program was capitalized at approximately $30 billion.[195] (See Figure 7-1.) When loans are paid back, additional funds become available for new lending. FY 2000 appropriations for the SRF amount to $1.325 billion.

Figure 7-1. Cumulative SRF Investments
(in billions of dollars, 1988–1999)



Source: EPA. 1999a.

States are responsible for fund management. Interest rates vary from 0% to a market rate, the average being about 3%. Repayment periods are as long as 20 years, with reimbursement beginning one year after project start-up.

Data collected by the State of Ohio indicate that as of June 30, 1995, states collectively had lent $14.6 billion, or 77%, of the $18.9 billion available to them. The percentages of funds that were loaned varied significantly from state to state, with 8 states having loaned more than 90% of their funds; 11 states, less than 60%; and 3 states, less than 40%.

A GAO (1996c) study found that various obstacles had limited states' lending, including the lack of states' experience in managing revolving loan funds. In addition, the requirement that loans be repaid has discouraged applications from some small communities with a limited number of ratepayers to support project costs. In at least two states, the possibility of obtaining grants from other federal programs appears to have discouraged loan applications for SRF.

Eight federal agencies manage 17 different programs that may be used by rural areas for the construction, expansion, or repair of water and wastewater facilities. Some states report that larger communities with solid credit ratings may be able to borrow money at more favorable conditions from private-sector sources than from the SRF program.

Unlike the Construction Grant Program it replaced, the SRF program funds a number of initiatives other than municipal wastewater treatment, including projects that address stormwater; combined (sanitary and storm) sewer overflows; and agricultural runoff. Over 150 loans worth more than $1 billion have financed investments to control combined sewer overflow. In addition, approximately 100 loans worth about $100 million have financed measures to control agricultural and urban runoff.

Although it is beyond the scope of this report to provide an evaluation of the grant and SRF programs, the population served by modern sewage treatment has doubled over the past 30 years. EPA has stated that "the SRF is probably the most efficient program of its kind in the federal government."[196]

In addition to the SRF program, a number of other initiatives support the construction of sewage treatment works and related activities. A sampling of these initiatives follows.

- EPA's Public-Private Partnerships (P3) initiative tries to identify opportunities for municipalities to cooperate with the private sector to finance public wastewater treatment operations.
- The Hardship Grants Program for Rural Communities helps small, disadvantaged rural communities deal with their wastewater treatment needs. EPA provides funding for either the planning, design, and construction of wastewater treatment facilities or technical assistance on the operation and maintenance of such facilities. To qualify for this program, communities must meet the following criteria, among others:
    1. It must be located in a rural area.
    2. It must have a population of fewer than 3,000.
    3. It must have no centralized wastewater treatment facilities.
    4. It must have a per capita income that is 80% or less than the national average.
    5. It must have an unemployment rate that is at least 1% above the national average.

- Section 106 Water Pollution Control Program Grants help establish and implement ongoing water pollution control programs, including permitting, pollution control activities, surveillance, monitoring, enforcement, advice and assistance to local agencies, and the provision of training and public information. These grants provide federal assistance to states, territories, the District of Columbia, Native American Indian Tribes, and interstate agencies. Increasingly, Section 106 grants are focusing on basin-wide approaches to water quality management.
- Section 104(b)(3) Water Quality Cooperative Agreements are grants that promote the coordination of environmentally beneficial activities, including stormwater control, sludge management, and pretreatment. These grants provide federal assistance to state agencies that seek to control water pollution; interstate agencies; and other nonprofit institutions, organizations, and individuals.

7.10 Accelerated Review of New Pesticide Formulations

When a pesticide manufacturer makes application to EPA to register a new pesticide, that pesticide may move closer to the front of the queue if the new pesticide can be demonstrated to substantially reduce risk to human health and the environment relative to the pesticide that is currently available. EPA articulated this policy in the *1994 Annual Report of the Office of Pesticide Programs*.[197] OPP further clarified the policy on reduced risk in the staff paper that is part of the OPP public participation process. In that document, OPP described how registration actions are ranked in the queue.[198] Accelerated review for lower risk formulations is an important benefit to the manufacturer of the new product for two reasons. First, pesticide registration can take a number of years. Second, the patent protection clock generally is running during the period when the registration application is being evaluated by EPA. This open policy has incentives that are clear and recognized by all parties. It has been successful in communicating the benefits of generating new research on safer pesticides to pesticide registrants.

7.11 Subsidies That May Harm the Environment

Some subsidies are widely believed to have the unintended effect of encouraging environmentally harmful activities. In many cases, such subsidies were not designed as environmental policy instruments, but they have had adverse environmental consequences. This section briefly discusses a few examples of such subsidies.

7.11.1 Subsidies for Timber, Minerals, and Water Extraction

It has been widely asserted that timber, minerals, water, and public grazing land have been priced below their true social cost and, in many cases, even below their private cost. For all of these resources, user fees such as those described in Chapter 4 have been assessed. However, to the extent that these fees are lower than the private cost of the resources or services on which they are charged, such resources and services are actually being subsidized to the detriment of environmental protection.

As mentioned in Chapter 4, for example, livestock grazing fees on federal lands that are imposed according to a formula established by the 1978 Public Rangelands Improvement Act (PRIA) are widely believed to be below market value. Fees have been between $1.35 and $1.98 per animal unit month (AUM) since 1986. However, the Bureau of Land Management (BLM) and the

Forest Service estimated that fair market values in 1992 were $4.75 per AUM for sheep. Furthermore, they estimated that these market values varied across regions and ranged from $4.68 to $10.26 per AUM for cattle and horses. The costs of the grazing programs were $2.40 to $3.24 per AUM for the Forest Service and $2.18 to $3.21 per AUM for BLM.

The low end of the cost range applies only if the funding directly linked to the livestock grazing program is considered, while the high end considers all range management funding. Moreover, state and private fees are significantly higher than PRIA fees. Data from the National Agricultural Statistics Service indicate that, in 1993, private fees in 17 Western states averaged $9.80 and state government fees averaged $4.58. The PRIA fee that year was $1.86.

Table 7-17 shows that estimated irrigation water subsidies provided by the U.S. Bureau of Reclamation in selected areas ranged from 57% to 97% of the Bureau's full cost for water delivery. Excessive irrigation has been associated with a number of environmental problems, including water shortages and the contamination of water with natural pollutants and agricultural inputs.

Table 7-17. Water Subsidies of the U.S. Bureau of Reclamation

IRRIGATION DISTRICT	IRRIGABLE ACRES	SUBSIDY PER ACRE (in dollars)	SUBSIDY AS % OF FULL COST
Oroville-Tonasket	9,500	$417	82
Black Canyon #2	53,200	762	89
East Columbia Basin	134,500	1,619	97
Cachuma Project	38,700	1,378	81
Truckee-Carson	73,000	931	83
Glen	152,300	101	91
San Luis Unit	571,900	1,422	85
Coachella Valley	78,500	1,000	70
Wellton-Mohawk	65,800	1,787	89
Imperial Valley	519,500	149	74
Moon Lake	75,300	58	57
Grand Valley	23,300	1,623	85
Elephant Butte	102,100	363	64
Lugert-Altus	47,100	675	90
Malta	42,400	812	92
Lower Yellowstone #1	34,500	507	73
Farwell	50,100	1,446	93
Goshen	52,500	416	74

Source: U.S. Department of Interior, *Acreage Limitation*, Interim Report, Government Printing Office, Washington, DC, March 1980, pp. 38-41, as cited in Kanazawa (1994), p. 114.

Historically, the mining industries—which include the oil and gas industries—and timber industries have benefited from preferential taxation of their income. The effect of subsidizing mineral and timber production through the tax code is to favor virgin material use over secondary (recycled) materials. Two types of adverse environmental effects may result from such subsidies: (1) the destruction of natural areas as minerals and timber are harvested; and (2) the excessive disposal of materials that otherwise might be recycled.

Percentage depletion allowances for petroleum and other minerals, for example, allow companies to write off arbitrary percentage reductions in mineral deposits that result from their operations as expenses. The value of these allowances for the oil and gas industries was estimated at more than $2 billion annually from 1980 to 1982. Its value has since decreased to insignificant levels. One reason for the decrease is that only independent oil and gas companies (which account for about 30% of total U.S. oil and gas consumption) are now entitled to allowances. Moreover, only 25%–40% of these independent companies pay the standard tax (rather than the alternative minimum tax) required to maintain their eligibility for percent depletion allowance claims, Many of these companies are excluded from claiming percent depletion by other criteria under the tax code.

Percentage depletion allowances for other minerals were worth over $500 million annually for much of the early 1980s. These allowances, however, fell in value after the 1986 Tax Reform Act. Oil, gas, and other mineral extraction companies also have the advantage of being able to expense (rather than capitalize) exploration and development costs.

In the past, timber companies were allowed to consider certain income from timber as capital gains, which are subject to lower tax rates. This practice, worth about $800 million a year in the first half of the 1980s, was eliminated by the 1986 Tax Reform Act. However, the elimination of this practice led timber companies to increase their use of other previously underused tax advantages: (1) provisions that allowed timber management and reforestation costs to be expensed rather than capitalized; and (2) tax credits and accelerated amortization for reforestation activities. The federal government's construction of roads to facilitate the harvesting of timber is another form of subsidy for this industry.

7.11.2 Agriculture

The effect of the price support program for sugar on the Florida Everglades is frequently cited as an example of an environmentally harmful subsidy. The federal government subsidizes the sugar industry by guaranteeing a floor price of $0.18 per pound, which is almost twice the price on world markets. This U.S. policy is further supported by tariffs of $0.16 per pound on imported sugar that is in excess of quota levels. In 1992, this support program resulted in $161.5 million in benefits for sugarcane farmers and $107.7 million for processors.

The increases the amount of water diverted to sugarcane fields as well as the amount of runoff. The diversion and the runoff, which is contaminated with pesticides and fertilizers that sugarcane growers apply to maximize production, damage the ecosystem of the Everglades. Agricultural subsidies appear to be having similar adverse effects elsewhere in the United States. A Competitive Enterprise Institute study found that the use of pesticides and fertilizers in several Midwestern states was higher on subsidized fields than elsewhere. The study concluded that "the complete elimination of subsidies could result in a 35% reduction in chemical use per acre and a 29% reduction in fertilizer use per acre."

USDA's peanut subsidy program has also been accused of promoting environmental degradation. It requires farmers to grow peanuts on the same land so they can retain their production quotas. Thus, critics charge, the program results in the increased use of pesticides in order to counteract the negative effects of the lack of crop rotation.[199]

7.11.3 Mortgage Interest Tax Deduction

Although most interest deductions from personal income tax were eliminated by the 1986 Tax Reform Act, the deduction of mortgage interest remained in place. This deduction in effect subsidizes the construction and purchase of large homes. To the extent that larger homes use more building materials, take up more space, and require more energy, the deduction has a negative impact on the environment.

8. Liability Approaches

The purpose of liability mechanisms in environmental management is twofold: first, to give polluters an economic incentive to make more careful decisions; and second, to compensate the victims of pollution. The incentive effect is clear, since environmental values in effect become part of the overall cost of doing business. Avoiding harm to the environment is a good practice for companies when it reduces the overall cost of doing business.

Liability for harm to the environment acts as a financial incentive, much like a fee on emissions, with at least two important exceptions. One, liability for harm creates much greater uncertainty as to the magnitude of the payment that will be due for a given release of pollutants. Two, liability for harm can generate relatively large costs in terms of assessing environmental damage and the amounts due. These concerns aside, liability is an important incentive mechanism, one that is seeing increasing use in environmental policy.

8.1 Introduction

Two federal environmental statutes, the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Oil Pollution Act of 1990 (OPA), provide liability for the cleanup of releases of hazardous substances and petroleum, respectively, that pose a threat to human health and the environment. The statutes also provide for compensation for the lost use of polluted natural resources and for the restoration of the environment.

Several of the federal environmental statutes provide for civil and criminal liability for failure to comply with environmental regulations. The incentive effect of civil and criminal liability is to encourage individuals to comply with what are largely traditional forms of regulation. Such an incentive is qualitatively different from the subject matter contained in this report: incentives that put a price on pollution that harms health, the environment, or natural resources.

No study has attempted to address whether the existing combination of liability, penalties, and enforcement produce the correct incentive effect, which would encourage an optimal level of investment in pollution control. Excessive investment in pollution control is possible if entities seek to avoid penalties that are too harsh. It is also possible that firms will expend too little effort at pollution control if penalties are low and enforcement is lax. One recent study found that some types of chemical spills are more numerous in states that have imposed strict liability, an unexpected finding that calls into question many of the assumptions that policy makers have made regarding the effects of liability mechanisms as a tool of environmental management.[200]

In addition to liability for cleanup, and civil and criminal liability for violating environmental laws, individuals may use tort law to seek compensation from polluters for harm to their property or person. The difficulty of proving harm caused by pollution, particularly chronic health effects, creates a severe barrier to such cases.


Pollution Charges, Fees, Taxes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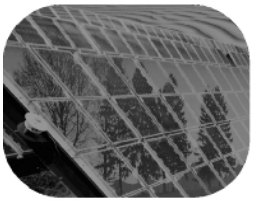
Subsidies for Pollution Control


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Consequently, tort law has serious deficiencies as a mechanism to make polluters pay for the harms they cause. In fact, it was largely the failure of tort law to address many types of environmental harm that led to the passage of the principal environmental statutes.

8.2 Liability for Cleanup Costs

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 responded to an issue without precedent: the legacy of sites contaminated with hazardous wastes. Love Canal in New York was the most celebrated case, although others such as Times Beach, Missouri, also attracted national media attention. CERCLA established a trust fund (the Superfund) that was financed primarily by three mechanisms: (1) a tax on corporate income; (2) a tax on crude oil and certain chemicals; and (3) general appropriations. (The taxing authority expired in the 1990s, leaving the Superfund reliant on annual Congressional appropriations, cost recoveries, and interest on the existing fund.) EPA uses the fund to pay for cleanup and restoration activities at sites where no solvent responsible party can be identified or at sites where an immediate response is deemed necessary.

Section 107(a) of CERCLA provides for liability for anyone who caused, or threatened to cause, a release of a hazardous substance or for anyone who has threatened to cause a release that creates a need for cleanup actions. The courts have interpreted this section of the law as requiring strict, joint and several liability for parties that have been deemed responsible for disposing of—or generators that arranged for the disposal of—hazardous wastes that pose risks to human health and the environment. The term "joint and several liability" means that if the government can identify just one party out of many that contributed wastes to a site, then that one party can be held responsible, potentially, for all cleanup costs. In turn, any potentially responsible parties that have been identified by the government may seek to involve other potentially responsible parties. The term "strict liability" is a standard that holds parties responsible, regardless of the circumstances of their action, e.g., without regard to whether the party acted negligently.

The most important feature of CERCLA centers on the cleanup of hazardous waste sites that pose a threat to human health and the environment. CERCLA is unique among the principal environmental statutes in that it looks backward, seeking to remedy problems stemming from past actions, rather than forward by trying to prevent damage from current or future activities. Cleanup costs paid by the private sector under CERCLA could amount to several tens of billions of dollars. The incentive effects of being held responsible for cleanup must lie outside of the actual costs of cleanup, since the actions that precipitated the need for cleanup are historical, not contemporaneous. But the mere prospect of CERCLA cleanup liability is affecting current and future decisions regarding the disposal of hazardous waste.[201] Large firms are managing most of their hazardous wastes on-site so as not to commingle their wastes with others and face the possibility of strict, joint and several cleanup liabilities for wastes from other generators. At present, minimizing wastes and preventing pollution are definitely more attractive strategies for businesses than risking liability under CERCLA.

The Resource Conservation and Recovery Act (RCRA) creates cradle-to-grave responsibility for managing hazardous wastes. Generators, transporters, and disposal facilities face strict, joint and several liability for the ultimate disposition of hazardous waste into a federally permitted facility. Each shipment of hazardous waste must be accompanied by a manifest to facilitate enforcement. The system creates powerful incentives for each actor in the hazardous waste management chain

to know the other parties and to be satisfied that they are acting responsibly. With this approach, Congress effectively multiplied the enforcement capabilities of EPA.

8.3 Liability for Damage to Natural Resources

Until 1990, damage to natural resources resulting from oil spills was within the scope of CERCLA. Where responsible parties can be identified, CERCLA provides for compensation to the public by the responsible party for the loss of services from natural resources. These so-called "interim lost uses" persist after a release of pollution until restoration is complete. Residual damages may exist if restoration is not complete.[202] CERCLA designates federal and state authorities as trustees for natural resources.

Trustees, in conjunction with the U.S. Justice Department, pursue damage assessments of natural resources. At the federal level, the U.S. Department of the Interior is the trustee for freshwater anadromous fish, migratory birds and waterfowl, and endangered species. The National Oceanic and Atmospheric Administration (NOAA) is trustee for the coastal and marine environment, including commercial and recreational fisheries, marine mammals, and anadromous fish in salt water.[203]

The Oil Pollution Act of 1990 (OPA), was enacted following the 1989 Exxon Valdez spill in Prince William Sound, Alaska. This Act created an independent statute separate from CERCLA for addressing damages resulting from oil spills. In Section 1006(e)(1), OPA directed NOAA, a part of the U.S. Department of Commerce, to promulgate regulations for assessing natural resource damages. On January 5, 1996, NOAA issued final regulations on natural resource damage assessment (NRDA) that was conducted under OPA. Later in 1996, the U.S. Department of the Interior issued regulations governing NRDA under CERCLA. These regulations were patterned closely after NOAA's approach.[204]

The OPA and NOAA regulations have two goals. First, they seek to restore the natural resources and services to their baseline condition. Second, they seek to compensate the victims of pollution for the interim lost use of natural resources and services through restoration, rehabilitation, or replacement, and through the acquisition of comparable resources, comparable services, or both. Damage assessments conducted by trustees in conformance with the NOAA regulations are accorded the status of a rebuttable presumption. This term, "rebuttable presumption," means that the parties responsible for the damage bear the burden of showing that damage claims presented by trustees are inappropriate.

The two components of a natural resource damage assessment ensure that the public is made whole following an oil spill: The resource and its services are restored, and the public is compensated for any lost use of the resource and resource services. OPA gives potentially responsible parties a financial incentive not to spill oil. Enforcement of the Act ensures that the responsible parties will pay the amounts necessary to restore the natural resource and compensate the public for lost use.

By 1996, under provisions of CERCLA, OPA, and the Clean Water Act, federal agencies had settled more than 100 natural resource damage cases. Awards for total damages reached well over $700 million. By that date, state agencies acting as trustees also had settled several cases on their own, with their awards totaling at least another $20 million.

