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THE UNITED STATES EXPERIENCE WITH ECONOMIC INCENTIVES IN ENVIRONMENTAL POLLUTION CONTROL POLICY

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In the past several years, economic incentives have assumed a prominent position among the tools for environmental management. Nowhere is this role more explicit than in the 1990 Clean Air Act Amendments. That legislation authorizes incentive-based mechanisms for the control of acid rain, for the development of cleaner burning gasoline and less polluting vehicles, for states to use in controlling urban ozone and carbon monoxide, and to facilitate the reduction of toxic air emissions.

As other key environmental statutes such as the Clean Water Act and the Resource Conservation and Recovery Act come up for reauthorization, potential applications of incentive mechanisms may be actively debated. EPA is currently evaluating a variety of incentives to support these debates as well as working to implement other mechanisms under existing statutory authority. At the state level, a wide variety of incentive programs have been implemented, and many other proposals are currently under active consideration. Outside the United States a diverse group of nations are extending the frontiers for applying incentives.

With current high levels of interest in incentive mechanisms for environmental management, it is useful to examine the record to date. Over the past 20 years, federal, state, and local authorities as well as many foreign nations have enacted a diverse array of environmental incentive mechanisms. How well have these mechanisms performed? What can be learned from the record that will assist in the formulation of new mechanisms? How economically efficient have these mechanisms been in achieving their objectives?

This report updates and extends a 1992 EPA review[1] of that record, highlighting applications of emission and effluent fees, charges for solid waste disposal, marketable permit systems for air and water pollution, deposit-refund systems, and information and liability mechanisms. The mechanisms described in this report all satisfy the basic requirement that a continuous signal be provided to pollution generators to be aware of and act on opportunities to reduce releases of pollution to the environment.

The report first reviews the available information on the economic efficiency and environmental effects of economic incentives in general. The literature uniformly finds that economic incentives should be much more economically efficient in controlling pollution than the traditional command-and-control approaches. Some studies, however, indicate that the cost savings actually realized have fallen short of those predicted by these studies. Economic incentives should be particularly efficient when diverse sources of pollution are involved which are most efficiently controlled using little-known or yet-to-

[1] EPA (July 1992).

be developed technologies. The evidence on the environmental effects of economic incentives, while much less extensive than that on economic efficiency, suggests that incentives mechanisms are fully compatible with environmental objectives.

The historic record concerning individual incentive programs suggests that although there have been a number of important successes, in some cases incentive programs have failed to live up to their full theoretical promise. This appears to be the result of the particular design features of the programs tried, however, rather than the theoretical promise of the approach. In most cases, fees and charges have been designed primarily to raise government revenue, and have thus been set too low to have significant incentive effects. Trading systems have often been constrained by complicated regulations, but some new ones which have not as yet been fully implemented hold out considerable promise for being both effective and efficient in reducing pollution. Beverage container deposits appear to have greatly reduced litter, but there is only limited knowledge of the impact of other deposit-refund systems and virtually no analysis of the costs and benefits of any of the deposit-refund mechanisms. Some programs providing information appear to be having great impact among fully implemented incentives considered in this report and are likely to be economically efficient as well, but have not been examined with the detailed scrutiny necessary for a fair evaluation of performance. Liability mechanisms can and do act as effective incentives, but structuring liability rules to accurately internalize the costs of pollution has proved difficult.

Finally, a review of the use of economic incentives outside the United States suggests a preference for a somewhat different mix of incentive mechanisms but somewhat similar conclusions as to their effectiveness and efficiency as in the United States. The United States uses many more marketable permit systems than European countries, but much less environmental labeling. Also, a wider range of commodities are subject to deposit systems outside the United States. Although charges and fees are used more widely in Europe, they also tend to be revenue-raising instruments with few incentive impacts, as in the United States. The lack of incentive impact of charges is due primarily to their low magnitude and because a number of the charges are not closely linked to waste generation or product consumption. As in the United States, official interest in economic incentives appears to be increasing in Europe, Australia, South Korea, Chile, many parts of the former Soviet Union and elsewhere.

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FOREWORD

This report was prepared by Robert C. Anderson and Andrew Q. Lohof of Resource Consulting Associates under a subcontract to the Environmental Law Institute as part of cooperative agreement CR822795-01 between ELI and the U.S. Environmental Protection Agency. Alan Carlin, EPA's Project Officer, provided substantial assistance and helped to format the report for publication on EPA's World Wide Web Site.

Many individuals provided valuable assistance during the course of this research. Literally hundreds of individuals in the U.S. and abroad offered details as to the design and performance of individual market-based approaches used to manage pollution. As the work progressed, other individuals offered their technical comments and reviews. In particular the authors would like to thank Tom Gillis and Michael Podolsky of the EPA Economy and Environment Division, and Byron Swift, the Environmental Law Institute's project manager.

1. INTRODUCTION

In recent years, economic instruments have achieved a prominent place among tools for managing the environment. Once mainly an academic proposition, or a revenue-raising adjunct to command and control mechanisms, market-based economic incentives are now being used as the *principal* instrument of control for a number of environmental issues. Nowhere is this fact more evident than in the 1990 Clean Air Act Amendments, which created many programs 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. For example, solid waste disposal currently is priced on a per unit basis in more than 2,000 communities throughout the United States.

The reliance on economic instruments is growing, not only here, but in many other nations as well. Quite possibly nowhere else is interest in these mechanisms higher than in the former Soviet Union, where newly-independent nations are moving quickly from central planning to market-based approaches to improve the environment and overall economic conditions. The pace of change toward market-based mechanisms also has been rapid throughout Western Europe and other areas such as Australia, Korea, and Chile.

1.1. PURPOSE OF REPORT

A 1992 EPA report documented the use of economic instruments to manage the environment in the United States and also characterized many of the foreign experiences; its title: *The United States Experience With Economic Incentives To Control Environmental Pollution*. In the five years since that report was issued, many new instruments have been implemented and existing instruments subjected to evaluation by academics and government agencies, making it not only timely for an update but also a good opportunity for offering new insights and perspectives. While the basic conclusions of the 1992 report are not changed greatly, the number of instruments that are reviewed 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? What can be learned from the record that will assist in the formulation of new mechanisms? How economically efficient or cost-effective are these mechanisms in achieving the goals of environmental management? What have been their environmental effects? Why is it that the theoretical gains from economic instruments seldom are observed in practice and what can be done to improve this record?

1.2. DEFINITIONS

In order to bound the subject, economic incentives for the purposes of this report will be defined broadly as instruments that provide continuous inducements, financial or otherwise, for sources to make reductions in their releases of pollutants or to 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, the cost per unit of pollution faced by different sources should be comparable. In this fashion, pollution control costs are minimized for a given level of pollution. To achieve efficiency, the per unit costs of pollution faced by each source should be equated to the marginal 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 and does not have great regulatory significance.

This definition excludes mechanisms that use explicit or implicit price signals for activities that have pollution as a by-product. While sometimes termed environmental incentives, programs to provide ride sharing, bike paths, high occupancy vehicle lanes and parking surcharges and the like are beyond the scope of this report, except for a brief discussion of congestion pricing which addresses an externality not unlike (and quite likely linked directly to) pollution. While of interest because they may lead to a reduction in pollution, these mechanisms provide neither an explicit nor an implicit price on units of pollution. Excluding these mechanisms carries no implications for whether future EPA actions will consider them as economic incentives. Rather their exclusion is primarily for the purpose of drawing boundaries around the scope of this report and making it manageable.

Payments per unit of pollution are perhaps the clearest example of an incentive, as the term is used in this report. Market-based systems in pollution reduction credits and allowances also provide direct price signals, since sources receive a paper chit that can be sold and used by another source if they reduce pollution below permitted amounts. Subsidies for pollution control and deposit-refund systems also create continuous financial incentives. Finally, indirect financial incentives for continuous effort at pollution abatement are created through reporting requirements, liability rules, and voluntary programs. All of these incentive mechanisms provide a continuous prod to sources to take actions to reduce their emissions and to make their products more environmentally friendly.

The contrast between incentive mechanisms and traditional "command and control" 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 pure command and control approaches, sources are tempted to view releases within permitted amounts as costless and products with environmental performance better than required levels as having no incremental value because of that attribute. To achieve improvements in environmental quality, regulators must tighten requirements on individual sources and products. 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 new requirements equivalent to these improved levels on all activities of the firm. Thus, under command and control type regulations there may be perverse incentives not to innovate and not to improve the technology of pollution control.

It should be emphasized that although this report attempts to make a careful distinction between command-and-control and market-based approaches, these distinctions are often blurred in practice. A range of pollution control measures exists, spanning the spectrum from such purely regulatory measures as technology requirements to such purely market-oriented measures as deposit-refund systems or pay-per-bag methods for financing municipal waste disposal. Between there exists a broad range of instruments, with no clear dividing line between command-and-control 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 distinctively command and control type features.

1.3. ORGANIZATION OF REPORT

This report is organized into ten additional sections which are summarized briefly below.

Section 2 examines US government policies regarding incentive mechanisms. Since its early days in office the Clinton Administration has urged greater reliance on economic incentives for environmental management. The 1995 report "Reinventing Environmental Regulation," the 1996 *Economic Report of the President*, and the 1996 report of the President's Council on Sustainable Development all support greater use of economic instruments for dealing with environmental issues.

In the first years of the Environmental Protection Agency in the mid-1970s, incentive-based programs for environmental management were largely ignored. Early environmental legislation and agency action dealt primarily with easily identified problems at point sources using command and control approaches. As these problems were resolved, the emphasis in law and in Administration actions has shifted toward incentive-based mechanisms. Nowhere is this more evident than in the 1990 Clean Air Act Amendments with its highly successful market-based approach for controlling acid rain.

Section 3 reviews the efficiency and environmental effects of economic incentives to control pollution. The criterion of economic efficiency requires that environmental improvement be sought until the incremental benefits of further controls are just equal to the incremental costs of those controls. Neither economic incentives nor command and control mechanisms can guarantee this result; however, several incentive-based approaches lead to least cost means of accomplishing a given environmental goal. Such a result generally does not obtain with command and control approaches. In fact, a very large number of studies point to the conclusion that incentive-based approaches can save anywhere from 10% to 90% of the cost of controlling pollution under traditional command and control approaches.

Analysts agree that an important determinant of the long run success of an environmental management strategy is whether it stimulates technical change and innovation in pollution control. On this ground, pure command and control strategies score poorly. Well-designed incentive-based mechanisms, on the other hand offer a continuous inducement for sources of pollution to find better and cheaper ways to control their pollution and improve the environmental performance of their products.

Section 4 treats fee, charge and tax systems in place in the United States. From an economic perspective, fees, charges and taxes are largely interchangeable in terms of their effects, but to governments there may be important distinctions such as which committees and agencies have jurisdiction, how the receipts may be spent and so forth. There are far fewer of these instruments actually labeled taxes than called fees. Environmental taxes are found on landfill operations, and the disposal of hazardous wastes.

Pollution-based fees are imposed on the quantity and/or quality of emissions released to the environment. Some examples include air emission permit fees in California, Texas and other states; effluent permit fees in Washington, New Jersey, Wisconsin and other states; and per can solid waste disposal fees found in over 2,000 communities across the nation. User fees are levied for use of a resource, with examples including grazing fees and water use and sewage fees.

From the perspective of environmental management, most fee and tax systems impose rates that are far too low to have significant impacts on pollution. The reason is that if tax or fee rates were set at the economically efficient level (equal to marginal damages) or a level high enough to accomplish environmental goals, polluters typically would have to make large payments to government agencies. While such payments are not real resource costs, they are important to the sources of pollution, might affect product prices and demand for their output, and could affect their competitive position in internationally traded goods. With few exceptions, fee and tax rates have been set at levels far below what efficiency or the satisfaction of environmental goals would dictate. In those exceptional cases with high fees, a mechanism exists by which the payments for pollutants are rebated to the sources in proportion to output of useful goods, so that the polluting sector experiences almost no net payment to the government (e.g., Swedish NOx charge).

Product charges are sometimes levied on products believed to have environmentally harmful effects. Some examples of product charges include chlorofluorocarbon taxes, the gas guzzler tax, state taxes on fertilizer, motor oil, packaging and other materials. Other fees may be charged on activities that are potentially damaging to the environment; examples include wetland development fees and storm water runoff fees.

Section 5 considers deposit-refund systems, which may be characterized as a product charge used in conjunction with a recycling subsidy. In the United States, deposit systems have seen the most extensive application for lead-acid batteries but also are used in some jurisdictions for a number of other products such as beverage containers, pesticide containers, and tires. When used products are valuable, as is currently the case for lead-acid batteries and in years past was true of beverage containers, the private sector may create and manage a disposal system.

Deposit-refund systems appear to be most appropriate for discrete, solid commodities such as containers, batteries, and car bodies that would cause environmental harm through improper disposal. Government mandated deposit systems for substances such as water and air pollutants have not been attempted but might be feasible. There certainly are examples in industry where valuable substances in pollution streams are captured and sold.

One of the main difficulties with deposit systems are their often high transactions costs. The administrative costs of running these programs can be large and additional transactions costs imposed on those who collect and return the commodities for credit.

Section 6 covers trading systems. Trading programs can come in many forms; two of the best known involve credits for pollution reductions that have been achieved and emissions cap and allowance trading programs which provide allowances for future releases of pollution. Credits and allowances may be exchanged for cash payments. Most of the markets where these items are traded are informal, but organized auctions also take place periodically.

Beyond the best known examples of trading such as the acid rain allowance program and RECLAIM, are a wide variety of other programs that feature some form of trading in rights to release pollutants. Some of the high mountain communities in Colorado require permits to operate wood-burning appliances. Developers who wish to instal such a device are required to retire two existing permits, a rule that has resulted in pollution reduction and fostered an active market in permits. Certain classes of heavy duty engines are subject to emissions averaging, in effect intra-firm trading. The rights to burn grass are subject to trading in Spokane County, Washington. Land development rights are subject to trading in a few jurisdictions in Maryland, New Jersey and Florida. Wetland mitigation credits can be created, banked and sold to offset the adverse effects of development activities on wetlands.

Trading programs have certain features that have made them increasingly popular in the United States. Conceptually, they can achieve much of the same efficiency of a tax approach but have the advantages of protecting the assets of existing firms and providing more certainty about the magnitude of environmental improvement. A number of drawbacks are also observed, though, including high transactions costs and inactive markets. The long-term effects of trading programs on innovation and technical change are variable among programs. Some, such as the acid rain program, have spurred considerable innovation, while others have not due to high transactions costs. At worst, trading programs are neutral in their effects on costs and the environment. Sources will not engage in trades that worsen their financial situation. Also, pollution increases generally are not allowed with trading. As an escape valve to burdensome command and control regulations, trading programs can offer relief.

Section 7 discusses subsidy systems. Generally looked upon with disfavor by economists because they encourage more of an activity than would occur under a polluter pays approach, subsidies nonetheless are a commonly-used instrument of government environmental policy. The subsidies reviewed in this report include grants, low-interest loans, favorable tax treatment, and preferential procurement policies for products believed to be environmentally friendly.

The following broad areas of application are reviewed: pollution prevention and control, the 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.

Section 8 deals with liability as an incentive. The Clean Water Act requires cleanup of oil and petroleum product spills into the nation's waters. The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and the Oil Pollution Act (OPA) create liability for harm to the environment caused by releases of hazardous substances and petroleum, respectively. The incentive effect is clear as environmental costs become part of the overall cost of doing business. Awards and settlements for damages to natural resources under these and related state statutes total over $700 million, with a number of large cases involving a similar sum still in varying states of litigation. Cleanup costs, while not documented as fully, certainly have involved even larger sums.

Many of the federal environmental statutes provide for civil and criminal liability for failure to comply with the law and with implementing regulations. The incentive effect of this form of liability is to encourage individuals to comply with what are largely command and control regulations. While civil and criminal provisions of environmental laws are reviewed briefly in this report, such incentives are qualitatively different from those that price services of the environment and for the most part not within the scope of this report.

Section 9 scrutinizes the potential incentive effects of information reporting requirements of two laws, the Emergency Planning and Community Right-To-Know Act (EPCRA) and California's Safe Drinking Water and Toxic Enforcement Act, commonly referred to as Proposition 65. The Toxic Release Inventory reporting requirements of EPCRA have led to a large reduction in releases of the listed substances, even though no reductions are actually required by the law. Merely requiring that public reports be filed seems to provide a strong encouragement for sources to reduce their releases.

Other forms of information reporting are also reviewed in this Section, including environmental impact assessment reporting, product labeling, environmental performance awards, Securities and Exchange environmental reporting requirements, and lead paint and radon disclosure requirements. Information approaches used outside the United States are discussed in Section 11.

Section 10 looks at programs under which EPA asks companies to voluntarily participate in activities to protect the environment. Such programs have become increasingly popular in the 1990s; a recent EPA publication *Partnerships in Preventing Pollution* describes 28 such measures. One incentive for firms to participate in these programs is favorable public relations, which could help product sales and lessen regulatory pressures. Another reason some firms participate is technical assistance that may be offered by the regulatory agency. Voluntary programs may also reduce possibly adversarial relations with residents living near a facility and with the environmental community.

Voluntary programs are criticized for their lack of teeth, for the fact that firms with already-good environmental records tend to participate but bad actors do not, and for the general lack of accountability. While positive results are observed for certain programs, it is difficult to document significant changes in environmental performance as a consequence of many of the voluntary programs.

Section 11 provides an overview of foreign experiences with economic instruments for managing the environment. A broad array of economic instruments exists outside the United States. While the United States has relatively more experience with trading mechanisms, information reporting requirements and, possibly, voluntary programs, the rest of the world has relatively more experience with sophisticated pollution tax systems, a broader array of deposit-refund systems, and the use of environmental funds.

1.4. SCOPE OF REPORT

Though a great many incentive programs are reviewed herein, 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 exhaustive, an attempt has been made to identify those mechanisms that are most likely to have long-run significance In doing so, many important initiatives have undoubtedly been omitted either through lack of information or the need to draw limits and make this project manageable. For example, economic mechanisms for allocating water are noted only briefly, despite their potential linkages to the environment, because pollution control is not their primary objective. Likewise, the brief discussion of highway pricing and congestion charges merely serves to introduce this important application of incentives, since the environmental effects of such charges, though potentially significant, have yet to be documented.

Readers of this report who are aware of interesting applications of incentive mechanisms that they believe should be included in subsequent revisions of the report are encouraged to send that information to Robert Anderson at the following Email address: boba@erols.com.

2. GOVERNMENT POLICIES ON ECONOMIC INCENTIVES

Since its first days in office, the Clinton Administration has expressed strong support for greater reliance on economic incentives in environmental management. Having witnessed the success of the acid rain control program, policy makers are convinced that similar approaches can work in other environmental policy areas.

As discussed in Section 6, experiences with the acid rain control program are very positive to date, showing that environmental protection can be achieved at less cost than previously believed. Not only have pollution abatement costs been much less than expected, the magnitude of emissions reductions has significantly exceeded requirements to date. Moreover, recent scientific evidence indicates that the health benefits are far greater than originally forecast.

2.1. SOME RECENT POLICY DEVELOPMENTS

2.1.1. Reinventing Environmental Regulation

Released on March 16, 1995 by the Clinton Administration, "Reinventing Environmental Regulation" outlines major policy initiatives designed to improve environmental regulation so that the nation achieves a better environment at lower cost.[1] Two of the "10 Principles for Reinventing Environmental Protection" are that environmental regulation must be "performance-based," allowing flexibility while requiring accountability in attaining goals and that "market incentives should be used to achieve environmental goals, whenever appropriate." Open-market air emissions trading and effluent trading in watersheds are two of the "25 High Priority Actions" described in the document. Some of the actions seeking to improve compliance, accountability, and enforcement are coordinated through the Environmental Leadership Program described in section 10 of this report. These include incentives for auditing, disclosure, and correction. Project XL (another voluntary program discussed in section 10) is described as one of the "Building Blocks for a New System" of environmental regulation.

2.1.2. Economic Report of the President

Under the terms of the Employment Act of 1946, the President's Council of Economic Advisors prepares annually an *Economic Report of the President*. Among the topics discussed in the 1996 report is 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." Regulatory reinvention efforts take several forms, including "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 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 and air pollution and for fishing quotas are discussed at length. On the subject of water pollution, the report contains Administration estimates that annual compliance cost savings of several hundred million to several billion dollars could be achieved through expanded use of effluent trading.

2.1.3. Council on Sustainable Development

Appointed by President Clinton in May 1993, the Council on Sustainable Development is composed of representatives from the Cabinet, industry, and environmental groups. The President assigned the Council the task of developing a strategy to achieve long-term economic growth without harming natural resources.

In its report released in March 1996, the Council recommended the use of performance targets in lieu of technology standards, commending Project XL for allowing companies to develop innovative pollution control methods. It also recommended the adoption of incentives and 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 endorsed by the report is the Common Sense Initiative, under which industry and environmental groups are working with EPA to study ways to improve environmental regulations affecting six specified industries.

(report site: www.whitehouse.gov/WH/EOP/pcsd/#council_report)

2.1.4. Vice-Presidential National Performance Review

Vice President Gore's National Performance Review released a report in 1993 entitled *Creating a Government That Works Better & Costs Less*. Focused on reinventing government, the report included a number of recommendations for improved environmental protection, some of which advocated the use of economic incentives. It suggested that EPA work with Congress to encourage incentive approaches to reduce water pollution, including wastewater discharge fees. Another recommendation was the modification of the conditions of access to federal resources for activities such as grazing and mining to ensure that the government obtains a fair return on its land and to provide incentives for appropriate land management.

2.1.5. Executive Order 12866 and Related OMB Guidance

The central idea of President Clinton's Executive Order (EO) 12866 of September 30, 1993 is that regulations should be imposed only if their benefits justify their costs. (This EO replaced President Reagan's EO 12291 described below.) Agencies are required to conduct cost-benefit analysis for any "significant regulatory action." Actions deemed "significant" are 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.

EO 12866 also requires that agencies consider the possibility of using incentive-based approaches for any significant regulatory action. Two specific "Principles of Regulation" in EO 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 guidelines for economic analysis of proposed federal regulations under EO 12866. Among the topics discussed in these guidelines were the importance of performance-based standards, alternative compliance methods, information approaches, and economic incentives.[2]

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 command-and-control 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."

2.2. SOME SIGNIFICANT EARLIER POLICY DEVELOPMENTS

2.2.1. Economic Incentives: Options for Environmental Protection

A 1991 report by the EPA Economic Incentives Task Force, *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. The report focused on four areas where incentives might be applied: municipal solid waste management, global climate change, water resource management, and multimedia 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."

2.2.2. 1990 Clean Air Act Amendments

With the passage of the 1990 Clean Air Act Amendments, the legislative branch of government showed a strong interest in economic incentives and a major shift in approach away from command-and-control requirements that previously had dominated air pollution control policy. Among the incentive mechanisms included in the Amendments are the acid rain control program, provisions for offsets and other trading programs in ozone non-attainment areas, offset provisions for hazardous pollutants, fees based on pollutant emissions, marketable credits for certain fuel constituents, marketable production allowances for ozone-depleting substances, and labeling of ozone-depleting substances. These incentives are discussed in Appendix B and in relevant sections of this report.[3]

2.2.3. The Project 88 Report

Sponsored by Senators Heinz and Wirth, a group of public policy scholars prepared a report identifying 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 nonpoint sources of water pollution;
- a deposit-refund system for containerizable hazardous wastes;
- taxes on fuel-inefficient vehicles with rebates for fuel-efficient vehicles;
- taxes on certain pesticides;
- 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.

2.2.4. Executive Order 12291 and EPA Guidelines for Performing Regulatory Impact Analysis

President Reagan's EO 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 EO 12866. EO 12866 replaced EO 12291.) 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 EO 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 nonregulatory approaches." In "Considering Alternative Approaches," the guidelines call for 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 must submit all RIAs and proposed regulations to OMB for review. Although EPA's RIA guidelines could lead to increased use of incentive mechanisms in environmental regulation, no study appears to have addressed the extent to which the over 100 RIAs prepared to date have considered incentive-based alternatives.

EO 12291 builds on a number of earlier Executive Orders and regulations dating back to President Nixon's "Quality of Life" reviews requiring an assessment of alternatives and cost comparisons for proposed regulations. President Ford's EO 11821 of 1974 and EO 11949 of 1976 required inflation impact statements for major regulations. President Carter's EO 12044 of 1978 required Regulatory Analyses of the economic consequences of proposed regulations and alternatives under consideration and instructed agencies to select the "least burdensome" alternative.[4]

2.3. CONCLUSIONS

In short, government policy, as well as industry and the environmental community, appears to have embraced the following beliefs:

1. Environmental protection should be achieved in such a way as to limit regulatory burden. Regulation should stress performance targets rather than prescribed compliance methods.

2. Industry and government should act as partners rather than adversaries in environmental protection.

3. The use of economic incentives in environmental protection should be increased.

These beliefs have important implications for the incentive mechanisms described in the rest of this report.

3. THE ECONOMIC EFFICIENCY AND ENVIRONMENTAL EFFECTS OF INCENTIVE SYSTEMS

3.1. BACKGROUND

This Section compares various incentive-based strategies for managing the environment with traditional command and control approaches. The goal of environmental management is the control of pollution, or externalities in the terminology of economists. Pollution is an output that occurs outside of normal market transactions. It has no cost to the source but may impose 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. Under the assumptions of costless transactions and no strategic behavior, 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 (Coase). While the assumption of no strategic behavior may be reasonable in many cases, costless transactions, which are necessary for the victims of pollution to negotiate successfully with sources, may never be a realistic assumption. The more victims there are, and the more geographically disperse are the victims, the higher transactions costs are likely to be.

Because negotiations between victims and sources of pollution cannot be relied upon as a means of control, environmental legislation dictates other mechanisms for internalizing pollution externalities. In one approach the pollution control authority specifies in considerable detail requirements for different source categories. The regulations may impose discharge limits or much more, such as the technology that must be used, the inputs that must be used, or characteristics of the outputs that are produced. This regulatory approach is termed “command and control.” Market-based or incentive approaches, by contrast, provide rewards for reducing pollution (and conversely penalties for releasing pollution). The rewards may be of a financial nature, but need not be. In contrast to the command and control approach, an incentive-based regulatory strategy gives sources great flexibility in selecting both the type and magnitude of response.

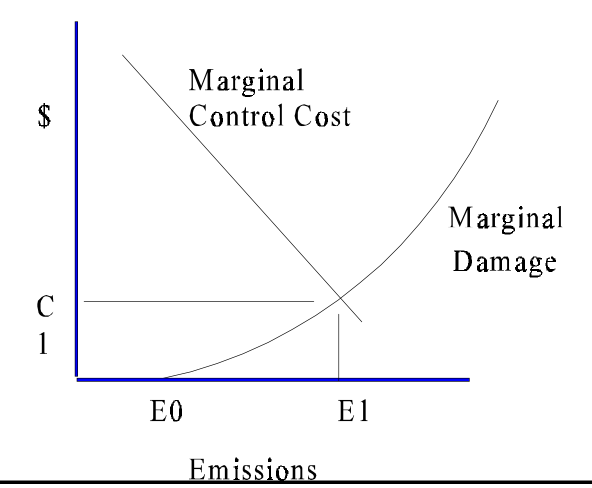
The basic reference point is Figure 3-1, a stylized depiction of the incremental damage of increased levels of pollution and the incremental costs of controlling pollution. The economically efficient level of control limits pollution to E_1. Up to that level of pollution the incremental damage from successive units of pollution are less than the incremental costs of control. Beyond E_1, incremental damage exceeds incremental control cost. Net benefits of pollution control are maximized at E_1.

If cost and damage functions are as well-behaved as depicted in Figure 3-1, traditional command and control approaches generally will not perform as well as incentive-based mechanisms such as pollution taxes, marketable permits, and liability in yielding the efficient level of pollution control. Several factors affect the economic efficiency of different tools for environmental management. As will be shown, market-based instruments offer a number of distinct advantages over traditional command and control approaches. Which instrument performs best, though, depends upon the specific characteristics of the problem. Consequently, a case-by-case approach probably is advisable in selecting the most appropriate instrument from among those potentially available.

Consider first, 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?

On the damage side, 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? At which juncture do major uncertainties arise: imprecise knowledge of the effect of pollution on environmental quality, exposures, physical effects, or economic valuation of effects? How many parties are experiencing pollution damage? Is it critical to control pollution within narrow limits to achieve environmental goals, or are damage functions such that there is a continuum of effects from less serious to more serious, with no obvious unacceptable level of pollution?

Figure 3-1: INCREMENTAL DAMAGES AND COSTS OF CONTROLLING POLLUTION



Depending upon these parameters, some tools of environmental management are likely to perform better than others. Of course, performance can be measured in a number of ways. While economists would place the emphasis on economic efficiency, other criteria such as fairness, political acceptability, stimulus for innovation and technical improvement, enforceability and consistency with religious and moral precepts also could be used in place of or in conjunction with efficiency. Cost-effectiveness is a compromise criterion that takes both economics and the political and legal structure into account by finding the least cost means of achieving a stated environmental goal. Alternatively under this criterion, one could identify the pollution control measure that maximized environmental gains within a given cost budget.

The following sections describe alternative means for managing the environment, pointing out circumstances under which one mechanism is likely to perform better than others.

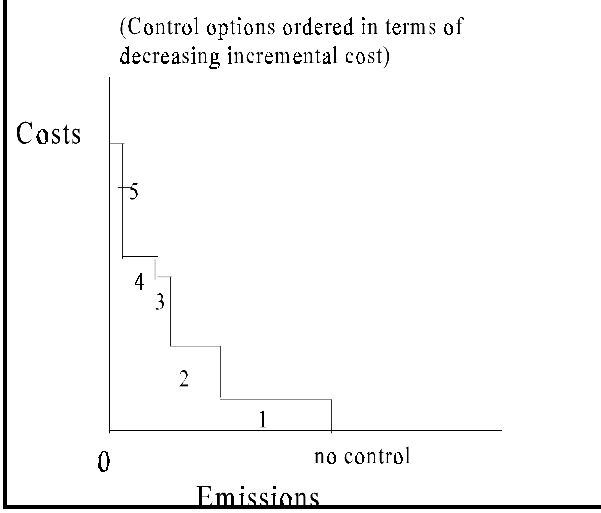
3.2. COMMAND AND CONTROL

Command and control mechanisms normally operate through one of three means: ambient standards, source-specific emission limits, or technology requirements. A brief description of each means illustrates both the strengths and weaknesses of command and control. Ambient standards specify a minimum level of environmental quality (e.g., a maximum concentration of pollutants in the atmosphere, or minimum levels of dissolved oxygen in water) to be achieved through limits on sources, products, and other sources of pollution. Ambient standards at first blush are unambiguous, though how they are set and the means by which they are to be achieved clearly is open to debate. Upon closer inspection, the means by which environmental quality is measured (e.g., the number and location of monitoring stations, the number of excursions allowed above the standard) also provides ample room for disagreement.

In principle, ambient standards could be established with reference to incremental control costs and incremental pollution damage. Environmental laws rarely give EPA this discretion. The Clean Air Act requires that national ambient air quality standards be set to protect human health with an adequate margin of safety (below the threshold of effects E_0 in Figure 1). Cost is not supposed to enter the decision process as a criterion. Similarly, water quality standards such as fishable, swimmable, or drinkable are selected by states for each body of water. EPA sets effluent limitation standards for different industrial sectors on the basis of technologies already adopted by cleaner facilities. Cost enters the standard-setting process only to the extent that large segments of industry must not be driven to bankruptcy.

Unless costs can be taken into account explicitly in setting standards, the ambient standards approach may lead to unsatisfactory outcomes from an efficiency perspective. The ambient standards approach under the Clean Air Act is built on the twin concepts of thresholds below which effects cannot be observed and margins of safety above thresholds for protecting health with a margin of safety. This approach is giving EPA increasing difficulties because even small amounts of some air pollutants are likely to have measurable effects on health or the environment. The lowest levels where effects can be detected have moved steadily lower as scientific techniques improve and as effects on sensitive subgroups are studied. Referring to Figure 3-1, the ambient standards approach built on the assumption of thresholds, eventually would set the maximum permissible emissions below E_0 where effects are first detected. But this results in the control of emissions from E_0 to E_1 whose marginal costs of control exceed marginal damage. By focusing only on environmental improvement, ambient standards are likely to be set at too ambitious a level; large costs may be incurred to achieve incremental improvements in environmental quality that are worth far less than they cost.

Figure 3-2: CONTROL OPTIONS FOR A SOURCE



Emission (or effluent) limits are applied to individual sources as a means of achieving health or environment-based ambient standards. Referring to Figure 3-1, the pollution control authority might attempt to limit total pollutant releases to E_1 , E_0 or some other level by setting emissions standards for individual sources, such that total emissions just equaled those amounts. If pollution rights are "grandfathered" to existing sources, new entrants and expanding existing sources are disadvantaged unless existing sources can transfer some of their pollution rights. Other pollution allocation formulas could be used, such as a set number of pounds of pollution per unit of output, that do not disadvantage new sources.

Unless the pollution control authority is able to identify which sources have the lowest incremental control costs and insist that those sources implement controls first, the incremental cost of controlling emissions to E_1 will be higher than C_1. As Figure 3-2 depicts, each source generally will have a number of options for controlling emissions. The least cost option (1) will control some emissions.

Other successively more expensive measures may be implemented until all emissions are controlled. It is very difficult in practice to identify the least cost strategy for the total emissions from several sources (the incremental cost curve of Figure 3-1). If all control measures and their costs are known, linear programming could be used to find the marginal cost curve. Generally all control measures are not known, and even if they are, pollution control laws do not permit an agency to impose control measures for different sources on this basis. Sources would argue that it is not fair. Consequently, emission or effluent limits are likely to be inefficient.

From a dynamic perspective, identifying the strategies that should be implemented to achieve least cost control is more problematic. Technology is not static. Over time, the number of possible options increases, most of which offer improvements over previous technologies, either in terms of cost or environmental performance. A command and control strategy to identify and mandate least cost controls would lock firms into technologies that become progressively less attractive over time.

Technology requirements specify the techniques or equipment that sources must use to control pollution. Some examples of technology-based standards include the ban on lead in gasoline and the requirement that automobiles be equipped with catalytic converters. Some standards that are nominally performance-based demand a level of emission control that can be met only with one technology and there fore are best classified as technology standards (e.g., new source performance standards for SO_2 emissions at coal-fired electric power plants require a 90% reduction relative to uncontrolled emissions, a degree of control that can be met only by scrubbing). Technology standards are likely to be less efficient than emission or effluent standards; 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, discouraging technical change and innovation. When emissions cannot be measured, and / or there are concerns about the feasibility of enforcing tax or trading systems, technology standards provide an objective indicator that something is being done about pollution. For that reason, if no other, technology standards remain popular despite their lack of efficiency.

3.3. INCENTIVE-BASED MECHANISMS

While incentive-based systems have existed in some form for decades as tools of environmental management, the federal government has aggressively sought their implementation for only the past 10 to 15 years. Economic incentives rely on decentralized decision-making by hundreds or thousands of economic agents, all acting in their own self interest, to protect the environment. In contrast, traditional command and control approaches for environmental management depend upon regulatory commands by a central authority (the EPA) to limit the amount of pollution. While actual compliance is accomplished by firms and individuals subject to the regulations, the flexibility sources have to choose technology, as well as the extent of pollution control, tend to be quite limited under a command and control approach. Economic incentive methods generally allow sources to select both the amount of control and the technology.

3.3.1. Pollution Taxes, Fees, and Charges:

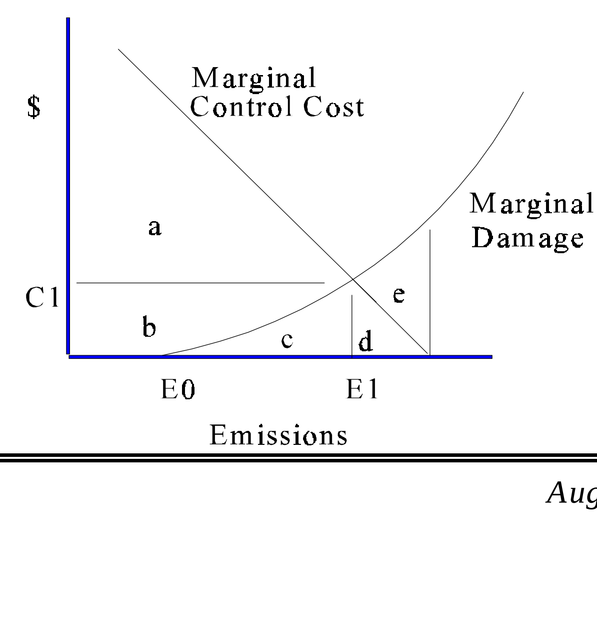
The feasibility of imposing emission fees, taxes and charges depends on a number of parameters, one of which is whether one can measure emissions. From an economic perspective, these instruments are interchangeable, though from a legislative and legal perspective there are some differences. Proposed taxes must be reviewed by the House Ways and Means Committee, since tax revenues are a part of general federal revenues. Perhaps for that reason, there are few environmental taxes labeled as such (one notable exception being the CFC tax). Fees and charges, in contrast, are designed to recover some or all of agency administrative costs and need only be reviewed by environment committees and subcommittees. Fees and charges can arise in two ways: (1) the activity subject to fees and charges may be specified by an environmental statute, and (2) Section 6501 of the Omnibus Budget Reconciliation Act of 1990 authorizes EPA to assess and collect fees and charges for services carried out under the nation's environmental laws.

Long ago economists pointed out that an emission tax provides the pollution control agency with limited control over the physical quantity of emissions. If the magnitude of emissions is very important, as could be the case with important health exposure thresholds, an emission tax may be viewed as an inadequate control over actual emissions. Environmentalists sometimes oppose emissions fees because they seem to sanction polluting activities; emission fees become a "license to pollute."

In the remainder of this discussion, the simple analytics of fees, charges and taxes (the terms are used interchangeably) will be described from an economic perspective. Refer to Figure 3-3 in which a tax per unit of emissions is imposed. A cost-minimizing polluter faced with an emissions tax controls those emissions for which control costs are less than the tax and releases the remainder, paying the tax on each of those units of pollution. For example, if an emissions tax just equal to C_1 were imposed, cost-minimizing polluters would reduce total emissions to E_1. If the tax were less than C_1, emissions would be greater than E_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 areas b+c in Figure 3-3. They spend an amount equal to area d to control emissions beyond E_1 and reduce environmental damage by an amount d+e. Emission fees set at levels to materially change behavior typically would result in large revenue transfers to the government. That is, area b+c tends to be large relative to area d. For this reason, polluters usually oppose pollution charges, taxes and fees that would be high enough to have an incentive effect. Legislation

Figure 3-3: MARGINAL DAMAGES AND COSTS FOR TAX PER UNIT OF EMISSIONS APPROACH TO POLLUTION CONTROL



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 at the margin are only a few percent of marginal control costs.