In comparison, cleanup settlements by that date under CERCLA alone totaled at least $10 billion, approximately 10 times the magnitude of the natural resource damage settlements. If no settlement agreement can be reached with the responsible party, OPA authorizes the trustee to file a civil action for the damages in federal district court or to seek funds from the Oil Spill Liability Trust Fund administered by the Coast Guard.[205] The fund was financed by a fee of five cents per barrel on imported and domestic petroleum. Collection of the fee ceased at the end of 1994 as the trust fund had reached its funding limit. Because it is far easier to file a claim against the fund than to identify and pursue those responsible for "mystery" spills, this mechanism may reduce incentives for states to pursue those parties that are responsible for large numbers of small spills.

A number of large NRDA cases are still pending, at least three of which could amount to at least $500 million in awards. In addition, several important cases involving the federal government as a responsible party are outstanding. Table 8-1 summarizes the largest cases reported as settled (or partially settled) by 1996. The list excludes both the Exxon Valdez and the Shell Oil spill at Martinez, California. NOAA does not list the $620 million (present value) award in the Exxon Valdez case because it was settled before the NOAA Damage Assessment Center was established. The Martinez case is not listed because it was brought by the State of California, not by the U.S. government.

Table 8-1. Largest Natural Resource Damage Settlements Brought by the U.S. Government

CASE NAME	LOCATION OF DAMAGE	AMOUNT OF AWARD (in dollars)
Southern California	Palos Verdes Shelf, CA	$54,200,000
City of Seattle	Elliott Bay, WA	24,250,000
AVX	New Bedford, MA	21,127,000
Southern Pacific	Cantara Loop Derailment, CA	14,000,000
Simpson/Port of Tacoma	Commencement Bay, WA	13,035,000
Exxon Bayway	Arthur Kill, NY	11,113,000
Blackbird Mine	Salmon, ID	7,200,000
Apex Houston	San Francisco, CA	5,416,000
Tenyo Maru	Olympic Peninsula, WA	5,160,000
Eagle Pitcher Industries	Tri-State Site: MO, KS, OK	4,734,000
Nautilus	Kill Van Kull, NY/NJ	3,300,000
Sharon Steel Corp.	Midvale Tailing Site, UT	2,600,000
Schlumberger	Crab Orchard Wildlife Refuge, IL	2,500,000
New York Trap Rock Co.	Portland Cement Site, UT	2,207,510
Presidente Rivera	Delaware River, PA	2,141,000
Greenhill	Timbalier Bay, LA	1,878,000
Elepis	Florida Keys National Marine Sanctuary, FL	1,660,000
Charles George Trucking Co.	Charles George Reclamation Trust Landfill, IL	1,378,350

Sources: Guerrero. 1995; NOAA. 1996.

It is clear that liability for natural resources is having an effect on corporate behavior. Shortly after the Exxon Valdez incident and about the same time as the passage of OPA, the petroleum industry announced the creation of the $600 million, industry-funded Marine Spill Response Corporation, an organization that would develop response capabilities specifically for large

spills. Another sign of change is the care taken when tankers transit congested waterways and load or offload petroleum. In the Arthur Kill and Kill Van Kull waterways of New York and New Jersey, tug escorts now accompany tankers, and offloading tankers are surrounded by booms.

One largely unresolved issue concerns oil spills and releases that are too small to justify a natural resource damage assessment under either CERCLA or OPA. For example, the Coast Guard has record of between 5,000 and 10,000 oil spills occurring per year, but fewer than 20 are followed by an assessment of natural resource damage. While the expected damage from many of the smaller spills may not justify the costs of a traditional damage assessment, some natural resource damage may nonetheless exist. Not charging for natural resource damage gives incorrect price signals to potential polluters, since pollution is free rather than costing the responsible source an amount equal to the damage that is caused.

The petroleum industry has argued that the magnitude of the fines assessed in all assessments, including those for small spills, should closely match the actual damage to the environment. The reason they take this position probably has more to do with their attempts to avoid damage assessments that are calculated according to a formula than with their quarrel over the incentive effect of such a formula. The correct economic incentive for a given spill is provided to potential polluters if the calculated value of the assessment equals the average harm done by such a spill.

Alaska, Washington, Florida, and Texas have enacted compensation formulas or tables that assess charges based on the volume spilled, the nature of the receiving waters, and other factors. In 1995, NOAA proposed a similar approach for small spills. NOAA later withdrew the initiative for further study when it was pointed out that the proposed method resulted in unrealistically large assessments in some cases.

8.4 Civil and Criminal Liability

Congress first decreed pollution of the environment to be a federal crime in the Refuse Act of 1899. This Act made it a misdemeanor to “throw, discharge, or deposit” refuse of any kind other than runoff from streets and discharge from sewers into navigable waters of the United States. Violators convicted of violating the Act could be punished by fines not less than $500 and not more than $2,500, or by imprisonment for not less than 30 days nor more than one year. The court had the discretion to reward persons who provided information leading to the conviction of responsible parties with one-half of the fine.

More recently, the 1970 Amendments to the Clean Air Act punished violations of the Act as a misdemeanor. The 1970 Amendments to the Federal Water Pollution Control Act established misdemeanor penalties for “negligent or willful” release of pollutants into navigable waters without a permit or in violation of a permit. The Resource Conservation and Recovery Act of 1976, as amended by the Solid Waste Disposal Act Amendments of 1980, provides felony penalties for treatment, storage, or disposal of hazardous waste without a permit.

Continuing through the 1980s, Congress further refined the scope of environmental crimes, as well as the maximum fines and terms of imprisonment, in the Hazardous and Solid Waste Amendments of 1984, the Superfund Amendments and Reauthorization Act of 1986, and the Water Quality Act of 1990. In the Clean Air Act Amendments of 1990, Congress included felony provisions in the Act for the first time.

By 1995, the Justice Department had indictments against 443 corporations and 1,068 individuals, and it had recovered $297 million in criminal penalties. Sentences for individuals totaled 561 person-years of prison for those convicted.

State and local prosecutors also can pursue environmental crimes. In fact, they are required to demonstrate such a capacity in order to obtain EPA authorization to locally administer programs of the Clean Air Act, the Clean Water Act, and the Resource Conservation and Recovery Act. While most states are not actively pursuing environmental crimes, there are a number of important exceptions. New Jersey, Ohio, Pennsylvania, and California are active in their prosecution of environmental crimes. Los Angeles maintains its own team of investigators and prosecutes these cases.

An important sanction in addition to fines and prison sentences is the mandatory "blacklisting" of contractors under the Clean Air Act and the Clean Water Act. Both statutes prohibit the federal government from entering into new contracts with, or issuing grants to, any organization convicted of environmental crimes under these laws. Federal agencies and all states also have the authority to temporarily disqualify contractors from new work, pending receipt of further information, when a contractor violates a permit and is suspected of harming the environment. Consequently, environmental violations can adversely affect a firm or individual even if no criminal conviction is imposed.

The remainder of this section describes the principal civil and criminal penalties available under the nation's environmental laws.

8.4.1 Resource Conservation and Recovery Act (RCRA)

The purpose of RCRA is to establish a legal framework for a national system that oversees the management of hazardous waste. Congress included within the RCRA statute several enforcement authorities and penalty provisions. EPA relies on four types of compliance orders as its primary enforcement tools.

1. EPA may issue an order requiring compliance within a set time frame (usually 30 days) to facilities in violation of a regulatory requirement of Subtitle C. Such EPA orders include penalties for any noncompliance period.
2. EPA may require monitoring, testing, analysis, and reporting for facilities that present a substantial threat to human health or the environment.
3. EPA may issue corrective action orders requiring corrective action of other measures to interim status facilities (those without full RCRA permits) to protect human health and the environment.
4. EPA may sue any person who contributes or contributed to solid waste management practices that pose an imminent and substantial threat to human health or the environment.

Beyond forcing compliance with RCRA and making owners of facilities take actions to protect public health and the environment, compliance orders may also assess a civil penalty for past and current violations. Civil penalties can be as large as $25,000 per day for each RCRA violation. Criminal penalties of up to $50,000 per day of violation or imprisonment for as long as 5 years may be meted out to any responsible person who knowingly

- transports hazardous waste to a facility not permitted under RCRA;

- treats, stores, or disposes of hazardous waste without a permit;
- makes a false statement or representation in an application, label, manifest, record, or other document used for compliance with RCRA;
- generates, treats, or disposes of hazardous waste and intentionally destroys records or other documents required for compliance with RCRA;
- transports hazardous waste without a manifest; or
- exports hazardous waste without the consent of, or in violation of, procedures of the receiving county.

8.4.2 Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

Any person in charge of a vessel or a facility who knows of a release of hazardous substances from a vessel (other than a federally permitted release) must notify the National Response Center. Anyone who fails to provide notification "immediately," or who knowingly supplies false or misleading information, may be imprisoned for not more than 3 years (5 years in the case of a subsequent conviction) and fined in accordance with Title 18 of the Act. In addition, the Emergency Planning and Community Right-to-Know Act (EPCRA) requires that the person notify state and local emergency response officials.

8.4.3 Clean Water Act (CWA)

EPA can begin civil actions against violators of CWA permits and seek appropriate relief, which includes the use of permanent or temporary injunctions. EPA can seek criminal penalties including fines, imprisonment, or both, as shown in Table 8-2. After a person's first conviction, the fines and prison terms for subsequent convictions can be doubled.

Table 8-2. Criminal Penalties for Violations of the Clean Water Act

SEVERITY OF VIOLATION	FINE	IMPRISONMENT
Parties who negligently violate permit conditions and limitations	Not less than $2,500 per day of violation nor more than $25,000 per day of violation	Not more than 1 year
Parties who knowingly violate permit conditions and limitations	Not less than $5,000 per day of violation nor more than $50,000 per day of violation	Not more than 3 years
Parties who violate permit conditions and limitations and knowingly place another person in danger of death or serious bodily injury	Not more than $250,000	Not more than 15 years
Organizations that violate permit conditions and limitations and knowingly endanger human health	Not more than $1,000,000	Not applicable

Source: Clean Water Act

The CWA also provides for civil penalties for offenses other than permit violations, offenses that include making false statements on records, reports, and other documents filed under the CWA and wrongfully introducing pollutants into public sewage treatment facilities.

8.4.4 Clean Air Act (CAA)

The Administrator of EPA can seek a permanent or temporary injunction and civil penalties of not more than $25,000 per day for permit violations by major stationary sources (in general, those emitting more than 100 tons per year of a regulated pollutant). Criminal penalties that include both fines and imprisonment for up to 2 years may be sought for any person who knowingly violates permit terms and conditions through such actions as making material false statements or omitting material information. Convicted second-time violators can have their fines and sentences doubled.

Parties who *negligently* place another human in imminent danger of death or serious bodily injury are liable, upon conviction, for fines and prison sentences of up to 1 year. Parties who *knowingly* endanger human health may, upon conviction, receive fines, prison sentences of up to 15 years, or both. Finally, organizations can be liable for fines of up to $1,000,000 for knowingly committing permit violations and similarly endangering human health.

8.5 Tort Liability

Litigation concerning claims of personal injury from chronic exposures to toxic agents in the environment is a relatively recent phenomenon. It is, for the most part, the domain of asbestos workers. Workplace-related injury claims are not within the scope of this paper. However, a few cases involve alleged exposure to toxic substances in ambient air and water supplies.

The law under which these tort actions are brought has undergone considerable evolution in recent years. These modifications are due to several factors, which include the following: (1) the need to accommodate improved scientific information on the effects of human exposure to toxic agents; (2) the recognition of the potentially long latency periods between exposure and onset of a disease; and (3) a growing desire by the courts to hold defendants to a standard of strict liability. Despite the evolution of tort law in favor of plaintiffs, relatively few cases that claim harm from pollution in the environment have been filed. Of these cases, very few that involve the effects of pollution on human health have been decided in favor of plaintiffs.

The statute of limitations is an important barrier to litigation in a few states. However, most states have struck down this once-important obstacle by allowing plaintiffs to file a case from 1 to 3 years *after* the discovery of an injury, rather than starting the clock at the date of initial exposure.

In many situations of environmental harm, plaintiffs find it difficult to identify the party responsible for the harm. Identifying the source of contamination in well water would be a challenge for most households. Even if the contamination could be traced to a waste disposal facility, it might be very hard to identify whose wastes caused the contamination. For toxic pollutants in the air, identifying the parties responsible for such releases is even more difficult.

Demonstrating causation represents a major challenge because most diseases that have been linked to toxic substance exposure can be caused by multiple factors. In general, tort law requires plaintiffs to demonstrate that the harm they experienced was “more likely than not” caused by the defendant. Courts usually interpret this phrase to mean that the probability that the defendant caused the harm was at least 50%. Imagine a situation in which a polluter increased the risk of cancer by 20% in a nearby residential area. Rather than 100 people dying of cancer each year, 120 die. None of the 120 cases would receive compensation under the “more likely than not”

criterion. Two other issues should be noted: (1) that statistical data regarding causation are not likely to be accepted by courts, no matter what the standard of proof; and (2) that epidemiology is limited in its ability to detect elevated incidence of a disease, the smallest detectable rate of excess incidence being on the order of 30%.

In sum, the legal norms under which tort actions for harms caused by exposure to pollution are such that few cases can satisfy the burdens of identifying the responsible party and proving causation.

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9. Information Disclosure

For the purposes of this chapter, information approaches to environmental protection may be defined as policy instruments that influence the behavior of firms and individuals through the dissemination of information on inputs, production processes, and the environmental consequences of final products. Some information approaches rely purely on voluntary reporting, while others have mandatory reporting.

The environmental information embodied in these approaches has economic value to consumers, individuals, scientists, academics, and state and local government officials even in the absence of any changes in emissions by firms. For example, information on the use of hazardous materials may reduce the uncertainty faced by local officials in planning for emergency preparedness. Regulators can use the information to monitor the progress of voluntary efforts to control pollution. Consumers may gain utility from assurances that products are manufactured in ways approved by the federal government. Individuals can make more informed decisions about where to live and work. And scientists and academics gain new sources of data that can be used in research on health, business management, and the environment.

Information disclosure rules may have ancillary economic effects that stem from the incentives they create for change in producer or consumer behavior. For example, information disclosure approaches are an increasingly popular method of encouraging companies to voluntarily prevent pollution. In contrast to end-of-pipe traditional approaches or technological mandates, pollution prevention can be achieved through a much wider array of actions: changes in input use, technologies, processes, management, and other parameters. Because the full range of these parameters and possibilities cannot be well-known to regulatory agencies, governments try to stimulate firms to engage in pollution prevention by mobilizing workers, financial markets, and the community through the provision of information.

When a rule is promulgated, ancillary changes are hard to specify. The economic analyses of information rules often ignore these changes and consider the benefits and costs of environmental information as a good itself, one with independent production and consumption considerations. This chapter complements the partial equilibrium analysis of information embodied in many economic analyses by considering the incentives created by disclosure and the subsequent use of that information.

This chapter reviews many of the United States' unique experiences with information disclosure methods. Available evidence, some of it conjectural in nature, suggests that at least two factors are important in evaluating the incentive structure of information disclosure rules. First, the information should be accurate and credible. Perhaps the best information would be based on measured data and standardized criteria and provided or verified by an independent source, but few programs meet these ideals. Second, the information must be made available to the right people, at the right time, and in a format accessible to participants in an economic transaction. Unfortunately, not all information policies take note of these considerations.


Pollution Charges, Fees, Taxes


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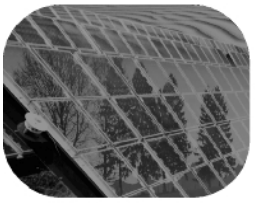
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9.1 Background

The earliest attempts at pollution control used approaches such as emissions standards, mandated reductions in emissions, or requirements that sources adopt particular control measures or technologies. After the most obvious and easily remedied pollution problems had been addressed, it became evident that the traditional regulatory approaches to pollution control would be excessively costly, incapable of achieving all environmental objectives, or both.

A second approach to pollution control responded to these limitations of traditional regulatory approaches by harnessing the forces of the market. These mechanisms included tradable permits, emission fees, deposit-refund systems, subsidies, and performance bonds. In most cases, they have complemented traditional regulatory remedies, but in some instances they are developed as stand-alone measures.

Although market-based approaches have helped improve the cost effectiveness of environmental regulation, the problems of pollution regulation have not been fully solved. Environmental regulators are burdened by the vast number of harmful substances that need to be controlled if environmental goals are to be achieved. Furthermore, they find that market-based mechanisms have limits in terms of the sheer numbers of substances that can be controlled and the modes of behavior that can be encouraged.

In response to these difficulties, pollution control policy evolved to provide information as a mechanism for making employees, shareholders, and customers of businesses active participants in the regulatory process. Information disclosure strategies are timely for at least three reasons. First, environmental regulators need more regulatory tools (as noted in the previous paragraph). Second, the means by which information is collected, processed, and disseminated are rapidly falling in cost. Third, with rising incomes and better education, the demand for environmental information by workers, shareholders, and consumers is increasing.

In the product market, consumers may react to environmental labels by buying "environmentally-friendly" products, even when they cost more. Some export markets for products may be effectively closed to firms until they achieve ISO (International Organization for Standardization) certification. Purchasers of intermediate products increasingly are concerned about a host of issues regarding their manufacture, such the raw materials used (e.g., virgin timber, recycled materials) and the environmental performance of the supplier. In the labor market, firms with better environmental records may be viewed as more attractive places to work, making it possible for them to hire more talented or productive employees. In the capital market, shareholders and lending institutions increasingly are concerned about the prospect of future environmental liability for pollution harms caused by a firm. Hence, firms with better environmental records may be rewarded with better access to, and a lower cost of, capital.

Information approaches have been used in environmental protection on both the state and federal levels. This chapter begins with a discussion of the National Environmental Policy Act, the first disclosure-type program. Following is a review of the Federal Emergency Planning and Community Right-to-Know Act (EPCRA) and two similar state programs. The chapter then discusses California's Proposition 65 and reporting requirements for the release of air toxics, reporting requirements for environmental impact assessments, product labeling, environmental performance awards, the Securities and Exchange Commission's (SEC) environmental reporting requirements, and disclosure requirements for radon and lead paint. Other voluntary programs in

which industry is encouraged to reduce pollution below permitted amounts are described in Chapter 10.

9.2 National Environmental Policy Act (NEPA)

The 1969 National Environmental Policy Act of 1969 (NEPA) is the basic environmental law of the United States.[206] The Act requires that environmental impact statements (EIS) be prepared for federal activities that significantly affect the environment. An EIS provides for a full, fair, public discussion of environmental impacts and an examination of reasonable alternatives that will minimize adverse impacts. Implementing regulations issued by the Council on Environmental Quality (CEQ) establish procedures to ensure that high-quality environmental information is available to public officials and citizens before decisions are made and actions are taken.[207] In numerous instances, the mere fact that potential adverse environmental impacts were anticipated and would have to be disclosed motivated project designers to alter their plans to reduce impacts.