Two exceptions that are described in more detail later in this report are worth noting: (1) U.S. chlorofluorocarbon taxes that were designed to remove a windfall that would otherwise accrue to producers while the quantities of CFCs allowed in commerce were being reduced by government regulation; and (2) the Swedish NO_x charge, which is set at a high level with the objective of changing behavior, then rebated to affected power plants in proportion to their energy output to avoid the large revenue transfers that otherwise would occur. Relatively "clean" facilities receive rebates in excess of payments while relatively "dirty" facilities pay more than they receive in rebates.

The pollution damage function depicted in Figures 3-1 and 3-3 is idealized. In many situations, the function is not well known, so the ability of an agency to set charges to equate marginal control costs and 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; regionally differentiated charges may be required to attain efficient pollution control.

3.3.2. Subsidies

Subsidies are the mirror image of emission taxes. Rather than taxes to encourage firms to reduce 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. While existing firms, farmers and the like have an incentive to reduce their pollution, new entrants may be attracted by the higher profits earned as a result of subsidies. In some extreme situations this could have the perverse effect of increasing total pollution.

3.3.3. Trading Systems

Two main forms of trading systems are observed: emission (or effluent) reduction credits (ERC), and tradable allowances for future pollution. ERCs are earned by releasing less pollution than authorized in a facility's permit. With either form of trading, sources with high marginal control costs will try to find sources with low marginal control costs. Trading ERCs or allowances in such a situation is mutually beneficial.

For trading systems to function well, a number of requirements must be satisfied. There should be several potential participants in trades to create a functioning market. 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 is a reasonable estimate. If sources are dispersed geographically, trading ratios other than one to one might have to be imposed to assure no degradation in environmental quality. This could dampen interest in trading. Trading requires that pollution control agencies have the ability to monitor emissions (or measure a surrogate) reasonable well. The commodity to be traded needs to be well-defined. Generally 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.

Price versus Quantity Instruments

The economics literature makes an important distinction between price and quantity instruments in a setting of uncertainty over control cost and damage functions (Weitzman). Quantity instruments, such as marketable permits and credit trading within caps, 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 have good information concerning the costs of a quantity-based approach, or the environmental consequences of a price-based approach. Which type of uncertainty is more serious? If there are important environmental threshold effects, a quantity approach would be preferred. But few pollutants have that characteristic; most exhibit stable dose-response relationships. Rather, the important discontinuities are likely to lie in the cost function, as different technologies must be used to achieve progressively greater control over emissions. Though he declines to

Trading systems tend to be more popular than tax systems with pollution sources because the sources generally do not have to pay for their rights to pollute up to permitted amounts. In fact those rights become the commodity that is traded and hence immediately have a value once a trading system is created.

The literature cited later in this Section predicts large potential savings from trading systems, yet available evidence points to relatively modest savings. In searching for reasons for the wide gap between the potential and what actually is accomplished, Stavins identifies transactions costs as the primary culprit. With transactions costs as a barrier to trading, sources tend not to venture far from their initial allocation of pollution rights. As transactions costs rise, the prices that sellers receive for pollution rights fall and the prices that buyers must pay rise, making transactions less likely. Transactions costs were especially high in EPS's early Emissions Trading Program, described later in this report, with the result that fewer than one percent of the emissions potentially available for trading actually were traded (Hahn, 1989). Transactions costs were lower for programs such as lead credit trading, resulting in a far higher proportion of available credits actually being traded. Transactions costs also feature prominently in the choice between making trades internally within a firm and externally between firms. For all of the trading programs that have been studied, firms exhibit a strong preference for internal trading when that is feasible, often even when larger cost savings are available externally. (Burtraw, Kerr)

3.3.4. Deposit-Refund Systems

A deposit-refund system operates like a tax system on the original purchase with a subsidy system for returning a used item to a designated collection site. The purpose of the subsidy or refund it to encourage individuals and firms to dispose of 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.

Though most deposit-refund systems are created by legislation, deposit-refund systems occasionally 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; the private sector has created deposit systems for lead-acid batteries in every other state, 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 through most European nations. In a few nations of Europe, deposit systems help assure the recycling of used motor oil.

Administrative costs may be important for deposit systems and potentially outweigh their other attractive features. Ackerman at al. (1995) estimate that these costs average about 2.3 cents per container (over $300 per ton for steel containers, $1,300 per ton for aluminum cans) in states with traditional bottle deposit legislation. These costs may be compared with disposal costs which average nearer to $100 per ton. Also potentially important are the costs imposed on consumers, who must store used containers and return them for redemption. 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.

3.3.5. Information Programs

By information programs, this report refers to mandatory disclosure requirements, such as those associated with Title III of the Superfund Amendments and Reauthorization Act of 1986 and California's Proposition 65. 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 retrospective study of eight firms, conducted by the Center for Environmental Management at Tufts University found that SARA Title III requirements gave a strong incentive for those firms to identify and act upon opportunities for reducing accidental and routine releases of hazardous substances. Information reporting requirements caused firms to behave as if all emissions were costly. Emissions that could be controlled relatively cheaply were reduced.

3.3.6. Liability for Health and Environmental Harm

One approach for resolving environmental issues is to make polluters liable for damage they cause. The purpose is twofold: first to get polluters to make more careful decisions and second to compensate victims of pollution. Liability operates to control pollution through the decentralized decisions of polluters.

Refer again to Figure 3-1. If polluters are liable (and must pay) for the damage they cause, they will control pollution to the optimal level where 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 and common law. Civil liability is expressly written into law. For example, many of the environmental statutes, worldwide, have liability provisions. In the US, the most important ones are the Comprehensive Environmental Response, Liability and Compensation Act (CERCLA) and the Oil Pollution Act (OPA), which hold responsible parties liable for cleanup costs and for damage to natural resources caused by releases of hazardous substances and petroleum, respectively. Liability under CERCLA applies to historic as well as contemporary releases. The form of liability is strict, joint and several, meaning that one contributor out of many can be held responsible for all of the damage. Further, since liability is retroactive, an individual can be held liable for actions that were perfectly legal at the time they occurred. The incentive effect of retroactive liability is open to question. Does it enhance efficiency? Will it affect future behavior in the desired manner? CERCLA is apparently the only statute (worldwide) with retroactive liability for actions that were legal at the time they were done. While the statute has withstood numerous legal challenges, it clearly lies well outside the mainstream of ordinary civil liability.

Harm to individuals and their properties caused by pollution is actionable under various doctrines of common law such as nuisance, trespass, and negligence. Whether these approaches are effective 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 limiting factor is the time limit within which cases can be filed, 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 cancer and other diseases of long latency that result from contact with 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. Typically, a defendant will be judged either guilty or innocent of causing the harm. The burden of proof required for a guilty verdict is usually the standard of "more likely than not," usually interpreted as greater than 50 percent probability. 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 criterion can be difficult. Even if a substance is implicated, it may be difficult to determine the polluter responsible for the harm. For example, an auto mechanics' mesothelioma may be attributed to inhaling dust from brake linings, but assigning responsibility to a particular manufacturer may be impossible. A minority of 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 transactions costs of pursuing a claim. These costs include the legal costs of obtaining evidence, agreeing among plaintiffs 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 with transactions costs small in proportion to the amounts awarded, if there are few defendants and clear causation, even if the number of plaintiffs is large.

3.4. RELATIVE ECONOMIC EFFICIENCY

Economic theory and common sense argue that incentive mechanisms should enhance the efficiency of pollution control relative to traditional command and control approaches. The reasons for this conclusion are several. First, some incentive-based mechanisms explicitly allow trading of pollution reduction obligations. With trading, sources with high incremental costs of control can have their obligations satisfied by sources with low incremental costs of 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 idealized world without transactions costs and competitive markets, both permit/credit trading and pollution charge approaches should result in the marginal cost of controlling pollution being the same at each source. At every level of pollution, control costs should be lower than (or at worst the same as) costs associated with a command and control approach.

A number of other incentive-based mechanisms, such as information reporting requirements, liability, and voluntary programs, rely on implicit charges for pollution. The efficiency consequences of such mechanisms are more difficult to predict because sources are reducing pollution for reasons that have only an indirect financial consequence. And sometimes that financial link is very tenuous. The motives for participating in voluntary programs are largely one of improving corporate image to customers, to employees, and to regulators, though management concern for the environment certainly could be a factor. While the motives for controlling pollution are very real, the benefit to the 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 as part of such programs to generate a willingness to pay for pollution reduction. One might find that forms respond in a systematic fashion to various of the indirect incentives. For example across a sample of firms, liability might generate higher willingness to pay for a unit of pollution reduction than does an information reporting requirement, which in turn might exceed the willingness to pay for strictly voluntary activities.

The following tables summarize results of theoretical studies that compare incentive mechanisms with command and control approaches for managing the environment. One observes that in every case the command and control approach would be more costly than the market-based approach, sometimes much more costly. Of course, these are merely theoretical studies of *potential* savings. Actual savings could be much less if sources face high transactions costs with trading regimes that are the basis for comparison in most of the studies.

Table 3-1: QUANTITATIVE STUDIES OF POTENTIAL SAVINGS FROM USING ECONOMIC INCENTIVES TO CONTROL AIR POLLUTION

Pollutant Controlled	Study Year, Source	Geographic Area	Command and Control Approach	Ratio of CAC to Market-Based Approach
Hydrocarbons	Maloney & Yandle (1984) T	DuPont facilities in U.S.	Uniform percent reduction	4.15
Nitrogen dioxide	Seskin *at al.* (1983) T	Chicago	Proposed RACT regulations	14.4
Nitrogen dioxide	Krupnick (1986) O	Baltimore	Proposed RACT regulations	5.9
Particulates (TSP)	Atkinson & Lewis (1974) T	St. Louis	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/m^3
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

Pollutant Controlled	Study Year, Source	Geographic Area	Command and Control Approach	Ratio of CAC to Market-Based Approach
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?	Toman *et al.* (1994) O	Poland	EC 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 Northeast	1.3 (NE only) 2.0 (CA + NE)

Table 3-2: QUANTITATIVE STUDIES OF POTENTIAL SAVINGS FROM USING ECONOMIC INCENTIVES TO CONTROL WATER POLLUTION

Substance Controlled	Source Year, Source	Geographic Area	Command and Control Approach	Ratio of CAC to Least Cost 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
Phosphorus	David et al. (1977) A	Lake Michigan		
Selenium	EDF (1994) O	Central Valley, CA	Best management practices	1.2

Table 3-3: QUANTITATIVE STUDIES OF POTENTIAL SAVINGS FROM USING ECONOMIC INCENTIVES TO REDUCE SOLID WASTE

Substance Controlled	Study Year, Source	Geographic Area	Command and Control Approach	Ratio of CAC to Least Cost Approach
Municipal solid waste	Palmer, et al. (1995) O	United States	Uniform percent reduction of 10%	2.0

Table 3-4: QUANTITATIVE STUDIES OF POTENTIAL SAVINGS FROM USING ECONOMIC INCENTIVES FROM OTHER POLLUTION-RELATED ACTIONS

Substance Controlled	Study Year, Source	Geographic Area	Command and Control Approach	Ratio of CAC to Least Cost Approach
Fuel efficiency	Charles River Associates (1991) O	United States	CAFE standards	4.5
Agricultural chemicals	Rendleman *et al.* (1995) O	United States	Uniform percent reduction	1.1
Traffic congestion	Hau (1990) O	Hong Kong	Car ownership restraint	2.5

Footnotes for Tables 3-1 to 3-4

a. Based on 85 percent reduction of emissions from all sources.

b. The trading of lead credits reduced the cost to refiners of the lead phasedown by about $225 million.

c. Ratio based on 40 g/m^3 at worst receptor, as given in Tietenberg (1985), Table 4.

d. Ratio based on a short-term, one-hour average of 250 g/m^3.

e. Because it is a benefit-cost study instead of a cost-effectiveness study, the Harrison comparison of the CA approach with the least-cost allocation involves different benefit levels. Specifically, the benefit levels associated with the least-cost allocation are only 82 percent of those associated with the CA allocation. To produce cost estimates based on more comparable benefits, as a first approximation the least-cost allocation was divided by 0.82 and the resulting number compared with the CA cost.

Acronyms Used: CAC—Command-and-control, the traditional regulatory approach. DO—Dissolved oxygen; higher DO targets indicate higher water quality. RACT—Reasonably available control technologies. SIP—State implementation plan.

Sources: A stands for Anderson *et al.* (1989); they did not compute the ratio or provide the other information left blank in this table. O stands for original reference. T stands for Tietenberg (1985), Table 5. See Appendix A for all references.

In many of these studies, a distinction was not drawn as to 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 identified through linear programming. Examining the performance of trading systems in particular, one finds that existing applications fail to achieve anywhere near their theoretical potential cost savings.[5] Trades have been fewer and cost savings smaller, according to this analysis, than indicated by economic modeling.

A number of explanations have been offered about why the predicted savings are not realized.[6] 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 is in addition to existing command-and-control programs. Various models have not fully reflected 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 limitations imposed by the regulatory structure, potential participants in trading systems may be reluctant to trade paper credits, 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. Further, markets in rights available for sale tend to be thin (Hahn) and it may be difficult to locate potential sellers of rights.

For tax, charge and fee systems, with a couple of exceptions in Sweden, the principal limitation to achieving the theoretical efficiency gains has been the generally low level of charge relative to what would be required to have a significant impact on pollution. Charges typically are set to recover administrative costs for a program, not to impact pollution.

Even if the cost savings 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 costs savings while achieving equivalent environmental goals. In other circumstances, the cost differences between an incentive program and a well designed command-and-control program will be less,[7] although the incentive program will provide a stronger stimulus for innovation and technical change.

3.5. ECONOMIC INSTRUMENTS AND TECHNOLOGICAL CHANGE

Market-based instruments should have significant advantages over command and control 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 firm. In contrast, under a command and control approach, once a source has satisfied the emission limits, all pollution within those limits is costless. Why spend valuable resources instituting further controls when there is no reward? In fact, the incentives may be negative, for a firm that controls to less than permitted amounts may be inviting reductions in what is permitted. In many parts of the nation pollution control agencies are constantly struggling to find ways of meeting ambient environmental quality goals. Firms 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 supply the catalyst for regulations that require other firms in the same industry to undertake what has been demonstrated as possible.

Figure 3-4: COSTS FOR EMISSIONS CONTROL FOR FIRMS UNDER EMISSIONS TAX AND COMMAND AND CONTROL APPROACHES

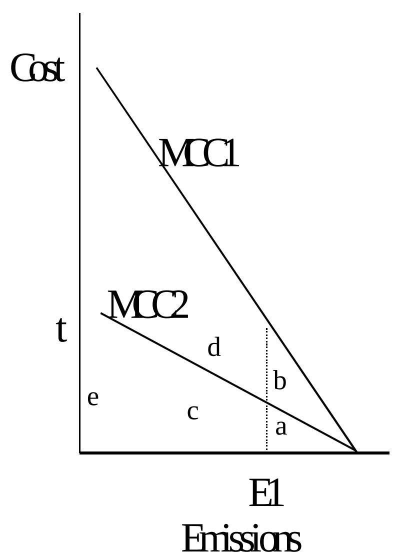


Figure 3-4 depicts graphically the difference in incentives for innovation between an emissions tax and a command and control policy. With marginal control costs of MCC1, a firm controls emissions to E1 with an emission standard set at that level, incurring costs equal to area (a+b). With an emissions tax set at t, the firm also would control emissions to E1, incurring costs equal to (a+b+c+d+e).

The incentive to the firm to find improved methods of pollution control are much stronger under the emissions tax, since total pollution control outlays are so much higher. If the firm finds a new pollution control technology with marginal control costs equal to MCC2, 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 decline by an amount equal to area (b+c).

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 command and control the least. Among command and control 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. One author said the rate of technological change in pollution control is "the single most important criterion on which to judge environmental policies." Another analyst termed innovation "the key to an effective solution" of environmental problems.

The available evidence suggests that existing environmental policies give only a mild stimulus for technical change and innovation, though there are important exceptions such as the U.S. acid rain control program where control costs have fallen dramatically due to major technical and behavioral changes. Outlays for research and development in pollution control are between two and three percent of total pollution control expenditures. This is about the same as the average R&D expenditure in all of U.S. manufacturing, but far lower than one might expect in a new and rapidly changing industry. A more apt comparison might be provided by drugs, electronics and information processing where R&D runs between 6 and 10 percent of expenditures. Research and development in pollution control appears to lag behind largely because of the command and control framework that has been chosen, not because of any other inherent limitation. Pollution control based more heavily on economic instruments would be expected to stimulate greater R&D and in turn reduce over the long run the costs of improving the environment.

3.6. IMPACTS ON ENVIRONMENTAL QUALITY

A full understanding of the effectiveness and economic efficiency of incentive programs requires information on the realized environmental benefits. The literature focuses almost exclusively on the cost side because of the presumption that the same environmental goals are being sought. In comparing incentive-based policies with command and control approaches, or among different incentive-based policies, there may be impacts on environmental quality that would be of interest to regulators and other parties.

Generally, incentive mechanisms based on trading are designed to produce environmental effects that closely approximate what would be achieved through a command and control approach. Some distinctions still apply, however, in that a "cap and trade" policy is likely to give greater control over total emissions than is an "open market" trading approach. Open market approaches do not provide a limit on total emissions; credits may be generated as sources see fit. If there is to be a control on total emissions, it would have to come from a companion command and control regime. In contrast, under a capped trading program, total emissions are limited. Either type of trading will reduce total emissions if trading ratios of greater than 1:1 are required. Some trading program described in this report have that feature (e.g., fireplace permit trading) but others do not (e.g., acid rain allowances).

Emission tax systems typically have not been designed to have an environmental impact. Rather, modest revenue raising has been the principal goal. 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 (Swedish NOx and SO2 charges, and United States CFC taxes).

Deposit systems appear to produce environmental effects greater than would be expected through a command and control method; however, there appears to be a threshold of deposit size needed in order to induce people to achieve the desired environmental objective. For example, deposits on automobile bodies function well in assuring the proper disposal of car hulks when set at a high enough level (see the section on international experiences). In contrast, thousands of abandoned car hulks 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. Often it is not correct to simply assume various approaches yield the same result. Oates et al. (1989) describe an example of particulate matter control in the Baltimore region in which "over control" in some areas required under a command and control approach yields environmental improvements that lessen the relative attractiveness of an incentive-based policy that produces more uniform pollutant concentrations.

3.7. FINDING THE RIGHT INSTRUMENT FOR THE PROBLEM

This section has described a wide range of instruments from the perspectives of economic efficiency, distributional consequences, environmental effects, and incentives to develop new technologies to deal with pollution. The evidence accumulated from literally hundreds of applications of economic that is reviewed in the following sections suggests that the set of instruments that can deal successfully with individual classes of environmental problems is fairly narrow. Table 3-5 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 Field and Dower for other perspectives on selecting the correct economic instrument for individual environmental problems.

Table 3-5: USES OF ECONOMIC INSTRUMENTS

Instrument	Types of Applications	Examples	Pros & Cons
Pollution Charges & Taxes	* damage function has little slope * monitoring data available	Emission charges Effluent charges Solid waste charges Sewage charges	Pro: stimulates new technology; effective if the charge is high Con: potentially large distributional effects; uncertain environmental effects
Input or Output Taxes & Charges	* numerous sources * no monitoring data * damage function has little slope * some link between environment and use of input or output	Leaded gasoline tax Carbon tax Fertilizer tax Pesticide tax Virgin material tax Water user charges CFC taxes	Pro: administratively simple; raises revenue Con: often weak link to pollution; uncertain environmental effects
Subsidies	* politically or economically infeasible to tax activity * unlikely to stimulate new sources to enter * monitoring is feasible	Municipal sewage plants Land use by farmers Industrial pollution	Pro: politically popular Con: budgetary cost; may stimulate too much of activity; uncertain effects
Deposit-Refund Systems	* reusable or recyclable * damage function has little slope	Lead-acid batteries Beverage containers Automobile bodies	Pro: deters littering; stimulates recycling Con: potentially high transactions costs
Marketable Permits	* damage function has steep slope * strict control over pollution important * marginal control costs vary across sources	Emissions Effluents Fisheries access	Pro: control over activity; stimulus to technical change Con: potentially high transactions costs;
Reporting Requirements	* damage function unknown or of low slope * strict control over pollution unimportant	Proposition 65 SARA Title III	Pro: flexible, low cost Con: impacts may be hard to predict
Liability	* links between pollution and harm are clear * harms not life threatening	Natural resource damage assessment Nuisance, trespass	Pro: strong incentive where applied Con: assessment and litigation costs can be high; burden of proof large; few applications
Voluntary Programs	* damage functions unknown * seeking control beyond what is required by law	Project XL 33/50 Greenlights	Pro: low cost; many possible applications Con: uncertain and perhaps low effectiveness

Endnotes for Section 3

1. A text of "Reinventing Environmental Regulation" can be found in *DEN*, March 17, 1995, p. E1.

2. The guidelines draw a distinction between "informational measures" and "market-oriented approaches." This report, however, considers information approaches as a type of economic incentive. Information approaches are described in Section 9.

3. For further information on economic incentive provisions in the 1990 Clean Air Act Amendments, see Appendix B of the previous version of this report: EPA (July 1992), *The United States Experience with Economic Incentives to Control Pollution*.

4. For a discussion of the evolution of benefit-cost analysis requirements, see Rusin et al (June 1996).

5. Atkinson and Tietenberg (1991).

6. See Atkinson & Tietenberg (1991), Dudek & Palmisano (1988), Hahn (1989), Hahn & Hester (1989), Liroff (1986), and Tietenberg (1985 and 1990).

7. Oates *et al*. (1989).

4. FEES, CHARGES, AND TAXES

4.1. INTRODUCTION

A pollution charge is a fee based on the quantity and/or content of pollutants discharged into the environment. A user charge is a fee paid in exchange for use of natural resources or collection or disposal of pollutants. Product charges are imposed on products that are believed to have environmentally harmful effects. Although the terms "fee,""charge," and "tax" are used interchangeably in this Section, they do not all convey the same connotation. Under federal law, a tax is a purely revenue-raising instrument, whereas charges or fees are intended to offset costs to government. Although the different types of fees, charges, and taxes discussed in this Section could be classified in various ways, they may be summarized as follows:

Table 4-1: OVERVIEW OF FEES, CHARGES, AND TAXES IN ENVIRONMENTAL POLICY

Instrument	Description	Examples
Pollution fee	Charge based on the quantity and/or content of pollutants released into the environment	1. Air emissions permit fees in California, Maine, other states 2. Effluent permit fees in Louisiana, California, Wisconsin, other states 3. Solid waste disposal fees
User fee	Fee for the use of resources	1. Water use fees 2. Road congestion fees 3. Grazing fees
Product charge	Charge on a product believed to have environmentally harmful effects	1. Gas guzzler tax 2. CFC tax 3. State taxes on fertilizers 4. State advance disposal fees on tires, motor oil, packaging, other goods
Other fees on environmentally damaging activities	Various mechanisms	1. Wetland development fees 2. Stormwater runoff fees

As discussed in Section 3, most environmental taxes are intended 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 damage to the environment and the administrative costs incurred by authorities in regulating polluters. To be economically efficient, environmental taxes should reflect these costs.

Although some charges, especially product charges, have been imposed on the federal level, the majority of them have been introduced on 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 charges as they have seen fit.

Given the multiplicity of environmental taxes imposed at various levels of government and the frequency with which they are adopted or modified, this Section does not attempt to provide a comprehensive description of all environmental taxes in place in the United States. Its purpose is rather to describe some of the more important taxes to stimulate discussion.

4.2. WATER FEES

Water fees take various forms, including user fees (for groundwater, surface water, or for 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 good but rather a scarce resource that should be priced to avoid inefficient use that can cause environmental problems.[1] The rationale for discharge fees follows from the polluter pays principle as described above. Most water fees are intended primarily to raise revenue, but user fees based on consumption and discharge fees based on volume or toxicity may have some incentive effect.

4.2.1. Indirect Discharge and User Fees

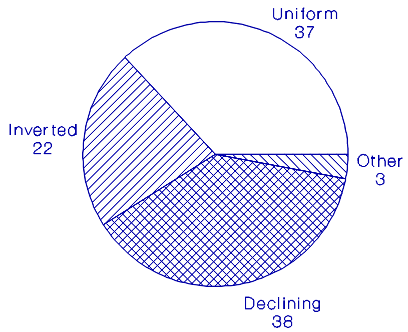
Fees are imposed on households and businesses for discharges into Publicly Owned Treatment Works (POTWs). Some larger businesses' fees are based not only on water use but also on discharge toxicity. To the extent that discharge fees are included in water consumption bills, they can be difficult to distinguish from water user fees.

As shown in Figure 4-1, periodic surveys of selected water utilities indicate that water fees are almost always based at least in part on water consumption. The declining block rate structure is becoming less common, the main reason for the shift being the desire to promote water conservation.

Figure 4-2 indicates that water and wastewater fees have risen significantly during every 2 year period since 1986. These price rises have exceeded inflation.

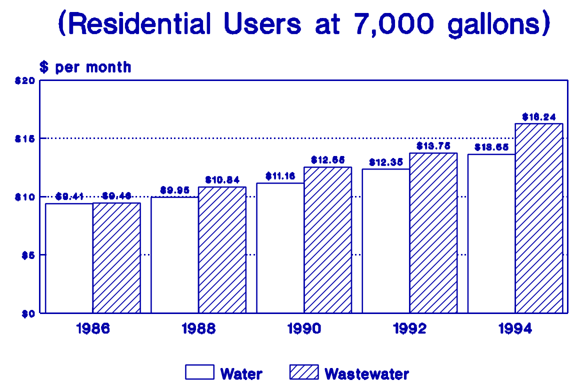
In addition to water and wastewater charges, stormwater charges have been imposed in a number of areas. Ernst and Young found that the number of utilities with such charges increased significantly from 1992 to 1994. Their use varies significantly across regions: They are used by over half of all utilities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

Figure 4-1: 1994 WATER CHARGE STRUCTURES



Source: Ernst and Young 1994 National Water & Wastewater Rate Survey, p. 7

Figure 4-2: MONTHLY WATER AND WASTEWATER CHARGES



Source: Ernst & Young 1994 National Water & Wastewater Rate Survey, p. 3

for measures to promote stormwater management.[2]

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.[3]

Sims (1977) found that pollutant-based charges provided an incentive for large industrial facilities to reduce discharges. Some studies have found that household water demand elasticity is low in winter but significant in summer, and others have found industrial and agricultural water demand to be sensitive to price.[4] Two European studies cited in Section 9 found residential water demand inelastic, between -0.05 and -0.30.

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 promulgated by EPA. All point sources must obtain National Pollution Discharge Elimination System (NPDES) permits in order to discharge effluent. EPA has authorized 40 states to issue NPDES permits. In the other ten 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.[5]

As shown in Table 4-2, 39 states assessed NPDES permit fees as of December 1993. In 18 of these states, fees varied according to discharge volume, and in an additional 10, fees varied according to discharge volume and toxicity.[6] Other criteria sometimes used in setting fees include the purpose of the water use, the receiving water, and the type of discharger. Some states use point or class systems with various criteria to determine different dischargers' fee levels. Fees for POTWs are sometimes based on the size of the population presumed to be connected to the local sewage system.

Table 4-2: STATE EFFLUENT FEES AS OF DECEMBER 1993

States with effluent fees that are flat or vary only according to industry or size of permittee.	Alabama, Alaska, Delaware, Hawaii, Kentucky, Maine, Massachusetts, Pennsylvania, Rhode Island, Utah, Virginia
States with effluent fees varying 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
States with effluent fees varying according to discharge volume and toxicity	California, Indiana, Louisiana, Maryland, Montana, New Jersey, Oklahoma, Texas, West Virginia, Wisconsin

Source: Duhl, p. 10.

4.2.3. Examples of State Effluent Fees: Louisiana, California, and Wisconsin

Although it is beyond the scope of this report to describe all state water effluent fees, examples from Louisiana, California, and Wisconsin should illustrate their characteristics. 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 assigning points on the basis of 1) facility complexity, 2) flow volume and type, 3) pollutants released, 4) heat load, 5) potential public health threat, and 6) major/minor facility designation. 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.

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: I, II, and III for water quality threat and a, b, and c for permit complexity. Permittees with a I-a rating, with the greatest threat to water quality and the most complex permits, pay the highest fees, $10,000 a year. III-c permittees 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 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 designed to identify hot spots, develop a water quality database, and help coordinate water policy. Bay Protection and Toxic Cleanup fees range from $300 for III-c permittees to $11,000 for I-a permittees. Dredging operations are charged an annual fee of up to $15,000.[7]

(Bay Protection and Toxic Cleanup fee schedule: www.swrch.ca.gov/pub/FEES/feebptc.zip)

The Wisconsin effluent fee system is believed to have potential incentive effects. Since the fee rate per pound of pollutant is inversely related to the permit limit for the pollutant, the most harmful pollutants are taxed at the highest rate. 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.

The primary purpose of NPDES permit fees is to raise revenue, especially for the permitting program, which explains why fees are often based on permit complexity. 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 comprehensively studied, several factors limit the likelihood of a strong impact. In some cases, fees are based not on actual discharge characteristics but rather on proxies for discharge data. Moreover, some fee structures place dischargers into classes for the purposes of discharge volume and/or toxicity and charge the same fees for all volume and toxicity levels within given classes. In such cases, polluters have no incentive to limit discharges unless they can move from one class to another. Finally, the charges are often modest relative to control costs. As of 1993, the largest effluent fees in the United States, paid by two facilities in New Jersey, amounted to $702,812, and most states had maximum fee levels of less than $100,000. For large facilities, annual effluent control costs typically exceed $5 million.

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 stormwater management in stream valleys. These fees differ from the utility stormwater fees described above in that they apply to runoff into surface water.

4.3. AIR FEES

As is the case with water pollution, there are no national air emissions fees. However, the Clean Air Act Amendments of 1990 provided for permit fees and for mandatory excess VOC fees in ozone non-attainment areas.

4.3.1. Permit Fees

The 1990 Clean Air Act Amendments require states to 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 criteria air pollutants (excluding carbon monoxide) and air toxics and specified that this amount should be adjusted for inflation. Each state is required to set fees to completely cover operating permit program costs. If the fees are greater than or equal to $25 per ton adjusted for inflation (currently about $30 per ton), EPA assumes that they 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 EPA full approval because insufficient information was submitted on fee adequacy. These states have received interim approval pending submission of evidence of fee adequacy.

Although states can meet the revenue-raising requirement through flat or other types of fees, most have chosen incremental fees of approximately $20-30 per ton. Some states base fees on the pollutant's potential harm to the environment. New Mexico, for example, charges fees of $150 per ton for air toxics but only $10 per ton for criteria pollutants[8]. Fee structures in Maine and Southern 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 from $2 to $5 per ton for emissions up to 1,000 tons, from $4 to $10 per ton for emissions between 1,001 and 4,000 tons, and from $8 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 cover sulfur oxides, NO_x, VOCs, and particulate matter. Having since been adjusted for inflation, their current levels are shown in Table 4-3. The fees apply to all permit holders, of which there are currently 517.

Maine has also imposed an air quality surcharge based on 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 adoption of the surcharge, the Director of Maine's Air Quality Bureau said it would give polluters an incentive to identify methods of reducing their emissions of the most toxic substances. An Air Quality Bureau official says that surcharge revenues have fallen and that the surcharge has had a slight incentive effect, but the impact is difficult to isolate from other potential factors such as the Toxic Release Inventory. Annual revenues are approximately

$1.8 million from permit fees and $0.6 million from toxicity surcharges. Revenues are used for the air permit program and other air quality activities

Table 4-3: AIR EMISSIONS PERMIT FEES IN MAINE
(in dollars per ton)

Amount emitted	Fee
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

.[9]

4.3.1.2. Air Emission Permit Fees in the South Coast Air Quality Management District

The South Coast Air Quality Management District (SCAQMD, located in Southern California) levies the highest unit air emissions fees in the United States. The fees shown in Tables 4-4 and 4-5 are adjusted for inflation every May.[10]

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[11].

(www.aqmd.gov/rules/html/r303.html)

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

Table 4-4: EMISSION FEES IN SCAQMD
($ per ton)

Annual Emissions	Organic Gases	Specific Organics[12]	Nitrogen Oxides	Sulfur Oxides	Particulate Matter
4-25 tons	$274.47	$49.16	$156.70	$190.49	$209.95
25-75 tons	$445.50	$77.83	$255.01	$308.27	$340.01
>75 tons	$666.72	$116.75	$384.05	$461.89	$509.00

Source: SCAQMD Rule 301 (www.aqmd.gov/rules/html/r301.html)

Table 4-5: AIR TOXICS AND OZONE-DEPLETING CHEMICALS FEES IN SCAQMD
($ per pound)

Pollutant	FY96-97	FY97-98
Asbestos, cadmium	$2.17	$3.00
Benzene, carbon tetrachloride, ethylene dibromide, ethylene dichloride, ethylene oxide	$0.90	$1.00
Methylene chloride	$0.05	$0.05
Hexavalent chromium	$2.67	$4.00
Chlorinated dioxins and dibenzofurans	$3.17	$5.00
Nickel	$1.67	$2.00
1,3-Butadiene, inorganic arsenic, beryllium, polynuclear aromatic hydrocarbons (PAH)	$1.50	$3.00
Lead, vinyl chloride	$0.50	$1.00
1,4-Dioxane	$0.11	$0.21
Formaldehyde, perchloroethylene	$0.21	$0.21
Chlorofluorocarbons	$0.18	$0.18
1,1,1-trichloroethane	$0.038	$0.40

Source: SCAQMD Rule 301 (www.aqmd.gov/rules/html/r301.html)

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 program is administered by the California Air Resources Board (CARB). The law also requires CARB to develop and adopt fees to cover administrative costs of the program 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 Section 9. The fees are discussed here.

(CARB Hot Spots description: arbis.arb.ca.gov/toxics/ab2588/2588summ.txt)

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 setting their own fees base them on amounts and toxicity of pollutants and one bases its fees on amount but not toxicity[13]. The toxicity-based fee structure of the Bay Area Air Quality Management District (BAAQMD) is described here.

BAAQMD bases fees on Unit Risk Values (URVs) for carcinogen emissions and Acceptable Exposure Levels (AELs) for other emissions. Fee amounts depend on quantities of weighted emissions. For carcinogens, weighted emissions are determined by multiplying the amount of each substance by 100,000 times its URV (in m^3/microgram). For other toxics, weighted emissions are determined by multiplying the amount of each substance by the reciprocal of its AEL (in m_3/microgram). The sum of the weighted emissions of all toxics is multiplied by a coefficient to calculate each source's fees. The coefficient varies from year to year depending on the costs incurred by CARB and BAAQMD in managing the Hot Spots program.

Facilities with fewer than 50 weighted pounds pay no fees, and facilities with weighted emissions between 50 and 1,000 pounds pay a 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 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. Emissions usually are not measured but rather estimated on the basis of toxics use data and emissions factors that depend on the abatement equipment.[14]

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 toxics use reduction. 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 structure was adopted.[15]

However, it is difficult to isolate the effects of the fees from other factors that could influence toxic emissions, including the information and reductions planning components of the Hot Spots program and federal TRI requirements. In addition, refineries have made large investments to comply with reformulated fuel and fugitive emissions standards.[16]

4.3.2. Ozone Non-Attainment Area Fees

The 1990 Clean Air Act Amendments also provide for excess VOC emissions fees in areas with dangerously high levels of ozone. To give these areas time to reduce their ozone levels, the fees will not enter into effect until the next century. Areas with ozone design values of 0.18 to 0.19 ppm have 15 years to comply with ozone standards; areas with values of 0.19 to 0.28 ppm have 17 years; and areas with values over 0.28 ppm, referred to as extreme ozone non-attainment areas, have 20 years. (California's South Coast Air Quality Management District is currently the only extreme non-attainment area.) Failure to attain specified levels by the deadlines will subject major stationary sources to VOC emissions fees of $5,000 (adjusted for inflation) for each ton emitted in excess of 80% of a baseline quantity.[17]

4.4. WASTE FEES

This subsection briefly discusses variable rate programs (a relatively new trend in household waste collection), landfill taxes, and hazardous waste disposal taxes. As discussed below, such taxes can reduce waste generation, but they also create incentives to dispose of waste illegally or in 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 included the collection costs in property taxes. Such pricing practices are inefficient in that the marginal price for the household is zero, whereas the marginal collection 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 over 3,400 communities in 37 states, reaching an estimated 11% 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 operating 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.[18] EPA is also encouraging variable rates and has held a series of workshops to explain their advantages and disadvantages and provide information on how to implement them. The report inventory on the EPA Economy and Environment World Wide Web site includes several of the documents cited in this subsection on variable rates.[19]

(Economy and Environment doc site: www.epa.gov/docs/oppe/eaed/eedhmpg.htm)

Variable rate programs can take several forms. Pre-paid garbage bags or stickers to affix to bags can be required for collection, or collection fees can be based on the number and/or size of cans. Some areas have weight-based systems. Others have mixed systems combining a fixed rate up to a certain amount of garbage and incremental rates for amounts in excess of the minimum covered by the flat rate. Such mixed systems are becoming increasingly common, perhaps because they are relatively easy and inexpensive to implement, provide a stable source of revenue for collection services, have the potential to reduce illegal dumping, and offer a minimum level of free service to many customers[20]. According to one source, collection systems that require periodic billing of customers are likely to be administratively more expensive than bag or sticker systems[21]. One disadvantage of bags is that they can tear, especially if handled improperly or penetrated by animals. Table 4-6 shows variable rate structures in various U.S. communities.

Table 4-6: VARIABLE RATE STRUCTURES IN SELECTED COMMUNITIES

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 60g carts: $19.01/month, 4¢/gallon 60g & 100g cart: $22.40/month, 4¢/gallon 2 100g 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 68g & 95g cart: $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 32g can: $16.49/month, 13¢/g

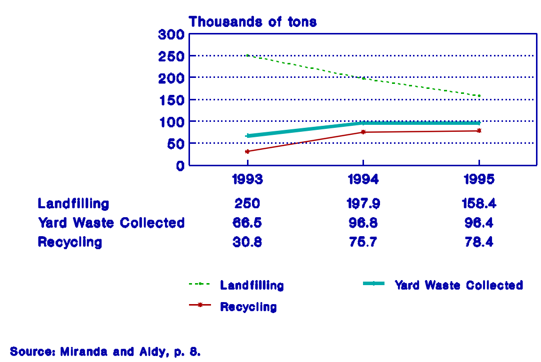
Community	Fee structure
Portland, OR	20 gallon can: \$14.60 / month, 18¢ / gallon 32 gallon can: \$17.60 / month, 14¢ / gallon 35 gallon cart: \$19.30 / month, 14¢ / gallon 60 gallon cart: \$24.05 / month, 10¢ / gallon 90 gallon cart: \$27.10 / month, 8¢ / gallon
Tacoma, WA	60 gallon can: \$17 / month, 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 30g can: \$6.01 / month, 5¢ / gallon
Colorado Springs, CO[22]	1 34g can + 1 30g 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
Grand Rapids, MI (City)	30-gallon bag: \$0.85, 3¢ / gallon 30-gallon can: \$44.20 / year, 3¢ / gallon
Grand Rapids, MI (Waste Management)	64-gallon cart: \$15 / month, 6¢ / gallon 104-gallon cart: \$17 / month, 4¢ / gallon
Grand Rapids, MI (Able)	90-gallon cart: \$17.35 / month, 5¢ / gallon
Hoffman Estates, IL	30-gallon bag: \$1.45, 5¢ / gallon
Lansing, MI (City)	30-gallon bag: \$1.50, 5¢ / gallon
Lansing, MI (Waste Management)	63-gallon cart: \$12 / month, 5¢ / gallon 104-gallon cart: \$15 / month, 4¢ / gallon
Lansing, MI (Granger)	60g cart: \$11 / month, 5¢ / gallon 90g cart + 3 30g bags: \$13.40 / month, 2¢ / g
Woodstock, IL	30-gallon bag: \$1.56, 5¢ / gallon

Sources: Miranda and Aldy; Bauer and Miranda

Table 4-6 shows that communities vary as to whether the city and / or private haulers collect waste. 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 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 collection fees charged by private haulers.