9.3 Emergency Planning and Community Right-to-Know Act (EPCRA)

Enacted in 1986 as Title III of the Superfund Amendments and Reauthorization Act, the Emergency Planning and Community Right-To-Know Act (EPCRA) requires emergency planning and disclosure of information on the releases and transfers of hazardous chemicals to disposal facilities. Section 313 of EPCRA requires certain businesses to report each year on the amounts of toxic chemicals that their facilities release into the environment and transfer to treatment, storage, and disposal facilities. As a result of the 1990 Pollution Prevention Act, reporting requirements were expanded beginning in 1991 to include source reduction and recycling information. Data for a given year must be submitted by July 1 of the following year. EPA then compiles the information and makes it available to the public as the Toxics Release Inventory (TRI).

Through 1998, TRI reporting was required of all manufacturing facilities that met the three following criteria: (1)they had at least 10 employees;(2) they operated in Standard Industrial Classification (SIC) codes 20 through 39; and (3) they manufactured, processed, or otherwise used one or more of the chemicals listed in the TRI in quantities that exceeded certain threshold amounts. Threshold amounts are 25,000 pounds per year for manufacturing and processing, and 10,000 pounds per year for other uses of any listed chemical during the calendar year. In 1998, seven additional industries were added. (See text box entitled “Industrial Sectors Subject to TRI Reporting in 1998.”) Federal facilities were required to submit their first TRI reports by July 1, 1995, for the 1994 calendar year. Data for 1998 were available in May 2000.[208]

Individuals and organizations can petition EPA to add or remove chemicals from the list. The number of listed chemicals was originally set at 320, but it has since increased. (A few chemicals have also been deleted from the list.) A significant expansion took place in 1994. That year, EPA added 286 new chemicals and chemical categories to the list, bringing the number to 654. These additions were in effect for the 1995 calendar year. In October 1999, EPA lowered the reporting thresholds for many persistent bioaccumulative toxic chemicals, and added several other such chemicals to the list.

Facilities that have a total annual reportable amount[209] of 500 pounds or less of a TRI chemical and that manufacture, process, or use 1 million pounds or less of a TRI chemical can now submit

a shorter, annual certification statement in lieu of the longer Form R. These streamlined requirements became effective for the 1995 calendar year. The rule attempts to strike a reasonable balance between maintaining the community's right-to-know about toxic chemical releases and the economic costs to EPA and industry of collecting the information. EPA estimated that simplifying the reporting process for some facilities would result in annual cost savings of about $18.4 million for industry and $700,000 for federal, state, and local governments.[210]

EPA makes TRI information available to industry, environmental groups, and the general public, so they can know about the toxic releases and other waste management activities of facilities. This information is available via several media, including printed reports, CD-ROM, and the Internet. The emergency-planning component of EPCRA calls for the creation of state and local emergency response bodies that will develop emergency response plans.

This part of EPCRA also requires facilities to perform the following three tasks.

1. Facilities must inform these emergency-response bodies that certain hazardous substances are located on their premises.
2. They must give immediate notice of accidental releases to emergency response bodies.
3. They must develop response plans that can be implemented in the event of the accidental releases of hazardous substances.

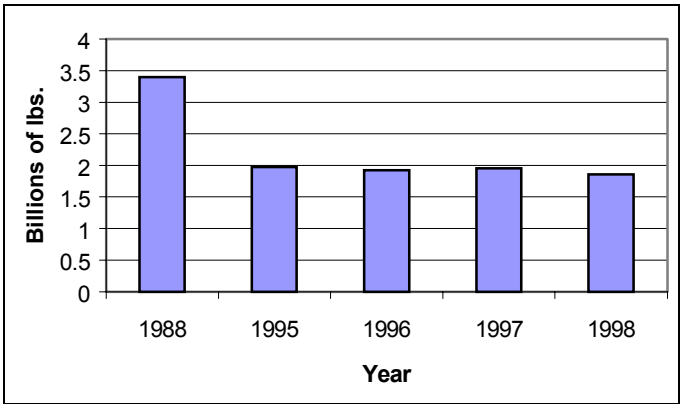
Information provided by facilities is available to the public.

Governments use TRI data to establish baselines, measure progress, set priorities, and identify targets of special concern. The general public uses TRI information to identify potential problems in their local environment and to take part in national and local debates concerning regulations that could affect their health and welfare. Corporations and investors use TRI data to gauge the performance of a corporation and individual facilities relative to their peers.

9.3.1 Trends in Toxics Release Inventory (TRI) Data

As shown in Figure 9-1, reported TRI releases have decreased 45.3% in the 10 years since 1988. Although the data suggest significant reductions in toxic releases, there are several reasons why these reported decreases may not be equal to *actual* decreases in releases. EPA points out that TRI increases and decreases can be "real changes" or "paper changes." The latter result from errors, changes in facilities' estimation or calculation techniques, changes in reporting guidance and facilities' interpretation of that guidance, and facilities' use of exemptions. In general, companies determine their TRI release amounts through an estimation process rather than through monitoring. EPA guidance has not been issued for all aspects of TRI reporting, and companies can sometimes lower reported releases by using different estimation techniques.

Figure 9-1. Reported TRI Releases



Source: www.epa.gov/tri/tri98

EPA indicates that estimation errors are more likely to occur for releases such as fugitive air emissions and complex wastewater effluent, releases for which little monitoring data are available. However, EPA audits have found companies' estimation techniques to be reasonably accurate. For example, EPA's review of TRI data quality for 1996 surveyed 60 industrial facilities: 27 in the primary metal industry, 14 in the electrical equipment industry, and 19 in the transportation equipment industry. The survey found that facilities were able to calculate thresholds for reporting correctly 95% of the time. For chemicals that exceeded the threshold, these facilities correctly identified the threshold 88% of the time. Reports by facilities concerning their releases agreed closely with an auditor's assessment in the transportation equipment industry. However, these reports differed significantly in the primary metals and electrical equipment industries. The differences were attributed to confusion over the definitions of the terms "recycling" and "reuse."[211]

Another potential problem is that most chemicals have not been subject to TRI requirements. A 1994 GAO study stated that over 70,000 chemicals are used commercially in the United States, of which only 320 had been included in the TRI. "Consequently," the study added, "the companies may maintain or even increase their usage of toxic chemicals while concurrently reducing the chemicals that are reported to EPA."[212] The original list focused on the most important toxics, and, as noted in a previous paragraph, EPA included another 286 chemicals in TRI requirements effective 1995. However, some highly toxic chemicals still have not been added to the list because they are generated in amounts that are too small to meet criteria for inclusion.

At present, facilities with fewer than 10 full-time equivalents employees in listed SIC codes are excluded from TRI reporting. Furthermore, all sources of releases outside that code range are also excluded. It is not known what percentage of releases is currently exempt from reporting.

Releases are not weighted according to the type of disposal method, the magnitude of potential population exposure to these toxic substances or the potential effects of these releases on human health and the environment. Moreover, the TRI data do not include information on the quantity of toxic chemicals in products leaving the facility. Such products themselves can eventually be released into the environment.

Although a reduction in releases is, for the most part, desirable, another important question is how the reduction is achieved. Methods include controlled disposal, recycling, conversion to energy, and source reduction. The 1990 Pollution Prevention Act set source reduction as the preferred method of reducing releases, but transfer data show no clear trend toward using this method. Since recycling and conversion to energy were not reported as transfers until 1991 (as required under the 1990 Pollution Prevention Act), 1988 total transfers are difficult to compare with total transfers in the subsequent period.

The assessment of achievements in source reduction is complicated by the lack of TRI data on the quantities of waste decreased by source reduction measures. Only the practices used to reduce waste— not their results—are included in the TRI. Changes in waste generation that are reported in the TRI could be due to factors other than source reduction, including estimation errors or changes in the production levels of specific products.

The trend of decreases in releases and transfers is more pronounced under the voluntary 33/50 program. (This program is discussed further in Chapter 10.) Total releases and transfers under

this voluntary program have decreased every year from 1988 to 1994, with a total reduction of 51% during that period.

9.3.2 Incentive Effect of the Toxics Release Inventory

The incentive effect of the TRI program on polluters cannot be assessed solely on the basis of reported decreases in releases. A number of factors, including traditional regulations and other economic incentive mechanisms discussed in this report, have affected releases. Pollution prevention is also influenced by a number of factors unrelated to the TRI program.

Nonetheless, the TRI program is widely believed to have a significant impact on polluters.[213] EPA has called it "one of the most powerful tools in this country for environmental protection" and "one of the most successful policy instruments ever created for improving environmental performance."[214] Vice President Gore called the annual TRI publication "the single most effective common-sense tool" to promote environmental protection.[215]

Shortly after the first TRI data were released in 1989, citizens groups placed a full-page advertisement in the *New York Times* that listed "the corporate top ten" land, water, and air polluters. Several of these polluters subsequently promised EPA that they would improve their environmental performance, effectively beginning the 33/50 voluntary releases reduction program. [216] Monsanto, for example, promised 90% reductions of 1987 air emission releases by 1992. AT&T said it would halt all TRI air emissions by 2000. Dow announced it planned to reduce overall emissions by 50% by 1995, and Dupont promised to cut air emissions by 60% by 1993 and cancer-causing components by 90% by the year 2000. In Minnesota, public outcry over revelations that an electronic circuits manufacturer was emitting methylene chloride led the facility to promise 90% reductions in emissions by 1993. After 1987 TRI data found an IBM facility in California to be the state's largest emitter of chlorofluorocarbons (CFCs), a public interest group organized a campaign. IBM subsequently promised to end the use of CFCs at the plant by 1993.[217] TRI data also appear to influence investors. Some of the investor interest may be attributed not so much to socially responsible investing but rather to the belief that companies with relatively high emissions might face mounting environmental costs in the future.

Hamilton (1995) found that the 1988 TRI performance of companies (as reported in June 1989) was of interest to journalists and investors. The higher a firm's TRI pollution figures, the study found, the more likely journalists were to write about the firm's toxic releases, especially those firms that were less associated with pollution. Companies that reported TRI releases under-performed the stock market for five days after the data were released. The more chemicals for which a company submitted data, the greater was the extent of under-performance by the company. The under-performance was less significant, however, for companies previously associated with pollution.

The Investor Responsibility Research Center has analyzed TRI data to provide clients with environmental profiles of companies. The Clean Yield Investment Portfolio Management Group compares companies' TRI data with industry-wide averages of releases per unit of sales. *Fortune* magazine has used TRI data in its "green index" of American manufacturers, assigning scores of 0 to 10 in 20 performance categories, including toxic emissions per unit of sales.

The regulated community uses TRI data as well. Wolf (1986) examined the effects of the program on regulatory agencies, legislatures, public interest groups, and affected firms. He found that major corporations issue environmental progress reports to counter the publicity generated

by their TRI reports. Often the progress reports specify baselines and milestones, so others can evaluate their progress. Pine (1997) suggested that TRI data are helping companies develop waste reduction strategies. Konar and Cohen (1997) studied the response of firms to large drops in their stock prices following the release of TRI data. The authors concluded that firms experiencing large, adverse impacts on the price of their stock reduced their TRI emissions more in subsequent reporting periods than the average firm in their industry. This action suggests that TRI reports *do* affect corporate behavior. EPA's economic analysis of the proposed rule to modify reporting requirements on persistent bioaccumulative toxic chemicals contains additional information on the beneficial effects of the TRI program.[218]

Although EPCRA's emergency-planning element has received less attention as an incentive mechanism than the TRI, EPCRA also could have a significant effect on polluters' behavior. Firms might reduce the amounts of hazardous substances on their premises if they are forced to disclose these amounts to local emergency response bodies and (indirectly) to the public. They might also manage hazardous substances more safely if they are required to plan for, and give immediate notice of, accidental releases.

9.4 State Chemical Reporting Programs

At least two states have toxic release reporting programs similar to the federal TRI program, but they have different reporting requirements. The requirements may cover additional chemicals, industries, or reporting elements; use of toxic substances and pollution prevention plans. The General Accounting Office (GAO) (Q: add to acronyms list) (1997b) conducted a survey of efforts to pass similar laws in other states, finding that initiatives had failed in California, Colorado, Florida, Hawaii, Maryland, and Michigan.

Programs in Massachusetts and New Jersey, for example, differ from their federal counterpart in that they require companies to use materials balance accounting to plan pollution prevention actions, to report their goals and progress on pollution prevention, and to examine whether material inputs to production are accounted for fully by the total of all outputs and pollution releases.

One advantage of requirements such as those in Massachusetts and New Jersey is that they offer more information on toxics use and wastes that could be of interest to companies, regulators, and the general public than do the TRI requirements. One disadvantage of these requirements appears to be the potential administrative burden they impose on polluters and regulators. If the state attempts to lessen its program costs by taxing the polluters, it adds to the polluters' burden. EPA has studied these programs in the context of its Phase III expansion, so the Agency can better understand how the federal EPCRA might be improved.

9.4.1 Massachusetts Toxics Use Reduction Act (TURA)

Enacted in 1989, the Massachusetts TURA requires the users of large quantities of toxic materials, including those in several SIC codes not covered by the federal EPCRA, to (1) submit an annual Toxic Use Report to the State Department of Environmental Protection, and (2) develop plans for using toxic chemicals and reducing waste. Facilities that are subject to these two requirements must report annually on their inputs and outputs of materials and on their waste generation and management methods.

Additional data must be reported every two years on actual and projected changes in chemical use and wastes compared to both planned and base-year amounts. Summaries of the chemical use and waste reduction plans also must be submitted biennially, but the detailed plans remain at the facilities to ensure confidentiality. These plans must be endorsed by state-certified Toxics Use Reduction Planners.

TURA also created two agencies to provide technical assistance to users of toxic substances and to conduct training and research on TURA and on techniques that reduce the use of toxic substances. The operations of these agencies and other program costs are covered by toxics use fees that are based on the number of employees at a facility and the number of chemicals it uses. These fees are limited to $31,450 per facility annually. They are not closely linked to the quantities or toxicities of the chemicals used. These fees generate roughly $5 million a year in revenues.

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For every production unit, facilities must also report on their use of chemicals and on use reduction techniques (within SIC range codes to protect confidential business information). Facilities must also indicate a Byproduct Reduction Index (BRI) and an Emission Reduction Index (ERI). ("Byproduct" can be considered "waste" in this context, although a byproduct may be reusable.) These two indices are determined in the following manner:

BRI = (A–B) x 100 and ERI = (C–D) x 100, where

A = Byproduct quantity in base year divided by the number of units of product produced in base year.
B = Byproduct quantity in reporting year divided by the number of units of product produced in reporting year.
C = Emissions quantity in base year divided by the number of units of product produced in base year.
D = Emissions quantity in reporting year divided by the number of units of product produced in reporting year.

Source : http://www.turi.org/turadata/WhatIsTURA/

TURA also contains provisions for citizen involvement. Citizens may assist in monitoring the use of toxic substances, and they can access the TURA information on toxics use that is reported to Massachusetts' Department of Environmental Protection. The Department is required to act on petitions to inspect a facility's plans and data if the petitions are filed by 10 or more residents living within 10 miles of the facility.

The information collected through TURA has also proven helpful to the subject facilities. By making facilities aware of the quantities of toxics used during production, released to the environment, and transformed into products, the reporting requirements allow them to identify improvements in their efficiency and cost-cutting opportunities relative to chemical use.

TURA set a waste reduction goal of 50% over 10 years, using 1987 as a baseline. Reporting began in 1991 for 1990 data. Between 1990 and 1997, toxics material use fell by 201 million pounds, toxic byproducts fell by 43.8 million pounds, and the on-site release of toxic materials fell by 16.2 million pounds. In 1999, the TURA program received an award for "Innovations in American Government."[219]

9.4.2 New Jersey Reporting Requirements

New Jersey's Worker and Community Right-to-Know Act was enacted in 1984, before the federal EPCRA. Since 1987, the state has collected data on inputs and outputs of materials and on the amounts of waste reduced through source reduction activities.[220]

The 1991 New Jersey Pollution Prevention Act required facilities to undertake pollution prevention planning. Like the Massachusetts law discussed in previous paragraphs, New Jersey set a goal of 50% reduction in waste output by 1997, with 1987 as a baseline. Plan Summaries must be submitted to the state's Department of Environmental Protection every 5 years.

Like Massachusetts, New Jersey requires the use of performance indices. Instead of focusing on waste generation and emissions, however, New Jersey has indices for waste generation and use of toxics. New Jersey requires that facilities making TRI reports provide additional information beyond the federal requirements. The additional information includes the quantities of each chemical brought on-site, produced on-site, used in the manufacturing process, and sent off-site in products or as waste. Such data, along with the federally required data on releases and transfers allows regulators to construct a materials balance for each chemical.

The New Jersey Department of Environmental Protection has conducted surveys showing that its reporting requirements have been beneficial to companies because the data helps them assess their options to minimize waste. Department officials also claim that the data allow companies to better manage their activities, including the implementation of the facility-wide permitting scheme described in Chapter 6.

9.5 Drinking Water Consumer Confidence Report

In an August 19, 1998, notice in the *Federal Register,* EPA required the suppliers of drinking water to provide households with information on the quality of their drinking water, beginning in 1999.[221] The reports must contain the following information:

- the lake, river, aquifer, or other source of the water;
- a brief summary of the susceptibility of the local drinking water source to contamination;
- how citizens can obtain a copy of the complete water system assessment from the supplier;
- the level (or range of levels) of any contaminants as well as EPA's health-based standards for the contaminants;
- the likely source of any contaminants;
- the potential health effects of any contaminants;
- the water system's compliance with other drinking water-related rules;
- an educational statement for vulnerable populations about how to avoid *Cryptosporidium;*
- educational information on nitrate, arsenic, or lead in areas where they are detected in quantities e that are more than 50% higher than EPA's standard; and
- the telephone numbers for additional sources of information.

EPA encourages water supply systems to post water-quality information online, and the Agency maintains links to this information on the Internet.[222]

9.6 EPA Reporting of Environmental Information

Several recent initiatives by EPA focus on two activities: (1) the aggregation or processing of environmental data that are submitted under existing programs; and (2) the reporting of this data in a form that is designed to be more useful to consumers, homeowners, and firms. This section describes three such initiatives.

9.6.1 Automobile Pollution Rankings

In 2000, the EPA launched a web site that uses emission certification data submitted by manufacturers to rank automobiles and light-duty trucks on the basis of their tailpipe emissions of hydrocarbons and NO_x.[223] Rather than report actual emission certification data, the site ranks emissions on a scale from 1 (worst) to 10 (best). The information can be used by consumers to make more informed choices. It also may indirectly pressure manufacturers to improve the emissions performance of their vehicles.

9.6.2 Envirofacts

EPA's Envirofacts database provides users with a single point of access to select EPA environmental data sets, as well as a mapping function that finds the geographic location for data of interest.[224] Envirofacts allows the user to retrieve environmental information on air emissions from sources and information on

- individual chemicals,
- facilities,
- hazardous waste generators and transporters,
- risk management plans for facilities,
- EPA's Superfund sites,
- toxic releases,
- water discharge permits,
- suppliers of drinking water, and
- microbes and disinfectants in drinking water.

9.6.3 Sector Facility Indexing (SFI)

Sector facility indexing is a pilot effort by EPA to integrate environmental data in each of five industrial sectors: petroleum refining, iron and steel, primary non-ferrous metals, pulp and paper, and automobile manufacture.[225] SFI combines data from TRI and EPA's national enforcement databases and provides information on releases, the number of inspections, compliance history, and enforcement actions. Users can review data on releases from, and the compliance history of, individual facilities and then compare these data with other facilities in the same industry. EPA recently announced that the program would be expanded to include certain federal facilities.[226]

9.7 Proposition 65

California's Safe Drinking Water and Toxic Enforcement Act, commonly referred to as "Proposition 65," was adopted by voter referendum in 1986. It requires polluters to issue warnings if they expose people to significant levels of carcinogens or reproductive toxicants that are included in a list maintained by the Office of Health Hazard Assessment. [227] As of August 2000, the list contained 461 carcinogens, 241 reproductive toxicants, 35 female reproductive toxicants, and 46 male reproductive toxicants.[228]

If a substance is listed as a carcinogen, businesses may not discharge it into drinking water unless the quantities discharged pose "no significant risk." State regulation sets the levels of "significant risk" for most of the most toxic and high volume chemicals on the list, but they can be superseded by more stringent exposure levels that are mandated by other environmental laws. The defendant bears the burden of proof that the exposure is below the level of significant risk. Drinking water utilities, government agencies, and organizations employing fewer than 10 people are exempt from the rule.

Citizens have the right to initiate lawsuits under Proposition 65 if authorities do not respond to their requests to pursue potential violators. Under the "bounty hunter provision," the person who brought the suit can receive 25% of any fines collected. Fines can be as high as $2,500 a day. Data obtained from the State Attorney General's office indicate that several environmental groups—including the Environmental Defense Fund and As You Sow—and individuals have been compensated for initiating lawsuits under Proposition 65.[229]

In some cases, businesses in California have avoided issuing clear warnings. They have been sued for providing warnings deemed too vague or inconspicuous. For example, the food, drug, and cosmetics industries established a toll-free product information number in lieu of placing hazard labels on their products. In another case, warnings for air emissions of ethylene oxide were published as advertisements in the classified section of a local newspaper. In both of these cases, the warnings were found by the courts to be insufficient.[230]

Process modifications, chemical substitution, and the use of pollution control devices have all been attributed to Proposition 65. Some products have been reformulated to avoid negative labeling. For example, solvents were removed from correction fluids and lead from foil and other products. The lead content of tableware was also reduced. However, products such as tobacco and alcohol have to bear warning labels. Businesses appear much more likely to take measures to avoid issuing warnings for products that consumers in general believe are safe, such as tableware, and for products that have unlabeled substitutes than they are for products that consumers know can be dangerous, such as spray paint.

At least one study found that consumers were indifferent to some warnings because they had become so prevalent. "Overuse of labeling may therefore result in a reduction of effectiveness."[231] Another study suggested that firms might collude to label in excess, thereby minimizing the impact of these warning labels.[232]

Proposition 65 gives polluters incentives not only to identify ways of reducing or eliminating toxic discharges but also to study the effects of toxics to determine safe exposure levels. Anecdotal evidence suggests that businesses devoted significant resources to assessing the risks of exposure to toxics after this law had been passed.[233] Business groups had asserted that compliance with the law would be very costly. However, they failed to provide evidence that

significant costs actually were incurred when they were given the opportunity to do so by the State of California during a retrospective analysis of the law.

9.8 Hot Spots Act

Adopted in 1987, California's Air Toxics Hot Spots Information and Assessment Act (AB 2588) requires stationary sources to report releases of certain substances into the air. According to the California Air Resources Board (CARB), the goals of the Hot Spots Act are "to collect emission data, to identify facilities having localized impacts, to ascertain health risks, and to notify nearby residents of significant risks."[234] The Act uses at least two potential incentive mechanisms to reduce toxic air emissions: public notification requirements and unit-based fees. The latter mechanism, which is also intended to cover all of the administrative costs associated with the Act, is discussed in Chapter 4. The former mechanism, public notification requirements, is discussed here.

Facilities are required to submit an air toxics emission inventory plan and a subsequent inventory to their respective air pollution control district. Certain high-priority facilities must also submit a health risk assessment. If air quality managers in the district determine that a facility's emissions pose a potentially significant health risk, the facility operator must notify all persons who have been exposed.

The Hot Spots Act originally relied on the information requirement and fees to discourage risky toxic emissions. In 1992, however, it was amended to require facilities to reduce emissions below the significant risk level within 5 years or a period not to exceed 10 years, as determined by the district. This amendment introduced a considerable element of traditional regulatory policy to what previously had been an incentive-based instrument. However, emissions data and health risk assessments remain accessible to the public, and they could give polluters incentives to reduce their emissions more substantially and quickly than they would if this data were not in the public domain.

According to CARB, the Hot Spots inventory requirements have increased facilities' awareness of their toxic emissions, leading to reductions in emissions. Surveys have revealed voluntary reductions of over 1.9 million pounds per year of air toxics from 21 facilities. Potentially reduced costs, concern for worker health, improved community relations, and anticipation of future regulations are some of the motives for these reductions.

9.9 Labeling Schemes

Labeling products according to their effects on the environment is another type of information approach to environmental management. Consumers can use the information provided by such labels in making purchasing decisions. If consumers, investors, and others prefer companies and products they believe are environmentally friendly, businesses have an incentive to improve their environmental performance to receive a favorable label or to avoid a negative one.

Table 9-1 shows the classification scheme for environmental labeling programs that were proposed by a 1994 EPA study.[235] Programs can be either voluntary or mandatory. Moreover, the information provided by labeling may be characterized in general as negative, positive, or neutral.

Table 9-1. Classification of Environmental Labeling Schemes

PROGRAM TYPE	POSITIVE	NEUTRAL	NEGATIVE	VOLUNTARY	MANDATORY
Seal of Approval	X			X	
Single attribute	X			X	
Report card		X		X	
Information disclosure		X			X
Hazard warnings			X		X

Source: EPA (1994a), p. 9.

Seals of approval are given to products that have been deemed less harmful to the environment, and single attribute programs certify that a product has a certain positive environmental attribute. Report cards and information disclosure schemes inform customers of the various impacts of products on the environment. Hazard labels warn customers of the harmful effects of a particular product.

Experience with labeling schemes indicates that they are more likely to influence behavior if they are accompanied by promotional activities that target retailers and consumers. In many cases, the label itself is only one element of a larger effort to promote the use of environmentally friendly products. As a result, it is often difficult to isolate the incentive effect of a label from that of related promotional activities.[236]

Although the United States does not have a national, government-initiated environmental labeling program like many other industrialized countries, it does have a few labeling programs that have been created by the public- and private-sectors. The Consumer Labeling Initiative (CLI), a pilot program of the U.S. EPA, began in March 1996. Its goal is to foster pollution prevention, inform consumer choice, and encourage the safe use of household and consumer products.[237] In the pilot phases, the CLI is exploring issues such as how consumers react to different types of labels and the best ways to present information. This program could evolve into a national labeling program.

9.9.1 OSHA Warning Labels

The Occupational Safety and Health Administration (OSHA) promulgated hazard communication standards (29 CFR 1910.1200) in 1983 to assure that the hazards of chemicals in the workplace are evaluated and that hazard data subsequently are transmitted to employees and employers.[238] These standards require Material Safety Data Sheets (MSDS), container labeling, and employee training, as appropriate. Under a Presidential Directive, the Hazard Communication Workgroup began an evaluation of the program in 1995 and presented its report in September 1996.[239] The workgroup report determined that the standard was good and should not be reopened for comment. The workgroup also noted that MSDS tended to be overly lengthy and could be simplified to better communicate necessary information to workers and employers.

9.9.2 FTC Guidelines for Environmental Marketing Claims

The Federal Trade Commission's (FTC) Guidelines for Environmental Marketing Claims or "Green Guides" were issued in 1992 and, at the time of this writing, were under review for possible revisions. These guidelines do not constitute a labeling system as such, but they are designed to have an effect on labeling. They are intended to prevent false or misleading use of advertising claims such as "environmentally friendly," "degradable," and "recyclable."

Confusion over the meaning of such terms has affected not only consumers but also companies, who were concerned about lawsuits over their environmental claims.

The guidelines outline four general principles for environmental claims: (1) qualifications and disclosures should be sufficiently clear and conspicuous to prevent deception; (2) claims should make clear whether they apply to the product, packaging, or just a component of either the product or packaging; (3) claims should not overstate environmental benefits; and (4) comparative claims should be presented in such a way that the basis for comparison is clear. The guidelines also address claims about environmental friendliness, degradability, compostability, recyclability, recycled content, source reduction, refillability, and ozone friendliness.[240]

9.9.3 Green Seal and Other Seals of Approval

Founded in 1989, Green Seal is the nonprofit organization that awards the Green Seal of Approval to products that it finds less harmful to the environment.[241] The organization develops a set of standards for each product category it studies. Categories are chosen according to the significance of their associated environmental impact and their range of products. Products within a category are then studied to determine their impacts on the environment in their various stages of production, use, and disposal. After public review and comment, Green Seal adopts a standard.

Standard criteria vary across categories but may include the reduction of toxic chemical pollution, improved energy efficiency, the protection of water resources, the minimization of impacts on fish and wildlife and their habitats, the efficient use of natural resources, the protection of the ozone layer, and the prevention of global warming. Products are not subjected to a complete life-cycle analysis. Instead, products are judged according to those aspects of their life cycle that have the most significant environmental impact. Standards are reviewed at least once every 3 years.

Manufacturers pay product evaluation fees to apply for the Green Seal mark, and accepted products are also subject to annual monitoring fees. The fees vary according to the product category and size and the number of manufacturing facilities. The Green Seal mark for approved products appears with an explanation of the basis for certification.

The organization has published environmental standards or criteria for about 35 types of products. Its list of certified products contains central air conditioning systems (1 brand); architectural coatings (2 brands); cleaning products (1 brand); compact fluorescent lamps (5 brands); recycled paper (5 brands); recycled newsprint (1 brand); re-refined engine oil (3 brands); reusable utility bags (3 models); showerheads (four models); toilets (2 brands); watering hoses (several models); one manufacturer's line of windows and doors; and one brand each of unbleached coffee filters, baking cups, and parchment. Readers interested in the specifications for these and other products may visit the Green Seal web page: www.greenseal.org/stanlist.htm.

Besides labeling, Green Seal helps market environmentally friendly products in several ways. A list of certified products is included in a catalog with product information and the addresses and the telephone numbers of product vendors. Documents entitled *Choose Green Reports* are available on topics such as "Environmentally Preferable Printing" and energy-efficient lighting, computers, and other office equipment. Organizations that agree to purchase environmentally friendly products, reduce waste, and increase recycling are eligible for the Green Seal Environmental Partners mark. This mark can be placed on reports, letterhead, and store signs.

In a Green Seal survey, 4 out of 5 consumers said that they would be more likely to purchase a Green Seal-certified product than other products of equal quality and price.[242] However, the incentive effects of Green Seal's activities do not appear to have been studied in any detail.

Some retailers have adopted labeling schemes for products they find environmentally friendly. In 1989, for example, Wal-Mart created a program under which shelves were labeled to indicate that certain products were environmentally friendly. Wal-Mart ended this program in 1992. Store officials had difficulty in determining the criteria for environmental friendliness and in assessing manufacturers' environmental claims.

Wal-Mart's experience illustrates one of the main problems encountered by environmental seal-of-approval schemes: the lack of agreed-upon criteria for assessing environmental friendliness. While seals of approval may be relatively easy for consumers to understand, they risk not only lacking agreed-upon standards but also oversimplifying complex environmental issues. Menell (1995) cites a number of cases in which the assessments of environmental friendliness that are necessary for labeling are difficult. For example, a study of the environmental impacts of disposable cups found that wax-coated paperboard was preferable to polystyrene in terms of reduced volumes of solid waste generation, but inferior in the areas of energy consumption, air emissions, water pollution, and weight of solid waste generation. Disposable diapers generate more solid waste than cloth diapers, but they also use less water and result in less water pollution. Another study cited by Menell found that the environmental impacts of washing machines depend less on the model of the machine than on how it is used.

9.9.4 Single-Attribute Labels

The problems of lack of criteria and oversimplification are likely to be less serious for labeling programs that are based on a single product attribute. EPA's office equipment label, Energy Star, is reserved for computers, printers, photocopiers, and typewriters that are relatively energy-efficient. This label is part of a voluntary initiative designed to promote the purchase and use of energy-efficient office equipment. (This program is described in Chapter 10.)

The Flipper Seal of Approval was created in 1992 and licensed by Earthtrust, a non-profit organization based in Hawaii. It is awarded to companies that harvest tuna in a manner that minimizes the number of dolphins killed. The seal has been awarded to tuna companies in the United States and abroad.

From 1986 to 1991, the Bonneville Power Administration, which supplies electric power in Oregon and Washington, managed a Blue Ribbon Award Campaign that promoted the use of energy-efficient refrigerators and freezers. Under this program, refrigerators and freezers in the top 15% of their size and function category were awarded blue magnetic ribbons.[243] A retailer's survey conducted early in the program estimated that about 22% of its customers had been "influenced" in their purchasing decisions by the presence or absence of these ribbons.[244]

Scientific Certification Systems (SCS), a for-profit business, has two single-attribute seal-of-approval programs. The first program, the SCS Forest Conservation Program, uses a 100-point index to evaluate the management of forest tracts by timber operations. A separate score is given for each of the following categories: the sustainability of timber resources, forest ecosystem maintenance, and the socio-economic benefits to the surrounding community. Scores over 60 are required in each category before timber companies can be awarded the "Well-Managed Forest" label. Operations scoring in the top 10% are further labeled as "State-of-the-Art."[245] In the

second program, SCS can use chain-of-custody certification to verify that wood products sold to consumers come from well-managed forests. About 10 forestry operations in South, Central, and North America have been scored by SCS.

SCS has also certified more than 500 environmental claims by manufacturers concerning recycled content, recycling rates, energy efficiency, water efficiency, biodegradability, and the lack of smog-producing ingredients. Some claims concern materials, whereas others concern final products and packages. Certified products are allowed to bear an authorized certification emblem.

According to SCS, anecdotal evidence indicates that its labels are valued by businesses and individuals, with consumers willing to pay a premium for products identified as environmentally friendly. Glidden Company, for example, found that a label designating its paints as free of volatile organic compounds (VOCs) is valued by institutional customers such as hospitals.

9.9.5 Report Cards and Information Disclosure

SCS also issues environmental "report cards" that rate products according to various criteria. (The company refers to these report cards as "eco-profiles.") These profiles are based on a cradle-to-grave assessment of the environmental burdens associated with the raw material extraction, manufacture, transportation, use, and disposal of a product. These environmental burdens include resource depletion, energy use, air and water emissions, and solid wastes. Bar graphs for each of approximately 20 types of environmental impacts are included on the label. Eco-profiles have been done for Holiday Fair (handbags, accessories, and travel ware); North American Plastics (plastic bags); Plasti-kote (paints); Wellman, Inc. (polyester fiber); and Zeta Consumer Products (plastic bags). Some companies request eco-profiles for internal use rather than for marketing purposes.

The advantage of such an eco-profile is that it provides more information than simple seals of approval. Among the disadvantages are that the information on the card can be difficult to obtain and understand and that the report card may be misinterpreted by consumers as a product endorsement. Since the SCS report cards are voluntary and appear only on a limited number of products, they have led many consumers to believe that the card itself implies the environmental superiority of a product.[246]

9.9.6 Energy Efficiency Labeling

Two energy-efficiency disclosure programs are managed by the federal government. The first such program is EPA's Fuel Economy Information Program. It requires new cars to have labels in their windows that list their mileage-per-gallon for city and highway driving, the estimated annual fuel cost associated with their operation, and the fuel economy of comparable models. This program was voluntary at its inception in 1974 but was made mandatory by the Energy Policy and Conservation Act (EPCA) as of March 1976. Car dealers were also required to have the *Gas Mileage Guide* of car fuel efficiency available to customers.

A 1976 study found that more than one-half of new car buyers had seen the fuel economy label and that those aware of the label bought cars with higher fuel efficiency than other car buyers did. The program was credited with reducing fuel consumption for 1976 model cars by 893 million gallons. However, the influence of the labeling program decreased as a result of reductions in gasoline prices after the mid-1970s. Moreover, 64% of buyers did not believe the

mileage estimates. Consumers believed that fuel efficiency was not assessed in realistic driving conditions and that mileage was therefore overstated. A 1981 DOE survey found that this skepticism was the main reason why more consumers did not rely on the fuel economy label. In 1985, EPA changed the procedure by which fuel efficiency was assessed to make it more realistic.[247]

The second energy efficiency disclosure program managed by the federal government is that for Energy Guide labels on household appliances. In 1975, EPCA required that these Energy Guide labels be placed on refrigerators, freezers, water heaters, washing machines, dishwashers, furnaces, air conditioners, and heat pumps. The content of the labels varies, depending on the type of appliance. At that time, however, all the labels included information on the manufacturer, appliance model number, and capacity as well as an energy-efficiency rating (EER) or estimated annual operating cost, the EER or annual operating cost of the most and least efficient comparable appliances, and a table showing the annual estimated costs of various patterns of usage for different energy prices. The 1992 Energy Policy Act expanded these requirements to include the labeling of fluorescent lamps, showerheads, faucets, water closets, and urinals.

The Federal Trade Commission changed the labels in 1994, so refrigerators, freezers, dishwashers, clothes washers, and water heaters now include the number of kilowatt hours (kWh) of energy used by the labeled appliance and a list of the most energy-efficient and least energy-efficient comparable appliances. Climate control appliances are labeled not according to kWh of energy use but rather to fuel efficiency indices such as EER, seasonal EER, annual fuel utilization efficiency, or heating seasonal performance factor. The energy cost table has been replaced by a single estimate of energy costs for products with kWh energy-use ratings and for room air conditioners. Other products must have operating cost information available either on fact sheets or in industry product directories. In a press release on the new labeling requirements, FTC stated that they would "make the labels easier to read and more useful to consumers in comparing the energy efficiencies of the appliances." [248]

An in-store survey of appliance buyers conducted for DOE showed that 90% of buyers had noticed the Energy Guide label and that three-fourths described it as "somewhat" or "very" helpful in comparison shopping. The same survey revealed that consumers found the labels confusing and believed that labels should emphasize one or two pieces of information, such as energy costs.[249] Studies have shown that the labels raise consumers' energy awareness without necessarily influencing their purchases. The energy efficiency of appliances has risen significantly since the adoption of EPCA, but this increase appears to be due more to traditional regulatory requirements than to the Energy Guide.[250]

FTC has also adopted labeling requirements for the resistance-to-heat flow in insulation materials, the emissions characteristics of alternative fuel vehicles, and the minimum content of alternative fuels.