Many communities with variable rates implement public education, curbside recycling, yard waste, white goods, and holiday greenery 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 curbside recycling, yard waste, white goods, and holiday greenery collection programs vary across communities. These complementary activities can have an important impact on the success of variable rate programs.

Figure 4-3: HOUSEHOLD WASTE LANDFILLING AND RECYCLING IN SAN JOSE



San Jose, California began its variable rate program in 1993. The city has contracted its waste collection and curbside recycling services to two different firms, one serving the approximately 80,000 single-family households in the northern half of the city as well as all multi-family housing and another serving 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 they 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 rates on occasion. San Jose also offers free curbside collection of recyclables since 1987 and yard waste and collects white goods for a separate fee of $18 for up to three items. Figure 4-3 suggests that the variable rate program has significantly reduced the amount of waste landfilled and increased the amount recycled. The amount of yard waste set aside for collection and subsequent composting also increased.

The variable rate systems described thus far base prices on waste volumes. Another, less common price basis is weight. Communities that have implemented waste-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 discourage consumers from compacting 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 more complicated, requiring more equipment and increasing the time needed to collect waste. Seattle, for example, found that collection times were extended by 10% under its weight-based system. But increased implementation costs could be offset by decreases in the weight of garbage collected.[23]

In most areas where variable rate programs have been introduced, amounts of waste collected have decreased significantly. 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%.[24] 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.[25] 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. (Some variable rate structures are more variable than others.) If the minimum container size is too large, consumers often have little incentive to alter their behavior.[26]

As shown in Table 4-7, another study found reductions in tons of waste landfilled ranging from 17% to 74% following the adoption of variable rates in 21 northern cities. The study found the magnitude of the unit prices to be positively correlated with the change in the amount of waste recycled and negatively correlated with the change in the amount of waste landfilled.

The recycling increases shown in Table 4-7 were achieved in 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 may be 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.[27] Another study estimates that a variable rate program will increase the percentage of waste diverted under existing recycling programs by 4-13%.[28]

Table 4-7: CHANGES IN WASTE DISPOSAL IN RESPONSE TO VARIABLE RATE PRICING PROGRAMS[29]

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, reprinted in Arner and Davis, p. 4.

Despite the evidence cited above, variable rate programs are not without problems. Data on decreases in collection can be misleading if the programs result in significant illegal disposal or diversion to cheaper disposal services. Illegal dumping includes direct discharge to the environment as well as placing waste in someone else's container or donating unrepairable 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 cities surveyed in the 14-city study mentioned above, "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, the locking of commercial dumpsters, high dumping fines, and minimum flat collection fees.[30]

Other problems that need to be addressed in designing and managing variable rate programs are that they can be difficult to implement in multi-family housing such as apartments and that they can have a regressive effect on the poor and large families. In addition, the programs can lead to significant decreases in revenue for municipal waste collectors. The magnitude of these decreases can be difficult to predict.[31]

Variable rate programs may not be appropriate for all communities. Analysts assert that variable rate pricing is unlikely to be successful in areas with affordable and environmentally acceptable landfill disposal options, lack of nearby recycling possibilities, nearby open spaces for easy illegal dumping, and lack of consumer willingness to pay variable rates[32]. In some areas, however, they 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."[33]

4.4.2. Landfill Taxes

According to the National Recycling Coalition, surcharges on waste delivered to landfills have been imposed in over 20 states.[34] If operators are capable of passing on such taxes to their customers in their tipping 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, the rates are 0.002 cents per gallon for the Solid Waste Services Tax and the Landfill Closure and Contingency Tax and 0.00225 cents per gallon for the Solid Waste Recycling Tax.[35]

In Pennsylvania, counties are required to create trust funds to finance the costs associated with closing landfills. The amount paid into the fund is a tonnage fee depending on the estimated cost of closing the landfill and the weight of the garbage to be disposed of at the landfill before it is closed.

Texas levies a fee of $1.50 per ton on all municipal solid waste disposal. Fee revenues are used to fund state solid waste control activities and to provide grants to local governments and other organizations for resource recovery, waste minimization, and waste facility efficiency enhancement programs.[36]

It is unclear whether these fees have produced a significant incentive effect. However, the District of Columbia's experiences with its nearby Lorton, Virginia landfill illustrate one of the drawbacks of increasing waste disposal fees. 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 elsewhere in Virginia and southern Pennsylvania, where tipping fees are lower. The resulting loss in tipping fee revenue led the District to suspend its recycling program in 1995. It subsequently re-established the program but with reduced service. Because of the instability of tipping fee revenues, the District now relies on general revenues to fund the recycling program[37]. As is the case with variable rate programs, other measures that increase incremental waste disposal prices create incentives to use alternative disposal options.

4.4.3. Hazardous Waste Taxes

A number of states, 31 as of 1990, impose taxes on the generation or management of hazardous wastes. Some of these have higher tax rates for land filling than for incineration, and several states impose no tax on incineration. In some states, taxes vary according to the type of waste and/or whether the waste was generated outside the state. In addition, on-site disposal is exempt in some states. In 1990, Vermont and California each had taxes of over $100 per ton for land disposal, and six other states had taxes of over $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, a middle-of-the-range estimate of hazardous waste disposal costs in the late 1980s was $132 per ton.

As shown in table 4-8, for example, hazardous waste disposal fees range up to $220 per ton in California.[38] Table 4-9 shows the generation fees in effect in the state, which are fixed within a given generation range.

Table 4-8: HAZARDOUS WASTE LAND DISPOSAL FEES IN CALIFORNIA, FY 1996

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

Table 4-9: HAZARDOUS WASTE GENERATION FEES IN CALIFORNIA, CY 1996

Generator Size (tons / year)	Fee ($)	$ / ton (mid-range)
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

According to the California Department of Toxic Substances Control, the fees above are intended to raise revenue and to encourage waste minimization. Tonnage has declined in the last ten years, but it is difficult 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.[39]

The findings of several studies suggest that hazardous waste taxes have a impact on disposal. In the 1980s, two engineering studies, one by CBO and one by EPA, concluded that such taxes significantly reduced land disposal. By 1987, ten states had taxes exceeding the level at which EPA predicts a 60% reduction in land disposal. Another study examined empirical evidence on the effects of a two-fold rise in hazardous waste taxes in New York in 1985 and 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 not as much as the amount of waste landfilled fell.

Sigman (1996) studied the impact of landfilling and incineration taxes on the generation of four types of chlorinated solvent wastes from metal cleaning. Using data from the 1987-1990 Toxic Release Inventories, the study includes a cross-section analysis of generation across states, using 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 found that elasticities of waste generation with respect to taxes on incineration were in the range of -7 to -22 and that the taxes encouraged generators to choose incineration or other treatment over landfilling as their waste management method. However, the impact of the taxes was estimated to be minor because they were small relative to total waste management costs.

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. Taxes should reflect the social cost of hazardous waste generation, but this cost depends on the type of waste, method of disposal, geographic location, and various other factors that are difficult to assess and incorporate into tax structures. Moreover, if 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."

Another problem is that current federal regulations impose high management costs that may already provide sufficient incentives to reduce hazardous waste. If existing (command-and-control) incentives are sufficient, taxes could raise waste disposal costs to a level that is higher than socially desirable.

4.5. PRODUCT CHARGES

Product charges are imposed either on a product or some characteristic of that product. Products that are believed to have environmental disadvantages are taxed to reflect the added social costs they impose. Although some product charges may have a significant effect on behavior, most of them are intended primarily to raise revenue. Some product charges take the form of advance disposal fees (ADFs), or taxes on a product to fund its proper disposal after its use.

4.5.1. Federal Product Charges

Unlike water, air, and waste fees, a number of product charges have been imposed on the national level. Subject to these taxes are fuels, transportation, transport equipment, and chemicals. Most of these taxes are intended to raise revenue; they have minimal incentive effect.[40] The following paragraphs discuss the Superfund taxes as well as taxes on fuel-inefficient automobiles and chlorofluorocarbons.

4.5.1.1. Superfund Taxes

Used to fund the cleanup of inactive hazardous waste disposal sites, the federal Superfund was until the end of 1995 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).[41] The oil and chemical taxes could be regarded as product charges, but their purpose is to raise revenue rather than prevent pollution.

4.5.1.2. Taxes on Fuel-Inefficient Automobiles

Introduced in 1978, the gas guzzler tax applies to all automobiles with a fuel efficiency of less than 22.5 miles per gallon. 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.[42] According to EPA, most gas guzzler tax payments have been for foreign luxury cars.[43]

Two measures that could have effects similar to gas guzzler taxes are fines for failure to meet corporate average fuel efficiency (CAFE) standards and luxury car taxes. CAFE fines, which could be regarded as non-compliance fees, are based on the extent to which an automaker violates CAFE standards. Luxury taxes are set at 10% of the sales price of a car in excess of a base level (originally $30,000 and currently $34,000). Since many luxury cars are relatively fuel-inefficient, luxury taxes could encourage the use of fuel-efficient vehicles.

4.5.1.3. Ozone-depleting Chemicals

In accordance with the terms of the 1987 Montreal Protocol on Substances that Deplete the Ozone Layer and subsequent amendments, production of ozone-depleting chemicals such as chlorofluorocarbons (CFCs) for most uses in the United States was phased out by January 1, 1996.[44] To facilitate the phaseout, the United States imposed a tax on selected CFCs on January 1, 1990 and expanded the tax to other CFCs the following year. The magnitude of the tax was determined by multiplying a base rate per pound 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. The ozone depletion factors, which are intended to indicate each chemical's damage to the ozone layer, were set by the Montreal Protocol. For example, methyl chloroform had a factor of 0.1, whereas Halon-1301 had a factor of 10.0. The tax was imposed on the production and importation of these chemicals as well as the importation of products which contained them or used them in their production processes.[45]

Unlike most product charges, this tax is widely credited with a significant incentive impact. CFC consumption (expressed in CFC-11 equivalents) fell from 318,000 metric tons in 1989 to 200,000 metric tons in 1990, the year the tax was introduced[46]. 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 CFC producers' windfall revenues resulting from a tightening supply situation.[47]

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. In 1988, EPA predicted that the average cost of halving CFC use would be $3.50 per kg. In 1992, the predicted cost was only $2.45 per kilogram.[48]

Although the tax is believed to have contributed significantly to the reduction in CFC use, other factors also had an impact, including a CFC trading system (described in Section VI), well-publicized CFC phaseout intentions, and EPA's work with the private sector on CFC recycling and substitutes. As a result of the multiplicity of 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. Many of these have taken the form of advance disposal fees (ADFs). This subsection describes charges that have been imposed on different products.

4.5.2.1. Tire Charges

Fees have been imposed on automobile tires in 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 sales price.[49] Fee revenue is typically used to finance the disposal of used tires, which may include the cleanup of tire disposal sites. 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 is likely to be minimal. As shown in Table 4-7, the Federal Government also imposes product charges on tires ranging from $0.15 to $0.50 per pound, but revenues from these charges are allocated to the Highway Trust Fund.[50]

4.5.2.2. Fertilizer Charges

Product charges have been imposed on fertilizers in 46 states. 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 fertilizer use. The most common use of charge revenues is inspection of fertilizers.[51]

4.5.2.3. Rhode Island Hard-to-Dispose Material Tax

Rhode Island imposes products charges on "hard-to-dispose material": lubricating oil, antifreeze, organic solvents, and tires. The amounts are 5¢ per quart of lubricating oil, 10¢ per gallon of antifreeze, 1/4 of one cent per gallon of organic solvents, and 50¢ per tire. Although incentive effects are assumed to be minimal, the charge incorporates at least some of the disposal costs of various materials into their prices. Charge revenues are deposited in a "hard-to-dispose material account" to fund educational and technical assistance programs, grants, research, and collection centers for hard-to-dispose material.[52]

Table 4-10: PRODUCT CHARGES ON TIRES

Taxing authority	Magnitude of tax	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	Tire recycling, tire disposal site cleanup, other similar activities

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

4.5.2.4. Florida ADF

On October 1, 1993, an ADF of $0.01 went into effect on a variety of containers in Florida. Exempted from the tax were containers made of plastic, plastic-coated paper, and glass with average recycling rates of at least 50%, glass containers with a 35% recycled content and plastic containers with a 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% requirement, they were exempt from the tax.[53] To further encourage recycling, legislation called for the tax to be doubled in January 1995.

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 exemption than to the ADF itself.[54]

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 recycled content over various containers, and recycling into other products equivalent amounts of previously discarded waste. 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 planned to build recycling facilities.

Both companies cited the ADF as the decisive factor in their decisions to build in Florida.[55]

One disadvantage of including various exemption possibilities into 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. The ADF expired in October 1995.

(criticism is on http://www.gmabrands.com/news/may95/5_12_95.htm)[56]

4.5.2.5. North Carolina ADF

North Carolina imposes an ADF on "white goods," such as refrigerators and freezers. The ADF is $10 for products containing CFCs and $5 for those without CFCs. It is to be discontinued in June 1998.

Although the ADF is unlikely to have a significant incentive effect, it generates revenues to manage the disposal of white goods. With the introduction of the ADF, county landfills are required to accept old white goods for disposal free of charge. Counties receive 75% of the ADF revenue on a per capita basis to fund the removal of CFCs and programs to recycle white goods and metal products. Additional ADF revenues are available for those counties whose disposal costs exceed their per capita ADF allocations.[57]

(Information taken from http://wastenot.ehnr.state.nc.us/SWHOME/avail.htm)

4.5.2.6. Texas Clean Fuel Incentive Surcharge

In 1989, Texas introduced a 20¢ per MMBtu surcharge on boiler oil. The surcharge applies only to industrial and utility boilers capable of using natural gas, in use between April 15 and October 15 of each year, and located in ozone non-attainment areas with populations of 350,000 or more. As part of a larger State effort to encourage the use of natural gas, the surcharge specifically addresses summer ozone problems resulting from NO_x emissions. Used oil and fuels derived from hazardous waste are exempt. Surcharge receipts are deposited in the State General Revenue Fund.[58] According to one TNRCC official, the surcharge has had little if any incentive effect because few facilities used fuel oil before the introduction of the surcharge.[59]

4.6. ROAD USER FEES

Found throughout the United States, toll roads are generally used to finance road construction and are beyond the scope of this report. Of particular interest, however, are congestion pricing tolls 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 in southern California, if the current level of vehicle miles traveled flowed smoothly, mobile source emissions would decrease by approximately 13%.[60]

On December 27, 1995, a private congestion-based 4-lane toll road opened in the median of the existing eight-lane Riverside Freeway (SR-91). The road was built and the toll system is operated by the California Private Transportation Company (CPTC), which is free to determine toll levels but 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 that motorists can plan their trips accordingly. Windshield-mounted transponders allow for motorists to pay for toll lane use without stopping at booths. High-occupancy vehicles with 3 occupants, public transit, zero-emission vehicles, and vehicles with a disabled person license plate are exempt from the tolls. CPTC can raise the allowable rate of return on its investment by raising HOV rates.

By March 1996, over 30,000 transponders were in use, a level the project had not expected to reach until late June.[61] As of May 1996, 45,000 transponders had been issued.[62] In interviews with the *Los Angeles Times*, express lane users have reported time savings of more than 30 minutes.[63] CPTC adds that the toll lanes have not only reduced travel times for their users but also diminished congestion on the adjacent freeway.[64]

As part of its Congestion Pricing Pilot Program, the Federal Highway Administration is studying the experiences of SR91 and funding nine other projects. Six of these are studies. The other three (in the San Diego area, on the San Francisco-Oakland Bay Bridge, and in Lee County, Florida) are implementation projects. The San Diego project is scheduled to be implemented in the Fall of 1996, whereas the San Francisco-Oakland project still requires legislative approval. The Lee Country project will involve peak and off-peak tolls on three bridges.[65]

France, Norway, and Singapore have adopted congestion pricing schemes. These are described in Section 11.

(See http://www.hhh.umn.edu/Centers/SLP/Conpric/short.html. Changed: need to update this link)

4.7. WETLAND COMPENSATION FEES[66]

Wetland compensation fee systems could be described as programs in which a regulatory agency collects fees in lieu of requiring a developer to compensate for wetland losses through on-site mitigation or acquiring credits generated by a mitigation bank. The fees are used in mitigation projects by an agency or non-profit organization. Thus compensation fees differ from mitigation banking (which is discussed in Section 6) in that they require a fixed payment as opposed to the purchase or generation of a mitigation credit. Like banking systems, wetland compensation fees offer the flexibility to mitigate wetland loss in a more cost-effective manner: Instead of doing on-site mitigation on its own, the 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 to 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 public or private 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) to fund site management, and a third (7% of the sum of the first two) as state tax. Interest accrued on the second fee revenues is used to fund site management. As of 1995, the Mitigation Park Program had received over $3.8 million and purchased over 5,600 acres.

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 either 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 based on prevailing market prices for agriculturally zoned or low density land with 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 do not require mitigation.[67]

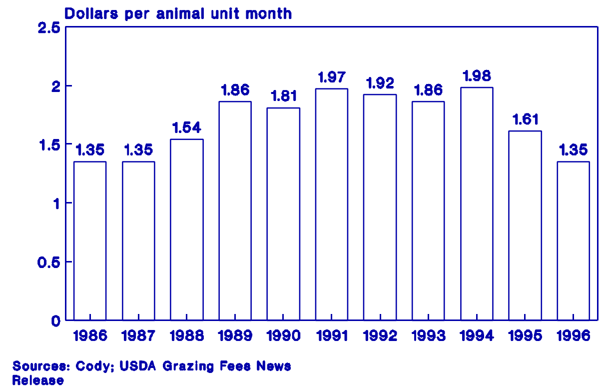
In Louisiana, companies are required to offset their damage to coastal wetlands by performing a mitigation project on their own property or by contributing mitigation fees to the Louisiana Wetlands Conservation and Restoration Fund. Mitigation fees range from $1,500 to $12,000 per acre depending on the quality of the developed wetland.[68]

Although the costs, benefits, and incentive effects of wetlands compensation fees have not been comprehensively studied and would be difficult to determine given the various uses and sources of value of wetlands, some evidence suggests 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 carrying out on-site mitigation on their own.[69]

(Crookshank report: www.api.org/cat/SEC12.htm#10)

4.8. GRAZING FEES

Figure 4-4: GRAZING FEES UNDER THE PUBLIC RANGELANDS IMPROVEMENT ACT



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 land and 94 million acres of Forest Service land. Grazing on this land accounts for approximately 2% of total beef cattle feed in the 48 contiguous states and supports about 10% of livestock producers in the 16 Western states in which fees are charged based on a formula set by the 1978 Public Rangelands Improvement Act (PRIA).[70]
(CRS primer on grazing: www.cnie.org/nle/ag-5.html)

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. As shown in Figure 4-4, the 1996 fee is $1.35 per AUM. Under the terms of a 1986 Executive Order, $1.35 is the minimum fee.[71]

(http://www.fs.fed.us/forum/graznews.htm)

The theory behind such fees is that animal owners should pay fair market value for use of the land and bear the costs of the damage inflicted by their animals. However, current fee levels are widely believed to be lower than market value. To the extent that the fees are too low, they amount to a form of subsidization and are therefore included in the discussion of environmentally harmful subsidies in Section 7.

(1995 Green Scissors on grazing fees: www.essential.org/orgs/FOE/scissors95/greenpart22.html)

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 its value before and after contamination. Property owners responsible for contamination that do not have approved cleanup plans pay contamination tax 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 notice of the contamination pay 25% of the property tax rate until a cleanup plan is filed, after which the rate decreases to 12.5%. According to a local tax official, the tax gives property owners "a strong impetus to clean up."[72]

Endnotes for Section 4

1. EPA (March 1991), p. 4-6.

2. For more information on such stormwater credits, see Reese (1996).

3. Morandi et al. (1995), p. 10.

4. EPA (March 1991), p. 4-6.

5. GAO (January 1996), pp. 1-4.

6. Unless otherwise stated, the rest of the information in this sub-section on state effluent fees is provided by Duhl (1993). This document is obtainable free of charge from the American Petroleum Institute. www.api.org/cat/SEC12.htm#12

7. The fee schedule can be found on the California Water Resources Control Board internet site: www.swrch.ca.gov/pub/FEES/feebptc.zip

8. Information in these last two paragraphs provided by Candace Carraway, Air Quality Management Division, Environmental Protection Agency, personal communication, June-July 1996.

9. All information on Maine's air pollution fees provided by *DEN*, June 22, 1993, p. B-6 and by Richard Limouze, Maine Air Quality Bureau, personal communication, 1996.

10. Information in tables 4 and 5 and on carbon monoxide fees taken from SCAQMD Rule 301 as revised on May 10, 1996. www.aqmd.gov/rules/html/r301.html

11. SCAQMD, Rule 303. www.aqmd.gov/rules/html/r303.html

12. These are defined in paragraph (b)(20) of rule 301 to include the following:
trifluoromethane (HFC-23);
chlorodifluoromethane (HCFC-22);
dichlorotrifluoroethane (HCFC-123);
tetrafluoroethane (HFC-134a);
dichlorofluoroethane (HCFC-141b);
chlorodifluoroethane (HCFC-142b);
1,1,1-trifluoroethane (HFC-143a);
1,1-difluoroethane (HFC-152a);
cyclic, branched, or linear, completely fluorinated alkanes;
cyclic, branched, or linear, completely fluorinated ethers with no unsaturations;
cyclic, branched, or linear, completely fluorinated tertiary amines with no unsaturations;
sulfur-containing perfluorocarbons with no unsaturations and with sulfur bonds

only to carbon and fluorine.

13. Carla Takemoto, California Air Resources Board, personal communication, May 1996.

14. Catherine Fortney, Bay Area Air Quality Management District, personal communication, May and June 1996.

15. Environmental Law Institute (August 1993), pp. 22-23.

16. Fortney, op cit.

17. The baseline amount is the lower of actual or allowable VOC emissions. For details, see Title I, Section 185 of Clean Air Act.

18. Skumatz (1996), p. 1.

19. The internet site for these documents is www.epa.gov/docs/oppe/eaed. For references, see Bauer and Miranda; Miranda, Bauer, and Aldy; and Miranda and Aldy in the bibliography.

20. Skumatz (1996), p. 2.

21. Miranda and Aldy (1996), p. 16.

22. The city of Colorado Springs neither collects garbage nor licenses haulers. The fees listed here are charged by Waste Management (one of the haulers operating in the city) when it supplies cans and bags. Customers supplying their own cans and bags pay other rates.

23. Miranda, Bauer, and Aldy (1995), pp. 8-9.

24. Skumatz (1993), pp. 283-284.

25. *Warmer Bulletin*, February 1996, p. 16.

26. Miranda and Aldy (1996), p. 19.

27. Skumatz (1994), p. 284.

28. Skumatz (1996), p. 4.

29. The source of the table is Marie Lynn Miranda et al., *Managing Municipal Solid Waste: The Unit-based Pricing Approach*, 1993, as reprinted in Arner and Davis (1994). An N/A in the recycling column denotes either that data were insufficient or that the municipality implemented a recycling program simultaneously with variable rate pricing.

30. Repetto et al. (1992), pp. 18-19.

31. *DEN*, pp. A5-6.

32. Skumatz (1994), p. 286.

33. Repetto et al. (1992), p. 27.

34. Miller, p. 3.

35. *DEN*, February 13, 1996, pp. B3-4. The rates for waste in liquid form were provided by Tom Lucas, New Jersey Taxation Division's Special Audit Section, personal communication, 1996.

36. GAO (February 1995), p. 23.

37. Information obtained from *DEN*, April 21, 1995, pp. A2-3 and from personal communication with Hallie Clem, DC Department of Public Works, 1996.

38. Disposal and generation fees taken from California Department of Toxic Substances Control, "Hazardous Waste Fee Summary, Effective 1996." The authors have added the last column to the second table to provide estimates of fees per ton.

39. Walt Larson, California Department of Toxic Substances Control, personal communication, May 1996.

40. For a list of federal environmental excise taxes, see Barthold (1994), p. 146.

41. Ibid, pp. 146-147.

42. Fullerton (1995), p. A7.

43. EPA (March 1991), p. 3-18.

44. Unless otherwise stated, the term "CFCs" refers throughout this section to a variety of ozone-depleting chemicals, including halons and methyl chloroform.

45. Barthold (1994), pp. 137-138.

46. Cook (1996), p. 5.

47. Congressional Research Service (1994), pp. 72-75.

48. Cook (1996), p. 5.

49. *Scrap Tire News Legislative Report*, "Scrap Tire Laws and Regulations," January 1996, pp. 18-19.

50. Fullerton (1995), p. A7.

51. Information on fertilizer taxes as of March 1994 was provided by the Fertilizer Institute.

52. Rich Girasole, Rhode Island Department of Environmental Management, personal communication, May 1996.

53. *DEN*, October 5, 1993.

54. Ackerman (1994), pp. 273-4.

55. Hoerner (1995), p. 16.

56. Grocery Manufacturers of America. Another source of information on the Florida ADF is Martin (1994).

57. North Carolina Department of Environment, Health, and Natural Resources. wastenot.ehnr.state.nc.us/SWHOME/grants.txt

58. Environmental Law Institute (August 1993), p. 24.

59. Randy Hamilton, Texas Natural Resource Conservation Commission, personal communication, June 1996.

60. Cameron (1991), p. 8.

61. Transponder figure provided by March 19, 1996 Earthlink release from Greg Brooks, California Private Transportation Company.

62. Martine Micozzi, Federal Highway Administration, personal communication, May 1996.

63. Federal Highway Administration, *Buyline$: Congestion Pricing Updates*, Spring 1996.

64. Brooks, CPTC, March 19, 1996 Earthlink release.

65. Federal Highway Administration, *Buyline$: Congestion Pricing Updates*, Spring 1996.

66. Unless otherwise stated, the information on wetland compensation fees is provided by Crookshank (1995). www.api.org/cat/SEC12.htm#10

67. Information on Mitigation Park Program and Maryland Nontidal Wetlands Compensation Fund provided by Crookshank (1995), p. 42. This document describes fee-based programs in Arkansas, Florida, Maryland, Louisiana, Mississippi, and Illinois.

68. "DNR Sets New Rules for Wetlands Mitigation," *Baton Rouge Advocate*, August 27, 1995.

69. For a discussion of the economic benefits of off-site mitigation and larger wetlands, see Anderson and Rockel (1991), pp. 50-51. www.api.org/cat/SEC12.htm#22

70. Cody (1994), p. 1. The states with federal fees calculated according to this formula are Arizona, California, Colorado, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, Utah, Washington, and Wyoming. Fees are different for eastern states and for national grasslands managed by the Forest Service.

71. U.S. Department of Agriculture Forest Service news release, "1996 Grazing Fees Announced." www.fs.fed.us/forum/graznews.htm

72. Hoerner (1995), p. 16.

5.1. INTRODUCTION

Deposit-refund systems (hereafter referred to as "deposit systems") are similar to the advance disposal fees described in the previous section except that the payer of the fee can obtain a partial or complete refund by returning the used product for recycling or proper disposal. Such a system could be looked upon as a combination of a product charge and a recycling subsidy. Manufacturers or vendors of products subject to deposits incur additional costs in handling returned products, but these costs are often partially offset by interest earned on deposits, unclaimed deposits, and sales of collected used products.

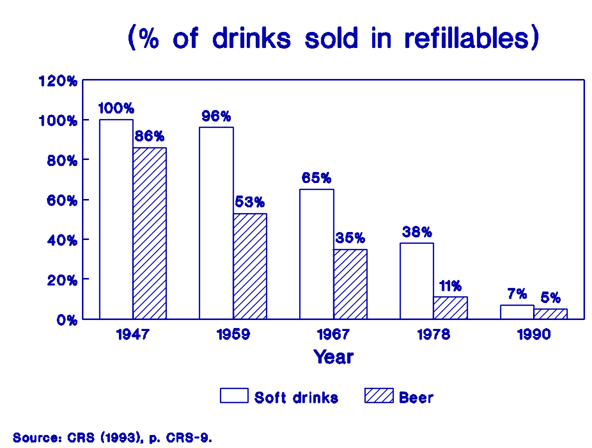
As noted below, deposit systems are used most commonly for beverage containers but have also been used for other products such as pesticide containers, lead-acid batteries, and tires. Some of these systems are voluntarily implemented by industry whereas others are required by government. As with most other incentive mechanisms discussed in this report, deposits have been required not by federal government but rather by state or local authorities, although federal legislation on deposits has been considered.

Several studies have concluded that deposit systems are more cost-effective than other methods of waste disposal reduction such as command-and-control regulations, recycling subsidies, and advance disposal fees. A recent study by Resources for the Future 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.[1]

(RFF study: www.rff.org / dpapers / abstract / 9533.htm)

Fullerton and Kinnaman (1995) concluded that waste collection should be priced positively if disposal and recycling are the only two disposal options, but that if illicit burning or dumping is also an option, the optimal policy is "a tax on output plus a rebate on proper disposal," i.e., a deposit system. While waste collection fees give waste generators an incentive to dispose of waste in an uncontrolled manner, deposit schemes give them an incentive to recycle.

Figure 5-1: U.S. MARKET SHARE OF REFILLABLE BOTTLES



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

5.2. BEVERAGE CONTAINERS

Like certain other products, beverage containers have been subject to both voluntary and mandatory deposit schemes. The beverage industry formerly made extensive use of voluntary schemes to recover refillable bottles, but as shown in figure #, this practice fell out of favor with the introduction of cheaper "disposable" containers.

As shown in Table 5-1, ten states have passed "bottle bills" mandating beverage container deposits ranging in magnitude from 2.5¢ to 15¢, the most common amount being 5¢. Beer and soft drinks are subject to deposits in all ten states, mineral water in six states, malt in four states, and wine coolers, liquor, and carbonated mineral water in three states. Michigan includes canned cocktails, New York includes soda water, and Maine includes juices and tea. In most states, deposit requirements apply to the full range of container types, including glass, plastic, aluminum, and steel, but Delaware 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 obliged 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 paid by distributors. As shown in table 5-1, in most states unclaimed deposits are kept by the distributor.

Not included in table 5-1 is a deposit system in effect in Columbia, Missouri since 1982. Under this system, consumers pay deposits of 5¢ on beer, soft drinks, malt, and carbonated mineral water containers. Although retail stores are required to take back containers, no handling fees are mandated. The overall redemption rate is estimated at 85-95%.[2]

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

5.2.1. Maine Bottle Bill

Maine introduced a deposit system for beer and soft drink containers on January 1, 1978. In distributing beer and soft drinks to retailers, distributors (or manufacturers) levy a 5¢ deposit as well as a 3¢ handling fee. Retailers in turn include these amounts in their sales prices. The customer can obtain a 5¢ refund by returning the container to any retailer selling the product or to a redemption center. Demand for containers is sometimes sufficiently high that customers can obtain refunds 10-20% higher than the deposit amount.[3] In some places, reverse vending machines also offer refunds for returned containers.

Table 5-1: STATE BEVERAGE CONTAINER DEPOSIT SYSTEMS

State	Since	Containers Covered	Refund Amount	% Returned	Redemption Sites	Unclaimed Deposits	Handling Fees
California	1987	Beer, soft drinks, wine coolers, mineral water	2.5¢ < 24 oz 5¢ > 24 oz	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, 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, 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, redemption centers	Kept by distributor or bottler	1¢
Maine	1978	Beer, soft drink, wine, wine cooler, liquor, juice, water, tea	Beer, soft drink, juice 5¢. Wine, liquor 15¢	Beer, soft drink 92% Spirits 80% Wine 80% Juices, non-car-bonated 75%	Retail stores and redemption centers	Kept by distributor or bottler	3¢
Massachusetts	1983	Beer, soft drink, carbonated water	5¢	Overall 85%	Retail stores and redemption centers	State	2.25¢
Michigan	1978	Beer, soft drink, canned cocktails, carbonated and mineral water	Refillables 5¢, nonrefillables 10¢	Overall 93%	Retail stores	75% environ-mental programs, 25% handling fees	25% of unclaimed deposits
New York	1983	Beer, soft drink, wine cooler, 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 drink, carbonated mineral water	Standard refillables 3¢. Others 5¢	Overall 85%	Retail stores	Kept by distributor or bottler	None
Vermont	1973	Soft drink, beer, malt, mineral water, liquor	Soft drink, beer 5¢. Liquor 15¢.	Overall 85%	Certified redemption centers. Retail stores.	Kept by distributor or bottler	3¢

Retailers and redemption centers then redeem the used containers to distributors (or manufacturers) in exchange for 8¢ refunds. Distributors typically pick up used containers while distributing new products. Retailers and redemption centers keep the 3¢ handling fees. Distributors (or manufacturers) have at least three sources of revenue to offset the costs of handling containers. They can sell the collected containers to processors and keep unclaimed refunds and handling fees. Half of unclaimed refunds formerly went to the State, but as a result of distributor complaints about costs, deposit initiators are now (effective January 1, 1996) allowed to retain all unclaimed refunds.[4] A third source of revenue is interest earned on deposits and handling fees before redemption.

The expansion of the deposit scheme to liquor and wine on September 1, 1990 and to bottled water, iced tea, and juice on December 31, 1990 resulted in new (and perhaps less efficient) types of deposit-refund arrangements. Unlike soft drinks and beer, juice is often distributed by several companies in the same geographic area. If several distributors operate in the same area, 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 charge in deposits, while for others, deposits may exceed refunds. Because distributors fear that they will lose money in charging deposits and paying refunds, manufacturers have had to charge deposits themselves and contract independent collectors to redeem containers. This collection method may be less efficient than collection by distributors who already travel to collection sites while distributing new products.

Another problem with juice containers has been misredemptions caused by in-state distribution without imposing deposits and in-state redemption of containers originally purchased outside the state. Such misredemptions 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 the first six months of 1995.[5]

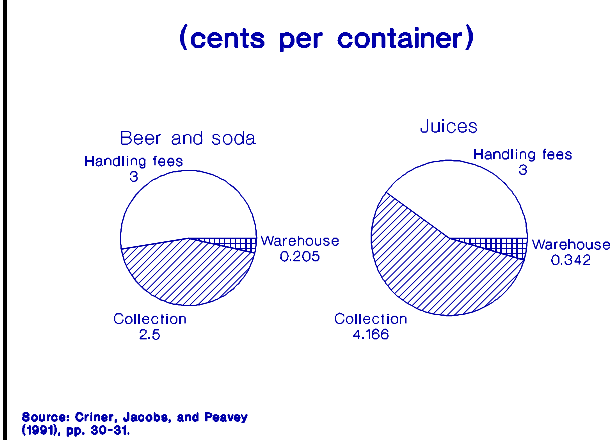
Retailers have complained that the deposit system (especially the expanded one) requires more storage space and more time for recordkeeping and bottle reception and sorting. In addition, traces of beverages in containers have attracted pests. The administrative burden has probably become more severe since the expansion of the system, as significant variations in juice containers make them more difficult to sort and store.[6]

The deposit in Maine is reported to have significantly reduced litter. A Maine Department of Transportation study (1979) found that total litter was reduced by 10% and that container litter was reduced by 56%.[7] Since the redemption rate has risen since 1979, it is likely that litter has decreased further. One reason for the decline in litter is that people sometimes collect bottle and can litter to obtain refunds. The deposit has also been credited with increasing recycling by creating a reliable supply of recyclable materials. Three container processing facilities were created as a result of the system. These facilities can in turn stimulate demand for recyclables collected outside the deposit system.[8]

Criner, Jacobs, and Peavey (1991) estimated that the costs of Maine's deposit system exceed those of curbside collection programs but also result in higher collection rates. They surveyed retailers, redemption centers, distributors, and manufacturers to develop cost estimates for the deposit system. Their comparison of the deposit system and curbside collection programs relied on the Waste Plan computerized waste management modeling system.[9] Readers should be aware of at least three potential shortcomings of the data used in the estimates that follow: 1) Survey responses were often incomplete. (For example, no beer distributors answered the survey, and soda distributors submitted only "weighted average" data.) 2) Although manufacturers, distributors, retailers, and redemption centers might have the best access to cost information, they might also have an incentive to overstate their costs associated with container handling. 3) The report was published in April 1991, probably too early to incorporate a full range of experiences under the expanded deposit system, which was not in effect until December 30, 1990.

Criner, Jacobs, and Peavey 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 3¢ per container handling fees appear to be set at a level that covers retailers' costs. The handling fee was originally 1¢ but rose to 2¢ in 1980 and again to 3¢ in 1990.[10]

Figure 5-2: ESTIMATED DISTRIBUTOR COSTS OF MAINE DEPOSIT SCHEMES



As shown in Figure 5-2, Criner, Jacobs, and Peavey estimate 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.) Two reasons why collection costs, storage facilities, and labor could be more expensive for juices are that larger variations in juice containers make them more expensive to sort and store and that manufacturers hire companies specifically to collect used juice containers.

Table 5-2 presents estimates of the costs of collecting recyclables under curbside programs and deposit systems for a community of 25,000 inhabitants in Maine.[11] The estimates suggest that the costs of deposit systems are not only significantly higher than curbside programs but also raise the costs of curbside collection when the two are implemented at the same time. This last effect could be caused by diversion of recyclables from curbside programs, thereby reducing economies of scale.

Table 5-2: ESTIMATED COLLECTION AMOUNTS AND COSTS OF CURBSIDE AND DEPOSIT PROGRAMS IN MAINE COMMUNITY OF 25,000 INHABITANTS

	No deposit	Original deposit	Expanded deposit
Curbside tons recycled, cost per ton	2,538 ($41)	1,917 ($80)	1,378 ($100)
Deposit scheme 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, Jacobs, and Peavey, p. 50.

A significant portion of the costs of Maine's deposit system appear to be passed on to consumers. In 1990, 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 were higher in Maine for soda and beer. As noted above, Massachusetts has a 5¢ deposit like Maine. Criner et al. speculate that the deposit system in Massachusetts has not resulted in beverage prices higher than those of New Hampshire and Rhode Island because distributors in the state face more competition than in Maine and because the state's density limits the cost of handling used containers.

Criner et al. also found that prices of most orange and non-orange juices sold at two Maine supermarkets increased during the period from the fall of 1990 to late February 1991, although prices of orange juice in large plastic containers (64-96 oz.) subject to deposit requirements fell significantly during the same period. Although these findings suggest that the expansion of the deposit to juices had an impact on prices, the price increases at the two stores were not compared with price changes elsewhere.

5.2.2. California Beverage Container Recycling Program[12]

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 differs significantly from that of other states in that retailers generally are not responsible for collecting deposits and offering refunds to consumers and 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. For containers of more than 24 ounces, the fee is 4¢ and the payment 5¢. The payment may be passed on to consumers to entice them to return containers.

This scheme 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 with a 1/2 mile radius of their store. In areas where there are no centers, retailers generally contract a recycling business to establish a collection site or reverse vending machine.

The State also assesses handling fees annually for each type of container. Manufacturers are required to either pay these fees or guarantee a scrap recyclable price equal to the cost of collection. These requirements have increased scrap prices in the State to the point of providing incentives to import scrap from other states. By law, such imports may not be redeemed.

In 1994/95, the BCRP received about $333 million in revenues. However, this figure is expected fall in the next few years as a result of reductions in processing fees required by 1995 legislation and increases in container redemption.[13] Unclaimed deposits and fees not paid out as subsidies finance grants for non-profit and government organizations for activities such as litter reduction and recycling.

($333 revenue figure: www.lao.ca.gov/a96b2.html)

Like all other states with deposit systems, California has specific beverage container labelling requirements. All containers must bear the label "CA Redemption Value" or "California Redemption Value." To increase awareness of the deposit system, the CRV must be posted separately on store shelves, in advertising, and on retailer invoices.[14]

The BCRP required the creation of a government structure to manage the program and initially generated relatively low return rates. By the early 1990s, however, after the initial 1¢ 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 1, the overall beverage container recycling rate has risen to 84%.

Ackerman et al. (1995) stated 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¢ in California and 2.3¢ in other bottle bill states.[15]

Although data are incomplete, anecdotal evidence suggests that beverage container deposit laws have significantly reduced litter in several states. As noted above, Maine reported decreases in litter following the introduction of its deposit scheme. Oregon reported a 75-85% decrease in roadside litter just two years after enacting deposit legislation.[16]

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. One study estimated 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.[17] A 1990 study found that almost 2/3 of the glass recycled in the U.S. 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 ten states accounted for over 80% of recycled glass. All deposit states also report aluminum can return rates in excess of the national average.[18]

A related phenomenon is the relatively high share of 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. The unweighted average for these nine states was 15% in 1990, three times the national average.[19]

A 1993 Congressional Research Service comparison of deposit systems and curbside recycling programs found that deposits generally resulted in higher percentages of materials returned and less contamination of collected materials. None of the states with large curbside programs but lacking deposits, the study found, 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 PET reported that because of concerns over contamination, more than 90% of the PET it purchased came from states with deposit schemes.[20]

The costs of deposit systems may be substantial for manufacturers, distributors, vendors, consumers, and regulatory authorities, and 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, but at least one study 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."[21] 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 reductions 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

Unlike beverage containers, lead-acid batteries are still subject to voluntary deposit systems in most areas. The lead in used batteries has positive economic value for battery makers. Deposit amounts are typically $5-$10. Consumers can obtain rebates by returning a used battery soon, usually 7 to 30 days, after the purchase of a new one.

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 goes to different parties.[22]

Table 5-3: MANDATORY LEAD-ACID BATTERY DEPOSIT SYSTEMS

State	Amount	Unclaimed Refunds	Refund Period
Arizona	$5	Retailer	30 days
Arkansas	$10	Retailer	30 days
Connecticut	$5	Retailer	30 days
Idaho	$5	Retailer	30 days
Maine	$10	Retailer	30 days
Minnesota	$5	Retailer	30 days
New York	$5	Retailer	30 days
Rhode Island	$5	80% State 20% Retailer	7 days
South Carolina	$5	Retailer	30 days
Washington	Minimum $5	Retailer	30 days

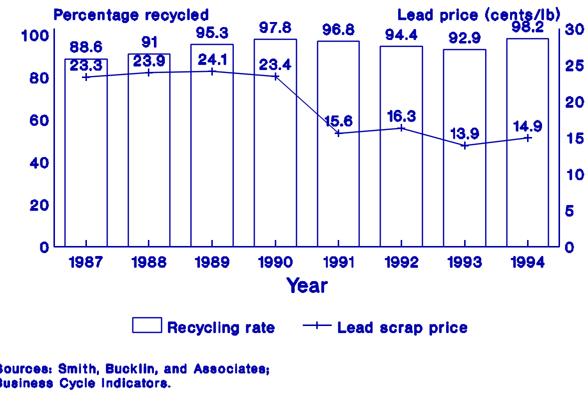
Source: Weinberg, Bergeson & Neuman.

As with beverage containers, deposit systems for lead batteries appear likely to have a significant incentive effect by offering motorists payments in return for a used product. As shown in Figure 5-3, the percentage of battery lead recycled has been estimated at over 90% since 1988.[23]

Figure 5-3 also suggests that recycling rates may be positively related to the price of lead. The fall in lead prices beginning in 1991 coincided with a fall in the percentage of battery lead recycled.[24]

(lead price data: www.mlinet.com/bci/pages/lsm023.htm)

Figure 5-3: BATTERY LEAD RECYCLING AND LEAD SCRAP PRICES IN THE U.S.



5.4. MAINE PESTICIDE CONTAINER DEPOSIT SYSTEM

The discovery of over 400 uncontrolled disposal sites in Maine led the state's authorities to initiate a deposit system for pesticide containers in 1985. The rule applies to all limited and restricted use pesticides sold in glass, metal, or plastic containers, a category consisting mainly of conventional agricultural and forestry applications. Deposit amounts are $5 for containers of less than 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 for container shredding equipment at the collection sites. According to the Director of the Maine Board of Pesticides Control, the deposit system has played a significant role in the reduction of improper container disposal.[25]

In 1985, the first year of operation of the deposit system, Board of Pesticides Control staff inspected 7,055 containers. Had these containers simply been drained rather than properly rinsed, 429 pounds of active ingredient would have been deposited into landfills. By guaranteeing that the containers were triple rinsed and therefore 99.998% clean, only 0.05 pounds of active ingredient was landfilled.[26]

One problem with the deposit system is that it does not apply to general use pesticide containers, which are far more numerous than restricted 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. For a similar reason, a few larger states have considered a program similar to Maine's but concluded they would not be able to inspect the large number of containers in their states.[27]

5.5. OTHER PRODUCTS

Rhode Island has required $5 deposits on all types of replacement vehicle tires since 1988. Customers can recover their deposits by returning old tires within 10-14 days of the date of purchase of the 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 imposes product charges of $0.75 on tires to finance the cleanup of old tire piles.[28]

Outside the United States, deposit systems have been applied to car hulks, light bulbs, lubricating oil, and other products. These systems are described in Section 11.

5.6. VOLUNTARY DEPOSIT SCHEMES

In addition to lead-acid batteries, a few other products are subject to deposit schemes 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. As noted in Section 11, voluntary deposit schemes appear to be much more common outside the United States.

5.7. PERFORMANCE BONDS

Performance bonds are deposit payments for which the payer can obtain a refund by fulfilling certain obligations. In that sense, a performance bond acts like a deposit-refund system.

As an example of an environmental issue addressed with performance bonds, the Surface Mining Control and Reclamation Act (SMCRA) of 1977 requires performance bonds for surface coal mining and reclamation permits. The amounts are determined by the regulatory authority (either the State or the Department of the Interior) and depend on reclamation requirements specified in the permit and anticipated difficulty of reclamation due to factors such as topography, geology, hydrology, and revegetation potential of the site. SMCRA requires that the amount be sufficient to finance reclamation by the regulatory authority in case of forfeiture. The minimum amount is $10,000 per permit area. Deposit amounts are adjusted as mined areas increase or decrease and as reclamation cost estimates change.

(SMCRA complete text: www.osmre.gov/smcra/smcra.html)

Although such performance bonds give companies an economic incentive to reclaim mining sites, they are backed up by a command-and-control requirement specified in a permit. The reclamation requirement may have more of an incentive effect than the deposit.

Notes for Section 5

1. Palmer et al. (1995), Abstract. www.rff.org/dpapers/abstract/9533.htm

2. The information in the last two paragraphs and in table 1 was supplied by the Container Recycling Institute.

3. Criner, Jacobs, and Peavey (1991), p. 20.

4. Lucinda White, Maine Department of the Attorney General, personal communication, July 1996.

5. For more information on redemption problems in Maine, see Maine Legislature Office of Policy and Legal Analysis (1996). Coca-Cola's over-redemption figures are stated on p. 20 of this source.

6. Criner, Jacobs, and Peavey, pp. 25-26.

7. Cited in Criner, Jacobs, and Peavey (April 1991), p. 41.

8. Criner, Jacobs, and Peavey, p. 44.

9. Tellus Insitute (1990), *WastePlan: The integrated solid waste planning model*, Boston, MA, as cited in Criner, Jacobs, and Peavey, p. 48.

10. Information on changes in handling fees provided by Lucinda White, Maine Department of the Attorney General, personal communication, July 1996.

11. In this table, the original deposit scenario assumes that no beer or soda containers are collected in the curbside program, and the expanded deposit scenario assumes that no beer, soda, juice, wine, or liquor containers are collected in the curbside program. Under the expanded deposit scenario, the curbside program collects only newspaper and ferrous, glass, aluminum, and HDPE containers or packaging for products other than beverages.

12. Unless otherwise stated, the information on California's deposit scheme is provided by McCarthy (1993).

13. California LAO internet site, "LAO Analysis of the 1995-96 Budget Bill, Resources, Part II." www.lao.ca.gov/a96b2.html

14. *Beverage World 1994-1995 Databank*, p. 275.

15. Ackerman, Frank, Dmitri Cavander, John Stutz, and Brian Zuckerman, *Preliminary Analysis: The Cost & Benefits of Bottle Bills*, Boston: Tellus Institute, January 1995, as cited in Palmer et al. (1995), p. 31.

16. EPA (July 1992), p. 4-1.

17. Wellman Inc. (1994), pp. 66-67.

18. The 1990 glass recycling study was cited by McCarthy (1993).

19. McCarthy (1993).

20. Ibid.

21. Ibid, summary.

22. The information on state lead battery deposits was supplied by Saskia Mooney and Weinberg Bergeson & Neuman, April 8, 1996, "Summary of State Lead-Acid Battery Recycling Law."

23. Smith, Bucklin and Associates (1995), p. 1.

24. Lead scrap price data were obtained from Business Cycle Indicators (BCI): www.mlinet.com/bci/pages/lsm023.htm. BCI monthly prices were averaged to determine annual price.

25. Bob Batteese, Director of Maine Board of Pesticides Control, personal communication, 1996.

26. Batteese (1988).

27. Bob Batteese, personal communication, June 1996.

28. *Scrap Tire News Legislative Report*, January 1996, "Scrap Tire Laws and Regulations," and Paul Dudra, Rhode Island Department of Environmental Management, personal communication, 1996.

6. TRADING SYSTEMS

Emission trading systems came into use in the U.S. in the mid-1970s as a means for new sources to locate in nonattainment areas without causing air quality to worsen. From this important but modest beginning, pollution trading systems now come in a wide variety of forms, apply to a large and growing number of sources of pollution that impact air, water and land.

The general principle of pollutant trading systems is that sources may satisfy their obligations by one of two means: (1) limiting their releases of pollution to no more than the permitted amount, and (2) releasing more (or less) than the permitted amount and exchanging credits representing any deficiency (or surplus) in the quantity of emissions controlled with other sources. Sources with marginal costs of pollution control that are about average are likely to meet their obligations without trading. Sources with relatively high marginal control costs are likely buyers of pollution reduction credits and sources with relatively low marginal costs of control are likely sellers of excess credits.

Trading systems have evolved to include far more than the exchange of pollution reduction credits. For example, the well-known acid rain trading system is based on allowances for future 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 for use as an additive in gasoline. Heavy-duty truck manufacturers can meet engine emission standards by averaging together the emissions performance of all engines they produce. Programs to trade water effluents are operating in selected locations. 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 below. 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 US is involved.

A few basic parameters may be used to characterize trading systems: (1) whether trading is restricted to averaging within single facility, allowed among facilities owned by the same firm, or allowed among firms or facilities under different ownership; (2) whether there is a cap on overall emissions or effluents; (3) whether tradable certificates are obtained as allowances for future pollution or as a credit for previous pollution control actions; (4) the required trading ratio (one to one or some greater ratio); (5) whether tradable certificates can be banked or stored for future use; and (6) how credit generation and trading is monitored. The success of the trading systems described in this Section do not appear to depend upon any particular formulation; however, trading probably would not function to lower compliance costs and protect environmental quality if one or more of these parameters is not defined.

6.1. TRADING OF AIR EMISSIONS

6.1.1. EPA's Air Emission Trading Program

6.1.1.1. Offset Program

EPA's air emission trading program had its origins in the mid-1970s as a solution to the problem of locating new sources of air pollution in nonattainment areas.[1] To accommodate new sources and expansion of existing sources of air pollution, the EPA proposed the "offset" policy that permitted growth in nonattainment areas provided new sources install pollution control equipment meeting Lowest Achievable Emission Rate (LAER) standards and offset any excess by acquiring greater emission reductions from other sources in the area. Through this process, growth could be accommodated while maintaining progress toward attainment of national ambient air quality standards.

Of more than 10,000 offset trades (a few of which are described later in this Section), over 90 percent have been in California. Nationwide, about 10 percent 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 closure of all or part of a facility.

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), generated when sources reduce emissions below the lower of actual or allowable emissions and apply for the state for certification of the reduction. To be certified as an ERC, the state must determine that the reduction is (1) surplus in the sense of not being required by current regulations in the State Implementation Plan (SIP); (2) enforceable; (3) permanent; and (4) quantifiable. ERCs are normally denominated in terms of the quantity of pollutant in tons released over one 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.[2] States have approved a variety of activities that sources may use to generate offset credits. California, for example, accepts the scrapping of older vehicles and lawn mowers as means of generating credits and applies a formula to determine the magnitude of air pollution credits for each old car that is scrapped.

The four emission trading programs were subject to numerous revisions, before being incorporated into EPA's Final Emission Trading Policy Statement, issued in 1986 and addressing trading of ERCs for criteria pollutants such as sulfur dioxide, nitrogen oxides, particulate matter carbon monoxide, and volatile organic compounds that contribute to the formation of ground-level ozone.[3] 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 unity and air quality modeling for some cases).

6.1.1.2. Bubble Program

The bubble program, 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. A bubble can include more than one facility owned by one firm, or 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. An additional 34 bubbles were approved 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. No estimates are reported for the number or savings from post-1986 bubbles. Bubbles are designed to be neutral in terms of environmental impact.

6.1.1.3. Banking

EPA's initial offset policy did not allow 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 willing to create and supply credits.

The offset policy in the 1977 amendments to the Clean Air Act included provisions for banking of emission reduction credits for future use or sale. Although the EPA has approved several banks, there has been limited use of the provision, most likely because of the uncertain nature of the banked ERC. EPA determined in 1980 that an ERC cannot be 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 banked ERCs.[4] A 1994 report identified 24 emission banks; some limited ERCs to a life of as little as five years.[5] 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.

6.1.1.4. Netting

Netting, the final component of EPA's emission trading policy, dates from 1980 and 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 the emission trading programs; one source estimates that between 5,000 and 12,000 sources have used netting.[6]

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 which 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).[7] 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 caused by the permitting process.

EPA's Office of Air and Radiation announced on April 3, 1996 a series of proposed revisions to new source regulations expected to reduce by more than one-half the number of permitting actions new sources and sources undergoing changes must take. Because the proposal shares many of the features of netting, it is described here. The proposed regulations would allow sources to use plantwide limits and 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 plantwide emissions cap (generally this would be the source's maximum potential emissions). Process changes could be made so long as the changes did not result in an increase in emissions beyond the cap.

6.1.1.5. Evaluation of Emissions Trading Program

Foster and Hahn provide the most comprehensive evaluation of the emissions trading program, using data for offset transactions in the Los Angeles area.[8] They obtained data on trading activity from the South Coast Air Quality Management District, reported 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.

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 (indicating 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.[9] 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 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 transactions costs to the seller (thought to be a minimum of $10,000 per transaction). In a few cases, transactions costs apparently exceeded the market value of the credits that were exchanged.

Though the highest and average prices increased over the period, most of the change in 1991 can be attributed to a change in SCAQMD rules 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.

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 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 transactions 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 the many emission trading features of the 1990 Clean Air Act Amendments. In some respects, however, the 1990 Amendments reduced the scope of trading programs. For example, Section 173(b) restricts the use of growth allowances in State Implementation Plans, limiting the use of offsets. 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 as described below). The Los Angeles area has developed a much more significant trading initiative known as RECLAIM with an emissions cap and phased reductions in allowable emissions of SO_2 and NO_x. Illinois expects to have a similar program with an emissions cap in place soon.

Regional trading programs that involve several states also are under development, as described below. In June 1993 NESCAUM (Northeast States for Coordinated Air Use Management) launched a Demonstration Project to trade *discrete emission reductions*

(DERs). The Ozone Transport Commission (OTC) received approval from EPA for "cap and trade" system in NO_x emission allowances. The Ozone Transport Assessment Group (OTAG) is working on a regional trading program for NO_x and perhaps also VOC that would cover the eastern one-half of the U.S.

Table 6-1: EMISSION TRADING ACTIVITY IN THE LOS ANGELES AREA
(all trades reported to SCAQMD)

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

Source: Foster and Hahn

6.1.2. RECLAIM

The highest ozone levels in the nation are recorded in the Los Angeles area, with readings often exceeding twice the national ambient air quality standard of 0.12 ppm.[10] The South Coast Air Quality Management District (SCAQMD or District) also fails to meet the particulate and CO standards, though not by such a large margin. Historically, the SCAQMD has relied on command and control rules to limit emissions of ozone precursors (as well as other pollutants).

Despite making substantial progress over the past three decades in improving air quality in the Los Angeles Basin, it was apparent to SCAQMD officials that further progress toward attaining federal standards would be prohibitively expensive using traditional regulatory approaches.[11] By 1990 the marginal costs of NO_x control in the District had reached $25,000 per ton at electric power plants, versus $5,000 (or less) nationally. Proposed SO_2 controls on catalytic cracking units at refineries would have cost $32,000 per ton, versus national costs of perhaps $500 per ton (see the section describing the Acid Rain allowance trading program). Consequently, the District began to investigate the feasibility of creating a marketable permit in the ozone precursors VOC and NO_x as well as SO_2 (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) that would include about 2,000 sources of reactive organic gases (representing about 85 percent of permitted stationary source emissions), 700 sources (representing 95 percent of permitted NO_x emissions), and about 50 sources of SO_2 (representing about two-thirds of permitted stationary source emissions). Each market would start with an allocation of emissions equal to the 1994 emissions target in the District's Air Quality Management Plan (AQMP). Each marketable permit program would reduce emissions annually by amounts necessary to achieve the AQMP targets: attainment of air quality standards by 2003 for SO_2 and NO_x and VOC emissions goals by 2010.

For the NO_x and SO_2 programs, emissions originated at combustion sources with well-defined exit points to the environment. Emission monitoring would be based on stack gas measurement, a relatively simple task that increasingly is accomplished with remote sensing devices. For VOC the market was based largely on evaporative emissions, which are inherently more difficult to measure. Prospective VOC trading also was complicated by the fact that ROG are not homogeneous; some react much more readily than others to form ozone. Further, some ROG also are classified as toxic pollutants and regulated separately. After about one year of analysis and discussion, RECLAIM officials decided to defer including ROG and concentrate on program design for NO_x and SO_2.

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 due to concerns 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 was computed in the AQMP by taking reported 1987 emissions and deducting projected reductions 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. 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 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 participating facilities in RECLAIM. Sources installed continuous emission monitors (costing $100,000 to $150,000 each) on every boiler emitting 10 tons annually or more. The CEM recorded pollutant readings minute by minute and sent the readings to a remote terminal that averaged the readings over fifteen minute periods and 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 command and control regulations would be an average of $58 million annually for each of the next ten years, muting industry 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.[12] After 2003 the balance remains constant. The RTC are denominated in pounds: one RTC equals one pound of emissions. Sources are free to trade RTCs for the current year or for future years; however, all RTCs are good only for the year for which they are issued. Trades in RTCs 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 RTCs and shares that information with market participants. The RTC bulletin board can be reached via modem at 909-396-3499.

Under RECLAIM rules, the District may impose penalties for net emissions (including trades) in excess of permitted amounts. One potential penalty is a reduction of next year's emission allocation by the amount of the exceedance. Other possible actions include civil penalties and the loss of the operating permit.

In 1994, the NO_x and SO_2 markets began with 370 sources and 40 sources, respectively. Both markets represented approximately 70 percent of stationary source emissions. Analysis shows that the program should reduce NO_x emissions by an average of 8.3 percent per year (amounting to a cumulative reduction of 80 tons per day by 2003) and SO_2 emissions by 6.8 percent per year (a cumulative 15 tons per day by 2003). The District projects that RECLAIM will lower compliance costs by 42 percent compared to a command and control approach: $80.8 million versus $138.7 million.

As a means of jump starting the market, the SCAQMD held an auction of RTCs 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_2 credits changed hands at the auction. Prices for RTC were low for near years and much higher for more distant years (See Table 6-3). In all cases, though, the cost for a ton of credits was far lower than the marginal control costs from recently enacted or proposed command and control regulations. In a privately negotiated transaction in August 1995, Unocal reported paying Anchor Hocking $3.65 million for 8.6 million pounds of NO_x emission credits. 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.

Table 6-2: RECLAIM TRADING CREDIT PRICES
(July 1994 auction)

Year	NO_x	SO_2
1994	2	
1995	334	1,500
1996	574	1,900
1997		
1998		
1999	1,480	
2000	1,580	
2001	1,700	
2002	1,830	
2003	2,090	

Source: BNA *Daily Environment Report*, August 10, 1994, p. A-1

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 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 met with fierce opposition from environmentalists who charged that the 1989 baseline selected for emissions could result in a huge increase in emissions over 1993 levels when the program starts.[13] Regulators sought the 1989 baseline to avoid locking industry into emission levels associated with recessionary conditions in 1991 through 1993. Industry representatives note that the AQMP has a schedule for orderly reductions over time toward the 2010 goals. In their view, emissions increases 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 SCAQMD governing board set aside in January 1996 the proposed rule to include trading of VOCs within RECLAIM and directed its staff to develop a program to trade VOC emissions separately.

RECLAIM officials hope to launch by the fall of 1996 an expansion of the program to 30,000 companies, from the 400 at present. And in the latest of its innovations for reducing ozone precursor emissions, the SCAQMD announced on May 13, 1996 that it will offer tradable "smog credits" to lawn mower retailers for accepting and scrapping the 1.7 million gasoline-powered mowers in the District.[14] SCAQMD estimates that a single mower used for 20 hours a year emits as much VOC emissions as a new car driven 26,000 miles. Credits for scrapping lawn mowers would complement other means available to firms for earning credits, such as scrapping older cars and increasing employee use of car pools.

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.[15] According to the report, RECLAIM, demonstration projects to stimulate technological development, and outreach and compliance programs have helped save or create over 10,000 jobs while achieving air quality improvement.

6.1.3. Other State Air Emission Trading Programs

6.1.3.1. Illinois

Unveiled in March 1995 and expected to begin operations in 1997, the Illinois Clean Air Market will allow the trading of VOC emission credits between firms in the Chicago nonattainment area. Like RECLAIM, the program is 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. If all eligible sources of 10 tons of VOC per year choose to participate, the program would have 283 participants. The Illinois EPA estimated that companies would have the potential to save $160 million annually in compliance costs.[16]

An earlier program in Chicago was aimed at trading NO_x allowances; however, the *Lake Michigan Ozone Study* released in 1994 showed that reducing NO_x emissions substantially could have the effect of increasing ground level ozone. Consequently, efforts to reduce NO_x levels in the immediate Chicago area have been put on hold.

6.1.3.2. Delaware

In December 1995, the state Department of Natural Resources and Environmental Control proposed a trading program in VOC and NO_x emissions. The program would stationary sources and mobile sources, through such features as vehicle scrapping and employee trip reduction efforts. The program is expected to become operational in early 1996.

Delaware also was one of the first states to approve facility-wide permitting. In October 1995 Chrysler obtained permission to set a facility-wide limit on air emissions from its Newark Delaware auto assembly plant.[17]

6.1.3.3. Massachusetts

In September 1993, Massachusetts officials announced a trading program involving new and existing stationary source and mobile source emissions of three pollutants: VOC, NO_x, and CO. The program allows sources to bank emission reduction credits (ERC) obtained for reducing emissions below permitted levels. On February 22, 1995 the US EPA gave tentative approval to the program. In June 1995, Massachusetts officials announced the first trade under the program, as Montaup Electric bought NO_x credits from New England Power Company. Montaup Electric also announced that it would donate to the state 5 percent of the 65 tons of ERCs it purchased and retire any credits it does not use.

6.1.3.4. Michigan

The Michigan Department of Environmental Quality designed a voluntary statewide air emissions trading program in VOC and all criteria pollutants except ozone that took effect on March 16, 1996. The Michigan program is voluntary, allowing all stationary and mobile sources to participate. Sources earn ERCs for emission reductions beyond what is required by an emission standard or limitation. Sources may bank ERCs for future use, trade emission reduction credits, or engage in emission averaging. To ensure an environmental benefit, the DEQ will retire 10 percent of all ERCs.

6.1.3.5. New Jersey

Under the 1991 Pollution Prevention Act, the State's Department of Environmental Protection is testing the use of facility-wide permits that would incorporate pollution prevention into the permitting process and improve the overall administrative efficiency of permitting by consolidating the air, water and waste permits into a single, facility-wide permit.[18] This meant that as many as 150 separate permits at a facility were rewritten as a single permit. As an inducement for firms to participate in the pilot test, New Jersey allows operations with facility-wide permits to change processes without prior approval provided the facility continues to meet existing emission standards and the process changes do not increase hazardous air emissions or wastes. Firms that apply for the pilot program must agree to expand the number of pollutants in their pollution prevention plans. As of December 1995, New Jersey had accepted three firms (out of 18 applicants) into the program.

In mid-June 1995, New Jersey officials proposed an air pollution trading system that would allow companies to meet permit limits by acquiring credits earned by other companies for reducing emissions below permitted amounts. The US EPA indicated the proposal would be accepted.[19]

6.1.3.6. Texas

With a grant in 1992 from the EPA, the Texas Air Control Board began to evaluate and design a marketable permit program for air pollutants with special emphasis on the Houston nonattianment area. Using an incremental approach, the State first created an emission reduction credit bank in 1993 and later adopted rules for community-wide trading. One of the means by which ERCs may be generated is scrapping polluting motor vehicles. The Texas scrappage provisions require actual measurement of vehicle emissions to determine the number of credits earned. This differs from the approach in California which relies on a formula to determine credits.

The first trade under the trading program took place in July 1995 and involved Anchor Glass Container, which sold 125 tons of NO_x ERCs to Rollins Environmental Services. Rollins plans to use only 96 tons of ERCs with the remainder to be retired to improve air quality in Houston. A broker involved in the transaction indicated terms of the sale are confidential, but that if Anchor has more credits for sale they could be sold for between $5,000 and $15,000 per ton in the Houston area.[20]

The Texas ERC bank had 370 tons of VOC in inventory as of July 1995 waiting for a buyer. Demand for VOC credits has been slow because sources have been able to achieve required reductions internally, partly as a consequence of new "flexible" permitting rules.

Texas implemented "flexible" air permit rules effective December 1994 that allow a company to make equipment and process changes at a facility provided that total emissions remain below a permitted maximum level. Emission caps under this program are set at levels that reflect use of state of the art equipment and are generally lower than what is allowed under traditional permitting. Historically, the State required the approval of individual pieces of pollution control equipment and the modification of a source's permit every time there was a process change. The "flexible" permitting approach allows sources to engage in intra-plant trades within the emission cap. In the 14 months to March 11, 1996, the State had issued 11 "flexible" air permits.

6.1.3.7. Wisconsin

In 1996 the Wisconsin Air Bureau expects to have EPA approval for a trading program in VOC and NO_x emissions. The chief remaining point of contention in developing the program is the credits to offer in instances of facility shutdown and production rollback. To discourage the long-term banking of emission credits, the State proposed to subject banked shutdown credits to a "banking" fee of $35 per ton in the first year the credit is certified, with the fee doubling every year thereafter until the credit is used or sold.[21] Like the four other state programs described above, the Wisconsin proposal was developed largely in response to provisions of the Clean Air Act Amendments of 1990 regarding the use of offsets for new sources.

6.1.4. NESCAUM/MARAMA Demonstration Project

The NESCAUM/MARAMA Demonstration Project, initiated in June 1993, joins regulators, environmentalists and members of the business community to resolve the issues surrounding emission trading in the states from North Carolina to Maine.[22] The first phase in 1993 developed principles for creating discrete emission reductions (DERs). The second phase, completed in 1995, developed portocols to promote an environmentally sound trading system by reviewing actual and proposed trades. The third phase assisted the EPA in developing its Open Market Trading Rule, enacted on July 26, 1995 (see below).

Phase two reviewed twelve proposed DER trades. Several trades were completed, including a June 1 1995 transaction in which Merck purchased 10 tons of NO_x credits valid for one year from Public Service Electric and Gas Co. for $16,000, or $1,600 per ton, to meet requirements in its operating permit.

6.1.5. OTC/OTAG Regional NO_x Reduction Program

Title I of the Clean Air Act Amendments establish a northeast transport region consisting of 12 states and the District of Columbia, which runs from northern Virginia to New England. This region in effect is treated as one Moderate ozone nonattainment area requiring RACT controls. Title I also called upon EPA to establish an Ozone Transport Commission (OTC) as a consensus building organization with representation from each affected jurisdiction to recommend additional control measures. By September 1994, the OTC had obtained agreement among all participants except for Massachusetts and Virginia that its model rule for controlling NO_x should be implemented.[23] Massachusetts signed recently, leaving Virginia as the only non-signatory. Virginia has declined to sign the agreement before ozone modeling is done (possibly a reflection of the fact that northern Virginia, the only part of the state in the OTR, has few large NO_x sources.

The agreement divides the region into three zones with different magnitudes of NO_x reduction. Within the Inner Zone, which includes the northeastern corridor from northern

Virginia to southern New Hampshire, large stationary NO_x sources (utilities and industrial boilers) must achieve the less stringent of a 65 percent reduction relative to 1990 baseline emissions or an emissions rate no greater than 0.2 pounds of NO_x per million Btu by May 1, 1999. By 2003 these requirements become a 75 percent reduction and 0.15 lb/MBtu for Inner Zone facilities. Facilities in two other zones, designated the Outer Zone and the Northern Zone, are required to achieve lesser reductions.

The agreement establishes a program for trading NO_x reduction credits that closely parallels the acid rain allowance trading program. Both programs create allowances and provide for trading of allowances under a cap that decreases over time and both programs encourage banking of excess allowances. The OTG has worked out the total NO_x budget for 1999 and 2003, as well as allocations to each state. Under the OTC plan, states would be responsible for the further division of allocations to individual sources within the state. OTC estimates that the trading feature of its proposal will save approximately 30 percent in compliance costs (nearly $80 million on an annualized basis) relative to uniform reductions at each source. The OTC NO_x trading program is scheduled to begin in May, 1999.

The issue of expanding the control of NO_x emissions (and perhaps also VOC emissions) outside the ozone transport region is being addressed by the Ozone Transport Assessment Group, which was organized through a March 1995 EPA policy memorandum that asked each of the 37 states east of the Mississippi River and the District of Columbia to look at the problem of ozone formation and transport within that entire region.[24] OTAG is at a much earlier stage of development than its OTC counterpart. Its primary activity to date is modeling the effects of different ratios of NO_x and VOC throughout the OTAG region. NO_x has been the primary focus of the modeling efforts since it is transported over greater distances than are VOC. If OTAG determines that controls on NO_x or VOC beyond those called for the Clean Air Act Amendments of 1990 are required, OTAG is expected to propose a trading option.[25]

6.1.6. Open Market Trading

On March 16, 1995, President Clinton announced 25 initiatives for regulatory reinvention at EPA, the first one of which was an "open market" air emissions trading rule to help achieve the national ambient air quality standard (NAAQS) for ozone in nonattainment cities faster and at lower cost. The announcement read in part:

> EPA will issue an emissions trading rule for smog-creating pollutants that will allow States to obtain automatic approval for open market trading of emissions credits with accountability for quantified results. Expanding use of market trading on a local and regional level will give companies broad flexibility to find lowest cost approaches to emissions reductions. The rule will encourage experimentation with new trading options, while enabling States to pursue more quickly allowance-

based cap systems, which are already under development in some areas.[26]

In August 1995, EPA published a proposed open market trading rule, demonstrating the Agency's strong support for innovative, market-based approaches that would produce less expensive and faster progress toward meeting the NAAQS for ozone.[27] The term "open market" was used to distinguish the approach from programs with an emissions budget or cap, the so-called "closed market" system. Offered as a model of what states could adopt within their State Implementation Plan (SIP), the proposed rule would allow sources to legally substitute discrete emission reductions (DER) for on-site compliance with pollution control equipment. DERs could be offered on the market by sources that control more than required, much like the earlier offset program. The open market trading rule placed responsibility for the quality of DERs on firms that used them for compliance.

The Agency received numerous comments on the proposal, not all of them favorable. One of the most common complaints was that the seller of DERs should bear some (or all) of the responsibility for assuring their quality. Otherwise, the market could be flooded with offers, many of them of dubious quality, and sources seeking to use the DERs for compliance would have great difficulty determining the quality of what they were acquiring. The market in DERs could flounder unless this problem is resolved, according to potential DER users. Whether (and in what form) the Agency reproposes the open market trading rule remains under consideration as of the writing of this Section.

Many of the programs developed by states and local areas in response to (or are at least compatible with) EPA's open market trading initiative are summarized in the EPA Directory of Air Quality Economic Incentive Programs: On-line Database, which can be accessed from the following Web address: http://www.epa.gov/omswww/market.htm.

6.1.7. Acid Rain Allowance Trading

An early solution to the problem posed by SO_2 and nitrogen oxide emissions from power plants was to build tall stacks to disperse the pollutant away from populated areas. By the 1980s, though, this strategy fell into disfavor as studies began to demonstrate probable harm to lakes and forests, agricultural crops, materials, and other valuable resources from acidic precipitation. Studies also revealed that acidification of soils and waters could release heavy metals and aluminum previously bound in the soils, posing a risk to human health and to ecosystems.[28]

Though great scientific uncertainty surrounded almost every aspect of the acid rain issue, legislators in states affected by acid rain were understandably interested in implementing some form of control program. In Title IV of the Clean Air Act Amendments of 1990, Congress created a program for the control of SO_2 emissions from utility sources that would cut total national emissions by approximately one-half at an estimated cost of \$4 to \$5 billion per year. The program sets a cap of 8.95 million tons of SO_2 per year, to be achieved in two phases. During the Phase I, which began in 1995 and ends in 2000, the 110 highest emitting coal-fired power plants (with a total of 256 coal burning "units") must reduce emissions to meet a tonnage cap equal to 2.5 lbs. of SO_2 per million Btu multiplied by each unit's average 1985-1987 Btu consumption.[29] The tonnage cap is expressed in terms of "allowances," with each allowance good for one ton of SO_2. Phase I will yield a nationwide reduction in emissions of 3.5 million tons of SO_2. Sources that fail to meet these limits are subject to a penalty of $2,000 per ton of "excess" emissions. In the second phase, which begins in 2000, all power plants producing more than 25 megawatts and all new facilities must meet an emission cap computed as 1.2 lbs. of SO_2 per million Btu times each unit's 1985-1987 Btu consumption.[30] Phase II reductions will total an additional 5 million tons and will reach the overall 8.95 million ton cap.

Utilities must install continuous emission monitoring systems (each one costing approximately $250,000) to verify compliance with the emission limits, and file quarterly reports of their hourly emissions data with EPA. Initially sources mailed these data to EPA on floppy disks, but EPA is now encouraging electronic transmission. Continuous emission monitoring systems (CEMS), the accepted industry standard for measuring SO_2, NO_x, and CO_2, provide an accurate accounting of emissions, assuring both buyers and sellers that the commodity they are trading is real.

Prior to the drafting of this title of the Clean Air Act, a number of studies had identified potential cost savings of up to $1 billion per year through emission trading due to significant differences among utility sources in the marginal cost of abatement.[31] Title IV created a market-based trading system in SO_2 under which utilities may buy or sell allowances for future production of SO_2. Title IV also sets allowable limits on NO_x emissions from utility boilers. Though these emissions are not subject to the same type of market-based trading system as SO_2, an owner of two or more power plants may comply with the NO_x requirement by averaging emissions across all of its power plants.

SO_2 allowances may be used for 30 years, giving utilities the flexibility to develop compliance approaches during their regular planning cycles. Utilities may satisfy their emission limits by controlling emissions to the required extent or through participation in the allowance market. Under the authority of Title IV, EPA developed an allowance tracking system that serves as the official record of ownership and transfers. In addition to private transactions in allowances, Title IV directed EPA to offer at an annual auction beginning in 1993 allowances equivalent to about 2.8 percent of total allowances to assure that some allowances would be available for utilities that planned on complying with their emission limits by purchasing allowances. EPA also was authorized to make a small quantity of allowances available at the price of $1500 per ton to guarantee the availability of allowances if utilities found themselves out of compliance and had no other recourse.

Beginning January 1, 1995 the EPA can allocate up to 300,000 bonus allowances from its Conservation and Renewable Energy Reserve to utilities that undertake energy efficiency and renewable energy measures. In December 1995, the EPA announced awards to ten utilities totalling 8,635 allowances under this program.[32]

In March 1995, EPA expanded the acid rain program to include industrial facilities that burn fossil fuels. The rule establishes an "opt-in" program that allows industrial and other sources to participate in the existing SO_2 program that previously included only utilities.[33] Industrial sources that participate in the program will have an allocation of allowances that they can use for compliance or sell or trade to other sources.

Results from 1995 and 1996 show that the Acid Rain Program has been very successful, with firms over-achieving the reductions target at less than one-half the forecasted cost. These results appear to derive more from the emissions cap and flexible technological requirements, rather than trading, per se. By early 1997 utilities had exchanged over 7.2 million allowances and purchased an additional 300,000 allowances through the annual auction. Intra-firm transfers, which are believed to be significant, are not included in this total. While this activity is not negligible, most utilities were not relying on trading allowances to achieve compliance. The price of allowances has been far below what had initially been forecast, an issue that has attracted considerable attention (see Table 6-3). Before the Clean Air Act Amendments of 1990 were passed, industry estimates of abatement costs were as high as $1500 per ton, leading Congress to use that figure for the price of direct allowance sales by the EPA.