The National Fenestration Rating Council (NFRC), which is an industry initiative, rates the energy efficiency of windows. More than 120 manufacturers have submitted over 25,000 window products for NFRC ratings. According to NFRC, building energy codes and utility programs rely increasingly on these ratings. In addition, manufacturers try to improve energy efficiency to avoid being listed in the NFRC directory as a company with poor ratings. [251]

9.9.7 Hazard Labels

Hazard labels inform consumers of the environmental risks associated with particular products. Proposition 65, which was discussed in Section 9.7 of this chapter, requires manufacturers to disclose information on the environmental hazards that could be caused by their products. This mandate frequently results in product labeling, and products have been altered to avoid a negative label. However, Proposition 65 warnings frequently take forms other than labels.

Ozone-depleting substances are subject to warning labels under the Clean Air Act. The incentive effect of this label might have been diminished by announcements that such substances would be phased out earlier than originally expected.

A variety of toxics, including polychlorinated biphenyls (PCBs) and asbestos, have been required to bear warning labels under authority granted to EPA by the Toxic Substances Control Act. Pesticides are subject to detailed labeling requirements under the Federal Insecticide, Fungicide, and Rodenticide Act.

Since 1991, retailers in Vermont have been required to identify household products that contain hazardous constituents with warning labels. These labels must be placed either on the shelves stocked with these products or near the subject products. The goal of this law is to discourage consumers from purchasing such products. Among the types of products subject to the requirement are cleaning agents, auto and machine maintenance products, hobby and repair products, shoe polish, aerosols, and butane lighters. The state's label bears the text: "REDUCE TOXICS USE. These products contain HAZARDOUS INGREDIENTS." Green exemption labels can be attached to shelves displaying products that have been included in the warning program but contain none of the 24 ingredients listed in the Vermont Community Right-to-Know list of hazardous chemicals. Vermont has a parallel warning program for pesticides and commercial fertilizers.

9.10 Environmental Performance Awards

EPA and numerous state and local governments periodically issue awards for environmental behavior they deem to be exemplary. To the extent that such awards generate positive publicity, they could encourage environmentally friendly behavior.

In California, for example, 305 businesses won awards under the Waste Reduction Awards Program (WRAP) in 1995. The Target department store chain won awards at 2 distribution centers and 90 stores for recycling and their efforts to minimize waste, activities that have resulted in a 75% reduction in garbage. Winners received certificates of recognition from the Integrated Waste Management Board as well as the right to use the WRAP logo to publicize their waste reduction achievements.

The California EPA announces winners each year. The 1999 winners include Autrey Museum of Western Heritage, Cagwin & Dorward Landscape Contractors, Investec, Kraft Foods Inc. Visalia, Memorial Hospitals Association, Pebble Beach Company, Straus Family Creamery, Swinerton & Walberg Company, Trips for Kids/Re-Cyclery, and Unisys Corp.[252]

In Texas, Governor's Awards for Environmental Excellence are issued for the following categories: large business; large technical business; non-technical, small business; government, civic, and non-profit organizations; education; youth organization; media; agriculture; individual; and special.[253] These awards are part of the Clean Texas initiative under the Waste Reduction

Act of 1991. In the large technical business category, Lockheed Martin Tactical Aircraft Systems was the 1995 winner. The company has also received awards from EPA for reducing emissions of ozone-depleting chemicals and VOCs. It has also received the EPA Regional Administrator's Environmental Excellence Award for Excellence in Hazardous Waste Minimization Program Development.[254]

9.11 Securities and Exchange Commission Disclosure Requirements

Section 14(a) of the Securities Exchange Act of 1934 empowers the Securities and Exchange Commission (SEC) to require disclosure by publicly owned companies "as necessary or appropriate in the public interest or for the protection of investors."[255] To date, the SEC has interpreted this statement to require the reporting of information that would be deemed important by investors.

The SEC requires disclosure of environmental liabilities that could have a "material" impact on the company's financial or competitive position, information that would be important to investors. Companies also must report individual environmental enforcement proceedings that are expected to cost more than $100,000 as well as environmental litigation that might have significant financial impact on the company. SEC access to information submitted by companies to EPA enables it to verify company disclosures on Superfund sites, RCRA sites, and federal enforcement actions. The SEC is authorized to require companies to revise their filings in case of inaccuracies. In the past, the Commission has written to companies to inquire why the companies did not disclose certain environmental information in their filings.

The number of large companies disclosing environmental information in SEC Form 10-Ks is increasing. Among Standard & Poor's 500 companies, 322 submitted environmental information in 1990 as compared to 217 companies in 1988. The incentive effect of these disclosure requirements is not known. However, evidence presented elsewhere in this chapter indicates that information on the environmental performance of companies is of interest to investors.[256]

9.12 Summary

Information programs have the potential for creating incentives for environmental change if they are credible and present data in a usable form. The best known of the information programs is the TRI. While changes in reported releases have been large following the establishment of the TRI program, its actual impact is difficult to assess quantitatively because the data are not measured or verified and no assessment of relative risks accompanies the reports. Information from the TRI program is widely distributed, well-used, and likely to be affecting environmental performance at many companies.

State information programs tend to base data on materials accounting and thus partially address the concern of data reliability. The New Jersey and Massachusetts programs seem to be well-regarded and well-used. Proposition 65 places the burden of proof on industry, which has incentive effects on firms similar to that of requiring more reliable data. Data collected as the result of Proposition 65 are well-used

Experience with labeling schemes indicates that they are more likely to influence behavior if they are accompanied by promotional activities that target retailers and consumers. In many cases, the label itself is only one element of a larger effort to promote the use of environmentally

friendly products. As a result, it may be difficult to isolate the incentive effect of a label from that of related promotional activities.[257] One of the main problems encountered by environmental seal-of-approval schemes is the lack of agreed-upon criteria for assessing environmental friendliness. While seals of approval may be relatively easy for consumers to understand, they risk not only lacking agreed-upon standards but also oversimplifying complex environmental issues.

OSHA MSDS sheets have been criticized as overly lengthy and complicated. FTC Guidelines for Environmental Marketing are intended to prevent false or misleading use of advertising claims such as "environmentally friendly," "degradable," and "recyclable."

Experience with energy-efficiency labeling demonstrates the limitations of information that is perceived to be unrealistic, such as the fuel economy labels on automobiles before the 1985 revisions, or confusing, such as the Energy Guide labels on appliances.

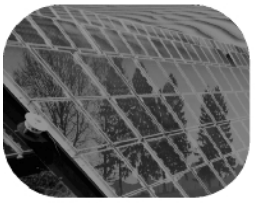
SEC-mandated environmental disclosures by firms increasingly are used by investors as indicators of proactive management, legal liability, or risk at particular firms.

10. Voluntary Programs


Pollution Charges, Fees, Taxes


Deposit-Refund Systems


Trading Programs


Subsidies for Pollution Control


Liability Approaches

Information Disclosure


Voluntary Programs

An important new trend in environmental management is the use of voluntary programs to accomplish the goals of environmental protection. This trend involves implementing methods to cut waste, conserve materials, and improve efficiency—outcomes that increase the value added by business, improve competitiveness, and reduce pollution. Voluntary programs are an important addition to the more market-based incentive measures discussed elsewhere in this report. While the market-based programs offer financial and other closely related incentives to encourage firms and individuals to reduce pollution, voluntary programs offer less tangible rewards such as public recognition and access to information on ways to reduce pollution at low or no cost. Governments promote voluntary initiatives for a variety of reasons, including the pilot testing of new approaches and the absence of legislative authority to establish mandatory programs. As such, many voluntary programs offer unique approaches to environmental management.

Two major federal initiatives are responsible for many of the federal voluntary programs. One is pollution prevention, particularly as articulated in the Pollution Prevention Act of 1990.[258] The second is the reduction of greenhouse gas emissions called for in the Clinton administration's 1993 Climate Change Action Plan (CCAP).[259] A variety of private-sector and state-led initiatives also are noteworthy.

Without other legislative authorities, the objectives of pollution prevention in the United States are pursued largely through voluntary actions by firms or agreements negotiated between government agencies and individual firms. The objective of pollution prevention is to reduce the pollution intensity of production through changes in input use, technologies, processes, management, and other parameters. Because the full range and effectiveness of these parameters cannot be well-known to regulatory agencies, governments pursue the goals of pollution prevention by providing information to firms and encouraging the firms to use production methods that are less pollution-intensive. Similarly, the Climate Change Action Plan relies on a series of voluntary initiatives that are supplemented by modest subsidy programs to induce meaningful reductions in greenhouse gas emissions.

10.1 Background

Because voluntary programs are relatively new and involve intangibles that are difficult to quantify (e.g., what would have been done anyway without the program), they are difficult to evaluate quantitatively. However, the Oak Ridge National Laboratory recently completed an initial assessment of about a dozen energy-related programs for EPA's Office of Atmospheric Programs (OAP). This assessment was conducted to support a forthcoming DOE study entitled *Scenarios for a Clean Energy Future*.[260] In addition, the proceedings from the American Council for an Energy Efficient Economy (ACEEE) have a number of peer-reviewed papers that review and evaluate a wide variety of voluntary energy conservation programs. These papers can be found in ACEEE's *Energy Efficiency Summer Studies* (1994, 1996, 1998, 2000).

One incentive for businesses to take part in these voluntary programs appears to be favorable public relations (PR). Favorable PR could result in less public pressure to regulate participants, better relations with employees and the community, and increased market share at the expense of competitors perceived to be less environmentally friendly. For example, polls have shown that consumers are willing to pay a premium for products that have environmental advantages.[261] Henriques and Sadorsky (1996) found that pressure from shareholders and customers significantly influenced Canadian firms' decisions to formulate environmental plans. In this respect, voluntary programs could have effects similar to the information approaches discussed in Chapter 9.

Another reason for corporate participation in voluntary programs is that the sponsoring regulatory authority may provide technical assistance to participants. Such assistance could be regarded as a subsidy, as discussed in Chapter 8. As noted in subsequent paragraphs, several companies have saved money by implementing the activities associated with voluntary programs such as Green Lights and WasteWise.

Moreover, voluntary programs sometimes are structured to limit potentially high litigation, monitoring, and enforcement costs that otherwise could be incurred by regulators and businesses. Some voluntary programs offer participating companies the opportunity to identify and address environmental problems in the present, problems that could subject them to regulatory sanctions in the near future. On occasion, these programs also give companies the flexibility to improve their environmental performance at less cost.

A Resources for the Future (RFF) study of EPA's 33/50 program cited several reasons other than publicity benefits and added flexibility to explain why firms might voluntarily exceed the standards set in environmental regulations. (The 33/50 program is discussed in 10.3.1, 33/50 Program.) In some industries, firms might improve their performance in the hope of leading the government to make such performance mandatory, thereby creating barriers to the entry of potential competitors. It has also been suggested that firms over-comply to forestall additional mandatory regulation. Another possibility is that the "lumpiness" of pollution abatement investments means that large investments offer significantly more abatement per dollar than a series of small investments made to comply with progressively tighter restrictions.[262]

Most voluntary environmental programs in the United States have been designed and implemented by the U.S. EPA. Industry also is involved in the oversight of a number of voluntary programs. The programs that have been created and managed solely by the federal government are classified as "public voluntary" programs. Acting independently or with other federal agencies, EPA oversees programs directed at climate change and pollution prevention. Programs developed by industry trade organizations for their member companies are termed "unilateral" programs in this report. Finally, there are voluntary programs that involve significant negotiation between government regulators and participants. These programs are called "negotiated agreements." The following sections review many of these programs.

10.2 Federal Initiatives: Climate Change

The great majority of voluntary programs are concerned with reducing the emissions of greenhouse gases: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), perfluorocarbons (PFC), hydrofluorocarbons (HFC), and sulfur hexafluoride (SF_6). The 1993 Climate Change Action Plan responded to the 1992 Earth Summit's call for reducing greenhouse gas emissions

by developing innovative public- and private-sector voluntary initiatives. Partnerships between the Environmental Protection Agency (EPA); the Departments of Energy (DOE), Agriculture (USDA), and Transportation (DOT); state and local governments; industry; farmers; nonprofit organizations; trade associations; and professional societies have focused on the low-cost and profitable opportunities for reducing greenhouse emissions. This collaboration has resulted in the development of more than 40 programs. The principal climate change programs are summarized in Table 10-1 and described in more detail in the following sections.

Table 10-1. Federal Voluntary Programs for Greenhouse Gases

PARTNERSHIP PROGRAMS (year program launched)	ENVIRONMENTAL GOAL
Green Lights (1991) www.epa.gov/energystar	Reduce energy consumption of lighting through cost-effective, energy-efficient lighting technologies.
WasteWise (1992) www.epa.gov/wastewise	Reduce municipal solid waste through waste prevention and the purchase/manufacture of products with recycled content. at business, government, and institutional partners
AgStar (1993) www.epa.gov/agstar	Promote cost-effective methods for reducing methane emissions at dairy and swine operations through improved manure management.
Climate Wise (1993) www.epa.gov/climatewise	Reduce industrial greenhouse gas emissions and energy costs through comprehensive pollution prevention and energy efficiency programs.
Commuter Choice (1993) www.epa.gov/ooaujeag/livability/com_choi.htm	Promote employer-provided commuting options designed to reduce traffic congestion, improve air quality, and allow employers to tailor transportation benefits to the needs of individual employees.
Natural Gas Star (1993) www.epa.gov/gasstar	Encourage natural gas industries to reduce methane emissions through cost-effective technologies and best management practices.
Ruminant Livestock Efficiency (1993) www.epa.gov/rlep	Reduce methane emissions from ruminant livestock operations.
Seasonal Gas Use to Control NO_x (1993)	Promote seasonal switching toward the use of low-carbon natural gas, particularly in the summer, in utility coal and oil plants and in industrial facilities.
State and Local Outreach (1993) www.epa.gov/globalwarming	Reduce greenhouse gas emissions from states and local communities by empowering officials with information and technical assistance.
The U.S. Initiative/Joint Implementation (1993) www.ij.org	Encourage private-sector investment and innovation in developing and disseminating technologies to reduce greenhouse gas emissions.
Environmental Leadership (1994) es.epa.gov/elp	Recognize and provide incentives to facilities that are willing to develop and demonstrate accountability for compliance with existing laws.
Energy Star (1994) www.epa.gov/energystar	Maximize energy efficiency in commercial, industrial, and residential settings by promoting new building and product design and practices.
Environmental Stewardship (1994)	Limit emissions of perfluorocarbons and hydrofluorocarbons in three industrial applications: electrical transmission and distribution systems, magnesium casting, and semiconductor production.
Coalbed Methane Outreach Program (1994) yosemite.epa.gov/methane/cmophome.nsf	Identify and remove obstacles to investment in coalbed methane recovery projects, which increases awareness of investment opportunities.
Landfill Methane Outreach Program (1994) www.epa.gov/lmop	Encourage profitable recovery of methane released from landfills by identifying viable technologies, markets, and financing sources.
Transportation Partners (1995) www.epa.gov/tp	Reduce the growth in vehicular travel through the voluntary adoption of local and regional transportation strategies that provide better, cheaper, transportation choices for citizens. Program was discontinued due to funding reductions at the U.S. DOT.
Voluntary Aluminum Industrial Partnership (1995) www.epa.gov/vaip	Reduce perfluorocarbon gas emissions from aluminum smelting.

10.2.1 Green Lights

One of the early voluntary partnerships between EPA and industry was the Green Lights Program. The primary purpose of the program was to encourage the use of energy-efficient lighting to prevent air emissions (CO_2, SO_2, and NO_x) and other emissions from the generation of electricity. By December 1994, Green Lights investments in energy-efficient lighting had resulted in annual energy savings of 1 billion kWh, translating into annual energy cost savings of about $92 million. By May 1996, the program had 1,316 Partners (corporations, industry groups, nonprofit organizations, hospitals, governments, and universities); 585 Allies (electric utilities, lighting manufacturers and distributors, and lighting management companies); and 286 Endorsers (professional and trade associations). In 1997, EPA consolidated Green Lights activities within the Energy Star Buildings program to encourage a more comprehensive approach to energy-efficiency investments.

Table 10-2 illustrates the energy savings achieved by three companies—Staples, the Atlanta Journal-Constitution (Cox Newspapers), and Mobil Corp—as a result of their participation in the Green Lights Program. More information on these and other success stories is available at the EPA Energy Star web site.[263]

Table 10-2. Energy Savings from Green Lights/Energy Star Program

PROJECT INFORMATION	STAPLES	ATLANTA JOURNAL-CONSTITUTION	MOBIL
Project costs ($) • Total expenditures • Costs per sq. ft.	$3.1 million $0.91	$1.007 million $0.53	$1.182 million $3.95
Cost savings ($) • Annual savings • $ saved/sq. ft.	$985,425 $0.29	$447,564 $0.53	$224,500 $0.75
Internal rate of return	29.3%	51%	19%
kWh savings	6.3 million	6.8 million	7.2 million
CO_2 savings (lbs.)	6.37 million	11.9 million	103 million

Source: http://www.epa.gov/buildings/esbhome

10.2.2 Energy Star Partnership Program

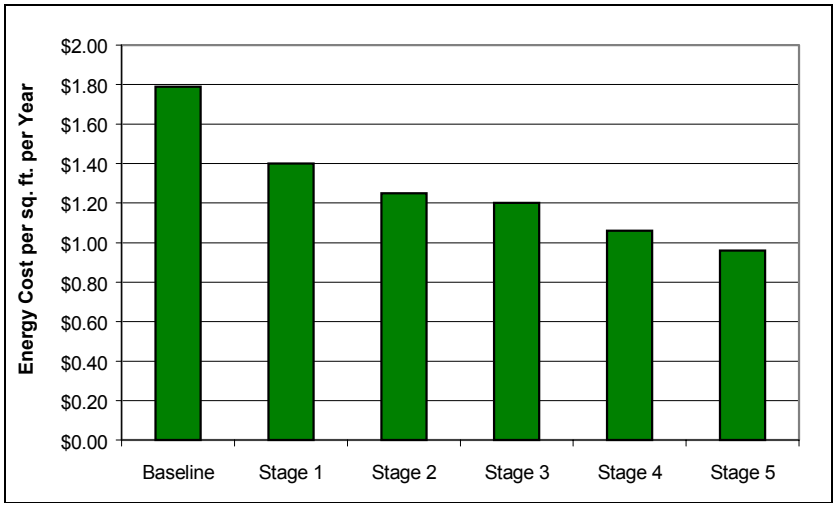
The Energy Star Partnership Program is designed to raise the level of public consciousness and action regarding energy conservation. Programs focus on fostering energy efficiency and reducing transaction costs for consumers and businesses. Three Energy Star programs discussed in this subsection have been especially successful in reducing annual carbon-equivalent pollution while maximizing energy cost savings.[264]

10.2.2.1 Energy Star Buildings

EPA asks participants in the Energy Star Buildings program to perform energy-efficiency upgrades in buildings where profitable. After installing energy-efficient lighting, participants tune up building systems, invest in upgrades to reduce heating and cooling loads, improve fans and air handling systems, and improve the heating and cooling plant. This five-stage upgrade process is part of an integrated approach to whole-building energy efficiency. Participants that follow this approach are often able to reduce their energy use by 30% while achieving an internal

rate of return (IRR) of 20% or greater on their investment. As shown in Figure 10-1, EPA predicted that energy costs at Energy Star Showcase Buildings could fall by nearly 50%.[265]

Figure 10-1. Energy Savings in Showcase Buildings



Source: EPA. 1994h.