In searching for explanations for the relatively low level of activity, analysts have cited transactions costs that could reduce realized gains from trading allowances, the behavior of public utility commissions, and state legislation that promotes the use of locally-produced coal.[34] Another factor is that utilities have traded between facilities owned by the same company (so-called "intra-utility" trading) rather than between facilities owned by different parent companies ("inter-utility" trading). Only the latter trades are included in the totals reported above.

Low allowance prices appear to have their explanations too, as detailed by Burtraw. Prices for virtually every form of compliance have declined well below what had been anticipated before 1990. The price of low-sulfur western coal delivered to midwest and eastern markets has declined due to productivity improvements in extraction and transport. Engineers have found ways to blend low-sulfur coal with high sulfur coal to reliably meet emission limits. Innovations in the scrubber market have cut the cost of scrubbing by approximately one-half. Apparently the decline in allowance prices over time is largely a consequence of improvements in productivity and technology, encouraged by the flexibility of the Acid Rain Program.

Economists have criticized the mechanics of the auction, suggesting that it may also contribute to lower prices than otherwise would occur.[35] The Act requires what is termed a discriminating price auction, which ranks bids from highest to lowest.[36] EPA has interpreted this as requiring that each seller receive the bid price of a specific buyer. The auction awards allowances offered by the seller with the lowest asking price to the bidder with the highest bid price first and moves up the supply list and down the bid list until no bidder is willing to offer what a seller demands. This unusual auction mechanism apparently causes sellers to misrepresent and under-reveal their true costs of emission control.[37] EPA may consider using a single price auction, which in theory should elicit higher bids

Table 6-3: ESTIMATED AND AVERAGE REALIZED ALLOWANCE PRICES
(nominal dollars per ton)

Pre-1989 industry esti-mates	1990 EPA esti-mate	Early trades	1993 CBOT auction	1994 CBOT auction	1995 CBOT auction	1996 CBOT auction	1997 CBOT auction
$1,500	$750	$250	$122	$140	$126	$66	$110

. The role that allowance trading is playing in stimulating cost-effectiveness in SO_2 control at coal-fired power plants will continue to be debated. There is no doubt that SO_2 control has experienced tremendous technological and productivity improvements over a very short period of time, leading to much lower allowance prices than had been anticipated. The issue is the extent to which these gains could have been achieved without allowance trading. One analyst concluded that it is the flexible, performance-based design of the acid rain control program, rather than allowance trading *per se* that has stimulated the development of low cost compliance measures seen in Phase I, and that allowances trading had played a positive but lesser role.[38]

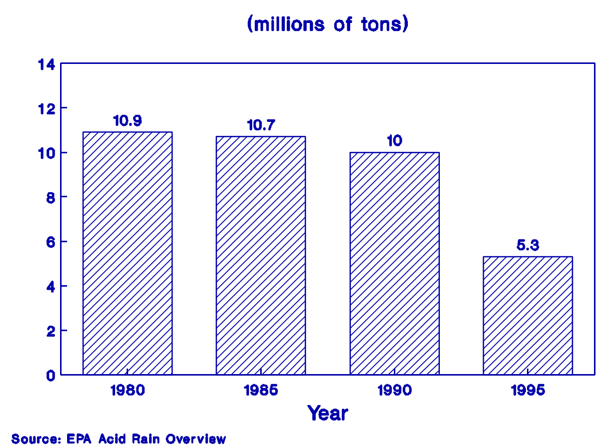
A question, then, is what effect trading actually has had - and what effect it is likely to have in the future. A few utilities clearly are buying allowances as part of their compliance plan. At the March 29, 1993 auction, Carolina Power and Light bought approximately two-thirds of the allowances offered. At the March 27, 1995 auction Duke Power bought over one-half of the allowances offered. More broadly, however, allowance transactions and especially auctions provide a very visible price benchmark against which utilities and regulators can gauge performance.

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

A recent 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.[39] Early estimates of the costs of acid rain control put the costs at $4.5 to $6 billion annually if a command and control approach were adopted.[40] The same report estimated the mean value of annual health benefits at $10.6 billion in Phase I and $40 billion in Phase II. Benefits to the environment and to materials previously had been placed at approximately $2 billion annually.[41] Interestingly, health benefits were not a major concern in the design of acid rain control legislation, yet they now appear to be the dominant benefit component, dwarfing earlier estimates for the environmental effects.

Phase I, which began in 1995, affects 263 separate combustion units at 110 coal-fired power plants. An additional 182 combustion units joined Phase I as compensation or substitution units, raising the total of Phase I units to 445. Preliminary emissions data compiled by EPA show that SO_2 emissions control is far ahead of schedule; during 1995, emissions from all Phase I sources amounted to 5.3 million tons, approximately 40 percent below the required level of 8.7 million tons and only about one-half of what these units had emitted during the 1980s (see Figure 6-1).[42]

Figure 6-1: PHASE I SO_2 EMISSIONS



6.1.8. Chlorofluorocarbon Production Allowance Trading

The Montreal Protocol on Substances that Deplete the Ozone Layer called for a cap on chlorofluorocarbon and halon consumption at 1986 levels, with reductions scheduled for 1993 and 1998.[43] 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.

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 command and control approach to end uses would cost more than $300 million for record keeping and reporting, versus only $2.4 million for the allowance trading approach.[44]

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 segregated by their ozone depleting potential.[45] 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 use of these substances, while 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, one percent of the allocation is "retired" to assure further improvement in the environment.

EPA coupled the marketable allowance trading system with excise taxes on CFC production, which are discussed in the section on fees, taxes, and charges. The rationale for the excise taxes was that the restrictions on the quantity of CFCs and halons offered on the market would lead to rapidly escalating prices. The excise taxes were designed to capture "windfall profits;" whereas the allowance trading system was designed to assure that production and import of the substances was efficient (concentrated at the lowest cost producers, who then produced the most valued CFCs).

6.1.9. Lead Credit Trading

As early as the 1920s tetra-ethyl lead was added to gasoline by refiners to increase octane and reduce premature combustion in engines, allowing more powerful engines to be built. Lead additives in gasoline were the least expensive of several ways of raising octane. The additives also prevented premature recession of valve seats.

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. New production vehicles by 1975 were equipped with catalysts to meet tailpipe emission standards for hydrocarbons, carbon monoxide and nitrogen oxides 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 run on leaded gasoline. As catalyst-equipped vehicles began to dominate the fleet, sales of unleaded gasoline reached about 80 percent of all gasoline sales by the mid 1980s.

Concerns about the role of airborne lead in adult hypertension and cognitive development in children motivated EPA to also 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 mounted concerning the magnitude and severity of the health effects attributable to lead.

EPA acted to curtail sharply the remaining use of lead in gasoline, initially setting as a limit 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 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, in effect extending 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 at 1.0 gm/gal, a refiner producing 1 million gallons of gasoline with average lead content 0.5 gm/gal would earn 500,000 lead credits. EPA enforcement relied on reporting requirements and random testing of gasoline samples. Reporting rules were simple; each refiner or importer was obligated to provide 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 percent of all transactions were reported accurately; however several dozen fraudulent transactions occurred.[46] 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, the lead credit trading program was quite successful. Lead credit trading as a percentage of lead use rose above 40 percent by 1987. Some 20 percent of refineries participated in trading early in the program, rising to 60 percent by the end of the program.[47] Early in the program 60 percent of refineries participated in banking, rising to 90 percent 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 when lead credits were traded, the price increased from about 3/4 cents/gm to 4 cents/gm.[48] Nearly one-half of all lead traded was between refineries owned by the same firm.[49] With external transactions, refiners revealed a preference to deal with normal trading partners even though they could obtain a better price elsewhere.

This indicates that even though there was an active market in lead credits, trading did not produce least cost outcomes.

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. The lead trading program 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, though, as noted above, refiners did not maximize gains from trade. Also, despite seemingly foolproof procedures for catching fraudulent trades, some small refiners and ethanol blenders nonetheless sold more credits than they had earned.

6.1.10. 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 refiners to develop reformulated fuels. The Amendments require tailpipe emission reductions of 35 percent for hydrocarbons and 60 percent for NO_x, starting with 40 percent 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 a further cut of 50 percent below these standards by 2003 unless it finds such reductions are not necessary, technologically feasible or cost-effective.

Title II requires that states with CO nonattainment areas with design values of 9.5 or higher must implement a program to supply oxygenated fuels in winter months. Gasoline sold in the 41 cities affected by this requirement must have an oxygen content of 2.7 percent 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 suppliers.

Title II requires that the 9 worst ozone nonattainment areas offer reformulated gasoline during the summer months and specifies several performance characteristics for reformulated gasoline, as well as certain fuel properties including a minimum oxygen content of 2 percent by weight beginning in 1995. Under so called "opt in" provisions, an additional 31 areas applied to be included in the RFG program. Title II allows states to 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 that collectively the standards were satisfied.

In October 1992, EPA issued rules for trading programs in oxygenates; however, participation is optional for the affected states.[50] 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, 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 percent 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 percent requirement.

While trading in oxygenates (and other fuel constituents) theoretically offers a cost-effective means of meeting RFG requirements, in fact the trading programs have been moribund. Only the Pennsylvania part of the Philadelphia ozone nonattainment area adopted trading rules and within that area no trades have been reported. Other areas have declined to allow trading, citing as prohibitive the costs of monitoring such a program.

6.1.11. Heavy Duty Truck Engine Emissions

Title II of the Clean Air Act Amendments of 1990 directs EPA to set standards for particulate and NO_x emissions from heavy duty truck engines. The standards must represent the maximum degree of reductions achievable, with the objective to accomplish a 75 percent reduction in the "average of actually measured emissions." EPA interpreted this language to allow engine manufacturers to average together the emission performance from all heavy duty truck engines they produce.

Averaging of emissions facilitates compliance, since not every class of engines has to meet the 75 percent reduction standard. How much engine manufacturers actually save is unknown; however, a recent paper that examined a similar type of engine performance averaging program for light-duty trucks proposed in California found that the cost savings were likely to be modest.[51]

6.1.12. Hazardous Air Pollutants

6.1.12.1. Early Reduction Program

In December 1992, EPA issued final rules for the early reduction of hazardous air pollutants.[52] If a facility qualifies by reducing hazardous air pollutants by 90 percent (95 percent in the case of hazardous particulate emissions) prior to EPA proposing MACT regulations on the source category, the facility may defer compliance with the new maximum available control technology standards (MACT) for up to six 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) percent emission limitation. Trading exists intertemporally in that sources exchange their early reductions for their later reductions.

EPA has shown how 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. Table 6-4 illustrates the time profile of emissions. The source has reduced emissions by 360 tons in years 1-4 in exchange for 48 tons of emissions in years 5-10. Total emissions are reduced by 312 tons.

Table 6-4: EXAMPLE OF EMISSION BENEFITS OF EARLY REDUCTION PROGRAM

Year	MACT Emissions	Early Reduction Emissions
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

By mid-1993 over 60 chemical plants had asked to participate so as to avoid for 6 years the synthetic organic chemical MACT standard. Other types of facilities also had applied to join the program.[53]

6.1.12.2. Petroleum Industry NESHAPS

This NESHAP rule, promulgated on August 18, 1995, establishes MACT requirements for process vents, storage vessels, wastewater streams and equipment leaks tanks 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 to 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 that affects new and existing marine bulk loading and unloading facilities that emit 10 tons or more of a hazardous air pollutant (HAP) or 25 tons of any aggregate HAPs. Affected facilities must install a vapor collection system to collect VOC displaced from marine tank vessels during loading. The vapor recovery system must achieve a 95 percent reduction in emissions (98 percent if combustion is used).

Both 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 its situation. The owner may over-control at some emission points and under-control at others to achieve the overall required level of emissions control.

6.1.12.3. Hazardous Organic Chemical NESHAP

The Hazardous Organic Chemical NESHAP (or "HON") affects more than 400 facilities of the Synthetic Organic Chemical Manufacturing Industry (SOCII). The final rule requires sources to limit emissions of organic HAPs to apply "reference control" or equivalent technology at 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 credits that can be used to offset debits for under-control at other points.

6.1.13. Corporate Average Fuel Economy Standards (CAFE)

The Energy Policy and Conservation Act set standards for domestic automobile manufacturers, beginning at 18 miles per gallon (mpg) in 1978 and rising to 27.5 mpg by 1985. The original standards were modified on two occasions, now standing at 27.5 mpg for 1990 and later production vehicles.

Corporate average fuel economy and compliance with the CAFE standard is determined as the harmonic average of the fuel economy of automobiles produced by each manufacturer. Harmonic average fuel economy is more difficult to achieve than would be 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 per automobile for every 0.1 mpg shortfall. There are carry back and carry forward provisions akin to banking that allow shortfalls in one year to be met with credits from another year.

While CAFE standards are directed at fuel economy, they do have a pollution consequence. CO_2 emissions rise and fall inversely with fuel economy (R^2 = .99), while emissions of CO, NO_x and hydrocarbons are largely unrelated to fuel economy.[54] Thus, the CAFE standard can be viewed as an intra-firm trading system to meet a *de facto* CO_2 reduction goal. It is only fair to point out that higher gasoline taxes would be a less costly means of reducing fuel use (and, implicitly, CO_2 reductions) since fuel taxes do not distort the selection of vehicles available to consumers as does a CAFE standard (under which smaller, less safe vehicles tend to replace larger, safer vehicles).[55] Further, a gasoline tax affects vehicle use as well as which vehicle is purchased, whereas higher CAFE standards have the perverse effect of stimulating more use of a vehicle (the so-called "rebound effect").

6.1.14. Wood Stove and Fireplace Permit Trading

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 command and control regulations. In 1977 the city passed an ordinance limiting new residential construction to one stove or fireplace per unit. While this might have slowed the deterioration in air quality, continued new construction virtually guaranteed that air quality would continue to worsen, which it did into the 1980s.

In 1987, the city adopted a program, part command and control and part modeled on air pollution offsets, that would guarantee improvements in air quality. Existing wood stove and fireplace owners were grandfathered with operating permits, but required to meet stringent performance standards within 3 years: 6 grams of particulate matter and 200 grams of CO per hour. During the first two years of the program these individuals converting their fireplaces and wood stoves to natural gas could earn a rebate of $750, partially defraying their costs. For new construction, no new permits would be issued for wood-burning stoves or fireplaces. To install such an appliance in new construction, the owner must produce permits to operate two fireplaces or stoves. The only place these permits could be acquired was 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 transaction prices for permits 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 that combined performance-based standards that encouraged the retirement of older inefficient fireplaces and wood stoves. The programs all aimed at reducing the burning of wood, but some offered no rebate for conversion 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.

6.1.15. Grass Burning Permit Trading

The City of Spokane, Washington nestled in the Spokane River basin about 400 feet below the surrounding Columbia River Plateau, forming a natural trap for air pollution during temperature inversions. The area exceeds the federal 24 hour PM10 standard several times each year, due to a combination of unpaved roads, wind-blown dust, grass burning and wood 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, Spokane County air pollution authorities implemented an innovative program to reduce grass burning as a source of PM.[56]

Grass burning had been subject to permit for years. The program superimposes on the permit process a County-wide cap of 35,000 acres that may be burned each year. Growers are allocated permits to burn 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 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 percent of the burnable acreage is deducted from the buyers 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 quantity offered was not all 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.

6.2. TRADING OF WATER EFFLUENTS

6.2.1. Effluent Bubble

In concept, a water effluent bubble operates identically to the air emission bubble described earlier. 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 below.

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.[57] 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 4 plants in the iron and steel industry that potentially would benefit from water bubbling as they went from BPT (best practicable control technology currently available) to BAT (best available technology economically achievable).[58] The iron and steel industry offered what might be unique opportunities for bubbling inasmuch as many plants had yet to consolidate their water treatment at a single processing facility. The projected savings from effluent bubbles were modest as a percent of control costs, though, as shown in Table 6-5.

EPA's implementation of the effluent bubble for the iron and steel industry was dictated by a 1983 settlement agreement among the EPA, the Natural Resources Defense Council, and the American Iron and Steel Institute. The agreement supports the use of bubbling under the Clean Water Act, but imposes constraints on the approach. Bubbling of effluents from iron and steel plants is acceptable provided that net reductions are achieved in total effluents. Relative to BAT limits that are in effect, bubbling must involve an average reduction of at least 15 percent in the mass of suspended solids and 10 percent in the mass of other pollutants. The NRDC reserved the right to challenge bubbles that might be proposed for other industries.

Since the bubble became available to the industry, 7 iron and steel plants in the midwest have used the provision.[59] Three of the mills no longer use the bubble: one facility closed and two have changed ownership, a cause for termination of bubbling rights. The steel effluent bubble undoubtedly has produced some compliance cost savings for the industry, but according to a former EPA employee who is now a consultant to the industry the bubble has not resulted in any pollution control innovations.[60]

6.2.2. Effluent Trading (point-point)

Effluent trading dates to the early 1980s, when 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 state water quality standards through the trading of effluent rights. The first and only application of this authority is on the heavily-industrialized lower Fox River.

Table 6-5: PROJECTED COST SAVINGS FROM EFFLUENT BUBBLE
(in thousands of 1978 dollars)

Facility	One-Time Savings in Capital Costs	Percent of BAT Capital Costs	Annual Savings in O&M Costs	Percent of Annual BAT O&M Costs
Republic Steel, Cleveland	328	5.7	15	3.6
Republic Steel, Warren	200	3.3	10	2.5
U.S. Steel, Gary	1,103	4.7	55	2.1
Wheeling Pittsburgh, Steubenville	800	6.2	32	2.7

Source: TBS, p.9.

Analysis showed that the potential from trading was significant: $7 million annually or roughly one-half of anticipated compliance costs for BOD (biological oxygen demand) regulations.[61] The program that was implemented allows trading between point sources of rights to discharge wastes that increase BOD. Sources that control more than required under their discharge permit may sell those incremental right to sources that control less 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 one year, but may not run past the expiration date of the seller's discharge permit, at most a five 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.

The State initiated BOD trading programs on two rivers: a 35-mile stretch of the Fox River and 500 miles of the Wisconsin River. For administrative reasons, the Fox River was divided into three segments, the Wisconsin River 5 segments. The Fox River program includes 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.[62] 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 and remain questions about the vulnerability of the program to legal challenge, since the Clean Water Act does not explicitly authorize trading and the standards set by the State do not conform fully to the national policy of uniformity established in the CWA. Finally, as noted above, the State imposed severe restrictions on the ability of sources to trade.

Currently, the EPA is investigating the feasibility of extending point-point trading to San Francisco Bay, where copper discharges would be traded, and Tampa Bay, where nitrogen and suspended solids would be traded.[63]

6.2.3. Effluent Trading (Point-nonpoint)

Three programs allow the trading of nutrient discharges between point and nonpoint sources: Dillon Reservoir, Cherry Creek Reservoir, and the Tar-Pamlico Basin. These programs are discussed in turn.

6.2.3.1. 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 nonpoint 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 nonpoint loadings. Discharges from new nonpoint sources are restricted through regulations requiring developers to show a 50 percent reduction from pre-1984 norms. The plan established a trading ratio of 2:1, whereby point sources that are above their allocation must obtain credits for twice the amount of the excess from sources that are below their allocation. New nonpoint sources must offset all of their discharges using a trading ratio of 1:1 with existing nonpoint sources. The system would be monitored through existing NPDES permits for point sources.

Trading has been very slow. Not only has the region experienced a recession for a number of years limiting 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 and population growth is once again evident, leading to the conclusion that more trading activity is likely.

6.2.3.2. Cherry Creek

Like the Dillon Reservoir, Cherry Creek Reservoir also is a source of water for the Denver region and an important recreation area. The Denver Regional Council of Governments established an effluent trading program for Cherry Creek very similar to that at Dillon. One difference is that trading at Cherry Creek has been nonexistent to date, reflecting the fact that phosphorus loadings at municipal wastewater treatment facilities remain below limits set by the Colorado Water Quality Commission.

6.2.3.3. 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. North Carolina law requires that upon designating an area as nutrient sensitive, 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 nonpoint 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 discharges from wastewater treatment plants: nitrogen at 4 mg/l in the summer and 8 mg/l in the winter; 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 cropland managers on a 3:1 basis. To date point source dischargers have found means of meeting new and stricter discharge limits without resorting to trading. In the future trading may become more attractive as a compliance option.

6.2.3.4. Other Point-Nonpoint Trading Proposals

The EPA is actively involved in a number of other projects that are likely to lead to effluent trading between point and nonpoint sources. These projects include: Chehalis Basin, Washington (BOD); Boone Reservoir, Tennessee (nutrients); Wicomico River, Maryland (phosphorus); Long Island Sound, New York (dissolved oxygen); Tampa Bay, Florida (nitrogen and suspended solids); and Chatfield Basin, Colorado (phosphorus). (EPA's May 1996 report *Draft Framework for Watershed-Based Trading*, appendix C, contains about 20 examples that will be put in a table as an update).

6.3. LAND PROTECTION TRADING

6.3.1. 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 date of the original colonization, the United States has lost over one-half of its original wetland acreage.

In recent years, as scientists pointed out the ecological importance of wetlands, government policies at the federal, state and local level have 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 the section on fees, charges 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 among federal and state officials and a bank administrator. Generally 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. Typically, 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 existing wetland mitigation banks, most MOUs allow the bank operator to sell credits only after the bank has actually accomplished wetland enhancement or preservation. A minority of states allow the manager 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 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. Nearly one-half of existing wetland mitigation banks were established by state highway departments to provide a means of mitigating losses due to highway construction. Other mitigation banks are operated by conservation organizations and for-profit entities that offer 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; and with banking there can be greater assurance of long-term management of the protected area.

Some 60 wetland mitigation banks in at least 15 states are currently in operation and about 40 more are in advanced stages of planning.[64] Wetland mitigation banking was featured in the 1996 Farm Bill as part of the Wetland Reserve Program. Wetland mitigation banking has been endorsed by the 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 this suggests that wetland mitigation banking will grow in importance as a means of protecting and enhancing the nation's wetlands.

6.3.2. Transferable Development Rights

To achieve the goal of restricting development in environmentally sensitive areas, many communities have sought to zone large tracts of agricultural land to preclude or severely limit development. Compensation to property owners in exchange for their accepting restrictive zoning in perpetuity typically takes one of two forms: transferable development rights (TDR) and purchase of development rights (PDR). PDR payments typically are established as the difference between appraisals of land value in agricultural use and for development.

No appraisals are needed with a TDR system. Rather, transferable development rights are allocated to property owners on the basis of acreage (e.g., one right per acre). TDRs are available for sale to urban areas designated by the community for further growth. Property owners in the designated growth areas are allowed to exceed normal building density limits provided they acquire sufficient TDRs. Thus the market mechanism provides a means of compensating rural property owners whose land holdings are restricted in terms of development; no government funding is needed. However, inasmuch as the price of TDRs is determined by the availability of TDRs and the demand for more intensive development in designated growth areas, there is no necessary connection between the payment and the decrease in value of rural land whose development is restricted.

A comprehensive treatment of all applications of TDRs is beyond the scope of this paper. Many of the earliest programs were poorly conceived and little used. A 1981 review of 23 separate TDR programs was able to identify only 6 trades that had taken place.[65] Instead of attempting to review all TDR programs, a small sample of cases are described that highlight some of the most successful programs to convey to the reader a sense of how such programs can operate in practice, the typical range of transaction prices, and some of the problems that have been encountered. Case studies reported here include Montgomery County, Maryland; Talbot County, Maryland; The Pinelands, New Jersey; and Palm Beach County, Florida (the latter to give a sense of why many programs have failed to live up to expectations). The TDR programs in Maryland are compared with the State's PDR program.

6.3.2.1. Montgomery County, Maryland

While both programs are directed at preserving agricultural land, Montgomery County's program differs from Palm Beach County's in one important respect: landowner participation is compulsory in the designated agricultural portion of Montgomery County. When Montgomery County downzoned about 90,000 acres in the western portion of the county from zoning of one dwelling per 5 acres to one dwelling per 25 acres in 1980 and 1981, it distributed TDRs to affected landowners at the rate of one TDR for every five acres, some 18,000 TDRs in all. Landowners who so elected could receive PDRs; however, few chose that option. The County designated other areas closer to Washington D.C. as "receiving" areas in which higher density development would be allowed if TDRs were submitted with the development application. Over 12,000 units of receiving capacity have been authorized to date and more than 5,500 TDRs used, at prices ranging from $3,000 to $7,000 each.

6.3.2.2. Talbot County, Maryland

Talbot County initiated two TDR programs in 1989. One program, designed to protect the shoreline of Chesapeake Bay and selected interior areas, allows landowners in the designated interior areas to earn one development credit for each 20 acres permanently set aside for agricultural use. The credits may be used to increase the density of shoreline development from one dwelling for every 20 acres to one for every 5 acres, provided measures are implemented to protect the shoreline from erosion. Under this program TDRs have changed hands for $40,000 to $50,000, a reflection of the high value of water-front property.

The second program attempts to protect undeveloped rural areas as farms and to concentrate future development in areas where land is most valuable. In the designated "Rural Agricultural Zone" the County distributed TDRs at the rate of one for each ten acres, the base development rate. The maximum allowed density was increased to one dwelling for every five acres; however, an extra TDR would have to accompany any proposal to subdivide a 10 acre parcel and build two dwellings. The result is that the least valuable lands are preserved in agricultural use while the most valuable areas are developed residentially.

6.3.2.3. Maryland PDR Program

Though not a trading system, the purchase of development right (PDR) program in the State offers a point of comparison with the TDR program. The State purchases development easements to protect farmland through a program that requires 40 percent cost sharing by the county. In the 1980s, the State spent some $26 million, of which the county shares totaled $11 million, to protect 23,500 acres, or about $1,100 per acre. In Montgomery County, landowners who chose to receive compensation in the form of PDRs instead of TDRs received an average of about $950 per acre.[66] The compensation as PDRs is quite similar to what has been received for TDRs (transaction prices were equivalent to $600 to $1400 per acre). More details on the Maryland PDR program are provided in the next section of the report, which deals with subsidy approaches to environmental management.

6.3.2.4. The Pinelands, New Jersey

The New Jersey Pinelands is a largely undeveloped, marshy area in the south eastern part of the State encompassing approximately one million acres that provides habitat for several endangered species. In an effort to direct development to the least environmentally sensitive areas, the Pinelands Development Commission established a system of TDRs known as Pineland Development Credits. Landowners in environmentally sensitive areas receive PDCs in exchange for limiting development at the rate of 1 PDC for every 39 acres of existing farmland, 1 PDC for every 39 acres of preserved upland, and 0.2 PDCs for every 39 acres of wetlands. One PDC could be used by a developer within designated growth areas to exceed the base density by four units.

While simple in concept, the program was actually complex in that it sought to include 52 local governments located within the Pinelands, several of which failed to see the advantages of participation at first. While the program was slow to gain acceptance, and suffered for years from a glut of already-approved development projects, more recently there are definite signs of success.

The Commission established a Pinelands Development Credit Bank to act as a purchaser of last resort for PDCs at the statutory price of $10,000 per credit. In 1990 the Bank auctioned its inventory at the price of $20,200 per PDC. To date, developers have used well over 100 PDCs.

6.3.2.5. Palm Beach County, Florida

In 1980, Palm Beach County adopted a plan directed at controlling growth and alleviating a chronic deficiency in public facilities. Future growth would be managed to encourage higher density development in built up areas of the County and 25,000 acres were earmarked for an Agricultural Reserve in which future development would be restricted. The County's plan for the agricultural area was ambiguous in that it continued to allow development on five acre lots throughout the entire 25,000 acres and more intensive 1 acre developments on planned unit developments of 40 acres on which farmers had based their borrowing. Investors who control about two-thirds of the 25,000 acres have held off selling TDRs since they expected the future value of the land for residential development to exceed what they could receive for TDRs and land restricted solely to agricultural uses.

Meanwhile, demand from developers has not materialized to the extent once anticipated. A large supply of permitted construction remains in the pipeline; for this no TDRs are needed. Also, developers can build more densely by obtaining the status of planned unit districts for which no TDRs are required. While the program eventually may succeed in protecting parts of the intended 25,000 acre Agricultural Reserve, to date very little has been accomplished.

6.4. INTERNATIONAL TRADING ACTIVITIES INVOLVING US GOVERNMENT

6.4.1. Joint Implementation

The concept of "Joint implementation" (JI) stems from the United Nations Framework Convention on Climate Change (FCCC) signed during the 1992 Earth Summit in Rio. By agreeing to the terms of the FCCC, over 100 countries committed themselves to reducing their greenhouse gas emissions. Under JI, businesses, non-governmental organizations, and government entities in one country jointly undertake mitigation and sequestration with similar interests in another. Projects that diminish, sequester, or avoid global greenhouse gas emissions may be considered JI projects if the source of emissions being offset and the site of the emission abatement are located in two different countries.

JI is in effect an incentive mechanism applied to countries by the FCCC, giving them an "offset" option to meet their greenhouse gas reduction commitments by implementing reduction activities abroad. Since reduction costs may vary among countries, JI provides industrialized countries with opportunities to reduce emissions at a lower cost abroad than they could within their borders. The possibility that such offsets eventually may become marketable reduction credits provides an added incentive. It should be noted, however, that the 1995 Conference of the Parties to the FCCC in Berlin decided that no Parties could earn credits through JI activities during the pilot phase of the project, which the Conference decided would end on December 31, 1999, at the latest. This decision has led some industry officials in the United States to ask why they should participate in JI activities.[67]

The United States Initiative on Joint Implementation was the first national JI program to adopt a formal set of criteria and evaluation process for JI proposals. An Evaluation Panel of representatives of U.S. government agencies determines the acceptability of proposed projects. The first seven United States JI projects were accepted in January 1995, and another eight projects were accepted in December 1995. Central America has hosted most of the projects, but Russia and the Czech Republic have each hosted one as well. Projects have involved biomass, geothermal, hydroelectric, and wind energy technologies and forestry management. Investments in the second round of projects could exceed $200 million.[68]

Japan is also asking businesses to participate in joint implementation projects. It plans to set up an " APEC environment technology exchange virtual center" to promote the transfer of Japanese carbon dioxide emission containment technologies to members of the Asia-Pacific Economic Cooperation Forum.[69]

6.4.2. Proposed Cross-Border Trading Program: El Paso Region

The El Paso, Texas region is a nonattainment area for the federal ozone, PM10 and carbon monoxide standards. Much of the pollution problem can be traced to sources in Ciudad Juarez, Chihuahua, directly across the Mexican border.[70] Because of the very different levels of economic development and pollution control in the two cities, there appear to be opportunities for cost-effective control of air pollution in the region through cross border trading.

On March 29 1996, U.S. and Mexican representatives created a binational committee to develop recommendations for the prevention and control of air pollution in the international air quality management basin (IAQMB). Work of the committee is expected to include the integration of air quality monitoring networks, exchange of information, development of outreach programs, evaluation of specific abatement strategies, and the development and implementation of economic instruments such as emission trading programs with emission budgets, allowances, and / or caps.

Endnotes for Section 6

1. See Tietenberg (1985) for a comprehensive review of emission trading policy.

2. For example, Unocal earned ERCs to apply against obligations at its Los Angeles refinery by scrapping old cars.

3. U.S. EPA December 4, 1986.

4. EPA (1980).

5. Crookshank (1994).

6. Hahn and Hester (1989).

7. Hahn and Hester (1989).

8. Foster and Hahn (1995).

9. All price data are expressed in 1992 dollars.

10. This is a one hour standard, not to be exceeded more than once a year (averaged over three years).

11. Background papers on RECLAIM include: Selmi (1994) and Lentz and Leyden, 1996.

12. The District originally planned to have a single expiration date of December 31 each year for all allocations. Concern that there could be a "logjam" of trading near the expiration date led District officials to randomly divide facilities into two categories of equal size: Cycle One sources with calendar year compliance dates, whose credits would expire on December 31 of each year; and Cycle Two sources with a July 1 to June 30 compliance calendar, whose credits would expire on June 30. Sources in Cycle One are free to trade with those in Cycle Two, but the expiration dates on the credits do not change.

13. The Natural Resources Defense Council contended that basing emissions allocations on 1989 emission levels could result in an increase in emissions of up to 71 percent over 1993 levels. See: "TRADING PROGRAM FOR VOLATILE ORGANICS STALLS OVER INITIAL EMISSION ALLOCATION," BNA *Daily Environment Report*, August 15, 1995, p. B-1.

14. "LA smog cops seek clean cut in dirty mowers," *Financial Times*, May 14, 1996, 14.

15. Review conducted by KPMG Peat Marwick and cited in BNA *Daily Environment Report*, March 3, 1995, p. B-2.

16. Illinois EPA, 1995. *Design for VOC Emissions Trading System*.

17. BNA *Daily Environment Report*, Nov. 11, 1995, B-1.

18. GAO (1996).

19. BNA *Daily Environment Report*, June 5, 1995, pAA-1

20. BNA *Daily Environment Reporter*, July 25, 1995, B-5.

21. BNA *Daily Environment Report*, August 29, 1995, B-1.

22. NESCAUM, which stands for Northeast States for Co-ordinated Air Use Management, is an association of the state air quality directors of each of the New England states, plus New York and New Jersey. MARAMA, which stands for the Mid-Atalntic Regional Air Management Association, is an association of the state air quality directors from Pennsylvania, New Jersey, Delaware, Maryland, Virginia, North Carolina and the District of Columbia.

23. The model rule was developed as a template for states to create their own individual state rules. The model rule may be accessed at www.dep.state.pa.us.

24. Information on OTAG is available on an electronic bulletin board EPA has set up as part of the Technology Transfer Network and accessible by modem at 919-541-5742.

25. According to Robert Shinn, commissioner of the New Jersey Department of Environmental Protection (www.thompson.com/tpg/enviro/airr/airrapril.html).

26. President Bill Clinton and Vice President Al Gore (1995).

27. 60 FR 39668.

28. Five years after the Act was passed, EPA analysis indicated that reduction of sulfates could have large health benefits, perhaps as much as $40 billion per year for Phase I of the Acid Rain program. See EPA, Office of Air and Radiation (November, 1995).

29. The 2.5 pounds of SO_2 per million Btu is adjusted, if necessary, so that aggregate emissions meet the overall reduction targets.

30. This will add over 700 additional sources to the program, mostly cleaner and/or smaller plants.

31. ICF Resources Inc. (1989a).

32. BNA *Daily Environment Report*, December 11, 1995, p. A-3.

33. U.S. EPA, *Federal Register*, March 29, 1995.

34. Burtraw (1995).

35. Cason (1995).

36. Section 416(d)(2) of the Act states "allowances shall be sold on the basis of bid price, starting with the highest bid and continuing until all allowances for sale at such auction have been allocated."

37. Cason (1995), p. 905.

38. Burtraw.

39. U.S. EPA 1995. *op cit*.

40. ICF Resources (1989).

41. Portney (1990).

42. http://www.epa.gov/acidrain/overview.html.

43. This agreement was ratified by the United States and 22 other countries in September, 1987.

44. EPA, *CFC Regulatory Impact Analysis*, 1988, vol 2.

45. Canada, Mexico and Singapore also implemented trading programs in CFCs.

46. Loeb (1996).

47. Hahn and Hester (1989).

48. Anderson, Rusin and Hoffman.

49. Kerr (1993).

50. EPA (1992).

51. Rubin and Kling (1993).

52. 57 FR 61970 (December 29, 1992).

53. Novello and Martineau (1993).

54. Khazzoom (1995).

55. See, for example, Crandall *et al.* (1986).

56. Skelton (1994).

57. Putnam, Hayes & Bartlett, Inc. (1981).

58. Temple, Barker & Sloane (1981).

59. Memorandum from Robert Graff and Brian Morrison, Industrial Economics, Inc., to Richard Kashmanian, Regulatory Innovations Staff, EPA, September 16, 1993.

60. Memo, *op cit*. p.12., citing conversation with Gary Amendola.

61. O'Neil (1983).

62. In return for a cash payment, the paper mill was able to close its wastewater treatment facility and send its effluent to the wastewater treatment plant.

63. "Effluent Trading in Watersheds Policy Statement" at http://www.epa.gov/OW/watershed/tradetbl.html

64. See Environmental Law Institute (1993) and Crookshank (1995).

65. Maabs-Zeno (1981).

66. Schiff.

67. Bureau of National Affairs, *Daily Environment Report*, June 1, 1995, p. A4.

68. Bureau of National Affairs, *Daily Environment Report*, December 20, 1995, pp. A5-6.

69. Bureau of National Affairs, *Daily Environment*, December 1, 1995, p. A4.

70. Texas Natural Resource Conservation Commission (1994).

7. SUBSIDIES

7.1. INTRODUCTION

For the purposes of this report, subsidies of interest involve government financial support of activities believed to be environmentally friendly. Types of subsidies described in this report include not only grants, low-interest loans, and favorable tax treatment, but also procurement mandates for products believed to have environmental advantages.

Research and development, information dissemination, and other services provided by government 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 charges on environmentally harmful products or activities such as emissions charges or product charges. 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 government if they are funded entirely by fees on the product paid by industry or consumers, this Section includes such mechanisms for the purposes of discussion.

Given the variety of subsidies used in environmental management at all levels of government, this Section does not attempt to cover the topic comprehensively. 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, the 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 section then 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 Section. The second column concerning who pays for the various subsidies does not attempt to assess distributional impact or the question of whether costs of subsidies are passed on to other businesses or consumers in some way. Information on funding sources other than general revenues is included in parentheses where available. Whether the recipients in column three pass on the subsidy benefits to customers or others is also not assessed. Environmental subsidies have also been used extensively outside the U.S. Information on these subsidies is provided in Section 9.

Table 7-1: THE USE OF SUBSIDIES IN U.S. ENVIRONMENTAL PROTECTION

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 (ADFs, waste taxes)	Public and private organizations
Unit-based waste collection or reuse payments	State governments (ADFs, waste taxes)	Businesses
Unit-based payments for alternative fuel vehicle use	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

Subsidy Instrument	Who Pays?	Recipients
Tax benefits		
Pollution control property	State governments	Private organiza-tions
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 com-pressed natural gas	Federal and state govern-ments	Alternative fuel manufacturers
Credits for alter-native fuel vehi-cles and equipment	Federal and state govern-ments	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 alterna-tive fuel vehicles	Federal, state, and local governments	AFV manufactur-ers
Recycled content requirements	Private organizations	Recycled products manufacturers
AFV use mandates	Private organizations	AFV manufactur-ers
Miscellaneous		
Reduced fines in return for supple-mental environmental projects	Federal and state govern-ments	Businesses

Subsidy Instrument	Who Pays?	Recipients
Relaxed regulatory requirements (eg. ethanol 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. POLLUTION PREVENTION AND CONTROL

This subsection 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.

7.2.1. Tax Benefits

Numerous states offer favorable tax treatment for pollution control property to promote the construction and installation of such property. In most states with such tax incentives, the equipment must have pollution control as its primary purpose. Equipment with other purposes in many states receives tax benefits on a prorated basis. Some states also require environmental regulators to certify equipment 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 are most commonly subject to 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 directly used in manufacturing also apply to pollution control equipment in many cases.[1]

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 businesses' property tax payments. 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 for equipment 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 tax revenue reductions of $26.6 million.