In 1999, EPA began providing an effective means of monitoring the progress of energy-efficiency upgrades to buildings; the mechanism was EPA's Energy Star Benchmarking Tool. Combining the values of building energy consumption and their relative impact on total energy consumption, performance levels can now be benchmarked against the top 25% of all similar-use buildings. Such information provides Partners with the opportunity to save energy and money and prevent pollution. It provides valuable input into business transactions involving the buying, selling, appraising, leasing, and insuring of the building as well as the contracting for energy, operations, and maintenance services.

Energy Star Buildings and Green Lights have over 5,500 participants. Partners have cumulatively invested more than $3.6 billion on energy-efficiency improvements. From 1995 to 1999, these upgrades have resulted in an estimated reduction in energy use of more than 108 billion kilowatt hours (kWh), with a corresponding reduction of over 23 million metric tons of carbon-equivalent (MMTCE). (See Table 10-2.)

10.2.2.2 Energy Star Products

Working with equipment manufacturers, the U.S. Department of Energy (DOE) and EPA are using Energy Star labels to promote highly energy-efficient products. Collaborations formed with DOE are also facilitating the development of initial markets for advanced technologies, for example, by encouraging large-volume purchases. These purchases help reduce manufacturing costs through economies of scale in initial production. More than 1,200 manufacturers now offer Energy Star products in over 30 commercial and residential product categories such as air conditioners, heating systems, and exit lights. These products are featured in over 4,000 retail stores. In 1999 alone, consumers purchased more than 100 million EPA-labeled Energy Star products, saving over 25 billion kWh of energy.[266]

10.2.2.3 Energy Star Homes

Jointly sponsored by DOE and EPA, Energy Star Homes promotes voluntary partnerships with homebuilders to construct homes that are 30% more energy- efficient than the guidelines of the Model Energy Code. (The Model Energy Code is a model national standard for residential construction.) The program also encourages lenders to provide Energy-Efficient Mortgages, which offer lower interest rates than conventional home loans, lower closing costs, up to a 4% extension of the maximum debt-to-income ratio, and a free home energy rating. (For more

information on Energy-Efficient Mortgages, see Chapter 7, Section 7.8) Fannie Mae and Freddie Mac encourage lenders to offer energy-efficient mortgages by providing incentives and specific criteria for the purchase of such mortgages.

10.2.3 Climate Wise

Climate Wise is helping companies realize environmental and economic benefits through cost-effective industrial energy-efficiency and pollution-prevention actions. Designed to reduce greenhouse gas emissions across all sectors, Climate Wise challenges participants to devise and implement innovative ways of limiting, reducing, or mitigating greenhouse gases. Methods include process modifications, use of alternative raw materials, carbon sequestration, and other measures that abate emissions.

The program is a partnership between EPA and the DOE. Collaborative initiatives with industry include AT&T, British Petroleum, DuPont, General Motors, and Weyerhaeuser, as well as 30 states and local governments. Partnerships number more than 550 and represent more than 13% of U.S. industrial energy use.

Most recently, EPA has partnered with the United States Agency for International Development (USAID). This partnership will now extend technical assistance to local municipalities and companies who seek energy savings and emission reductions in Brazil, Central America, India, Mexico, and the Philippines.

10.2.4 WasteWise

Created in 1994, WasteWise is a voluntary program intended to reduce the solid waste generated by businesses. The program's source-reduction and recycling efforts are intended to reduce greenhouse gas emissions by (1) reducing methane emissions from the decay of waste in landfills, (2) increasing carbon sequestered by forests, and (3) reducing emissions resulting from extracting and processing virgin materials and manufacturing products. There are many additional benefits of WasteWise, including the following: reduced extraction and processing of virgin materials; reduced waste disposal; reduction in air, water, noise, and other pollution associated with waste disposal and manufacturing; reduced costs of managing municipal solid waste; and new jobs and income created by new recycling enterprises.

To participate, partners are required to implement three significant waste prevention activities, improve collection programs for recyclables on company premises, and increase either their purchases of recycled products or the recycled content of the products they manufacture. In the first year of the program alone, participating companies conserved over 240,000 tons of solid waste, mostly transportation packaging. They also recycled about 1 million tons of waste and purchased 20 different kinds of recycled-content products.

With more than 1,000 participating companies, members have saved a significant amount of money through the program. WasteWise partners reduced a total of 7.8 millions tons of solid waste in 1998. The cost savings they achieved by not having to dispose of these wastes increased from $38 million in 1994 to $280 million in 1998.[267]

10.2.5 Methane Reduction Programs

Methane, a potent greenhouse gas, can be recovered for energy use. To promote methane recovery, EPA has launched at least three voluntary programs: the Coalbed Methane Outreach

Program, the Landfill Methane Outreach Program, and Natural Gas Star. In addition, joint efforts of EPA and the U.S. Department of Agriculture (USDA) have encouraged the profitable collection and reuse of methane in two agriculture-based programs. These programs are the AgStar Program and the Ruminant Livestock Efficiency Program.

10.2.6 Coalbed Methane Outreach Program

In 1990, methane emissions associated with coal mining operations accounted for approximately 18% of human-related U.S. methane emissions. Launched in spring 1994, the Coalbed Methane Outreach Program disseminates information that addresses a number of obstacles to mine methane recovery and development, including the lack of information on recovery technology, difficulties in obtaining financing for recovery investments, the lack of markets for recovered methane, and the uncertainty concerning ownership of mine methane. EPA has also developed guides for state, local, and federal assistance programs that pinpoint sources of loans, grants, and technical assistance for profitable coal mine methane projects as well as a comprehensive guide for private-sector financing of coal mine methane projects.

Under this program and as a result of the Energy Policy Act of 1992, methane recovery by the coal industry has more than doubled since 1993. Partners increased the quantity of methane recovered to nearly 2.0 million tons of carbon equivalent (MMCTE), which is equivalent to eliminating the emissions from about 1.5 million cars per year.[268]

10.2.7 Natural Gas Star Program

Initiated in March 1993, the Natural Gas Star Program encourages natural gas companies to adopt cost-effective technologies and practices that reduce emissions of methane from natural gas transmission and distribution systems. Methane emissions can be decreased by up to one-third by improving inspection and maintenance practices to reduce fugitive emissions, replacing equipment that normally vents gas with low-emission technologies, and repairing or replacing leaking service lines.

More than 70 natural gas transmission and distribution companies have joined the program since it was expanded in the summer of 1995 to include gas producers. By working with the natural gas industry, the program has identified more than 50 cost-effective best management practices for methane-reduction.

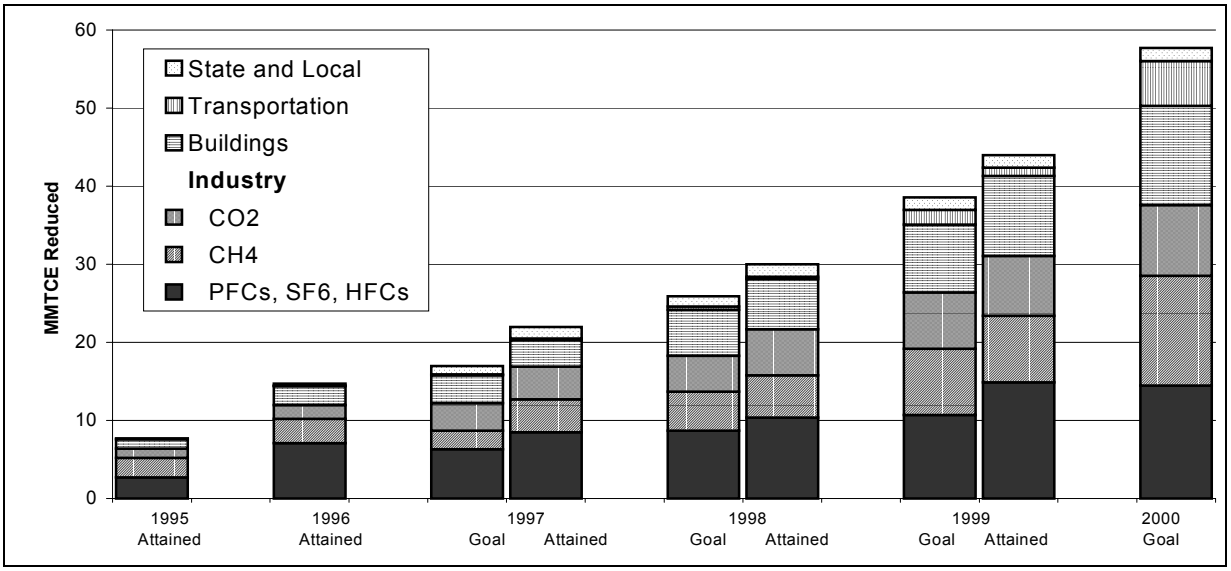
10.2.8 Agstar Program

The AgStar Program was launched in the summer of 1993. Under the program, EPA works with the Departments of Energy and Agriculture to encourage swine and dairy producers to recover methane from their animal waste management systems. Participants commit themselves to conducting three activities: (1) surveying their facilities, (2) installing AgStar-selected technology wherever profitable, and (3) appointing managers to oversee their participation in the program. EPA helps partners optimize systems and recoup some of their investments through energy recovery. More than 500 farms are currently AgStar Partners. The program also has 50 Allies, which represent system and equipment manufacturers, educational institutions, and state and local governments.

10.2.9 Assessment of Climate Change Programs

EPA reported to the U.S. Senate Appropriations Committee in February 2000 that the Agency's climate change programs have continued to meet their greenhouse gas reduction goal since 1995, as shown in Figure 10-2. Cumulatively, greenhouse gas emissions have been reduced by 118.2 MMTCE from 1995 to 1999, with 88.1 MMTCE of the reductions coming from the industrial sector. Within the industrial sector, carbon dioxide (CO_2) emissions have been reduced by 20.8 MMTCE; methane (CH_4) by 23.7 MMTCE; and perfluorocarbon (PFC), hydrofluorocarbon (HFC), and sulfur hexaflouride (SF_6) by 43.6 MMTCE. The baseline for evaluating program performance through 1999 has been a forecast of U.S. greenhouse gas emissions in the absence of the Climate Change Action Plan programs. This baseline was developed and updated as part of an interagency evaluation of the Climate Change Action Plan in 1997, which built on a similar baseline forecast that was developed in 1993 for the Climate Change Action Plan.

Figure 10-2. Goals and Accomplishments of EPA's Climate Change Programs: 1995–2000



Source: EPA. 2000c Note: 1999 attained values are estimated.

EPA's own evaluation of climate change activities recognizes the difficulties of measuring effectiveness.

> *Prior studies have focused on estimating the localized energy savings that could be attributed to products and services that were purchased by eligible utility customers, with the incentives of rebates and subsidies. Participant micro data specifically, customer billing data and customer measure installation data, were used to estimate changes in customer energy consumption due to participation in the program.*
>
> *Recently, the market transformation programs operated by the federal government have shifted program emphasis away from energy savings and towards promoting market growth for energy-efficient products and services. This shift in program paradigms requires a parallel shift in program evaluation designs. Energy-efficiency program evaluation concepts such as free riders and*

free drivers have only indirect use for evaluating whether, and to which degree, a program has quickened the overall pace of market movement. For these reasons, the paradigm for evaluating market transformation programs cannot center on estimating changes in participant energy use and inferring participant intentions. Rather, it must focus on the dynamics and the determinants of market outcomes.

EPA is now moving to new methods of program evaluation that are more appropriate for the types of programs that EPA operates. These evaluations will assess the market transformation impacts success in promoting market growth for energy-efficient products and services, as well as the reductions in greenhouse gas emissions and energy consumption. With the programs now producing sizable results in the market place, EPA can use market-based assessments to evaluate its programs, as opposed to requiring an analysis of program participant micro data as a means of inferring market impact.[269]

10.3 Public Voluntary Initiatives: Pollution Prevention

EPA's first major voluntary program, 33/50, was designed to promote pollution prevention. Most prevention programs seek to reduce a subset of toxic chemicals released and transferred by manufacturers. Before the 33/50 Program ended in 1995, it encouraged manufacturers to voluntarily reduce emissions of 17 target chemicals by 50%. Other prevention programs, such as Design for the Environment and Green Chemistry, are designed to promote the development of cleaner products and industrial processes. This section reviews several of the public voluntary programs for pollution prevention identified in Table 10-3. Information on other programs not discussed here can be found on the web site of EPA's Office of Policy, Economy and Innovation and in various EPA publications.[270]

10.3.1 33/50 Program

The 33/50 Program, introduced by EPA Administrator Riley in 1991, encouraged industry participation through a challenge to the more than 16,000 facilities releasing any of 17 priority toxic chemicals. The challenge: Reduce your emissions (reported as TRI releases and transfers) by 33% by 1992 and by 50% by 1995, relative to a 1988 baseline for the facility.

EPA first issued invitations to take part in the 33/50 Program in February 1991, focusing initially on 555 primarily large companies that had the highest releases of the 17 chemicals targeted by the 33/50 Program. As of March 1994, EPA had invited more than 8,000 companies to join, and almost 1,200 had said they would participate.

Of the largest 600 emitters, approximately 60% agreed, ultimately, to participate. In the aggregate, the actual emissions reduced by these companies exceeded EPA's expectations and occurred ahead of schedule. From those perspectives, the program may be viewed as a considerable success. Zatz and Harbour (1999) cite six factors as key to the success of the 33/50 Program:

- voluntary participation
- flexibility in the goals and the methods used to reduce emissions
- no additional reporting requirements

- public recognition for participants and their successes
- finite life of program
- an economic benefit for companies

Table 10-3. Federal Voluntary Pollution Prevention Programs

FEDERAL VOLUNTARY PROGRAMS (year program launched)	ENVIRONMENTAL GOAL
33/50 Program (1991)	Reduce total releases and transfers of 17 priority chemicals by 33% by 1992 and by 50% by 1995, relative to a 1988 baseline. Program ended in 1995.
Environmental Accounting (1992) www.epa.gov/oppintr/acctr	Increase corporate understanding of environmental costs and how to incorporate these costs into routine business operations.
Design for the Environment (1992) www.epa.gov/dfe	Help business incorporate environmental considerations into the design of products, processes, and technical systems.
Green Chemistry (1992) www.epa.gov/dfe/greenchem	Promote the design of chemical products and processes that reduce or eliminate the generation of hazardous substances.
Water Alliances for Voluntary Efficiency (1992) www.epa.gov/owm/genwave	Promote water efficiency in hotels, schools, universities, and office buildings.
Pesticide Environmental Stewardship (1993) www.pesp.org	Promote integrated pest management and pesticide risk reduction in agricultural and nonagricultural settings.
Waste Minimization National Plan (1994) www.epa.gov/wastemin	Reduce the presence of persistent, bioaccumulative, and toxic chemicals in hazardous waste.
Indoor Air Quality (1995) www.epa.gov/iaq	Promote simple, low-cost methods for reducing risks to indoor air quality.
Community-Based Environmental Protection (1998) www.epa.gov/ecocommunity	Integrate environmental management with human needs, consider long-term ecosystem health, and highlight the positive correlation between economic prosperity and environmental well-being.
Adopt Your Watershed (1994) www.epa.gov/adopt	Encourage and facilitate citizen involvement in local watershed protection activities.
Environmental Technology Verification (1995) www.epa.gov/etv	Verify the performance of innovative technologies to accelerate their entrance into the marketplace.
Voluntary Mobile Source Emission Reduction Program (1997) www.epa.gov/oms/transp/traqvolm.htm	Provide flexibility to states in meeting federal air quality goals.
Pesticide Environmental Stewardship Program (1994) www.epa.gov/oppbppd1/PESP	Reduce risk from pesticides through improved pesticide stewardship.
Commuter Choice Leadership Initiative (2000)	Promote the reshaping of employee benefits packages to include commuting benefits.

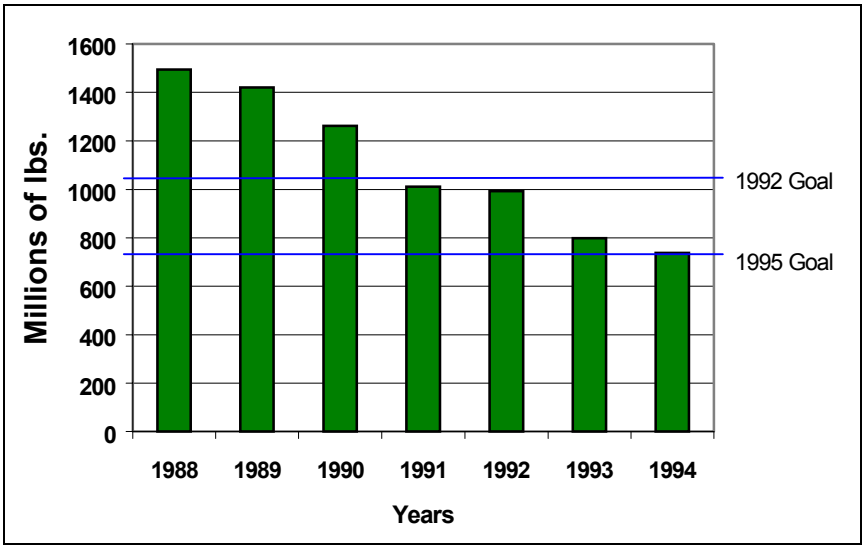
EPA data, shown in Figure 10-3, demonstrate that the program goals for 33/50 were achieved 1 year ahead of schedule and that the reductions were greater than anticipated. While some have criticized the methods by which EPA made these calculations, the program clearly seems to have been a success.