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.[2]

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 <u>exceed</u> requirements.

7.2.2. Louisiana Environmental Scorecard[3]

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 (IPTEP). In contrast to the previous practice of awarding 100% exemptions for local property taxes, new equipment, and other capital expenditures, the scoring system set companies at a base exemption of 50% and 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. The values in the second column of table 2 were multiplied by coefficients ranging from 1 for violations in the past year to 0 for violations 6 years or older. In column 3, one job was equivalent to $25,000 of payroll. 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 job creation for high unemployment areas, could also influence point totals.

Data suggest that this program had a significant incentive effect. Final scores during the year of existence of the program averaged 94.9, 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 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 (IPTEP). It was industry's opposition that led the governor to terminate the program in 1992.

Table 7-2: POINTS AWARDED AND SUBTRACTED UNDER LOUISIANA SCORECARD SYSTEM

Violation fine	Points subtracted from 25	Pounds of emissions per job	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 (August 1993), p. 119.

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, they have increased in the 1990s and are now included in as much as one in ten enforcement actions. More than 200 were approved in 1992. In the first six months of 1992, one EPA official estimated, EPA negotiated 164 SEPs worth approximately $23 million. In 1995, 348 SEPs valued at $104 million were negotiated.[4]

Most SEPs have been pollution prevention activities and involved violations in the Toxic Substances Control Act (TCSA) or the Emergency Planning and Community Right-To-Know Act (EPCRA), but 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 a Federal Insecticide, Fungicide, and Rodenticide Act violation (supplying restricted-use pesticide to an uncertified user) 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 $7,496. In a RCRA case involving improper characterization of waste streams, leakage of hazardous wastes from a sewer, and operation of an unpermitted incinerator, Eastman Kodak will have its penalty reduced by up to $3 million in return for investing $12 million in six SEPs expected to reduce hazardous wastes at its Kodak Park facility by 2.3 million pounds by the year 2001. In a CWA case, the City and Country of Honolulu agreed to spend $30 million on SEPs for treating and reusing wastewater and sludge.[5] Fines have also been reduced in cases for early compliance with existing environmental laws.

The advantage of SEPs for EPA is that fines that would be paid to the Treasury are instead used for environmental protection activities and that the cost of these activities usually exceeds the negotiated reduction in the fine. Estimates of the ratio of the cost of the SEP to the reduction in the fine range from 2:1 to 6:1. At the state level, on the other hand, SEPs have proven much less popular, in part because most states rely on fine revenues to fund environmental activities.

Despite the high SEP-fine reduction ratio, SEPs can offer violators potential advantages 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 a fine, a SEP involves business expenditures that lower taxes. Since all SEPs are voluntarily agreed to by violators, the SEP mechanism appears to have a significant incentive impact.[6]

7.2.4. Loans and Tax-exempt Bonds

The federal government exempts from taxation interest on debt 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.[7]

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 $1,000,000 to $20,000,000 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 the Eel River Sawmills' electricity generating facility. The equipment purchased through this financing reprocesses ash waste through the electrical generating facility, thereby reducing the amount of ash waste landfilled per day by 60%, from 24 tons to 10 tons.[8]

In addition to these tax-exempt bond programs, CPCFA formerly offered CLEAN (California Loans for Environmental Assistance Now) loans for pollution control investments. Under this program, CPCFA issued bonds and lent proceeds at interest rates about 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 undertaken without the 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.[9]

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 paid by the borrower and the lender into a loss reserve account for the lender. In case of default, the account covers losses. The maximum loan amount is $2.5 million, because the maximum premium CPCFA can pay is $100,000 per loan[10]. 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 compared with only $3 million in 3 years under CLEAN. Under CalCAP, every dollar contributed by CPCFA has resulted in $23 lent.[11]

7.3. BROWNFIELDS PROGRAMS

Various measures have been taken to subsidize the development of brownfields, or contaminated industrial sites that pose a relatively low risk to the environment compared to the most heavily polluted Superfund sites. One reason for the adoption of incentive measures in this area is that the Superfund program, with its command-and-control approach to site cleanup, has progressed much more slowly than originally projected, largely because of litigation surrounding responsibility for cleanups.

One important type of incentive in brownfields development is the limitation of liability for those who agree to undertake remediation activities at such sites. This liability-based incentive is discussed in Section 8. This Section briefly discusses the use of subsidies (grants, loans, and tax benefits) in brownfields programs.

7.3.1. EPA Pilot Project Grants

Under EPA's Brownfields Economic Redevelopment Initiative, whose goal is "to empower states, communities and other agents of economic redevelopment to work together in a timely manner to prevent, assess, safely clean up, and sustainably reuse" lightly contaminated areas,[12] EPA has selected and sponsored 60 pilot projects with funding of up to $200,000 per project. States, counties, communities, and tribes have been awarded grants to fund a variety of activities related to brownfields development, including identifying and assessing sites and promoting them to potential developers. Detroit, for example, received a grant to fund initiatives to combine empowerment zone activities with case studies of assessment, cleanup, and redevelopment and the preparation of a manual on brownfields development. Lowell, Massachusetts was awarded a grant to fund site rankings and assessments, conduct a comprehensive brownfields education program, and develop sustainable brownfields development funding sources.

EPA intends to use the results of these pilot projects to design a national program.[13]

(EPA brownfields site: earth1.epa.gov/swerosps/bf/answers.htm#5.)

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 entered into effect in January 1996, developers of contaminated sites can 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. Loans for cleanups are funded by a dedicated 5% portion of the state Hazardous Discharge Site Remediation Fund. To qualify for the 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 zero in the tenth year.[14]

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. 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 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.[15] As of the end of 1995, 25 letters of intent (the first step in the application process) had been submitted for grants and loans to conduct assessments and remediation projects. At least four grants, one loan, and one combination grant/loan have been approved for a total value of $1.62 million.[16]

(Pennsylvania brownfields information: www.dep.state.pa.us/dep/deputate/airwaste/wm/landrecy)

In 1995, Delaware added credits for brownfields development to its Blue Collar Jobs Tax Credit program.[17] Minnesota and Ohio offer loans to fund cleanups, and Ohio also provides tax incentives. Arizona and Tennessee pay for cleanup of orphan shares at sites containing wastes from more than one source.[18]

On the federal level, the Clinton Administration released a proposal in March 1996 that would allow cleanup costs in designated brownfields areas to be fully deductible the year in which they are incurred. This seven-year, $2 billion plan could result in the development of approximately 30,000 contaminated sites.[19]

7.4. FARMING AND LAND PRESERVATION

Among the types of subsidies used in farming and land preservation are grants, loans, and tax benefits offered in exchange for improved conservation practices as well as payments to landowners to either take land out of cultivation or manage it in a certain manner. As shown in table 7-3, numerous subsidy programs have been implemented in agricultural land preservation policy.

Table 7-3: U.S. DEPARTMENT OF AGRICULTURE CONSERVATION SUBSIDY PROGRAMS[20]

Program, Amount[21]	Purpose	Areas	Financial assistance
Agricultural Conservation Program $628.2 million	Prevent soil loss and water pollution and conserve water, forest, and wildlife	All states and territories	Up to 75% of total activity cost; maximum $3,500 per person per year
Colorado River Basin Salinity Control Program $46.9 million	Install conservation practices to reduce salinity of Colorado River	7 states	Up to 70% of total activity cost
Emergency Conservation Program $134.9 million	Repair agricultural land damaged by natural disasters and conserve water during drought	All states and territories	Up to 64% of cost; maximum $200,000 per person per disaster
Forestry Incentives Program $44.4 million	Plant trees and improve timber stands to increase supplies from nonindustrial private forests	All states and Puerto Rico	Up to 65% of total activity cost; maximum $10,000 per person per year
Great Plains Conservation Program $91.5 million	Solve soil and water problems on farms and ranches in the Great Plains	556 counties in 10 states	Up to 80% of total activity cost; maximum $35,000 per agreement
Rural Clean Water Program None	Control agricultural nonpoint source pollution	22 states	Up to 75% of total activity cost; maximum $50,000 per person

Program, Amount[21]	Purpose	Areas	Financial assistance
Small Watershed Program $547.0 million	Support activities in watersheds under 25,000 acres to prevent flooding, reduce erosion, and improve water quality	37 states and Puerto Rico	Up to 50% of construction cost; maximum $100,000 per person over life of program
Soil and Water Conservation Loan Program $1.5 million	Provide loans to develop, conserve, and make proper use of farm and ranch lands	All states	Up to $50,000, reimbursable within 40 years
Stewardship Incentive Program $54.8 million	Enhance management of nonindustrial private forest lands to increase timber supply and improve wildlife habitat and recreation	All states and territories	Up to 75% of total activity cost; maximum $10,000 per person per year
Water Quality Incentives Projects $55.3 million	Support farm practices or systems to reduce agricultural water pollution	All states and territories	Payment of up to $25 per acre (maximum $3,500 per person per year) plus cost-sharing up to $1,500 per person per contract
Conservation Reserve Program $6,676.4 million	Conserve and improve soil and water resources by renting land to retire from production and to establish 10-year conservation cover	All states and territories	Up to 50% of cost of erosion control measures plus annual rents up to $50,000 per person
Emergency Wetland Reserve Program $39.2 million	Restore wetland functions on flooded cropland	8 states	75%-100% of restoration costs plus market value to buy easement

Program, Amount[21]	Purpose	Areas	Financial assistance
Farm Debt Cancellation-Conservation Easements Program None	Protect lands under federal farm loan by buying an easement	All states and territories	Full or partial debt cancellation (maximum 33% of principal for current borrowers)
Forest Legacy Program $28.4 million	Protect environmentally important nonindustrial private forests	18 states and 1 territory	Market value to buy conservation easement
Integrated Farm Management Program Option None	Support use of resource-conserving cropping practices	All states and territories	Annual price support for acres planted to conserving uses
Water Bank Program $45.2 million	Conserve water and protect and enhance migratory waterfowl habitat	13 states	Up to 75% of total activity cost; maximum $3,500 per par-ticipant per year; annual rents
Wetlands Reserve Program $206.3 million	Restore and protect agricultural wetlands	10 states	Market value easements; 50-75% of restoration costs
Programs Adopted Under 1996 Farm Bill			
Environmental Quality Incentive Program $1,330 million	Promote environmental and conservation improvements on farmland	TBD	Cost-sharing and easement terms to be determined
Farmland Protection Program $35 million	Protect prime and unique farmland	TBD	Conservation easements

Program, Amount[21]	Purpose	Areas	Financial assistance
Conservation Farm Option $197.5 million	Promote soil, water, wetlands, and habitat conservation measures	TBD	Payments
Wildlife Habitat Incentives Program $50 million	Promote management practices to improve wildlife habitat	TBD	Cost-sharing

Sources: GAO (April 1995); USDA (April 1996).

Most of this subsection is devoted to USDA land conservation subsidy programs, including cross-compliance provisions linking farm program support benefits to environmental performance and new programs created under the 1996 Farm Bill. The subsection concludes with a discussion of selected state subsidy schemes, including purchasable development rights programs to prevent the conversion of agricultural lands to alternative uses.

7.4.1. Conservation Reserve Program

Established by the Food Security Act of 1985 (also known as the 1985 Farm Bill), the Conservation Reserve Program (CRP) seeks to protect soil and water resources by taking land out of cultivation. Participating farmers receive annual payments of up to $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 (usually requiring the planting of grass cover). The federal government pays not only annual rents so that the land is not cultivated but also half the cost of the erosion control plan measures.

Since landowners have offered more acres than the CRP can afford, they bid for enrollment. For the first nine signups (through August 1989), bids had to be at or below the "maximum acceptable rental rate" for a given area. Problems with this approach were that it did not actively target environmentally sensitive cropland and that farmers gradually increased their awareness of maximum rates and set their bids accordingly, often resulting in rental payments in excess of market value.[22]

As a result of the 1990 Farm Bill, which shifted the emphasis of the CRP to water quality, the bidding system was changed beginning with the 10th signup in May 1991. Bids less than or equal to the market rental rate for comparable land in a given area are evaluated using an Environmental Benefits Index (EBI), which includes the following seven factors: surface water quality improvement, ground water quality improvement, preservation of soil productivity, conservation compliance assistance, encouragement of tree planting, and whether the proposed parcel is in a Water Quality Initiative area or conservation priority area. The EBI is compared with the bid amount to decide whether to enroll the parcel.

In financial terms, the CRP is USDA's largest conservation program, accounting for about 77% of its conservation appropriations for FY 1992-95. As of August 1992, 36.4 million acres had been placed in the CRP, nearly 10% of total U.S. cropland estimated at 395 million acres. No funds were appropriated for enrollment for FY 1993-95. The first nine enrollments were mainly in the Great Plains and Mountains states, but the emphasis on water quality goals introduced by the 1990 Farm Bill led to increased concentrations in the Midwest and Great Lakes regions in subsequent enrollments. With 4.2 million acres, Texas had the most enrollment. As shown in Table 7-4, for the first 12 enrollments, annual CRP rental payments averaged $50 per acre.[23]

Table 7-4: CRP ACREAGE AND RENTAL PAYMENTS FOR FIRST 12 ENROLLMENTS

Region	Acres	Annual rental payments (millions)	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	$49.69

Source: GAO (February 1995), p. 13.

In 1990, when 33.9 million acres were enrolled, USDA estimated the net social benefits of CRP at $4.2-$9.0 billion over the life of the program. Table 7-5 shows the estimated amounts of different types of social costs and benefits.[24]

Table 7-5: PROJECTED SOCIAL BENEFITS AND COSTS OF CRP
(in billions of dollars)

Benefit	Value
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 due to windblown dust	$0.3-$0.9
Wildlife enhancements	$1.9-$3.1
Total benefits	$9.5-$19.5
Cost	
Higher consumer food costs	$2.9-$7.8
Vegetative cover on CRP land	$2.4
USDA technical assistance	$0.1
Total costs	$5.4-$10.3
Net benefit	$4.2-$9

Source: USDA (December 1994), pp. 180-1.

Statistics on the first nine enrollments indicate annual soil erosion reductions of 700,000 tons, an average of 19 tons per acre. This represents a 22% reduction in cropland erosion compared with prior conditions.

One criticism of the CRP is that it could be more cost-effective by concentrating enrollment on land that is more environmentally sensitive. By concentrating on enrolling buffer zones instead of entire fields, a GAO study claimed, only about 6 million acres would need to be enrolled to protect surface water, groundwater, air, and soil. However, wildlife habitat protection would require significantly more acreage.[25]

The 1996 Farm Bill 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 authority to agree to future early terminations. The possibility for such terminations is intended to give USDA the opportunity to refocus enrollment on land that is more environmentally sensitive.

7.4.2. Wetlands Reserve Program

Under the Wetlands Reserve Program, which was created by the 1990 Food, Agriculture, Conservation and Trade Act (i.e., 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 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 ten 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 easements, the government shares in the cost of approved conservation measures.

As shown in Table 7-6, the number of acres for which bids were made was roughly five times the acreage enrolled in WRP during the first enrollment. In 1994, WRP was expanded to several other states.[26]

Table 7-6: WRP FIRST ENROLLMENT (1992)

State	Bid offers (thousand acres)	Enrolled (thousand acres)	Total cost ($000)	Cost per acre ($)
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	46,057	923

Source: USDA (December 1994), p. 194.

The 1996 Farm Bill reauthorized WRP through 2002 while capping total enrollment at 975,000 acres. Beginning October 1996, land is to be 33% permanent easements, 33% 30-year easements or less, and 33% wetland restoration agreements with cost sharing. 75,000 acres of land in less than permanent easements must be placed in the program before additional permanent easements are placed. The Bill provides cost-sharing assistance to landowners of 75%-100% for permanent easements and 50%-75% for 30-year easements and restoration cost-share agreements.

7.4.3. Agricultural Conservation Program

Initiated in 1936, the Agricultural Conservation Program (ACP) offers cost-sharing and technical support to farmers who adopt approved land conservation practices. Up to $3,500 is provided annually under 10-year agreements. As noted below, the ACP is one of several programs being replaced by the Environmental Quality Incentive Program under the terms of the 1996 Farm Bill.

One ACP activity, Integrated Crop Management (ICM), provides cost-sharing assistance of 75% (usually $7-$20 per acre depending on the type of field) for practices to increase the efficiency of fertilizer and pesticide use. An analysis of the first year of the program as implemented in selected areas showed that ICM resulted in a 16%-32% fall in nitrogen fertilizer application on crops such as corn, wheat, and cotton, but that use of other fertilizers and insecticides remained generally unaffected.[27]

7.4.4. Compliance Provisions

Introduced in the 1985 Farm Bill, compliance provisions require farmers to implement approved conservation plans on highly erodible land and refrain from draining wetlands to be eligible for farm support programs such as price support loans, federal crop insurance, and disaster payments. Considering the large amounts of support at stake, compliance provisions are likely to have a strong incentive effect.

7.4.5. Highly Erodible Land Conservation Compliance and "Sodbuster"

Under the highly erodible land conservation compliance provision, farmers are required to develop and implement approved conservation plans for designated "highly erodible" land farmed between 1981 and 1985 to ensure support eligibility. 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 ploughing, minimum tillage, and shelter belts. The sodbuster provision is similar except that it applies to highly erodible land not farmed between 1981 and 1985 and 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.[28]

This cross-compliance rule appears to have a strong incentive effect. Plan implementation costs 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.[29]

As shown in table 7-7, the estimated net benefit of the conservation compliance provision varies substantially across regions. Air quality benefits 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.[30]

Table 7-7: BENEFITS AND COSTS OF CONSERVATION COMPLIANCE

	Per-acre benefit from:			Per-acre cost to:			
Region	Water quality	Air quality	Productivity	Producers	Federal government	Net economic benefits	Benefit/cost ratio
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 US	13.81	1.93	0.21	3.78	3.43	8.74	2.21

Source: USDA (December 1994), p. 186.

7.4.6. Swampbuster Program

Under the swampbuster program, support program benefits are denied to farmers who plant crops on wetlands 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 swampbuster provisions which according to USDA "will give farmers more flexibility in complying with wetland conservation requirements while protecting natural resources."[31] The bill expands wetland mitigation areas and options, allowing mitigation through restoration, enhancement, or creation, provided that wetland functions and values are maintained and stipulating that conversion activities authorized by a Clean Water Act permit will be accepted for Farm Bill purposes if adequately mitigated. The bill also establishes a mitigation banking pilot program. (See Section 6 for information on mitigation banking.)

7.4.7. Acreage Reduction Program

Under the Acreage Reduction Program, farmers are required to set aside farmland to remain eligible for price supports. The amounts of land to be set aside depend on overall crop supplies. Although this program is intended more to limit crop supplies than to preserve farmland, it promotes land conservation.

Table 7-8 presents some of the effects of USDA conservation programs. The Water Quality Program activities consist mostly of educational and technical assistance but also include some financial assistance. Monetary values of some of these impacts have been estimated. For example, the benefits of salt reduction under the Colorado River Salinity Control Program have been estimated at $61 annually per ton.[32]

7.4.8. Subsidy Programs Created under 1996 Farm Bill[33]

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 (in funding) is the Environmental Quality Incentives Program. Others include the Farmland Protection Program, Conservation Farm Option, and Wildlife Habitat Incentives Program.

7.4.9. Environmental Quality Incentive Program

As shown in table 7-3, 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.[34]

Table 7-8: IMPACTS OF CONSERVATION PROGRAMS ON EROSION AND CHEMICAL USE, FY 1988-93[35]

Impact and Program	1988	1989	1990	1991	1992	1993
Erosion reductions	Million tons					
Conservation Reserve Program	514	596	644	654	672	692
Conservation compliance	0	0	0	NA	236	458
Agricultural Conservation Program	40	34	33	34	30	29
Conservation Technical Assistance and Great Plains Conservation Program	463	353	353	282	298	321
Annual Acreage Reduction Program	107	62	55	60	39	46
	Million lbs.					
Nitrogen application reduced by Water Quality Program	NA	NA	NA	0.9	8.9	NA
Phosphorus application reduced by Water Quality Program	NA	NA	NA	1.7	38.5	NA
	1,000 lbs. active ingredient					
Pesticide load reduced by Water Quality Program	NA	NA	NA	8.1	5.9	NA
	1,000 tons					
Salt load reduced by Colorado River Salinity Control Program	62	75	92	105	127	163

Source: USDA (December 1994), p. 168

The Environmental Quality Incentive Program (EQIP) is intended to replace the Agricultural Conservation, Colorado River Basin Salinity Control, Water Quality Incentives, and Great Plains Conservation Programs, all of which are scheduled for phaseout by the end of 1996. EQIP will assist farmers and livestock producers with environmental and conservation improvements. Participating landowners will agree to five- to ten-year contracts with conservation plans and receive up to 75% cost-sharing assistance for structural conservation practices. Payments are limited to $10,000 per person per year or $50,000 for any multi-year agreement. USDA intends to select projects so as to maximize environmental benefits per dollar spent under the program.

EQIP has placed added emphasis on livestock as a pollution problem. Half of program funding is reserved for livestock-related conservation problems, and half for other conservation problems. Levels of funding are $130 million in FY 1996 and $200 million annually from 1997 to 2002.

7.4.10. 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.

7.4.11. Conservation Farm Option

Under this pilot program for producers of cotton, rice, feed grains, and wheat, producers may consolidate their CRP, WRP, and EQIP payments into one annual payment in exchange for entering into 10-year contracts and implementing conservation plans addressing water, soil and related resources as well as wildlife habitat. The incentive effect of the possibility of consolidating payments is unknown. A total of $197.5 million will be provided for this program through 2002.

7.4.12. Wildlife Habitat Incentives Program

This program is intended to offer cost-sharing assistance to landowners to plan and adopt approved management practices to ameliorate wildlife habitat. Total funding from FY 1996 to FY 2002 is $50 million.

7.4.12.1. State Initiatives

In addition to the federal programs described above, 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.[36]

In Lake Okeechobee, Florida, phosphorus from dairy waste has posed a threat to water quality. The "Dairy Rule" that entered into effect in June 1987 required dairy farmers to use specified techniques to prevent barn wash water discharges. The Florida Department of Agriculture and Consumer Services (DACS) provided cost share construction funds from the state legislature to facilitate implementation of this policy. Of the 49 dairy operations 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 their land. The buyout program took 14,039 cows out of production.[37]

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-in with federal programs. In Indiana, the Wildlife Habitat Cost-Share Project pays up to 90% of the cost of establishing permanent wildlife habitat, windbreaks, brushpiles, vegetation management, and wetland improvement. Property tax assessments are lowered for landowners who adopt measures to enhance or preserve existing wildlife habitat.[38]

Minnesota has a property tax exemption for undisturbed wetlands and ungrazed prairie.[39] The State also has a Pheasant Habitat Improvement Program under which landowners can receiving cost-sharing assistance of up to 75% and technical assistance in return for improvements such as food plots, nesting cover, and woody cover.[40] 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.[41]

In November 1995, voters in Texas approved a constitutional amendment to allow open-space land used for wildlife management to be taxed in the same manner as open-space agricultural land: based on its 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."[42]

7.4.12.2. Purchasable Development Rights

A number of states (11 as of April 1996) and several counties and local governments have purchasable 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 7-9, such programs are especially common in the Northeast and have involved over 400,000 acres at a cost of almost $730 million. In addition to food security and agricultural objectives, PDR programs have several environmental objectives, including maintenance of habitat and resting places for wildlife and the aesthetic value of open space. Among the advantages of PDRs are their voluntary nature that helps avoid legal conflicts that can arise from zoning laws and their low cost for state and local governments compared to outright land purchase. PDR program funding mechanisms vary from state to state and include general revenues, land transfer taxes, property taxes, and bonds. Criteria used to select land parcels to be purchased include cost, threat of conversion, and location. Many programs prefer to purchase development rights on parcels that are near each other. Another policy instrument to prevent excessive development, transferable development rights (TDRs), can be regarded as a trading system and is therefore discussed in Section VI.

Table 7-9: STATUS OF PDR PROGRAMS AS OF APRIL 1996[43]

State	Year Started	No. of Farms	No. of acres	Funds spent ($000)	Funds Available ($000)
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	730,049	205,250

*Denotes county or other local programs
Source: American Farmland Trust.

7.5. CONSUMER PRODUCT WASTE MANAGEMENT

Consumer product waste management is one area where command-and-control measures may be less likely than incentives to protect the environment because it is difficult to monitor the behavior of millions of consumers. Bans on landfilling used motor oil or containers, for example, are hard to enforce. Consumers are more likely to respond to factors such as more convenient collection service (brought about by subsidies) 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 primarily on the state and local levels.

The example of used tire management, as illustrated in Table 7-10, shows the variety of subsidy measures that have been adopted in waste management.

Table 7-10: SUBSIDIES FOR USED TIRE MANAGEMENT

Type of subsidy	Number of states
Tax benefits	13
Payments based on tires recycled	7
Public procurement	28
Grants and loans	34

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

7.5.1. Advance Disposal Fee Systems

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

In Virginia, an ADF of $0.50 per tire in effect since 1990 generates revenues for the State's Waste Tire Trust Fund. Annual ADF revenues are about $2 million, and the Fund had a balance of $7.6 million as of January 1996. The fund finances used tire disposal site cleanups, activities in several regions to manage the current flow of used tires, permitting and inspection, and subsidies of $22.50 per ton for end users of tires.[44]

(Info on VA program: www.deq.state.va.us/envprog/tires.html)

7.5.2. Deposit Handling Fees

In most states with 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¢ per bottle. Such handling fees have encouraged used bottle collection to the point that many redemption centers have been voluntarily created to earn profits. See Section 5 for details on deposit-refund systems in California, Maine, and other parts of the U.S. and Section 11 for information on such systems outside the U.S.

7.5.3. Recycling Loans and Grants

A total of 24 states have grant or loan programs to promote the recycling industry.[45] Under Washington's Model Litter Control and Recycling Act, grants are awarded to persons developing recycling programs. Under the Litter Control and Recycling Act, Rhode Island provides grants to communities and organizations for litter and recycling initiatives.[46]

As shown in Table 7-11, 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 are either general rebates offered for up to five years to offset the increased cost of making or processing recyclable materials generated in the state or property rebates covering 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.

Table 7-11: WISCONSIN RECYCLING FINANCIAL ASSISTANCE PROGRAMS
(in thousands of dollars)

Program	1994-95
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.

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: energy recovery, including the production of combustible by-products; road base in highway improvement projects; recycling to make a new product; and other uses approved by the Department of Natural Resources. Uses must be approved in advance. Businesses receive payments based on documented tire use over the course of a given calendar year. Expenditures for 1990-94 totalled approximately $5.5 million.[47]

As shown in Table 7-12, at least 16 states had loan funds for recycling businesses in 1995. In one of these states, Iowa, loans have included $485,000 for a project to convert waste gypsum into new wallboard, $145,000 to convert used electrical wire into cushion for the dairy cattle industry, and $245,000 to manufacture rubber mats from used tires.[48]

Table 7-12: STATE LOAN FUNDS FOR RECYCLING BUSINESSES

State	Maximum loan	Interest rate	Fund size	Funding source
California	$1 million	5.8%	$25 million by 1996	Landfill tipping fees
Colorado	$150,000 initially	prime	$1-1.5 million per year (total $4 million)	$1 tire fee
Florida	unknown	<prime	$3.5 million	ADFs
Illinois	$750,000	5%	$1-3 million per year	Landfill tipping fees
Indiana	$500,000	<prime	$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%	$16 million initially, reduced to $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	$4 million	General revenues
Mississippi	$200,000	2% below prime	unknown	unknown
New Jersey	$500,000	3% below prime	$21 million	landfill tipping fees
New York	$500,000	<prime	$5 million, $100,000 remaining	Petroleum overcharge funds
Pennsyl-vania	$300,000	3%	$5 million	Landfill tipping fees
Vermont	TBD	TBD	TBD	TBD
Wisconsin	$750,000	4%	$5.6 million	Business tax

Sources: Trombly (June 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 up to 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.[49]

(CA recycling loans: www.calepa.cahwnet.gov/epadocs/mar96.txt)

Louisiana's used tire subsidy program combines a loan program with rebate payments based on the number of tires recycled. Loans of up to $600,000 are available for waste tire processing activities. Each loan is limited to 25% of the value of the processing facility and 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.[50]

(Louisiana tire program: www.deq.state.la.us/osec/n950124.htm)

7.5.4. Tax Incentives

28 states have offered tax incentives for recycling businesses. Idaho, for example, enacted a tax credit in 1994 pertaining to equipment for manufacturing postconsumer

paper.[51] "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 recyled goods."[52]

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 subsection considers only government as opposed to private procurement practices. Mandates governing private sector use of recycled materials are discussed in the next subsection.

Preferential procurement could take one of at least two forms. Price preferences refer to willingness to pay a higher price for recycled products. Set-asides and goals refer to rules or targets concerning the percentage of total product purchases that must be recycled products.

Paper is the product most commonly subject to recycled goods procurement policies. An executive order signed by President Clinton requiring 20% postconsumer content in federal paper purchasing took effect in January 1995. EPA required the authors of this report to print it on recycled paper. At least 50 cities and 26 states are now following the federal policy.[53]

A 1993 survey conducted by the Northeast Maryland Waste Disposal Authority found that all fifty states and the District of Columbia favored recycled products, compared to only 13 states in 1986. In the 38 states (including DC) that had price preference policies, the preferences were usually 5% (15 states) or 10% (20 states). 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 on its purchases, 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. The first state had set-asides of 90% recycled printing and writing paper by January 1, 2000 and 100% recycled tissue products by January 1, 1992. Montana had a set-aside of 95% by 1996. Nebraska bought only recycled paper and was considering similar policies for plastic bags, motor oil, and carpet. North Carolina required the use of recycled paper for all 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.

Newark, New Jersey required that its agencies use recycled product 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 from waste tires. The 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 disposed of in landfills has decreased since 1989.[54]

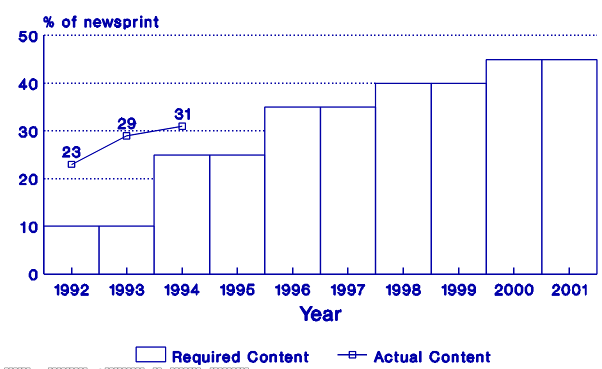
7.5.6. Recycled Content Policies

To facilitate discussion, recycled content policies as defined here refer only to requirements that private 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 and therefore discussed in the previous subsection.

Although there is a large element of command-and-control regulation in policies requiring 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 and 15 states have created voluntary agreements for recycled content in newspapers. (The voluntary agreement in Massachusetts is described in Section 10 on voluntary programs.) A typical example is the 1990 Wisconsin Recycling Law, which requires newspapers to use recycled content newsprint. As shown in Figure 7-1, the minimum content requirements are rising from 10% in 1992 to 45% in 2000.[55] Publishers failing to meet these requirements are subject to fees based on the extent of non-compliance. In this respect, the law also could be considered a product charge on non-recycled newsprint. However, the Department of Natural Resources sometimes exempts publishers from fees if they can show that they could not obtain recycled newsprint at reasonable cost.

Figure 7-1: WISCONSIN NEWSPAPER RECYCLING AND RECYCLED CONTENT REQUIREMENTS



In 1992 and 1993, over 90% of publishers exceeded the minimum content requirement of 10%, and fewer than 1.5% failed to meet the requirement. In 1994, however, when the standard was increased to 25%, 14 publishers (18%) failed to meet the standard.[56] Five of these paid the fee.[57]

7.6. NEW JERSEY INFORMATION AWARDS PROGRAM[58]

Under this program, which became effective in 1990, citizens who report illegal dumping to environmental authorities receive the larger of 10% or $250 of any civil penalty collected. 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 for reporters of violations:

1. Major Hazardous Waste Facilities Siting Act: 50% of any criminal penalty collected for the illegal treatment, storage, or disposal of hazardous waste;

2. Regional Low Level Radioactive Waste Disposal Facility Siting Commission: 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: 10% or $250 of any civil or criminal penalty collected for violations.

4. Ocean Dumping Enforcement Act: 10% of any criminal penalty collected for violations.

This scheme differs from most subsidies and other incentive mechanisms featured in this report in that it seeks to affect behavior by rewarding 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 of $250, 10% of the penalties, were awarded in these three cases. Other rewards are pending.[59]

A similar source of support for environmentalist organizations is attorney's fees awarded in successful citizen suits against environmental violators. As noted in Section 9, attorney's fees awards appear to create stronger incentives for private parties to initiate suits under California's Proposition 65 than the so-called "bounty hunter provision" under which the person who brought the suit can receive 25% of any fines.

Although other state and federal laws include the possibility of rewards for reporting potential environmental violations or initiating suits, 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.[60] Some of these subsidies result in environmental improvements, but as noted below, alternative fuels are also subsidized for other reasons.

7.7.1. Federal Subsidies

As shown in Table 7-13, 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.

(API paper on this topic: www.api.org/cat/SEC12.htm#11)

Table 7-13: ALTERNATIVE FUEL AND ALTERNATIVE FUEL VEHICLE SUBSIDIES
(in millions of 1994 dollars)

Type of subsidy	1994	2000 (Projected)
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
RVP waiver for ethanol blends	95	120
Total	1,115	2,174

Source: Anderson (September 1994), pp. 18-21.

The "other direct subsidies" in Table 7-13 include 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 currently 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.

Tax credits for AFVs and refueling stations currently amount to about $20 million annually but 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. of RVP in a 10% ethanol blend. Without the waiver, ethanol blends would be disadvantaged in the marketplace.) This waiver is worth approximately $0.09 per gallon of ethanol, based on additional costs incurred by refiners to produce a blend stock with lower vapor pressure.

Table 7-13 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 are scheduled to become more stringent over time. Table 7-14 shows these requirements, many of which will eventually also be applied to private vehicle fleets.

The federal government also provides income tax deductions of $2,000 to $50,000 for clean-fuel vehicles. Electric vehicles purchases are eligible for 10% income tax credits up to $4,000. The cost to the government of the electric vehicle credits has been estimated at $65 million in 1995.[61]

7.7.2. State Subsidies

Besides the federal AFV purchasing requirements imposed on state governments shown in table 8, several states, including New York and Massachusetts, have their own vehicle purchasing requirements. In addition, most states offer tax benefits or grants for AF or purchases of AFVs.[62]

(Site containing information on state subsidies: www.ccities.doe.gov/documents/funding/toc.html)

In Connecticut, for example, vehicles powered by natural gas, propane, or electricity, vehicle conversion equipment, and AF refueling station equipment are exempt from the state's 6% sales and use taxes. In addition, businesses are entitled to 50% tax credits for investments 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%.[63]

Table 7-14: ALTERNATIVE FUEL VEHICLE PROCUREMENT REQUIREMENTS[64]
(percentage of new vehicles purchased that must be AFVs)

Model year	Federal	State	AF suppliers	Private Fleets
1993	5,000			
1994	7,500			
1995	10,000			
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 (September 1994), p. 10.

The California Air Resources Board (CARB) requires that the seven largest vehicle manufacturers' sales in the state be at least 2% AFVs by 1998. The percentage will increase to 5% in 2001 and 10% in 2003. The direct incremental and infrastructure costs of this mandate have been projected at $19.5 billion through 2010, which makes up almost 80% of the expected costs of all AF promotion activities.[65]

A number of cities use AFVs in their mass transit systems. In Los Angeles, for example, the Metropolitan Transit Area board has adopted the policy that all future bus purchases will be AFVs.[66]

As shown in Table 7-15, which focuses on the Ozone Transport Region consisting of 12 Mid-Atlantic and Northeastern states and the District of Columbia, state subsidies for AF and AFVs are expected to rise significantly over the next fifteen years.

Table 7-15: ANNUAL ALTERNATIVE FUEL AND ALTERNATIVE FUEL VEHICLE SUBSIDIES IN THE OZONE TRANSPORT REGION[67]
(excluding federal mandates, in millions of dollars)

Type of subsidy	1995	2000	2005
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.

(Perkins paper: www.api.org/cat/SEC12a.htm#52)

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 elimination of the excise tax reduction would result in a 50%-90% reduction in ethanol use.[68] 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 definitely cleaner than gasoline. Ethanol, however, generates less carbon monoxide in winter but worsens ozone conditions in summer. Alternative fuels are promoted not just for environmental reasons but also because their use is thought to increase U.S. energy security and to provide a market for part of the country's large agricultural surpluses.

7.7.3. Car Buyback Schemes

Several private programs have been implemented to offer cash payments to motorists to turn in old, high-emitting automobiles. As noted in Section VI, the South Coast Air Quality Management District (SCAQMD) allows the generation of emission reduction credits for scrapping not only old vehicles but also lawnmowers, both of which are blamed for significant air pollution.

In 1990, Unocal Corporation purchased and scrapped 8,376 pre-1971 vehicles in Los Angeles at $700 per vehicle. Since SCAQMD estimated at $4,900 per ton the cost of combined NO_x and ROC reductions through scrappage of pre-1972 vehicles compared to $10,000 to $20,000 per ton for traditional control methods, this vehicle scrappage program appears to have been relatively cost-effective.[69]

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¢ per kwh, adjusted for inflation. For 1995, the credit was 1.6¢ 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.[70]

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 roughly $100.[71]

7.9. MUNICIPAL SEWAGE TREATMENT PLANT CONSTRUCTION

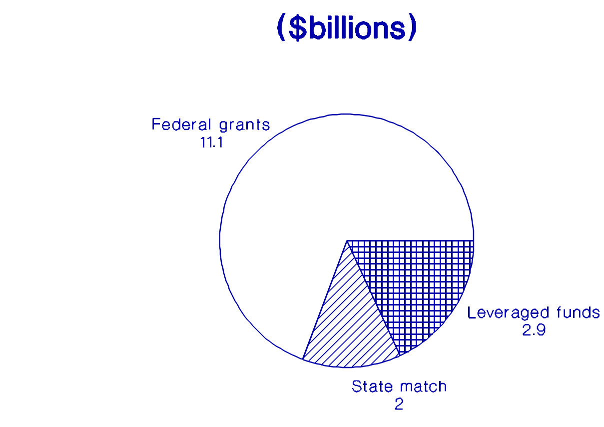
The federal government has subsidized the construction of municipal sewage treatment plants since the 1956 Water Pollution Control Act Amendments. The subsidies took the form of cost-sharing grants in which the federal government's contribution was limited to 55% in 1956, raised to 75% by the Federal Water Pollution Control Act of 1972, then decreased back to 55% by the 1981 Municipal Wastewater Treatment Construction Grant Amendments. The 1987 Water Quality Act (commonly referred to as the Clean Water Act) significantly reduced the amounts of funding available and provided for a transition from grants to loans.[72]

Although the grants undoubtedly encouraged construction activities that increased public access to sewage treatment, they 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 covering part of the non-federal share that effectively lowered communities' share to 10-25% of costs.[73]

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. SRFs in all fifty states and in Puerto Rico are capitalized by federal government grants (83%) and required state matching funds (17%). (States are required to provide 20% matching funds for all federal grants.) As shown in Figure 7-2, states have leveraged the federal grants as security for bonds to raise additional funds, bringing total SRF FY 1988-95 investment to approximately $16 billion.[74] One study found that 21 states have used leveraging in this manner.[75] The SRF appropriation for 1996 is $1.348 billion, of which $50 million is set aside for small communities.[76]

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.