Aurora and Cason (1995) found that the 33/50 Program had a significant incentive effect. Although the willingness to participate varied greatly across industries and firms, and a relatively small percentage of any industry's firms participated, those that did participate were responsible for most of the toxic emissions within their respective industries. In the case of petroleum and chemicals, for example, participating companies were responsible for over 80% of their

industries' total emissions. The participation of large polluters allowed the program to be effective in targeting the main sources of pollution.

Aurora and Cason also found that participation rates were higher for industries that were less concentrated (those having many firms) and that participants in Green Lights were significantly more likely to participate in 33/50 as well. This "suggests that 'environmentally conscious' firms seek to improve their reputation by participating in several voluntary pollution reduction programs at the same time."

Figure 10-3. Releases of TRI Chemicals (1988–1994)



Source: EPA. 1996c.

Some reviewers assert that the proclaimed benefits have been overstated. The baseline data and the date the program was initiated allowed participants who had already achieved the reductions to join the program after the fact. Indeed, some participants had achieved more than a 50% reduction before they joined 33/50 in 1991. Aurora and Cason (1995) found that one of the main determinants of participation in the program was a desire by the firm to achieve favorable publicity. Overall, the program achieved real reductions. GAO (1997b) estimated them to be on the order of 20%, and participants, in general, realized cost savings. Khanna and Damon estimated that participation in the program also resulted in a reduction of 28% in future TRI releases.[271]

10.3.2 Design for the Environment (DfE)

EPA's Design for the Environment (DfE) Program helps businesses incorporate environmental considerations into the design and redesign of products, processes, and technical and management systems. Initiated by EPA's Office of Pollution Prevention and Toxics (OPPT) in 1992, DfE forms voluntary partnerships with industry, universities, research institutions, public interest groups, and other government agencies.

Activities of Project Partners include broad institutional efforts aimed at changing general business practices as well as cooperative projects with trade associations and businesses in specific industries. The DfE Program ensures that the information developed through this voluntary effort reaches the people who make decisions—from managers to industrial design engineers to those who specify materials to buyers. By disseminating the information to these individuals, the program encourages its Partners to incorporate environmental considerations into their traditional decision-making process.

DfE works with entire industrial sectors, typically through trade associations and industry leaders. Several of the current DfE partnerships are highlighted below.

- The Printing Sector: DfE works with the screen printing, lithography, and flexography sectors to improve their environmental performance, principally through solvent use and reclamation technologies.
- The Printed Wire Board Sector: Traditional methods for making printed wire boards require the use of substantial amounts of water, energy, and certain toxic chemicals. DfE has collaborated with this sector to evaluate alternative methods and processes.
- The Computer Manufacturing Sector: DfE is collaborating with this sector to perform life-cycle cost assessments of cathode ray tubes and flat panel displays in computers, assessments that include environmental impacts.
- Garment and Textile Industries: DfE is working with this sector to reduce the public's exposure to perchloroethylene, a chemical used in dry cleaning. DfE is also exploring alternatives in the dyes and finishes used in textile processing or in clothing design (or in both) to reduce the need for dry cleaning.
- Industrial Cleaning Sector: Through partnerships with detergent formulators, DfE is trying to encourage the development and adoption of safer, more cost-effective effective industrial cleaning agents.
- Auto Refinishing Sector: DfE is working with auto refinishers to identify and adopt cleaner, safer, and more cost-effective practices that reduce the use of harmful chemicals and solvents.
- Manufacturers of foam Furniture and Bedding Adhesives: The adhesives used in these products can contain chlorinated and flammable solvents, and these solvents are increasingly coming under environmental regulation. DfE is working with manufacturers to develop adhesives that are more environmentally friendly.

10.3.3 Environmental Accounting Project (EAP)

EPA initiated the Environmental Accounting Project (EAP) in 1992 out of concern that pollution prevention would not be used to manage the environment until managerial accounting practices were modified to account for environmental costs. In cooperation with the Institute for Management Accountants, the American Institute for Certified Public Accountants, the U.S. Chamber of Commerce, the Business Roundtable, and the American Association of Cost Engineers, EPA developed agendas for 10 different stakeholder groups. The goal of the EAP is to help business understand the full range of environmental costs they incur and how to incorporate these costs into their decision-making.

The EAP encourages businesses to focus on energy costs, capital and operating costs of equipment that controls pollution, remediation efforts, salaries of environmental managers, public relations outlays, and other costs associated with the environment. Closer tracking of these costs enables businesses to identify opportunities to reduce or eliminate various elements of these costs. Companies can improve their environmental performance, gain a competitive advantage, and achieve cost savings or increased revenues.

EPA maintains a network of over 800 members of the EAP who share information and ideas. EAP has prepared several guidebooks for implementing these concepts, and it has developed a

number of case studies that illustrate the gains that can be achieved. Much of this information is available on EPA's web site.

10.3.4 Environmental Leadership Program (ELP)

ELP uses innovative approaches to environmental protection by focusing on flexible laws and regulations. In addition, ELP seeks ways in which to use the greater availability of environmental information to empower citizens and communities. EPA launched the pilot phase of ELP in June 1994. In April 1995, ELP formally selected 12 projects from a pool of 40 proposals. The projects, which included 10 companies and two federal facilities, centered on compliance management systems, verification procedures, management accountability systems, and community access and participation in compliance. EPA indicated that participants would be allowed a limited period of time in which to correct minor violations that were discovered in their audits, without the application of penalties. Two conditions, however, were attached to this offer: The violations could not be criminal in nature; and they must not present an imminent and substantial risk to public health or the environment. Participants receive public recognition for their efforts.

One ELP participant, Gillette Co., is working with EPA and state authorities on auditing and certifying their environmental management system. The company's ELP project involves the following four steps: (1) developing criteria for compliance audits; (2) preparing detailed instructions for conducting such audits; (3) preparing guidelines for third-arty verification of these audits; and (4) using the guidelines when auditing three company facilities.

Gillette officials have cited several reasons for participating in the program. It prepares them for compliance with ISO 14000 environmental management certification standards, which are expected to become important in the years to come. The program also gives the company the chance to monitor itself, which will help the firm to avoid excessive monitoring by EPA.

It is not clear to what extent the results of audits conducted under ELP will be made available to the public. Public interest groups believe that they are entitled to access such information. Businesses, however, maintain that much of the data contained in audits should be kept confidential.

10.3.5 Water Alliances for Voluntary Efficiency (WAVE)

Another EPA initiative, Water Alliances for Voluntary Efficiency (WAVE), encourages businesses and institutions—primarily in the lodging sector—to reduce water use while increasing efficiency, profitability, and competitiveness. EPA says that the program "is designed to focus attention on the value of water and the need for efficient use of this important natural resource."[272]

WAVE participants include partners, supporters, and endorsers. Program Partners agree to equip new facilities with water-efficient equipment and to install such equipment in existing facilities wherever profitable. In exchange, they receive technical support and EPA assistance in publicizing their water efficiency initiatives. Program Supporters publicize the benefits of water use efficiency and assist partners in their conservation efforts. Supporters are also supposed to implement water efficiency measures. Endorsers include "conservation-minded environmental groups, trade and professional associations" who "are invited to review and endorse the WAVE program."[273]

As of April 2000, there were 40 WAVE industry partners, all of which were in the lodging sector. Several of the partners were large chains such as Westin, Hyatt, and Sheraton, with multiple facilities participating in the program. In addition, two hospitals and two educational institutions are counted as Partners. The list of Supporters consisted of more than 50 consulting firms, equipment distributors, manufacturing companies, utilities, and water management companies. The American Hotel & Motel Association, the American Water Works Association, Green Seal, and three other institutions were WAVE Endorsers as well.

EPA has stated that WAVE's measures can result in significant decreases in energy, water, and wastewater management costs. Through the program, the lodging industry potentially could save 32 billion gallons of water and more than 1 trillion Btu per year of related energy use. According to an EPA official, the main incentive for businesses to participate in WAVE is cost savings, but positive publicity is also a factor. Although the program has resulted in water and energy savings, it has not been without problems. The development of water management software has taken longer and has cost more than originally expected. In addition, marketing the program to hotels and motels has been slowed by a reluctance of the lodging industry to embrace change and by significant variations in the ownership and management structures of hotel branches.

10.3.6 Community-Based Environmental Protection (CBEP)

Initiated in 1997, this program integrates environmental management with human needs, considers ecosystem benefits, and emphasizes relationships between economic well-being and environmentally sustainable development. As its name implies, CBEP works with communities to protect and improve their local environment.

EPA has established several core principles for implementing CBEP.

- Focus on a definable geographic area.
- Interact with stakeholders through a range of partnership mechanisms.
- Determine overall environmental conditions in the area.
- Integrate environmental, economic, and social objectives and encourage local stewardship.
- Rely on appropriate public-sector, private-sector, regulatory, and non-regulatory tools.
- Monitor results and adjust programs in light of the results that are observed.

EPA's role in CBEP varies from one situation to another. In communities that cross state boundaries or are nationally important, EPA takes the lead role. In other cases EPA helps to define goals and methods, and provides environmental information, monitoring and scientific analysis to community organizers and stakeholders. Because individual projects are expected to take many years to achieve full success, the agency uses measures of performance that reflect incremental progress toward the goals.

10.3.7 Voluntary Mobile Source Emission Reduction Program (VMEP)

In the area of mobile sources, EPA has developed the Voluntary Mobile Source Emission Reduction Program (VMEP). This policy was initiated on October 23 1997, with the purpose of providing flexibility to states in meeting their federal air quality goals through State Implementation Plans (SIPs). Through this policy, EPA makes it easier for states to obtain SIP

credits for voluntary activities, and it seeks to further encourage innovation and investment in effective programs and actions. Thus, the policy provides an incentive for states, localities, and the public to voluntarily reduce air pollution in their communities.

To obtain these SIP credits, a voluntary program under VMEP must be quantifiable; surplus (i.e., yield reductions in addition to those credited in other parts of the SIP); enforceable, and permanent. The most distinctive difference between a VMEP control measure and a regular SIP control measure is that the VMEP is enforceable against the state for the emission reductions only, as opposed to the regular SIP control measure that is enforceable against the regulated parties for specified actions to reduce emissions.[274] This provision encourages industry, community groups, and third parties to voluntarily agree to emission reductions. The state then estimates the reduction in emissions it expects will result from the agreements, and includes this as a control program in their SIP. VMEP submissions are limited to 3% of the emission reductions needed to obtain the National Ambient Air Quality Standards (NAAQS) in the non-attainment area.

The cities of Dallas, Houston, Chicago, Atlanta, and Las Vegas are including, or are planning to include, VMEP programs in their SIP. Programs include ozone action-day programs, technology retrofits, lawnmower buybacks, alternative fuel programs, commuter choice programs, and land use measures as well as many other programs. Support for the policy, in terms of technical and programmatic support, has been conducted through the Regional and State Programs Division of the Office of Transportation and Air Quality.

10.3.8 Pesticide Environmental Stewardship Program (PESP)

Under the Pesticide Environmental Stewardship Program (PESP), EPA works with many different organizations to promote environmentally responsible pesticide stewardship. Membership in PESP requires that organizations develop and adhere to well-defined goals for improving pesticide stewardship. Only those organizations that meet these goals are allowed to publicize their membership in the program in their promotional materials.[275]

10.3.9 Commuter Choice Leadership Initiative

On October 17, 2000, EPA and several leading U.S. employers launched the Commuter Choice Leadership Initiative. Under a Commuter Choice Leadership agreement, employers commit to working with EPA to develop new commuting benefits and services for their employees. (Employers who have joined this initiative are also known as "Commuter Choice Leaders.") This initiative is part of an effort to redefine the "comprehensive employee benefits package" to include commuting benefits alongside other standard employee benefits, such as health plans and retirement packages. New Commuter Choice benefits will help American employees get to and from work in ways that cut air pollution and greenhouse gas emissions, improve public health, increase worker productivity, and cut taxes and other expenses for employers and employees.

This initiative is the first step in a national effort to provide employers across the country with the opportunity to partner with EPA in providing new commuting choices and services to their employees. If one-half of all U.S. employers offered the same commuting benefits as those promised by Commuter Choice Leaders, air pollution in the United States would be cut by the equivalent of about 15 million cars.

The commuting options promoted through the Commuter Choice Leader Initiative include the following: parking cashout (allowing employees to trade their free parking space for cash), transit fare subsidies, telecommuting, compressed work schedules, flexible work schedules, carpools, vanpools, bicycling to work, walking to work, environmentally-friendly vehicles, and others.

Because of recent changes in the U.S. tax code, employees frequently enjoy a reduced tax burden when taking advantage of these commuting options. Likewise, U.S. employers enjoy a reduced tax burden when providing commuting benefits that encourage these commuting options. The initial Commuter Choice Leaders include The Calvert Group, GEICO DIRECT, Intel, Kaiser Permanente, Nike, Pitney Bowes, and The Walt Disney Company.

EPA has committed itself to helping Commuter Choice Leaders and their employees in several ways: (1) by providing public recognition to Commuter Choice Leaders; (2) by providing technical assistance on commuting options and services; (3) by providing communications and analytical tools; (4) by helping employers and employees identify federal, state, and local commuting options, benefits, and services; and (5) by providing a forum for exchanging ideas and experiences with other leading employers.

10.4 Industry Initiatives

In contrast to EPA programs, which primarily seek to reduce pollution, unilateral industry-led strategies are designed first and foremost to improve public opinion. They are also designed, however, to accomplish a broad range of worthy objectives. Responsible Care, which began as an initiative of the Chemical Manufacturers Association (CMA), a 190-member industry trade association in the United States, has grown to be truly international in scope. This initiative includes firms in at least 40 nations, firms that represent more than 85% of the global chemicals industry.[276] CMA provides its members with general guidance documents that explain how companies may adopt management codes in six areas:

- community awareness and emergency response
- pollution prevention
- process safety
- distribution
- employee health and safety
- product stewardship

For the most part, other industry-sponsored efforts in the United States could be characterized as extending the Responsible Care initiative to other industries. Examples include the American Petroleum Institute's (API) STEP program, "Strategies for Today's Environmental Partnership," and the American Forest and Paper Association's "Sustainable Forestry Initiative." The National Association of Chemical Recyclers has developed a "Responsible Recycling Code," which extends Responsible Care principles to chemical recycling. The Synthetic Organic Chemical Manufacturers Association has adopted the pollution prevention management codes of Responsible Care. The Great Printers Project is a hybrid effort developed by the Printing

Industries of America, the Environmental Defense Fund, and the governors from four states in the Great Lakes Region.

10.5 Federal Negotiated Agreements

Negotiated agreements are voluntary in the sense that firms are free to participate, or not, as they see fit. However, once a firm has signed a negotiated agreement, the firm is committed to fulfilling its part of the agreement. If the firm fails to deliver on agreed-upon actions or fails to achieve the results specified in the agreement, the firm risks adverse publicity and increased scrutiny by EPA. The goals of two negotiated voluntary programs are shown in Table 10-4.

Table 10-4. Federal Negotiated Voluntary Programs

PROGRAMS (year program launched)	ENVIRONMENTAL GOALS
Project XL (1995) www.epa.gov/ProjectXL	Develops innovative strategies to test better and more cost- effective ways of protecting the environment and public health.
Common Sense Initiative (1994) www.epa.gov/commonsense	Addresses environmental management by industrial sector rather than by environmental medium (air, water, land). Now an EPA Sector Program.

A primary goal of negotiated strategies is to improve efficiency by reducing regulatory burden. In practice, most Project XL and CSI (Common Sense Initiative) projects attempt to reduce the administrative costs associated with reporting, monitoring, and permitting.

10.5.1 Project XL

In 1995, EPA launched a portfolio of high-priority initiatives that sought new ways to protect the environment and public health, while demonstrating how EPA, the regulated community, and the public together can improve environmental management to address complex environmental issues. Since then, businesses, communities, and other federal agencies have responded to this challenge by participating in these initiatives, including Project XL (which stands for e*X*cellence and *L*eadership). Project XL was developed to accelerate environmental progress through collaboration on environmental problem solving, to modify certain constraints, and to reduce some costs that could be associated with environmental regulations.

Project XL solicits ideas from EPA's partners: private-sector and public-sector facilities, other government agencies, trade associations, and communities. The project then assesses those ideas that propose solutions to difficult regulatory or technical problems and that explore new approaches to protecting public health and the environment, usually at a lower cost or lessened regulatory burden for the project sponsor. The basic tenet of Project XL can be explained in terms of its three elements: Through prudent experimentation and regulatory flexibility, EPA and its partners can (1) find economic gains for businesses and government, (2) more effectively engage the public in decisions that affect their local environments, and (3) achieve a cleaner environment.

Project XL is providing a forum for companies to test new technologies and alternative regulatory approaches that eventually might be used more widely to boost energy efficiency and achieve greater environmental protection. One criticism of federal efforts to protect the environment is that EPA's regulatory requirements can be too prescriptive. For years, EPA has heard: "Give us environmental goals to meet, but don't tell us how to meet them." For the past

decade, EPA has been building greater flexibility into regulatory programs through the trading of emission "allowances" and other approaches. Through Project XL, EPA is providing companies and other project sponsors with additional opportunities to demonstrate their abilities to find innovative approaches to environmental protection. EPA is finding that a little flexibility can go a long way toward getting better results.

The experiments being conducted under Project XL are in various stages. As of November 2000, 16 projects have been underway for a year or more, and 34 projects have been in progress for less than 1 year. Early evaluation results show benefits to the environment, project sponsors, and the communities. Data from several projects indicate the potential that innovative approaches have for significantly improving current methods for managing the environment.

Features of Project XL

- Superior Environmental Protection
- Cost Savings and Reduced Paperwork
- Stakeholder Involvement
- Innovative Pollution Prevention
- Transferability
- Feasibility
- Monitoring, Reporting, and Evaluation
- No Shifting of Risk Burden

In fact, Project XL's greatest opportunity, and its greatest challenge, is taking successful ideas from individual pilot projects and moving these ideas into system-wide practice and into EPA's everyday way of doing business. Through experimentation and evaluation, Project XL can add to an ever diversifying set of tools for environmental protection by identifying new approaches, discovering the keys to their effective use, and better enabling EPA to match the right tool to the right problem.

Under Project XL, project sponsors have gained operational flexibility, such as expediting or consolidating permitting, reducing the amount and frequency of recordkeeping and reporting, creating facility-wide emission caps, and supporting innovative technology. As a result of operational flexibility, project sponsors, in turn, gain additional benefits from improved administrative or technological efficiencies, industry recognition and leadership, better leveraging of employee expertise, better community and stakeholder relations, and improved relationships with regulators. EPA encourages firms to view the flexibility provided by Project XL as an opportunity to create real incentives for environmental improvement, whether they are financial, competitive, technological, community-related, or otherwise.