Figure 7-2: SRF INVESTMENT FY 1988-95

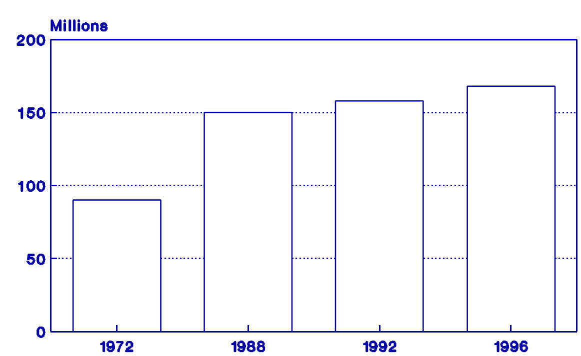


Source: EPA, "The Clean Water State Revolving Fund," p. 12.

Data collected by the State of Ohio indicate that as of June 30, 1995, the states collectively had lent $14.6 billion, or 77%, of the $18.9 billion available to them. The percentages lent varied significantly from state to state, with 8 states having lent over 90% of their funds, 11 less than 60%, and 3 less than 40%. A GAO study found that various obstacles had limited states' lending, including lack of state experience 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 SRF loan applications. Eight federal agencies manage 17 different programs that may be used by rural areas for 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 sources than from the SRF.[77]

Unlike the grant program it replaced, the SRF program funds a number of initiatives other than municipal wastewater treatment, including projects addressing stormwater, combined (sanitary and storm) sewer overflows, and agricultural runoff. About 150 loans worth roughly $1 billion have financed combined sewer overflow control investments, and approximately 100 loans worth about $100 million have financed agricultural and urban runoff control measures.

Figure 7-3: U.S. POPULATION SERVED BY MODERN SEWAGE TREATMENT FACILITIES



Source: EPA, "The Clean Water State Revolving Fund," pp. 6-14

Although it is beyond the scope of this report to provide an evaluation of the grant and SRF programs, figure # shows that the population served by modern sewage treatment has increased significantly. EPA has stated that "the SRF is probably the most efficient program of its kind in the federal government."[78]

7.10. ENVIRONMENTALLY HARMFUL SUBSIDIES

Some subsidies are widely be-lieved to have the unintended effect of encouraging environ-mentally harmful activities. In many cases, such subsidies were not designed as environmental policy instruments but have had adverse environmental consequences. This subsection briefly discusses a few examples of such subsidies.

7.10.1. 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 Section IV 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 Section 4, for example, livestock grazing fees on federal lands imposed according to a formula established by the 1978 Public Rangelands Improvement Act (PRIA) are widely believed to be below market value. Although fees have been between $1.35 and $1.98 per animal unit month (AUM) since 1986, the Bureau of Land Management (BLM) and Forest Service estimated in 1992 that fair market values were $4.75 per AUM for sheep and varied across regions from $4.68 to $10.26 per AUM for cattle and horses.[79] 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 if only the funding directly linked to the livestock grazing program is considered, while the high end considers all range management funding.[80] 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 average $4.58. As noted in Section IV, the PRIA fee that year was $1.86.[81]

(CRS Grazing fees primer: www.cnie.org/nle/ag-5.html)
(1995 Green Scissors on grazing fees: www.essential.org/orgs/FOE/scissors95/greenpart22.html)

Table 7-16 shows that estimated U.S. Bureau of Reclamation irrigation water subsidies in selected areas ranged from 57% to 97% of the Bureau's full water delivery cost. Excessive irrigation has been associated with a number of environmental problems, including water shortages and contamination of water with natural pollutants and agricultural inputs.

Table 7-16: U.S. BUREAU OF RECLAMATION WATER SUBSIDIES[82]

Irrigation district	Irrigable acres	Subsidy ($/acre)	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. Dept. of Interior, as cited in Kanazawa, p. 114.

Historically, the mining (including oil and gas) and timber industries have benefitted from preferential taxation of their income. The impact 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: destruction of natural areas as minerals and timber are harvested and excessive disposal of materials that otherwise might be recycled.

Percentage depletion allowances for petroleum and other minerals, for example, allow companies to write off as expenses arbitrary percentage reductions in mineral deposits resulting from their operations. The value of these allowances for oil and gas was estimated at over $2 billion annually from 1980 to 1982 but 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 (rather than alternative minimum) tax required for eligibility for allowance claims, and many of these are excluded from claims 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 but fell in value after the 1986 tax reform. Oil, gas, and other mineral extraction companies also have the advantage of being able to expense (rather than capitalize) exploration and development costs.

Timber companies were formerly allowed to consider certain timber income 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. However, the elimination of this practice led timber companies to increase their use of other previously underused tax advantages: provisions allowing timber management and reforestation costs to be expensed rather than capitalized and tax credits and accelerated amortization for reforestation activities. Government construction of roads to facilitate harvesting is another form of subsidy for timber.[83]

7.10.2. Agriculture

The effect of the sugar price support program on the Florida Everglades is frequently cited as an example of an environmentally harmful subsidy.[84] The federal government subsidizes sugar by guaranteeing a floor price of $0.18 per pound, almost twice the world market price. The policy is further supported by tariffs of $0.16 per pound on imported sugar 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 positive impact of the subsidy on sugarcane production 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 U.S. 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 percent reduction in chemical use per acre and a 29 percent reduction in fertilizer use per acre." The USDA peanut program has also been accused of promoting environmental degradation. By requiring farmers to grow peanuts on the same land more often than they otherwise would to retain their sales quotas, critics charge, the program results in increased pesticide use to counteract the negative effects of lack of crop rotation.[85] Price supports for cotton have been accused of similar effects.[86]

7.10.3. 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.

Endnotes for Section 7

1. Goldhammer et al. (1995), pp. 1-5.

2. *DEN*, March 24, 1995, p. B1-2.

3. Unless otherwise stated, all information on the Louisiana Scorecard system is provided by Environmental Law Institute (August 1993), pp. 118-21.

4. Joe Acton, Environmental Protection Agency, Office of Enforcement and Compliance Assurance, personal communication, 1996.

5. The Kodak and Honolulu SEPs are described in EPA (May 1995), p. 2-14.

6. With the exception of the estimate of the number and value of SEPs negotiated in 1995 and information on Kodak and Honolulu SEPs, the information on supplemental environmental projects comes from *Environment Reporter*, February 12, 1993, pp. 2692-4.

7. Whitehouse (1996), p. 74.

8. California Pollution Control Financing Authority, "Small Business Pollution Control Tax-Exempt Bond Financing Program."

9. James Goldstene, California Pollution Control Financing Authority, personal communication, June 1996.

10. California Pollution Control Financing Authority, "California Capital Access Program."

11. Goldstene, op cit.

12. *DEN*, May 26, 1995, p. E100.

13. *DEN*, July 27, 1995, p. A4. For more information on brownfields pilot projects, see EPA brownfields internet site: earth1.epa.gov/swerosps/bf/answers.htm#5.

14. *DEN*, January 16, 1996, p. A10.

15. Pennsylvania Department of Environmental Protection internet site, "Land Recycling Fact Sheet 8: Financial Assistance (Grants and Loans)." www.dep.state.pa.us/dep/deputate/airwaste/wm/landrecy/

facts/fs8.htm

16. Pennsylvania Department of Environmental Protection, "Pennsylvania's Land Recycling Program: Six-Month Progress Report," 1996. www.dep.state.pa.us/dep/deputate/airwaste/wm/landrecy/facts/6monrpt.htm

17. *DEN*, July 18, 1995, p. B2.

18. Environmental Law Institute (1995), p. 76.

19. *Environment Reporter*, May 17, 1996, p. 279.

20. Table adapted from GAO (April 1995), pp. 2-6. Information on programs created by 1996 Farm Bill provided by USDA (1996).

21. For all programs created before the 1996 Farm Bill, appropriations in this column are totals for FY1992-1995. For the four programs created by the 1996 Farm Bill (at the bottom of the table), appropriations are totals for FY1996-2002.

22. GAO (February 1995), p. 13.

23. Ibid, p. 16.

24. USDA (December 1994), pp. 180-1.

25. GAO (February 1995), p. 21.

26. USDA (December 1994), p. 194.

27. Osborn et al. (February 1994), p. 16.

28. USDA (December 1994), p. 182.

29. Rolfe (1993), p. 21. internet: yvrww1.pwc.bc.doe.ca/ec/frap/fr-pof.html

30. USDA (December 1994), p. 186.

31. USDA (April 1996).

32. USDA (December 1994), p. 166.

33. Information on programs created by the 1996 Farm Bill provided by USDA (April 1996) and by Tim Osborn, USDA Economic Research Service, personal communication, 1996.

34. GAO (April 1995), pp. 17-18.

35. Ibid, p. 168.

36. USDA (December 1994), p. 175.

37. Sidhu (November 1993), pp. 30-32. www.api.org/cat/SEC12.htm#13

38. Sendak (1995), p. 5.

39. *DEN*, July 14, 1995, pp. A3-4.

40. Sendak (1995), p. 5.

41. *DEN*, May 2, 1995, p. B1.

42. *DEN*, November 14, 1995, p. B5.

43. American Farmland Trust, "Purchase of Agricultural Conservation Easements: Status of Programs as of 4/12/96," unpublished table.

44. Virginia Department of Environmental Quality, "Waste Tire Program." www.deq.state.va.us/envprog/tires.html. The amount of the end user subsidy was provided by *Scrap Tire News Legislative Report*, p. 19.

45. Steuteville (1995), p. 36.

46. *Beverage World 1994-1995 Data Bank*, pp. 274-286.

47. Bonderud and Shanovich (1995), pp. 11-32.

48. Trombly (June 1995), pp. 35-38. The information on Louisiana was added to the table from Louisiana Department of Environmental Quality, "DEQ Announces Programs to Aid Tire Dealers and Tire Processors," January 25, 1995. California's interest rate was lowered from 6% to 5.8% on January 1, 1996.

49. "State Waste Board Lowers Interest Rate on Recycling Loan" (March 1996), *CAL/EPA Report*. www.calepa.cahwnet.gov/epadocs/mar96.txt

50. Louisiana Department of Environmental Quality (January 25, 1995), "DEQ Announces Programs to Aid Tire Dealers and Tire Processors," www.deq.state.la.us/osec/n950124.htm.

51. Steuteville (1995), p. 36.

52. *Beverage World 1994-1995 Databank*, pp. 277-8.

53. Steuteville (1995), p. 36.

54. Florida Department of Environmental Protection (1995), "Waste Tires in Florida: State of the State," and Bill Parker, Florida Department of Environmental Protection, personal communication, May 1996.

55. Wisconsin Department of Natural Resources, "Wisconsin's Newspaper Recycled Content Requirements: 1994 Update."

56. Ibid.

57. Julia Barrett, Wisconsin Department of Natural Resources, personal communication, May 1996.

58. Unless otherwise stated, all information on New Jersey's Information Awards Program is provided by Environmental Law Institute (August 1993).

59. Toni Hendricksen, New Jersey Department of Law and Public Safety, personal communication, May 1996.

60. Unless otherwise stated, all information on federal subsidies for alternative fuels and alternative fuel vehicles is provided by Anderson (September 1994). www.api.org/cat/SEC12.htm#11

61. Whitehouse (1996), p. 74.

62. For a description of state alternative fuel vehicle incentives, see "Clean Cities Guide to Alternative Fuel Vehicle Incentives & Laws," DOE internet site:www.ccities.doe.gov/documents/funding/toc.html

63. Perkins (September 1995), pp. 15-17. www.api.org/cat/SEC12a.htm#52

64. Information provided by Anderson (September 1994), p. 10. The requirements for private fleets could be introduced three years earlier if the Department of Energy determines that early introduction is necessary in order to attain alternative fuel replacement goals for 2000 and 2010.

65. Sierra Research (1995), pp. 4-6.

66. Ibid, pp. 33-34.

67. Source: Perkins (September 1995), p. 9. AFV requirements refer to requirements for zero-emission vehicles and ultra-low emissions vehicles. Negative numbers are in parentheses. The Ozone Transport Region is composed of Connecticut, Delaware, the District of Columbia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, and Virginia.

68. DEN, September 26, 1995, p. A4.

69. Environmental Law Institute (August 1993), pp. 5-7.

70. Information on the 1.6¢ per kwh renewable electricity credit was provided by *DEN*, March 21, 1995, p. A2.

71. Joe Mikrut, Joint Committee on Taxation, U.S. Congress, personal communication, July 1996.

72. Freeman (1990), pp. 100-1.

73. Ibid, p. 138.

74. EPA (January 1995).

75. Study by the Ohio State Water Development Authority cited in GAO (April 1996).

76. Rafael Stein, EPA, personal communication, May 1996.

77. Information in this paragraph provided by GAO (April 1996). This document also cited the Ohio State Water Development Authority survey. GAO reported that EPA did not compile nationwide SRF lending data.

78. EPA (January 1995).

79. For an explanation of the concept of animal unit month, see the discussion on grazing fees in Section IV.

80. Cody (1994). www.cnie.org/nle/ag-5.html

81. Green Scissors Campaign of Citizens United to Terminate Subsidies (January 1995). www.essential.org/orgs/FOE/scissors95/greenpart22.html.

82. 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.

83. For more information on subsidies for timber, mining, energy, and water, see EPA (August 1994b), *Federal Disincentives: A Study of Federal Tax Subsidies and Other Programs Affecting Virgin Industries and Recycling*. For a list of taxes affecting timber, mining and energy, see Barthold (1994), p. 149.

84. See, for example, *DEN*, August 16, 1995 or Tolman (1995).

85. Tolman (1995).

86. *DEN*, February 16, 1996, p. A8.

8. LIABILITY APPROACHES

Two federal environmental statutes, CERCLA and OPA, provide liability for 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 lost use of injured resources and for restoration of the environment. 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 good practice when it reduces the overall cost of doing business.

Several of the federal environmental statutes provide for civil and criminal liability for failure to comply with the law and implementing regulations. The incentive effect of this form of liability is to encourage individuals to comply with what are largely command and control regulations. Such an incentive is qualitatively different from the subject matter for 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 level of penalties and enforcement produce the correct incentive effect (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. Also possibility is too little effort at pollution if penalties are low and enforcement is lax.

Tort law is a fourth means through which liability encourages behavior that improves the state of the environment. Under tort law, individuals may 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, meaning that many environmental costs will not be internalized through a liability mechanism. In fact, it is largely the failure of tort law to address many types of environmental harm that led to the passage of the principal environmental statutes.

8.1. LIABILITY FOR CLEANUP COSTS

Enacted by Congress during the change-over from a Democratic to a Republican administration in 1980, the Comprehensive Environmental Response, Liability, and Compensation Act (CERCLA) responded to an issue that had no precedent: the legacy of contaminated sites containing hazardous wastes. CERCLA established a trust fund (the Superfund) which is financed primarily by a tax on corporate income, crude oil and certain chemicals. EPA uses the fund to pay for cleanup and restoration activities at sites where no solvent responsible party can be identified or where immediate response is deemed necessary.

The most important feature of CERCLA centers on the cleanup of hazardous waste sites posing a threat to human health and the environment. CERCLA is unique among the principal environmental statutes in that it is backward looking, seeking to remedy problems stemming from past actions, rather than forward looking and trying to prevent damage from current or future activities. The incentive effects of CERCLA cleanup responsibility must lie outside of the actual costs of cleanup, since the actions that precipitated the need for cleanup are historical not contemporary. But the mere prospect of CERCLA cleanup liability can affect current and future decisions regarding the disposal of hazardous wastes.

Section 107(a) of CERCLA provides for liability for anyone who is did something "from which there is a release (of a hazardous substance), or threatened release which causes the incurrence of response costs..." The courts have interpreted this to require strict, joint and several liability for parties deemed responsible for disposing of hazardous wastes that pose risks to human health and the environment. Joint and several liability means that if the government can identify just one party out of many that contributed wastes to a site, potentially the one party can be held responsible for all cleanup costs. In turn any potentially responsible parties identified by the government may seek to involve other potentially responsible parties. Joint and several liability appears to some to be a recipe to ensure litigation over who is responsible for what. Strict liability is a standard that holds parties responsible regardless of the circumstances of their action.

Private sector cleanup costs under CERCLA certainly have run into the tens of billions of dollars already and eventually may amount to several hundred billion dollars. As noted earlier, transactions costs associated with determining liability run high under this program.

8.2. LIABILITY FOR DAMAGE TO NATURAL RESOURCES

Until 1990, CERCLA included damage to natural resources resulting from oil spills within its scope.[1] 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: so called "interim lost uses" while pollution and cleanup are ongoing, and residual damages if restoration is not complete. CERCLA designates federal and state authorities as trustees for natural resources. Trustees, in conjunction with the Justice Department pursue the natural resource damage assessments. At the federal level, the Department of the Interior is the trustee for freshwater anadromous fish, migratory birds and waterfowl, and endangered species. The National Oceanic and Atmospheric Administration is trustee for the coastal and marine environment, including commercial and recreational fisheries, marine mammals and anadromous fish in salt water.

The Oil Pollution Act of 1990 (OPA), enacted following the 1989 *Exxon Valdez* spill in Prince William Sound, created an independent statute separate from CERCLA for addressing damages resulting from oil spills. In Section 1006(e)(1) OPA directed the National Oceanic and Atmospheric Administration (NOAA), a part of the Department of Commerce, to promulgate regulations for assessing natural resource damages. On January 5, 1996 NOAA issued final regulations on natural resource damage assessment conducted under OPA.[2] The Department of the Interior is expected to issue NRDA regulations for assessments under CERCLA in 1997; those regulations are expected to follow closely NOAA's approach. The goal of OPA and the NOAA regulations is to restore the natural resources and services to their baseline condition and to compensate for the interim lost use of natural resources and services through the restoration, rehabilitation or replacement through the acquisition of comparable resources and / or services. Damage assessments conducted by trustees in conformance with the NOAA regulations are accorded the status of a rebuttable presumption, which means that 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 assure that the public is made whole following an oil spill. The resource and resource services are restored and the public is compensated for any lost use of the resource and resource services. In assuring that responsible parties will pay the amounts necessary to make the public whole, OPA gives potentially responsible parties a financial incentive not to spill oil.

By 1996, under provisions of CERCLA, OPA, and the Clean Water Act, federal agencies had settled more than 100 natural resource damage cases for a total of well over $700 million. By that date state agencies acting as trustees also had settled several cases on their own for a total of at least another $20 million. In comparison, cleanup settlements by that date under CERCLA alone totaled at least $10 billion, or approximately 100 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 for the damages.

A number of large NRDA cases are still pending, at least three of which could amount to at least $500 million. Several important cases involving the federal government as a responsible party also are outstanding. The following table summarizes the largest cases reported as settled (or partially settled) by 1996. Somewhat surprisingly, neither the *Exxon Valdez*, nor the Shell Oil Martinez, CA refinery spills are listed. NOAA does not list the $620 million (present value) *Exxon Valdez* since the case 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.

It is clear that liability for natural resources is having an effect on firm 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 of New York and New Jersey, tankers are now accompanied by tug escorts and offloading tankers are surrounded by booms.

One largely unresolved issue concerns spills and releases that are too small to justify an a natural resource damage assessment under either CERCLA or OPA. For example, the Coast Guard records approximately 10,000 oil spills 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 (because it fails to internalize an externality). The petroleum industry has argued that the magnitude of these small assessments should closely match the actual damage done. The reason for this position probably has more to do with attempting to avoid formula-type assessments altogether than with a quarrel over the incentive effect of 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.

Table 8-1: LARGEST FEDERAL NATURAL RESOURCE DAMAGE SETTLEMENTS

Case	Location	Dollar Amount
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 Kul, 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 NMS, FL	$1,660,000
Charles George Trucking Co.	Charles George Reclamation Trust Landfill, IL	$1,378,350

Sources: Department of Justice, NOAA[3]

At least four states, Alaska, Washington, Florida and Texas have responded by enacting 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 formula approach for small spills, but later withdrew the initiative for further study when it was pointed out that the proposed method resulted in unrealistically large assessments in some cases.

8.3. CIVIL AND CRIMINAL LIABILITY

Congress first decreed pollution of the environment to be a federal crime in the Refuse Act of 1899, which made it a misdemeanor to "throw, discharge, or deposit" into navigable waters of the United States refuse of any kind other than runoff from streets and discharge from sewers. Violators convicted of violating the act could be punished by fines not less than $500 nor 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 conviction 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 increased the penalty provisions to felonies.

By 1995 the Justice Department had indictments against 443 corporations and 1,068 individuals, and had recovered $297 million in criminal penalties. Sentences for individuals totaled 561 person-years of prison for those convicted.[4]

State and local prosecutors also can pursue environmental crimes, since they are required to demonstrate such a capacity in order to obtain EPA authorization to administer locally programs of the Clean Air Act, the Clean Water Act and RCRA. While most states were not active in pursuit of environmental crimes, there are a number of important exceptions. New Jersey, Ohio, Pennsylvania and California are active in the prosecution of environmental crimes. Los Angeles maintains its own team of investigators and prosecutes cases.

An important sanction in addition to fines and sentences is mandatory "blacklisting" of contractors under the CAA and the CWA. 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 is 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.

8.3.1. RCRA

The purpose of RCRA is to establish a legal framework for a national system to oversee 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 to facilities in violation of a regulatory requirement of Subtitle C an order requiring compliance within a set time frame, usually 30 days. 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 (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 five 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.

8.3.2. CERCLA

Any person who releases hazardous substances, other than a federally-permitted release, from a vessel must notify the National Response Center. Failure to provide notification "immediately" or knowingly supplying 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.

Within 180 days of enactment of the Act, any person who owns, operates a hazardous waste storage facility, or who accepted hazardous wastes for transport and selected a treatment or disposal facility for the wastes, must notify the Administrator of EPA of the existence of such a facility and supply information concerning the wastes as requested by the Administrator. Parties subject to the above requirement must retain records concerning the identity, characteristics, origin and condition of the wastes for 50 years. Failure to comply with either provision can result upon conviction in a fine of not more than $10,000 or imprisonment for not more than one year.

8.3.3. CWA

The EPA can begin civil actions against violators of CWA permits and seek appropriate relief including permanent or temporary injunctions. EPA can seek criminal penalties, including fines of net less than $2,500 nor more than $25,000 per day of violation or imprisonment for not more than one year, or both, for parties who negligently violate permit conditions and limitations. EPA may seek criminal penalties of not less than $5,000 per day nor more than $50,000 per day of violation or imprisonment of not more than three years, or both for parties who knowingly violate permit conditions and limitations. EPA may seek criminal penalties, including a fine of not more than $250,000 or imprisonment of not more than 15 years, or both, for parties who violate permit conditions and limitations and knowingly place another person in danger of death or serious bodily injury. An organization found guilty of knowingly endangering another person may be subject to a fine of not more than $1,000,000. After the first conviction, the fines and prison terms for subsequent convictions can be doubled.

The CWA also provides for civil penalties for other offenses, including making false statements on records, reports and other documents filed under the CWA, or wrongfully introducing pollutants into treatment works.

8.3.4. 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 (generally those emitting more than 100 tons per year of a regulated pollutant). Criminal penalties that include both fines and imprisonment for up to two 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. Negligent violators who place another human in imminent danger of death or serious bodily injury, upon conviction, are liable for fines and prison sentences of up to one year. Knowing violators who similarly endanger human health may, upon conviction, receive fines and 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.

8.4. TORT LIABILITY

Litigation concerning claims of personal injury from chronic exposures to toxic agents in the environment is a relatively recent phenomenon and largely is 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 toxic tort actions are brought has undergone considerable evolution in recent years, brought about by several factors including the need to accommodate improved scientific information on the effects of human exposure to toxic agents, recognition of the potentially long latency periods between exposure and onset of a disease, and 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 have been filed that claim harm from pollution in the environment, and of these cases very few involving health effects have been decided in favor of plaintiffs.

The statute of limitations is an important barrier to litigation in a few states, but most states have struck down this once-important obstacle by allowing plaintiffs one to three years after the discovery of an injury to file a case rather than starting the clock with the date of initial exposure.

A difficult obstacle to plaintiffs in many situations of environmental harm is identifying 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 responsible parties is even more difficult.

Demonstrating causation represents a major challenge, since most diseases that have been linked to toxic substance exposure have multiple causes. Tort law generally requires that plaintiffs demonstrate that the harm they experienced was "more likely than not" caused by the defendant. Courts generally interpret this to mean that the probability the defendant caused the harm was at least 50%. Imagine a situation in which a polluter increased the risk of cancer in a nearby residential area by 20%. Rather than 100 people dying of cancer each year, 120 die. None of the 120 cases would be compensable under the "more likely than not" criterion. Two other things should be pointed out: (1) statistical data of this nature are not likely to be accepted by courts, no matter what the standard of proof, and (2) epidemiology is limited in its ability to detect elevated incidence of a disease, the smallest detectable 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.

Endnotes for Section 8

1. A good background source is: Ward, Kevin and John Duffield, 1992. *Natural Resource Damages: Law and Economics*, John Wiley & Sons, Inc.

2. Natural Resource Damage Assessments: Final Rule, 61 *FR* 440-510, January 5, 1996.

3. Department of Justice data cited in "Status of Natural Resource Damage Claims," testimony of Peter F. Guerrero, US General Accounting Office, before the Subcommittee on Commerce, Trade, and Hazardous Materials, Committee on Commerce, House of Representatives, June 20, 1995; and NOAA, "The Damage Assessment and Restoration Program," 1996.

4. Cooney, John F. et al., 1996 "Criminal Enforcement of Environmental Laws," in *Environmental Crimes Deskbook*, Washington, D.C., Environmental Law Institute.

9. INFORMATION APPROACHES

9.1. INTRODUCTION

For the purposes of this Section, information approaches to environmental protection may be defined as policy instruments that attempt to improve companies' environmental behavior through the collection and dissemination of information on the environmental consequences of their products and activities. They differ from command and control regulation in that they entail no requirements other than reporting, but the information reported could have negative or positive repercussions for the firm. If information on environmental performance is readily available, companies with poor performance could risk losing customers (and perhaps financing, labor, and other inputs) at the expense of companies with better environmental performance. Negative information could also be used in citizen suits against polluters. Information approaches could also help polluters see the impacts of their pollution on the environment and their profitability and develop appropriate abatement methods.

In assessing information approaches, one should bear in mind that having an incentive effect is not their only objective. The Toxics Release Inventory and other mechanisms discussed below are also intended to provide information to regulators, scholars, and others interested in pollution.

Information approaches have been used in environmental protection on both the state and federal levels. This Section begins with a discussion of the federal Emergency Planning and Community Right-to-Know Act (EPCRA) and two similar state programs. It then discusses California's Proposition 65 and air toxics release reporting requirements, environmental impact assessment reporting requirements, product labeling, environmental performance awards, Securities and Exchange Commission environmental reporting requirements, and radon and lead paint disclosure requirements. Information approaches used outside the U.S. are discussed in Section 11.

9.2. EMERGENCY PLANNING AND COMMUNITY RIGHT-TO-KNOW ACT (EPCRA)

Enacted in 1986 as Title III of the Superfund Amendments and Reauthorization Act (SARA), EPCRA requires emergency planning and disclosure of information on releases and transfers to disposal facilities of hazardous chemicals. 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 disposal facilities.[1] 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 normally must be submitted by July 1 of the following year, but the deadline for 1995 data was extended to August 1, 1996. EPA then compiles the information and makes it available to the public as the Toxics Release Inventory (TRI).

TRI reporting is required of all manufacturing facilities with ten or more employees in the Standard Industrial Classification (SIC) codes 20 through 39 that manufacture, process, or otherwise use one or more of the listed chemicals above certain threshold amounts. Thresholds are 25,000 pounds per year for manufacturing and processing and 10,000 pounds per year for otherwise using. Table 1 shows which industries are included in these codes. Federal facilities were also required to submit their first TRI reports by July 1, 1995 for the 1994 calendar year.

The number of listed chemicals was originally set at 320 but has since been increased. (A few chemicals have also been deleted from the list.) The most significant expansion took place in 1994, when EPA added 286 new chemicals to the list effective for the 1995 calendar year, bringing the number to 654.[2] Individuals and organizations can petition EPA to add or remove chemicals from the list.

Also in 1994, EPA streamlined reporting requirements for small businesses. Facilities that have a total annual reportable amount 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. "EPA believes that this rule strikes a positive balance between maintaining the community's right-to-know about toxic chemical releases, and the economic costs (both to EPA and industry) of collecting the information."[3] EPA estimates that the streamlining will result in annual cost savings of about $17.3 million for industry and $700 thousand for EPA.[4]

After expanding the number of listed chemicals in what it referred to as phase 1 expansion, EPA turned to phase 2, intended to expand TRI requirements to other industries that have significant releases of listed chemicals and which are related to facilities currently subject to reporting. The proposed expansion would extend reporting requirements to the following seven industries: metal mining, coal mining, electric utilities, commercial hazardous waste treatment, petroleum bulk terminals, chemical wholesalers, and solvent recovery services.[5] The expansion is not expected before 1998.

A third phase will focus on expanding the types of data to be collected for the TRI. New data could include chemical use and materials accounting information. This third phase is intended to provide more information on topics such as the results of companies' source reduction efforts and the amounts of chemicals in companies' finished products.

EPA has sought to make TRI information available to industry, environmental groups, and the general public so that they can know about facilities' toxic releases and transfers off-site. This information is available via several media, including printed reports, CD-ROM, and Internet.

(EPA TRI data: www.epa.gov/docs/TRI_94)

The emergency planning component of EPCRA calls for the creation of state and local emergency response bodies to plan for toxic releases. It also requires facilities to inform these bodies of the existence of certain hazardous substances on their premises, give immediate notice of accidental releases, and develop response plans to be implemented in the event of such accidents. Information provided by facilities is available to the public.

9.2.1. Trends in TRI Data

As shown in Table 9-1, reported TRI releases have decreased 44.1% since 1988. Decreases have been reported in most industry SIC codes.

Although the data in Table 9-1 suggest significant reductions in toxic releases, there are several reasons why they may not be equal to actual decreases in releases. EPA points out that TRI increases and decreases can be "real changes" or "paper changes."[6] 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. Companies generally determine their TRI release amounts through estimation rather than 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.

EPA says that estimation errors are more likely for releases such as fugitive air emissions and complex wastewater for which little monitoring data are available. However, EPA audits have found companies' estimation techniques to be reasonably accurate. An audit of 1987 data at selected facilities led to the conclusion that releases had been under-reported by 2%, but a 1988 audit found that companies reported about the same amount as the auditor's own estimate.[7]

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."[8] The original list focused on the most important toxics, and, as noted above, EPA included another 286 chemicals in TRI requirements effective 1995. However, some highly toxic chemicals have not been included because they are generated in amounts that are too small to meet criteria for inclusion.

In addition, a number of small sources in SIC codes 20-39 and all sources outside that code range are currently excluded from the TRI. It is not known what percentage of releases are currently exempt from reporting. As noted above, however, EPA intends to include other SIC codes in the system.

Table 9-1: TRI RELEASES BY INDUSTRY[9]
(in millions of pounds)

SIC	Industry	1988	1992	1993	1994	% Change 88-94
20	Food	9.1	11.9	12.0	10.3	13.7
21	Tobacco	1.2	0.6	0.6	1.0	-22.1
22	Textiles	34.3	19.1	17.6	15.9	-53.6
23	Apparel	0.9	1.3	1.0	1.3	42.9
24	Lumber	31.1	30.0	29.8	31.7	2.0
25	Furniture	61.4	53.2	54.0	50.6	-17.6
26	Paper	227.7	199.1	179.8	218.6	-4.0
27	Printing	60.7	40.4	35.9	34.2	-43.7
28	Chemicals	1322.8	991.3	874.4	700.7	-47.0
29	Petroleum	67.7	61.7	50.9	43.8	-35.3
30	Plastics	146.6	121.1	111.0	111.6	-23.9
31	Leather	11.9	7.2	4.4	3.6	-69.9
32	Stone / Clay / Glass	27.1	14.3	14.3	12.4	-54.3
33	Primary Metals	496.2	341.2	304.6	293.8	-40.8
34	Fabr. Metals	131.8	100.6	88.6	86.1	-34.7
35	Machinery	59.6	33.0	26.5	23.5	-60.6
36	Electrical	115.8	47.1	32.9	29.0	-75.0
37	Transportation equipment	191.0	125.3	123.8	119.7	-37.3
38	Measure., photo.	49.9	29.1	22.5	15.7	-68.5
39	Miscellaneous	28.6	16.9	15.2	13.7	-52.0
NA	Multiple codes 20-39	446.6	191.8	137.2	142.9	-68.0
NA	Code not reported or not in 20-39 range	14.0	13.6	20.1	16.9	21.2
	Total	3536.1	2449.6	2157.4	1976.9	-44.1

Source: 1994 Toxics Release Inventory: Public Data Release, p. 195.

Releases are not weighted according to toxicity or the dangers posed by various methods of disposing of various types of chemicals and do not indicate exposure or potential effects on human health and the environment. Moreover, the TRI does 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 generally 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 the transfer data in table 9-2 show no clear trend toward 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 period 1992-1994. Excluding these two types of transfers, reported transfers have decreased significantly since 1988 but show no clear trend since 1992. Total releases and transfers decreased significantly from 1992 to 1993 but increased slightly from 1993 to 1994. The decrease in releases from 1993 to 1994 coincided with an increase in transfers.

Table 9-2: TRI WASTE TRANSFERS[10]
(in millions of pounds)

Transfers	1988	1992	1993	1994	% Change 1988-94
Recycling	NA	2,609	2,057	2,234	NA
Energy	NA	431	447	463	NA
Treatment	396	257	254	290	-26.8
POTWs	297	226	186	180	-39.3
Disposal	437	217	267	280	-35.9
Other off-site	42	13	2	4	NA
Total transfers	1,173	3,752	3,213	3,451	NA
Total releases	3,536	2,450	2,157	1,977	-44.1
Total releases and transfers	4,709	6,202	5,370	5,428	NA

Source: 1994 Toxics Release Inventory, p. 171.

The assessment of source reduction achievements is complicated by the lack of TRI data on quantities of waste decreased by source reduction measures. Only the practices used to reduce waste and not their results are included in the TRI. Changes in waste generation reported in the TRI could be due to factors other than source reduction, including estimation errors or changes in production levels of specific products. Lack of information on source reduction and on chemicals in facilities' products is one of the main issues surrounding the phase III expansion of the TRI noted above.

As discussed in Section 10, the trend of decreases in releases and transfers is more pronounced under the voluntary 33/50 program. 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.

9.2.2. Incentive Effect of the TRI

The incentive effect of the TRI on polluters cannot be assessed solely on the basis of reported decreases in releases. A number of factors, including command-and-control 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.

Nonetheless, the TRI is widely believed to have a significant impact on polluters. EPA has called it "one of the most powerful tools in this country for environmental protection"[11] and "one of the most successful policy instruments ever created for improving environmental performance."[12] Vice-President Gore called the annual TRI publication "the single most effective common-sense tool" to promote environmental protection.[13] Shortly after the first TRI was released in 1989, citizen groups placed a full-page advertisement in the *New York Times* listing "the corporate top ten" land, water, and air polluters. Several of these polluters subsequently promised the EPA that they would improve their environmental performance, effectively beginning the 33/50 voluntary releases reduction program described in the next Section.[14] Monsanto, for example, promised 90% reductions of 1987 air emission levels by 1992.[15] AT&T said it would halt all TRI air emissions by the end of the century.[16] Dow said 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.[17] After 1987 TRI data found an IBM facility in California to be the state's largest emitter of CFCs, a public interest group organized a campaign and IBM subsequently promised to end the use of CFCs at the plant by 1993.[18]

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 companies' 1988 TRI performance (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 for firms previously less associated with pollution. Those companies that reported TRI releases underperformed the market during the five days after the data were released. The more chemicals for which a company submitted data, the greater its under-performance. 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 zero to 10 in 20 performance categories, including toxic emissions per unit of sales.[19]

Although EPCRA's emergency planning element briefly described above has received less attention than the TRI as an incentive mechanism, it could also have a significant effect on polluters' behavior. Firms might reduce the amounts of hazardous substances on their premises if forced to disclose these amounts to local emergency response bodies and (indirectly) to the public. They might also manage hazardous substances more safely if required to plan for and give immediate notice of accidental releases.

9.3. STATE EPCRA PROGRAMS

Several states have toxic release reporting programs similar to the federal EPCRA but with different reporting requirements. The requirements may cover additional chemicals, industries, or reporting elements; toxics use; and pollution prevention plans.[20]

The programs in Massachusetts and New Jersey, for example, differ from their federal counterpart in that they require companies to use materials accounting to plan pollution prevention activities, report their goals and progress on pollution prevention, and examine whether inputs and outputs balance.[21]

One advantage of such requirements is that they offer more information on toxics use and wastes that could be of interest to the companies themselves, their regulators, and the general public. 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 burden by taxing the polluters, it adds to the polluters' burden.

EPA has studied these two programs in the context of its phase III expansion to obtain insight on how the federal EPCRA might be improved.

9.3.1. Massachusetts Toxics Use Reduction Act

Enacted in 1989, the Massachusetts TURA requires large-quantity toxic material users, including those in several SIC codes not covered by the federal EPCRA, to submit an annual Toxic Use Report to the State Department of Environmental Protection and to develop toxic chemical use and waste reduction plans. Subject facilities must report annually on their inputs and outputs of materials and their waste generation and management methods.

For every production unit, facilities must also report on their use of chemicals and on use reduction techniques (within range codes to protect confidential business information) and indicate a Byproduct Reduction Index (BRI) and an Emission Reduction Index (ERI). ("Byproduct" can be considered "waste" in this context, although it 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 number of units of product in reporting year.

Additional data must be reported every two years on actual and projected changes in chemical use and wastes compared to planned and base year amounts.

Summaries of the chemical use and waste reduction plans must also be submitted biennially, but the detailed plans remain at the facilities to ensure confidentiality. These plans must be endorsed by certified Toxics Use Reduction Planners.