For example, Intel Corporation has announced that it will take advantage of some these concepts in their business planning. Early this year, Intel announced that it will build its first 300-millimeter, high-volume semiconductor manufacturing facility in Chandler, Arizona. Intel will be able to expand the Chandler facility under an existing air emissions cap that was established under Project XL in 1996. Table 10-5 provides examples of the actual and anticipated economic gains that have been reported by project sponsors.

EPA currently faces important questions regarding the Project XL challenge. As the information on project results expands exponentially, what are the best methods for transforming results into knowledge? As EPA evaluates and learns how these new tools work, how does it match the right tools to the right problems? How does the Agency increase its rate and scale of adopting new ideas into appropriate system-wide practice? How does EPA translate its innovation experience into improved processes that will enhance its ability to test new concepts?

Table 10-5. Economic Benefits for Select Project Sponsors of Project XL

- **Crompton Corporation's Sistersville plant** (formerly known as Witco) saved $58,000 from waste minimization and pollution prevention (WM/PP) activities in 1998 ($42,000 in one-time activities and $16,000 in savings from recurring air emissions reductions and methanol recycling). As of July 2000, 67 WM/PP initiatives have been implemented at the Sistersville plant, resulting in a total cost savings of an additional $1,010,000 during 1997-1999 and the first half of 2000. Crompton expects future savings of $800,000 over 5 years as a result of a negotiated deferral under the rules of the Resource Conservation and Recovery Act (RCRA). The company also identified potential, recurring cost savings of $620,000 per year that will be achieved through WM/PP activities.
- **Department of Defense Elmendorf Air Force Base** (Elmendorf AFB) aims to streamline the application, implementation, management, and renewal process for Elmendorf AFB's Title V permit through reduced monitoring and recordkeeping. EAFB estimates that total monitoring, recordkeeping, reporting, and overall permit management costs will decrease by about 80%, yielding about $1.5 million in savings over 6 years.
- **Department of Defense Vandenberg Air Force Base** (Vandenberg AFB) negotiated a protocol for source testing and validation with the Santa Barbara County Air Pollution District that is $2,400 cheaper than the standard EPA test ($600 per test rather than $3,000 per test). This protocol complies with administrative requirements to upgrade its infrastructure, pollution prevention programs, innovative technologies, and other approaches that will cost effectively reduce air emissions below mandated levels.
- **HADCO Corporation** has achieved some cost savings by reducing the number of sludge shipments it requires, an action that results from its voluntary installation of a sludge dryer. HADCO expects to see cost savings when it sends its sludge directly to a recycler instead of shipping it to an intermediate processor.
- **Intel Corporation** has avoided millions of dollars in production delays in the competitive quick-to-market semiconductor industry by eliminating 30 to 50 reviews per year. The company operates under a facility-wide permit that allows for equipment changes, process changes, and new construction at the site as long as the site's overall air quality limits are met. Early this year, Intel announced that it will build its first 300-millimeter, high-volume production manufacturing facility in Chandler, Arizona. Intel will be able to expand an existing facility under an air emissions cap that was established under Project XL in 1996.
- **Weyerhaeuser Company** achieved an estimated savings of $176,000 in reporting costs during the first year of operation as a result of the successful revision and reissue of the facility's air quality and wastewater discharge permits. The company is now saving $200,000 a year by recovering lime muds and reusing this solid waste in lieu of purchasing new lime for use in the mill's production. (It did incur a one-time cost of $150,000 in 1998 on related sampling collection and analysis.) Weyerhaeuser foresees avoiding $10 million in future capital spending. While it expects to spend $10 million on new water equipment, it will subsequently save $20 million that would otherwise have been spent on air pollution equipment.

Source: Project XL 1999 Comprehensive Report, and Project XL 2000 Comprehensive Report.
http://www.epa.gov/projectxl/guidexl.htm

10.5.2 Common Sense Initiative (CSI)

EPA designed the Common Sense Initiative (CSI) to take environmental protection beyond the command-and-control, pollutant-specific, and media-specific approaches. CSI used a sector approach, which focused on a particular business, service, or industrial sector, to achieve more efficient, effective, and timely environmental results. EPA believes that when industry works collaboratively with government and other stakeholders to consider releases to all environmental media concurrently rather in piecemeal fashion, industry sees more clearly the environmental and economic value of preventing pollution at the source. Furthermore, incentives can be tailored to meet the specific needs of an industry sector.

CSI was a 4-year (1994–98) pilot program for six large and small industry sectors. EPA worked with industry-sector representatives and other stakeholders in a consensus-based, federal advisory committee forum to find innovative ways to achieve "'cleaner, cheaper, smarter"

environmental performance. The sectors involved in CSI were metal finishing, petroleum refining, printing, auto manufacturing, computers and electronics, and iron and steel. This effort produced more than 40 sector projects and one sector-wide stewardship initiative, the Metal Finishing Strategic Goals Program (SGP).

Among the 44 CSI projects, 23 addressed regulations, 20 promoted pollution prevention, 7 sought to reduce recordkeeping and reporting, 9 addressed compliance and enforcement, 6 addressed permitting, and 9 attempted to stimulate new environmental technology. True to its experimental nature, CSI produced expected and unexpected results. Some results are tangible, such as the implementation of many formal recommendations to the EPA Administrator, while others are intangible. It provided learning opportunities on a variety of environmental, economic, and social issues. For example, CSI significantly improved working relationships among stakeholders, many of whom had only interacted as adversaries in the past. In fact, the printing, petroleum, and metal finishing sectors are continuing to address issues in a multi-stakeholder, federal advisory committee forum.

SGP was adopted by the metal finishing industry in October 1997, and the program is still very active. While voluntary in nature, this stakeholder-driven program has led to regulatory and non-regulatory incentives, tools, and actions to improve performance by facilities within this sector. The agreement contains commitments on the part of EPA to change regulations that affect the industry, such as industry-wide goals for full compliance, improved economic payback, and reduced emissions from facilities. The agreement also includes a comprehensive action plan for state and local regulators and other stakeholders. As an indicator of the incentive nature of SGP, more than 400 companies, 21 states, and over 75 municipalities are participating.

With SGP as a model, EPA is developing similar, targeted programs to achieve better environmental performance and lower regulatory burden in the meat processing, shipbuilding/repair, specialty-batch chemical, and metal casting sectors. These programs also benefit from strong industry support. One of many EPA projects is a joint effort with the metal casting sector to produce information for states that will help them to permit safe uses for spent sand from foundries. This action will give the metal casting industry the economic incentive to re-use, rather than dispose of, the spent sand. Hence, millions of tons less waste will be sent to landfills each year, saving millions of dollars in waste disposal expenses for the industry.

With the growing knowledge of how to use sector approaches to tackle tough problems, in 1998 EPA began a process to integrate sector work into the Agency's core functions. Sector Action Plans were developed for FY1999 and FY2000 to guide this effort. EPA's program offices have been encouraged to consider, where appropriate, an integrated cross-Agency, multi-media sector approach as a way of conducting their everyday business. The draft *EPA Sector Program Plan 2001–2005,* which is being reviewed by stakeholders, provides a vision for environmental excellence by U.S. industries. The plan affirms the validity of using all types of sector tools and approaches to protect the environment, whether these tools and approaches are voluntary or regulatory, single-media or multi-media, issue-specific or industry-wide. The sector approach is also being extended to include related economic entities through the supplier-producer-customer chain and other networks that directly impact an industry sector.

Sector approaches are increasingly common. Through the shared experiences of CSI and other sector programs, leaders from government, industry, and other stakeholder groups have become

more willing to sit down together to search for solutions to today's environmental challenges in a non-adversarial way.

10.6 An Assessment of Pollution Prevention Efforts

A 1998 EPA review of all of its Partners for the Environment efforts concluded that the results to date have been impressive. Environmental benefits achieved by EPA's Partners totaled

- 5.2 billion fewer tons of solid waste generated,
- 199 trillion fewer Btus of energy used,
- 24.7 million fewer tons of greenhouse gases emitted, and
- 1.2 billion fewer gallons of water used.

At the same time, these Partners saved $852 million in 1996.

10.7 Voluntary Programs Developed by EPA Regions

The regional offices of EPA have been active in the development and promotion of voluntary programs. Table 10-6 identifies many of these programs.

Table 10-6. Selected Regional Voluntary Programs of EPA

EPA PROGRAM	EPA REGION	EPA PROGRAM	EPA REGION
Agricultural Initiative	9	Metal Finishing Partnership	9
Air Quality Initiative	8	Osage Nation, Oklahoma, CBEP	6
American Heritage Rivers	8	Pollution Prevention (P2) Awards for Excellence	7
Bay Area Green Business Program	9	P2 Roundtable	7
Beneficial Landscaping	5	Pacific Northwest P2 Research Center	10
Brownfields Initiatives	1-10	Partners for Change	1
Business for the Chesapeake Bay	3	Partnership to Help Foundries Achieve Compliance	6
Center for Industry and Technology	1	PCB Used Oil Sweep	5
Chemical Safety Audit Program	3	Problem Oil Pit Initiatives	8
Chemical Safety Audit Program	4	Small Business Assistance Center	3
Chlor-Alkali Mercury Reduction	5	Southern Application Mountain Initiative	4
Clean Star Texas City	6	StarTrack	1
Community-Based Environmental Protection	8	StarTrack	3
Compliance Leadership	1	Sustainable Challenge Grants	4
Environmental Merit Awards	1	Texas City, Texas, CBEP	6
Evergreen Award	10	U. S. Auto P2 Project	5
Great Printers Project	5	Urban Initiatives	4
Greater Chicago P2 Alliance	5	Urban Initiatives for Sustainable Communities	4
Green Communities	3	Urban Livability	8
Headwaters Waste Mining Initiative	8	Utah 2002 Olympics	8
Henryetta, Oklahoma, CBEP	6	Voluntary Initiative for P2	3
Indoor Quality Initiatives	5	Waste Minimization Assessment	5
Merit Partnership	9		

10.8 State Programs

A comprehensive treatment of the hundreds of state and community voluntary programs for environmental protection is beyond the scope of this paper. However, a few programs are reported in the following paragraphs to illustrate the nature and scope of these activities.

10.8.1 Massachusetts Recycled Newsprint Program

Massachusetts has developed a voluntary newsprint recycling program. (This program can be contrasted to Wisconsin's program, which has recycled content requirements on newspaper publishers, and fees levied on those failing to meet the requirements. See Chapter 6.) Under the terms of a 1992 memorandum of understanding between the Commonwealth of Massachusetts and the Massachusetts Newspaper Publishers Association, the Commonwealth agreed to develop newsprint collection and processing programs within the state, and the Association agreed to increase its use of recycled content. The following targets for increasing the recycled content of newsprint were set: 13% of recycled content by December 1993, 23% by December 1995, 31% by December 1997, and 40% by December 2000.

The publishers agreed to give preference to purchasing newsprint that was recycled within the state. They are exempt from the targets described in the previous paragraph if high-quality recycled newsprint cannot be obtained at prices comparable to those of virgin newsprint.

In return for the publishers' efforts, the Commonwealth agreed to promote de-inking and processing facilities in an attempt to increase the supply of recycled-content newsprint that was available to the publishers. The state also agreed to oppose recycled-content mandates or penalties for the use of virgin newsprint and to facilitate private-sector investment in the publishing industry.

10.8.2 Adopt-a-Highway Programs

In Adopt-a-Highway Programs, volunteers agree to periodically clean up selected stretches of roadside. Although these programs vary from state to state, they typically involve agreements by organizations to clean up a stretch of roadside that is approximately two miles long and to do so two to seven times a year, for 1 to 3 years. The state usually offers trash bags, safety vests, and other gear. Perhaps most important for businesses that participate, the state usually provides at least one sign to be placed on the adopted roadside that indicates the name of the adopting organization. However, a 1994 survey revealed that 10 states did not allow businesses to adopt highways, and 33 states did not allow adopting organizations to contract others to perform the cleanup.

Adopt-a-Highway programs offer advantages both to states and to adopting organizations. They allow states to maintain roadsides at lower state expense, and they generate positive publicity for businesses and other adopting organizations.

Although there is no federal Adopt-a-Highway Program, state programs have spread rapidly since Texas created the first one in 1985. The number of states with programs increased to 41 by 1990. The aforementioned 1994 survey revealed that all states except Maine and Vermont had these programs. According to the same survey, 121,700 adopting groups composed of 1.3 million volunteers were participating in the programs, and over 200,000 miles of roadside had been adopted.

10.8.3 State Voluntary Cleanup Programs

More than 40 states have voluntary cleanup programs that offer a wide range of incentives for cleaning up and reusing brownfields. The voluntary programs vary by funding levels, types of activities funded, and the eligibility of entities. State incentives can include financial support, regulatory streamlining, and liability relief. EPA provides about $10 million annually to support state voluntary cleanup programs. In addition, 14 state voluntary cleanup programs have signed memoranda of agreement with EPA that clarify state and federal responsibilities and strengthen the role of the state programs.

10.9 Conclusions

Voluntary programs in the United States combine the features of unilateral, negotiated, and public voluntary approaches employed in the European Union (EU). In the United States, voluntary agreements have been crafted under the aegis of the Pollution Prevention Act, through the Climate Change Action Plan, by industry associations, and by state and local governments. Most U.S. voluntary efforts would be characterized as cooperative, non-mandatory strategies. Several authors have claimed that existing legislation impedes the implementation of industry-led voluntary agreements and public-sector projects that employ negotiation (Davies and Mazurek 1996; Kappas 1999; Boyd, Krupnick, and Mazurek 1998). The consequence is that voluntary approaches serve as a supplement to the main thrust of federally mandated air, water, waste, and toxic control programs.

In most of the U.S. voluntary programs, the task of evaluating program effectiveness is hampered by unique program features as well as limited data and monitoring relative to baseline conditions. While there are some data illustrating the administrative costs of developing certain types of voluntary agreements and the environmental effectiveness of a few of the energy conservation measures, a comprehensive cost-effectiveness assessment has not been performed for any of the voluntary programs.

EPA reports and other literature mention a number of desirable effects besides environmental improvement that result from these programs. Participants in Responsible Care, 33/50, CSI, and Project XL all cite enhanced public opinion or goodwill with regulators as significant benefits. In fact, a motivating factor for several Project XL participants was to improve relations with the community (Boyd, Krupnick, and Mazurek 1998). The Chemical Manufacturers Association (CMA) advocated Responsible Care primarily as a means of improving public opinion. CMA convinced its membership that the future of the chemical industry depended on their reversing the negative public perception of the industry. To facilitate the adoption of its program, CMA patterned Responsible Care on its members' ongoing environmental, health, and safety (EHS) programs.

Voluntary agreements appear to contribute to constructive dialogue among groups that normally act as adversaries. Voluntary agreements also provide for more opportunity for stakeholder participation than the status quo does. With improvements in administrative, monitoring, and participatory procedures, voluntary agreements could become an important element of the U.S. strategy for improving the cost effectiveness of environmental management.

Unilateral, industry-led voluntary agreements can suffer from what is termed the "free rider" problem. Such agreements provide benefits in the form of publicity and goodwill for all members. Members of an industry association may join a voluntary agreement, yet take minimal

actions to comply. Members can also choose not to join the voluntary agreement, but they can still benefit from the actions of those who have joined. Understandably, an association would be reluctant to eject members, since it depends on dues from them to survive. Thus, free-riding may be a significant problem from the point of view of truly motivating participants to join unilateral agreements. This problem was evident in the STEP program of the American Petroleum Institute (API). In this case, several API members joined STEP, yet they failed to follow through with all of its provisions.

Implementation of negotiated agreements is slowed because Congress did not give EPA the authority to offer firms relief from existing laws and regulations (Davies and Mazurek 1996). Two consequences follow. The first issue relates to procedure. Whenever government or trade associations have less than strong legal authority for their initiatives, they act through consensus-building processes. This approach gives individual participants potential veto power over such initiatives, and it may result in large transaction costs. Second, reliance on consensus-based methods also tends to result in goals that reflect the basic common denominator on which all parties agree.

While there were difficulties in the initial implementation of CSI, the experiment has demonstrated the value of collaborative, sector-based approaches to environmental protection. Many of the 300 participants in CSI have built positive relationships with former adversaries that have outlasted the program itself. Based on its experiences with CSI, EPA has expanded opportunities for involving stakeholders in the Agency's decision-making processes. EPA is using voluntary collaboration to improve traditional EPA functions such as regulation, permitting, and compliance assistance. By applying the many lessons learned from this unique program, EPA attempts to ensure that the next generation of initiatives for environmental protection is based on common sense and cost effectiveness.

The first few XL projects posed many challenges. EPA had never attempted this type of experiment. As a regulatory agency, EPA was cautious in the early stages. EPA and others had concerns about how to test new approaches and yet still maintain the same level of protection that the current regulatory system provides. The Agency had to learn as Project XL progressed. Project sponsors, regulators, and citizens alike invested significant resources and time in XL's creative and complex experiments. After gaining experience, the Agency had a better idea of what information was important for industry to include in their proposals and how decisions should be made. In 1998, EPA and its partners worked hard to streamline Project XL, so negotiations would go more smoothly, quickly, and predictably. This new process now yields agreements for most projects in six months to a year, compared to 24 months or longer under the old process. For example, the Atlantic Steel project, in Atlanta, Georgia, has already shown results by producing a signed project agreement for Phase One, just eight months after initial pre-proposal discussions with EPA.

The Agency's rapidly growing partnership programs continue to show promise for effecting improved stewardship.[277] These programs typically improve efficiency, cut waste, and conserve resources, thus lowering costs and yielding environmental benefits. As such, EPA has used partnership programs to address a variety of issues, including climate change, solid waste, pesticide risks, and to advance new environmental technologies and practices. These experiences have shown that voluntary approaches can be a strong complement to the traditional regulatory system and a tangible means for getting better environmental results.

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About the Report

This report has been prepared by the National Center for Environmental Economics in the EPA Office of Policy, Economics, and Innovation, which is a part of the Office of the Administrator. It builds on two previous reports (Carlin, 1992, and Anderson and Lohof, 1997) with similar titles. This report both updates and substantially expands on the United States portions of these earlier reports and was authored by Robert C. Anderson. The report has been extensively revised as a result of reviews by many EPA staff both inside and outside NCEE for both policy and technical accuracy. Comments were received from the following EPA offices, among others:

Office of the Administrator:
- Office of Policy, Economics, and Innovation
- Office of Communications, Education, and Media Relations

Office of Air and Radiation
Office of Enforcement and Compliance Assurance
Office of General Counsel
Office of Prevention, Pesticides and Toxic Substances
Office of Research and Development
Office of Solid Waste and Emergency Response
Office of Water
Region 10

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Because of the desirability of making possible future reports in this series as comprehensive as possible, readers who are aware of interesting applications of incentive mechanisms that they believe should be included in subsequent reports are encouraged to send that information to Alan Carlin (Carlin.alan@epa.gov) at EPA Mailcode 1809, Washington, DC 20460, who served as the principal coordinator for this report.

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