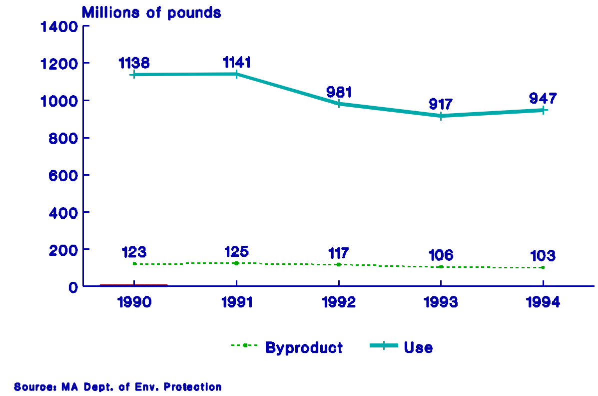
TURA also created two agencies to provide technical assistance to toxics users and conduct training and research on TURA and toxic use reduction techniques. The operations of these agencies and other program costs are covered by toxics use fees that depend on the number of employees at a facility and the number of chemicals it uses. These fees are limited to $31,450 per facility annually and are not closely linked to the quantities or toxicities of chemicals used. Annual revenues amount to about $5 million.

TURA also contains provisions for citizen involvement. Residents may assist in monitoring and access the TURA information on toxics use reported to the Department. 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 ten 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 chemical use efficiency and cost-cutting opportunities.

TURA set a waste reduction goal of 50% over ten years, using 1987 as a baseline. Reporting began in 1991 for 1990 data. As shown in figure #, toxics use and waste generation have fallen since 1990.

Figure 9-1: MASSACHUSETTS TOXICS USE AND BYPRODUCTS



(TURA internet site: www.state.ma.us/dep/bwp/dhm/tura)

9.3.2. 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 amounts of waste reduced through source reduction activities.

The 1991 New Jersey Pollution Prevention Act required facilities to undertake pollution prevention planning and, like the Massachusetts law discussed above, set a goal of 50% reduction in waste output by 1997, with 1987 as a baseline. Plan Summaries must be submitted to the State every five 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.

The New Jersey Department of Environmental Protection reports that it has conducted surveys showing that its reporting requirements have been beneficial to companies by providing them the information they need to assess waste minimization options. Department officials also claim that the data allow them to better manage their activities, including the implementation of the facility-wide permitting scheme described in Section 6.

9.4. PROPOSITION 65

Adopted by voter referendum in 1986, California's Safe Drinking Water and Toxic Enforcement Act, commonly referred to as Proposition 65, requires polluters to issues warnings if they expose people to significant levels of carcinogens or reproductive toxicants listed by the Governor. The list currently contains 570 chemicals.[22]

If a substance is listed as a carcinogen, businesses may not discharge it into drinking water unless it poses "no significant risk." For any other listed carcinogen exposures posing "significant risk," the business must provide "clear and reasonable warning." For reproductive toxicants, the same rules apply, but the threshold is 1/1,000 of the "no observable effect" exposure level.[23] The water discharge ban takes effect 20 months after listing, and the other requirements take effect 12 months after listing.

State regulation sets the levels of "significant risk" for most important chemicals on the list, but they can be superseded by more stringent levels mandated by other environmental laws. The burden of proof that the exposure is below the significant risk level is on the defendant. Drinking water utilities, government agencies, and organizations employing fewer than ten people are exempt from the rule.

Citizens have the right to initiate law suits 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. 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 Environmental Defense Fund and As You Sow) and individuals have been compensated for initiating Proposition 65 suits.[24] (A similar enforcement award scheme in New Jersey is discussed in Section VII.) However, a source in that office reports that the "bounty hunter provision" creates less incentive for private parties to initiate suits than the possibility of obtaining attorney's fees, as plaintiffs can recover all attorney's fees but must give the state 75% of penalties. As a result, plaintiffs and defendants frequently characterize entire negotiated settlement amounts as attorney's fees.[25]

In many cases, businesses in California appear eager to avoid issuing clear warnings and 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.[26]

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 had to bear warning labels. Businesses appear much more likely to take measures to avoid warnings for products such as tableware that consumers generally believe are safe and for which there are unlabeled substitutes than for products such as spray paint that consumers know can be dangerous.

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."[27] Another study has suggested that firms might collude to label to excess, thereby minimizing label impact.[28]

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 after passage of the law, businesses devoted significant resources to assessing the risks of exposure to toxics.[29] While business groups asserted that compliance with the law would be very costly, when given the opportunity by the State of California during a retrospective analysis of the law, they failed to provide evidence that significant costs actually were incurred.

9.5. HOT SPOTS ACT[30]

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 Act are "to collect emission data, to identify facilities having localized impacts, to ascertain health risks, and to notify nearby residents of significant risks." The Hot Spots 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 Section IV. The former is discussed here.

Facilities are required to submit to air pollution control districts an air toxics emission inventory plan, a subsequent inventory, and, for certain priority facilities, a health risk assessment. If the district judges that a facility's emissions pose a potentially significant health risk, the facility operator must notify all exposed persons.

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 five years or a period not to exceed ten years as determined by the district. This amendment introduced a considerable command-and-control element to what previously had been an incentive-based instrument. However, emissions data and health risk assessments remain accessible to the public and could give polluters incentives to reduce emissions more substantially and quickly than they otherwise would.

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, community relations, and anticipation of future regulations are some of the motives for these reductions.

(Summary of Hot Spots program: arbis.arb.ca.gov / toxics / ab2588 / 2588summ.txt)

9.6. ENVIRONMENTAL POLICY ACTS

Under the terms of the National Environmental Policy Act (NEPA), environmental impact assessments, statements, or reports must be prepared prior to certain government actions affecting the environment. The results of such reports could influence government, especially since they are subject to public review. However, most federal actions subject to NEPA do not concern activities initiated by the private sector.

On the state level, NEPA-like laws could influence private behavior. At least 14 states have such laws, which vary in nature from state to state but which generally require a government agency to engage in a public comment process on environmental impact assessments prior to making a decision.[31] In some of these states, the laws apply only to state-initiated actions. In states such as California, New York, and Massachusetts, however, the laws apply to public and private actions requiring permits. Laws in these states have resulted in the restructuring, reconsideration, or withdrawal of proposals before and after public review.

9.7. 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 avoid a negative one.

Table 9-3 shows the classification scheme for environmental labeling programs proposed by a 1994 EPA study[32]. Programs can be either voluntary or mandatory. Moreover, the information provided by labeling can be either negative, positive, or neutral.

Seals of approval are given to products 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 products' various impacts on the environment. Hazard labels warn customers of the harmful effects of a particular product.

Table 9-3: CLASSIFICATION OF ENVIRONMENTAL LABELING SCHEMES

Program Type	Positive	Neutral	Negative	Voluntary	Mandatory
Seal-of-Ap-proval	x			x	
Single at-tribute	x			x	
Report card		x		x	
Information disclosure		x			x
Hazard warn-ings			x		x

Source: EPA (1994a), p. 9.

Experience with labeling schemes indicates that they are more likely to influence behavior if accompanied by promotional activities targeting 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.[33]

Although the United States does not have a national government-initiated environmental labeling program like many other industrialized countries, it does have a few public and private labeling schemes. The rest of this subsection discusses various schemes that have been used in the U.S.

9.7.1. Federal Trade Commission Guidelines for Environmental Marketing Claims

Issued in 1992 and, at the time of this writing, under review for possible revisions, the FTC Guidelines for Environmental Marketing Claims or "Green Guides" do not constitute a labeling system as such, but they are designed to have an effect on labeling. The guidelines 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 affected not only consumers but also companies, who were concerned about lawsuits over their environmental claims.

The Guides outlined four general principles for environmental claims: qualifications and disclosures should be sufficiently clear and conspicuous to prevent deception; claims should make clear whether they apply to the product, packaging, or just a component of either; claims should not overstate environmental benefits; and comparative claims should be presented in such a way that the basis for comparison is clear. The guides also addressed claims concerning environmental friendliness, degradability, compostability, recyclability, recycled content, source reduction, refillability, and ozone friendliness.[34]

9.7.2. Green Seal and Other Seals of Approval[35]

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. 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 reduction of toxic chemical pollution, improved energy efficiency, protection of water resources, minimization of impacts on fish and wildlife and their habitats, efficient use of natural resources, protection of the ozone layer, and prevention of global warming. Products are not subjected to a complete life-cycle analysis but rather judged according to those aspects of the life cycle with the most significant environmental impact. Standards are reviewed at least once every three 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 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 25 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 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.[36]

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 addresses and phone numbers of product vendors. "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.

The incentive effects of Green Seal's activities appear not to have been comprehensively studied. In a Green Seal survey, however, 4 of 5 consumers said they would be more likely to purchase a Green Seal-certified product than other products of equal quality and price.[37]

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 their products were environmentally friendly. Wal-Mart ended this program in 1992, mainly because of difficulties 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: 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 environmental friendliness assessments 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 on the grounds 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.

9.7.3. Single-Attribute Seals of Approval

The problems of lack of criteria and oversimplification are likely to be less serious for labeling programs based on a single product attribute. EPA's Energy Star office equipment label is reserved for computers, printers, photocopiers, and typewriters that are relatively energy-efficient. This label is part of a voluntary energy-efficient office equipment promotion initiative described in Section X.

Created in 1992 and licensed by Earthtrust, a non-profit organization based in Hawaii, the Flipper Seal of Approval is awarded to companies that harvest tuna in a manner that minimizes killings of dolphins. The seal has been awarded to tuna companies in the United States and abroad.

From 1986 to 1991, the Bonneville Power Administration managed a Blue Ribbon Award Campaign to promote the use of energy-efficient refrigerators and freezers. Under this program, refrigerators and freezers in the top 15 percent of their size and function category were awarded blue magnetic ribbons.[38] A retailers survey conducted early in the program estimated that about 22% of customers had been "influenced" in their purchasing decisions.[39]

Scientific Certification Systems (SCS), a for-profit business, has two single-attribute seal of approval programs. 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: sustainability of timber resources, forest ecosystem maintenance, and socio-economic benefits to the surrounding community. Scores over 60 are required in each category to be awarded the "Well-Managed Forest" label. Operations scoring in the top ten percent are further labelled as "State-of-the-Art."[40] SCS can also use chain of custody certification to verify that wood products sold to consumers come from well-managed forests. About ten forestry operations in South, Central, and North America have been rated by SCS.

SCS has also certified over 500 environmental claims by manufacturers concerning recycled content, recycling rates, energy efficiency, water efficiency, biodegradability, and 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 VOCs is valued by institutional customers such as hospitals.[41]

9.7.4. Report Cards and Information Disclosure

SCS also issues environmental "report cards" that rate products according to various criteria. (The company refers to these as "eco-profiles.") These profiles are based on a cradle-to-grave assessment of the environmental burdens associated with raw material extraction, manufacture, transportation, use, and disposal of a product. The environmental burdens considered include resource depletion, energy use, air and water emissions, and solid wastes. Bar graphs for each of approximately twenty 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.[42]

9.7.5. Energy-Efficiency Labeling

Two other information disclosure programs are required and managed by the federal government. The EPA manages the Fuel Economy Information Program, under which new cars must have labels in their windows listing their milage-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 available for customers the Gas Mileage Guide of car fuel efficiency.

A 1976 study found that more than half of new car buyers had seen the fuel economy label and that those aware of the label bought cars with higher mileage than other car buyers. The program was credited with a fuel consumption reduction for 1976 model cars of 893 million gallons. However, the influence of the labeling program decreased as a result of falls 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 labels. EPA changed the fuel efficiency assessment procedure in 1985 to make it more realistic.[43]

The 1975 EPCA also required that Energy Guide labels be placed on refrigerators, freezers, water heaters, washing machines, dishwashers, furnaces, air conditioners, and heat pumps. The 1992 Energy Policy Act expanded these requirements to fluorescent lamps, showerheads, faucets, water closets, and urinals. Although labels vary depending on the type of appliance, they formerly all included information on the manufacturer and appliance model number and capacity, 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 annual estimated costs for varying use habits and energy prices.

The Federal Trade Commission changed the labels in 1994 so that for refrigerators, freezers, dishwashers, clothes washers, and water heaters, they now include the kWh of energy use of the labelled appliance and of the most and least efficient comparable appliances. Climate control appliances are labelled 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 energy cost estimate for products with kWh energy use ratings and for room air conditioners. Other products must have operating cost information either on fact sheets or in industry product directories. In a press release on the new labelling requirements, the FTC stated that they would "make the labels easier to read and more useful to consumers in comparing the energy efficiencies of the appliances."[44]

An in-store survey of appliance buyers conducted for DOE showed that 90% of buyers had noticed the Energy Guide label, and 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.[45] 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 rise appears to be due more to command-and-control requirements than the Energy Guide.[46]

FTC has also adopted labelling requirements for resistance to heat flow in insulation materials, emissions characteristics of alternative fuel vehicles, and the minimum content of alternative fuels.[47]

An industry initiative, the National Fenestration Rating Council rates the energy efficiency of windows. Over 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, and manufacturers try to improve energy efficiency to avoid being listed with poor ratings in the NFRC directory.[48]

9.7.6. Hazard Labels

Hazard labels inform consumers of environmental risks associated with particular products. Proposition 65, which was discussed above, has a hazard information requirement that 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 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 labelling requirements under the Federal Insecticide, Fungicide, and Rodenticide Act.

Retailers in Vermont have been required since 1991 to identify household products containing hazardous constituents with shelf warning labels. 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 label bears the text: "REDUCE TOXICS USE. These products contain HAZARDOUS INGREDIENTS." This label must be placed either on the shelf or near the subject products. Green exemption labels can be attached to shelves displaying products that have been included in the program but contain none of 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.

9.8. ENVIRONMENTAL PERFORMANCE AWARDS

EPA and numerous state and local governments periodically issue awards for environmental behavior they deem 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 waste minimization efforts 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.[49]

(WRAP awards announced: www.calepa.cahwnet.gov/epadocs/janfeb96.txt)

In Texas, Governor's Awards for Environmental Excellence are issued for the following categories: large business - technical, large business - non-technical, small business, government, civic and non-profit organizations, education, youth organization, media, agriculture, individual, and special.[50] (These awards are part of the Clean Texas 2000 initiative that also includes the Clean Industries 2000 program discussed in the next section.) 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 and the EPA Regional Administrator's Environmental Excellence Award for Excellence in Hazardous Waste Minimization Program Development.[51]

9.9. SEC DISCLOSURE REQUIREMENTS

The Securities and Exchange Commission (SEC) requires publicly owned companies to report financial information to allow investors to evaluate them. Included in this requirement are environmental expenditures or liabilities that could have a "material" impact on the company's financial or competitive position. Companies also must report individual environmental enforcement proceedings expected to cost over $100,000 as well as environmental litigation that might have significant financial impact. SEC access to information submitted by companies to EPA enables it to verify company disclosures on Superfund and RCRA sites and on federal enforcement actions. The SEC is authorized to require companies to revise filings in case of inaccuracies and has written to companies to inquire why they did not disclose certain environmental information in their filings.

The number of large companies disclosing environmental information in Form 10-Ks is increasing. Among S&P 500 companies, 322 submitted environmental information in 1990 compared to 217 in 1988. The incentive effect of these disclosure requirements is not known. However, evidence presented elsewhere in this Section indicates that information on company environmental performance is of interest to investors.[52]

9.10. RADON AND LEAD PAINT DISCLOSURE REQUIREMENTS

EPA and other public and private organizations have used information as an environmental policy tool in other ways. In many cases, educational activities have influenced behavior. EPA education on the dangers of radon, for example, has led many people to adopt appropriate abatement measures. Awareness of the problem has risen to the point that many homebuyers as well as lending institutions have requested radon measurements before making final purchases or participating in transactions. Such testing is recommended in EPA's "Home Buyer's and Seller's Guide to Radon." A number of states have also enacted radon disclosure requirements for real estate transactions. In Illinois, for example, the Residential Real Property Act, which went into effect in October 1994, requires sellers to disclose knowledge of elevated radon test result levels.[53]

(EPA pubs on Radon: www.epa.gov/docs/RadonPubs/index.html)

(Illinois radon act description: www.state.il.us/idns/radon/prgdecsr/radonprg.htm.)

An amendment to the Federal Lead-based Paint Poisoning Prevention Act entered into effect in 1995 requiring the owner of any house built before 1978 to alert potential buyers or tenants to possible hazards from lead paint and to disclose lead paint known to be in the house. The buyer has a 10-day grace period in which to test the house.[54]

Endnotes for Section 9

1. TRI data distinguish between releases and transfers. A release is an on-site discharge of a toxic chemical to the environment, whereas a transfer is a movement of waste to another facility for recycling, energy recovery, treatment, or disposal.

2. EPA (March 1995), "Expanding Community Right-to-Know," p. 4.

3. Ibid, p. 5.

4. *1994 Toxics Release Inventory*, p. A11.

5. *Wall Street Journal*, June 27, 1996, p. B12.

6. *1994 Toxic Releases Inventory*, p. 201.

7. Ibid, pp. C2-C3.

8. GAO (September 1994), p. 14.

9. Because all figures have been rounded to one decimal place, percentage changes may not correspond exactly with release data and total releases might differ slightly from the sums of the columns. Not included in these data are delisted chemicals, chemicals added in 1990, 1991, or 1994, and aluminum oxide, ammonia, ammonium sulfate (solution) and sulfuric acid.

10. "Other off-site" refers to transfers reported with no management code or invalid codes. For 1988, "other off-site" may also include codes not required to be reported in that year. Not included in these data are delisted chemicals, chemicals added in 1990, 1991, or 1994, and aluminum oxide, ammonia, ammonium sulfate (solution) and sulfuric acid.

11. EPA (March 1995), p. 3.

12. *DEN*, October 10, 1995, p. E1.

13. *Wall Street Journal*, June 27, 1996, p. B12.

14. Arora and Cason (1995), p. 9.

15. "The Nation's Polluters - Who Emits What, and Where," *New York Times*, October 31, 1991, as reprinted in ELI (June 1993).

16. "For Communities, Knowledge of Polluters is Power," *New York Times*, March 24, 1991, as reprinted in ELI (June 1993).

17. "Right to Know: A U.S. Report Spurs Community Action By Revealing Polluters," *Wall Street Journal*, January 2, 1991, as reprinted in ELI (June 1993).

18. *1994 Toxics Release Inventory*, p. D-2.

19. Ibid, pp. D7-D8.

20. For a summary of state TRI activities, see the *State Fact Sheets* section of the 1994 TRI.

21. Unless otherwise stated, information on TRI programs in Massachusetts and New Jersey provided by EPA (October 1995).

22. Susan Luong, California Office of Environmental Health and Hazard Assessment, personal communication, May 1996.

23. Helfand (1994), p. 290.

24. California Attorney General's Office (May 1996).

25. Edward Weil, California Deputy Attorney General, personal communication, June 1996.

26. Helfand (1994), p. 289.

27. EPA (April 1994a), p. 29.

28. Helfand (1994), p. 291.

29. Ibid, p. 293.

30. Unless otherwise stated, information on the Hot Spots Act provided by the California Air Resources Board, "Overview of the Air Toxics 'Hot Spots' Information and Assessment Act."
(arbis.arb.ca.gov/toxics/ab2588/2588summ.txt)

31. The states are California, Connecticut, Hawaii, Indiana, Maryland, Massachusetts, Minnesota, Montana, New York, North Carolina, South Dakota, Virginia, Washington, and Wisconsin. The District of Columbia and Puerto Rico have similar laws as well. For more information, see Environmental Law Institute (August 1993), pp. 122-124.

32. EPA (April 1994a), p. 9.

33. Ibid, p. 49.

34. *DEN*, October 23, 1995, p. A3.

35. Most information in this subsection is based on EPA (April 1994a).

36. A list of published environmental standards and criteria is found in the "Green Seal Order Form," and a list of products certified by Green Seal is found in "Green Seal's Choose Green Report: Catalog of Certified Products."

37. Harris and Casey-McCabe, p. 8.

38. EPA (April 1994a), p. 13.

39. Harris and Casey-McCabe, p. 8.

40. EPA (September 1993), p. 118.

41. Rebecca Ward, Scientific Certification Systems, personal communication, May 1996.

42. EPA (September 1993), pp. 145-146.

43. The studies cited in this paragraph are discussed in EPA (April 1994a).

44. Harris and Casey-McCabe, p. 11.

45. Ibid, p. 9.

46. EPA (April 1994a), pp. 27-28.

47. See 16 CFR Part 460 on insulation materials and 16 CFR Part 309 on alternative fuels and alternative fuel vehicles.

48. Harris and Casey-McCabe, p. 10.

49. "305 State Businesses Win Awards for Reducing Waste," CAL/EPA Report, Vol. 5, No. 1/2, January/February 1996. www.calepa.cahwnet.gov/epadocs/janfeb96.txt

50. TNRCC (March 1995), *A Report to the 74th Texas Legislature: Pollution Prevention and Waste Reduction in Texas*, p. 35.

51. Quinn (1996), p. 25.

52. Investor Responsibility Research Center, pp. 11, 61-62.

53. Illinois Department of Nuclear Safety, "Radon Program Strives to Increase Public Awareness," internet: www.state.il.us/idns/radon/prgdecsr/radonprg.htm.

54. "Lead in Paint: Controlling the Hazard," *Consumer Reports*, July 1995, p. 460.

10. VOLUNTARY PROGRAMS

This Section is devoted primarily to programs under which EPA asks companies to voluntarily participate in activities to protect the environment. Such programs have become increasingly popular in the 1990s: a recent EPA publication, *Partnerships in Preventing Pollution*, listed and described 28 such initiatives.[1] As the EPA stated in its June 15, 1995 report to the President on regulatory reform, "Over the past two years, EPA has shifted its emphasis from command-and-control to building partnerships with stakeholders to achieve environmental results in a cooperative manner."[2]

Although these voluntary programs may not be pure economic incentive instruments like pollution charges or deposit-refund mechanisms, they differ from command-and-control approaches. Instead of imposing requirements on businesses, these programs merely encourage them to participate.

One incentive for businesses to take part in these programs appears to be favorable public relations, which indirectly could result in less public pressure to regulate participants and increased market share at the expense of competitors perceived to be less environmentally friendly. Polls have shown that consumers are willing to pay a premium for products with environmental advantages.[3] 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 Section 9.

Another reason for participation in voluntary programs is that the sponsoring regulatory authority often provides technical assistance to participants. Such assistance could be regarded as a subsidy as discussed in Section 8. As noted below, some companies have saved money by implementing the activities associated with voluntary programs such as Green Lights and WasteWi$e.

Moreover, voluntary programs may limit potentially high litigation, monitoring, and enforcement costs incurred by regulators and businesses. Some of these programs offer participating companies the opportunity to identify and address environmental problems that could later subject them to regulatory sanctions. They also sometimes give companies flexibility to improve their environmental performance at less cost.

A Resources for the Future study of EPA's 33/50 program (discussed below) cited several reasons other than publicity benefits and added flexibility why firms might voluntarily overcomply with environmental regulations. In some industries, firms might improve their performance in the hope of leading government to make such performance mandatory, thereby creating barriers to the entry of potential competitors. It has also been suggested that firms overcomply 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.[4]

(RFF study abstract: www.rff.org/dpapers/abstract/9538.htm)

This Section discusses the following EPA-initiated voluntary programs: Green Lights and Energy Star, WasteWi$e, 33/50, XL, ELP, WAVE (Water Alliances for Voluntary Efficiency), Climate Wise, and methane recovery. (These programs are listed in table 10-1.) It concludes with a description of several state voluntary programs. Three other voluntary initiatives (supplemental environmental projects, joint implementation, and Brownfields activities) are excluded from this Section because they are discussed elsewhere in this report.

Table 10-1: EPA VOLUNTARY PROGRAMS

Program	Objective
Green Lights	Promote the use of energy-efficient lighting
Energy Star Buildings	Promote energy-efficiency in heating, cooling, and ventilation of buildings
Energy Star	Promote the use of energy-efficient office equipment and other devices
WasteWi$e	Reduce commercial solid waste
33/50	Reduce emissions of selected TRI chemicals
XL	Offer flexibility in meeting federal environmental standards
ELP	Offer flexibility in compliance management and verification systems
WAVE	Encourage businesses to reduce water use
Climate Wise	Reduce greenhouse gas emissions across all sectors
Methane recovery (4 programs)	Reduce methane emissions and promote reuse of methane as energy source

(enviroene site for voluntary programs: es.inel.gov/partners)

Businesses voluntarily carry out numerous environmental initiatives on their own, such as the Chemical Manufacturers Association's Responsible Care program and the Coalition for Environmentally Responsible Economies' (CERES) principles. While such purely private sector activities may promote environmental protection, they are beyond the scope of this report.

Some voluntary programs are directed primarily at individuals. For example, many municipalities encourage consumers to voluntarily recycle wastes such as beverage containers, newspaper, and used oil. These types of programs are not discussed here.

10.1. GREEN LIGHTS AND ENERGY STAR

One of the first of the EPA voluntary programs discussed in this Section, the Green Lights program was launched in January 1991. Green Lights participating companies agree to install energy-efficient lighting wherever profitable as long as lighting quality is not diminished. EPA provides technical assistance and public recognition for participation. The primary purpose of the program is to encourage the use of energy-efficient lighting to prevent air emissions (CO_2, SO_2, and NO_x) and other pollution associated with electricity generation.

The Washington Times installed at its headquarters 6,360 T8 lamps, 1151 compact fluorescents, 145 occupancy sensors, 409 halogen PAR lamps, and 153 LED exit signs, resulting in the following savings:

Electricity reduction:	1,085,328 kWh/year
Lighting electricity savings:	62.9%
Energy cost savings:	$72,810/year
Pollution prevented:	CO_2: 1,736,524 lbs/year
	SO_2: 8,899,686 grams/year
	NO_x: 2,821,851 grams/year

At its Fairfax, VA headquarters, Mobil Corporation installed a number of T8 lamps, electronic ballasts, halogen reflector lamps, compact quad-tube lamps, LED exit signs, and timed light switching devices, resulting in the following savings:

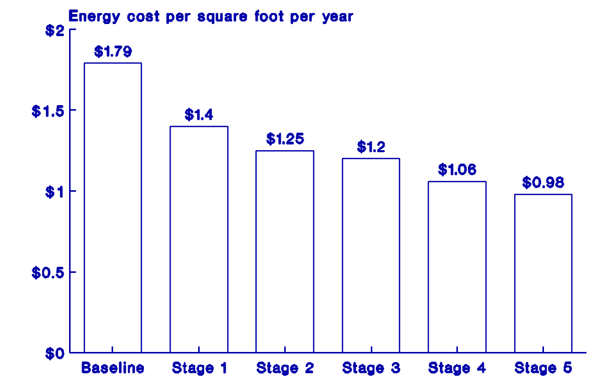
Electricity reduction:	2,036,794 kWh/year
Lighting savings:	47.19%
Energy cost savings:	$123,000/year
Pollution prevented:	CO_2: 3,258,869 lbs/year
	SO_2: 16,701,706 grams/year
	NO_x: 5,295,663 grams/year

2. Examples of Green Lights savings

As of 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), with 3.8 billion square feet committed to the program by December 1993 and 4.3 billion square feet by December 1994. 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. EPA predicted that the 3.8 billion square feet in the program in December 1993 would eventually result in the following annual reductions: 8.6 billion kWh of energy use, 1.8 million metric tons of carbon emissions, 49,590 metric tons of SO_2 emissions, 21,375 metric tons of NO_x emissions, and $600 million in electricity costs.[5]

The Green Lights program is the required first step in another voluntary energy savings program, Energy Star Buildings. Under Energy Star Buildings, EPA asks participants 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. The program began in June 1994 with a demonstration project based on 24 Energy Star Showcase Buildings, including both public and private facilities. As shown in Figure 10-1, EPA predicted that energy costs at Showcase Buildings could fall by nearly 50%.[6]

Figure 10-1: ENERGY SAVINGS IN SHOWCASE BUILDINGS



Source: EPA (November 1994), "Energy Star Buildings"

The Energy Star label is awarded to energy-efficient office products, including copiers, fax machines, computers, and printers. As of December 1994, more than 350 computer and monitor manufacturers had joined Energy Star and were producing eligible PC systems. In the first year of the program, 45% of PCs and 85% of printers sold in the U.S. met Energy Star guidelines. President Clinton has signed an Executive Order directing the U.S. government to limit computer purchases to Energy Star products.

EPA predicted that an office with 100 PCs and monitors, 20 printers, and 10 fax machines could save approximately $3,800 a year with Energy Star equipment.[7] Energy Star programs have also been created for transformers and selected household appliances.

10.2. WASTEWI$E

Created in 1994, WasteWi$e is a voluntary program intended to reduce businesses' solid waste. Participants 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.

EPA has offered several benefits to WasteWi$e participants. It provides technical assistance via a telephone hotline, electronic bulletin board, and other information services and allows participants to use the WasteWi$e logo in their advertising.

As of November 1995, 370 companies had joined WasteWi$e. In the first year of the program, participating companies conserved over 240,000 tons of solid waste, mostly transportation packaging. They also recycled about 1 million tons of waste and purchased twenty different kinds of recycled content products.

Some companies have managed to save a significant amount of money through the program. Target Stores saved $4.5 million in 1994 by switching to packaging for clothing requiring less time to unpack and prepare for display. Bank of America saved over $1 million by printing customer statements on both sides of a page.[8]

10.3. 33/50 PROGRAM[9]

The purpose of the 33/50 program is to reduce chemical emissions reported annually in the Toxic Releases Inventory. The specific goals are to reduce 1988 baseline amounts of 17 of the 320 TRI chemicals by 33% by 1992 and 50% by 1995.[10] These chemicals were selected for the program based on their toxicity, the high volumes in which they are released, and release prevention possibilities.

EPA first issued invitations to take part in 33/50 in February 1991, focusing initially on 555 primarily large companies with the highest releases of the 17 33/50 chemicals. As of March 1994, EPA had invited over 8,000 companies to join, and almost 1,200 had said they would participate.

The aforementioned RFF study found that the 33/50 program had a significant incentive effect. Although 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 allows the program to be effective in targeting the main sources of pollution.

RFF also found that participation rates were highest in "consumer contact" industries (proxied by advertising expenses) 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."

(RFF study abstract: www.rff.org/dpapers/abstract/9538.htm)

Figure 10-2: RELEASES AND TRANSFERS OF 33/50 PROGRAM CHEMICALS

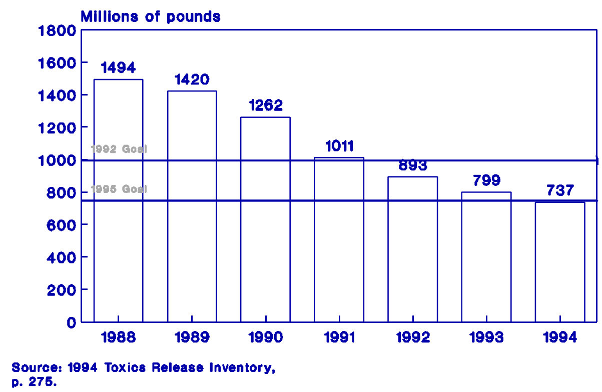


Figure 10-2 shows that as of 1994, the latest year for which data are available, 33/50 chemical transfers and releases had been reduced by 50.7% from their 1988 baseline level, surpassing the 50% goal set for 1995. Although some of these reductions may have been due to other factors such as publicity surrounding the TRI itself, reductions during the first full year of the 33/50 program (1992) of the 17 33/50 chemicals were four times greater than for non-program chemicals. During the period 1988-1994, non-program chemical releases and transfers fell by 38%, a significantly lower percentage than the 50.7% reduction achieved for 33/50 chemicals. However, this phenomenon could be due in part to the availability of more abatement options for 33/50 chemicals, one of the criteria for including them in the program.

10.4. PROJECT XL

Project XL (Excellence in Leadership) was created in part as a follow-up to the Amoco-EPA Yorktown refinery experiment which identified VOC abatement options that were more cost-effective than the wastewater VOC control measures being proposed by EPA. EPA formally launched XL with the announcement of eight Regulatory Reinvention Pilot Projects in November 1995. The project is designed to give companies, states, and communities flexibility in determining how to meet federal environmental standards. The pilot projects will "test a variety of regulatory management systems as alternatives to traditional command and control approaches to regulation."[11]

Selected projects had to meet the following criteria:
1. Improve environmental results;
2. Reduce costs and paperwork;
3. Enjoy stakeholder support and participation;
4. Develop an innovative strategy;
5. Have potential to serve as a model regulatory measure;
6. Be technically feasible;
7. Achieve measurable results;

8. Avoid shifting pollution to other areas.

The participants in the first eight projects are Intel, Anheuser-Busch, HADCO, Merck, AT&T Microelectronics, the Minnesota Pollution Control Agency, the South Coast Air Quality Management District, and 3M. Some of these projects entail different types of incentive mechanisms discussed elsewhere in this report. The SCAQMD project, for example, is a "flexible clean air partnership" under which businesses will have the flexibility to attain the goals of the Clean Air Act's employee trip reduction programs by implementing their own initiatives to reduce auto emissions. The Merck project will allow the company to operate its entire Elkton, VA facility under a single air emissions permit. Intel's "contract" with EPA and the state of Arizona requires it to exceed current environmental standards for air, land, and water pollution at its Chandler, Arizona facility in exchange for flexibility in meeting those goals.

EPA intends to implement 50 XL projects targeting specific facilities, entire industries, communities, and EPA-regulated government agencies. As of November 1995, EPA had received 20 to 25 applications, all of which either had been chosen or were being reviewed.[12]

10.5. ENVIRONMENTAL LEADERSHIP PROGRAM (ELP)

Like XL, ELP involves innovative approaches to environmental protection through flexible laws and regulations and seeks to use greater information to empower citizens and communities. However, ELP focuses on the role of compliance management systems in enforcement whereas XL focuses on regulatory management systems in regulation.

EPA launched the pilot phase of ELP in April 1995 by announcing the selection of 12 projects selected from a pool of 40 proposals. The projects, which involve ten companies and two federal facilities, center on compliance management systems, verification procedures, management accountability systems, and community access and participation in compliance. EPA has said that participants would receive public recognition for their efforts as well as a limited time period to correct minor violations discovered in their audits "so long as the violations are not criminal in nature and do not present an imminent and substantial endangerment to the public health or environment."[13]

One ELP participant, Gillette Co., is working with EPA and state authorities on environmental management system auditing and certification. The company's ELP project involves the following four steps: development of criteria for compliance audits, preparation of detailed instructions for conducting such audits, preparation of guidelines for third party verification, and use of the guidelines for audits of three company facilities.

Gillette officials have cited several reasons for participating in the program. Not only does it prepare them to comply with ISO 14000 environmental management certification standards, which are expected to become important in the years to come, it also gives the company the chance to avoid excessive EPA monitoring by monitoring itself.

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 to such information, but businesses maintain that much of the data contained in audits should be kept confidential. After the pilot projects are completed, EPA will seek to develop standards for participation in the final ELP program. EPA intends to have the final program in place by late 1997.[14]

10.6. WAVE

Another EPA initiative, WAVE (Water Alliances for Voluntary Efficiency) 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."[15]

WAVE participants include partners, supporters, and endorsers. The 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. The role of supporters is to publicize the benefits of water use efficiency and to 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."[16]

As of April 29, 1996, there were 30 WAVE partners, all of which were in the lodging sector. (Some of the partners had several hotels participating in the program.) The list of supporters consisted of 14 consulting firms, 10 equipment distributors, 13 manufacturing companies, 7 utilities, and 14 water management companies. The American Hotel & Motel Association, the American Water Works Association, Green Seal, and three other institutions were WAVE endorsers.

EPA has stated that WAVE's measures can result in significant decreases in energy, water and wastewater management costs. In 1995, the program resulted in estimated annual savings of 500 million gallons of water, 120 billion BTUs of energy, and nearly $3 million in water and energy costs. Table 10-2 shows examples of savings achieved by individual participants.

Table 10-2: WAVE INVESTMENTS AND SAVINGS

Hotel	Investments	Savings (millions of gallons per year, %)	Annual Cost Savings
Hyatt Regency Monterey (CA)	Water reclamation system for laundry area	4.563 (52% laundry)	$46,000
Sheraton Miramar, Santa Monica	New faucet aerators, shower heads, toilet dams	11 (28%)	$40,000
Outrigger East Hotel, Honolulu	Early closure devices, shower heads, faucet restrictors	7.9 (18%)	$60,000
Boston Park Plaza Hotel & Towers (Saunders Hotel Group), Boston	Faucet aerators, flush-meters	7.6 (14%)	$49,000
Westin St. Francis Hotel, San Francisco	Water reuse-system for laundry area	2.678 (48%)	$32,400

Source: EPA (September 1994)

An EPA official says that the main incentive for businesses to participate in WAVE is the cost savings that can be achieved, but that 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 cost more than originally expected, and marketing the program to hotels and motels has been complicated by reluctance of the lodging industry and by significant variations in hotel branch ownership and management structures.[17]

10.7. CLIMATE WISE

Designed to reduce greenhouse gas emissions across all sectors, this program 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 emissions abatement measures.

According to EPA, participating companies' Climate Wise activities will bring about annual savings of over $80 million by the year 2000 and emissions reductions of more than 5 million metric tons of carbon equivalent.[18] Participants include AT&T, DuPont, Martin Marietta, Weyerhaeuser, and Quad / Graphics.

The program is a partnership between EPA and the Department of Energy. It is working with the Small Business Administration to improve small businesses' energy efficiency investment financing possibilities and with state and local governments to improve technical support and outreach services.

10.8. METHANE RECOVERY PROGRAMS

EPA has launched at least four voluntary programs (Natural Gas Star, AgStar, Coalbed Methane Outreach, and Landfill Methane Outreach) to promote methane recovery. A greenhouse gas, methane can be recovered for energy use.

Initiated in March 1993, the Natural Gas Star Program is intended to reduce emissions of methane from natural gas transmission and distribution systems. Methane emissions can be decreased by up to 1/3 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. Over 25 natural gas transmission and distribution companies have signed on to the program, and the program was expanded in the summer of 1994 to gas producers. EPA intends to have Natural Gas Star partnerships in place with 70% of the gas transmission and distribution industry and 40% of the production industry by 1997.

Under the AgSTAR Program, which was launched in April 1994, EPA works with the Departments of Energy and Agriculture to encourage swine and dairy producers to recover methane from manure management. Participants commit themselves to surveying their facilities and installing AgSTAR selected technology wherever profitable and to appoint managers to oversee their participation in the program. In return, EPA provides technical assistance and information on potential financing sources for investments under the program.

The Coalbed Methane Outreach Program encourages coal mining companies to recover methane released during mining. The program disseminates information to address a number of obstacles to mine methane recovery and development, including lack of information on recovery technology, difficulties in obtain financing for recovery investments, lack of markets for recovered methane, and uncertainty concerning ownership of mine methane.

The Landfill Methane Outreach Program seeks to promote energy recovery from landfill gas. In April 1994, EPA estimated that over 700 U.S. landfills could install economically viable landfill gas recovery systems, but that only about 115 had recovery facilities in place. The program works with State Allies, who "agree to review and explore opportunities to overcome any unnecessary regulatory, administrative, and other barriers to widespread adoption of energy recovery at landfills," and with Utility Allies, who "agree to cooperate with EPA to develop win/win strategies that fulfill the goals and recognize the constraints of the Utility Ally while promoting the development landfill gas energy resources."[19] In addition to positive publicity, the program offers Utility Allies the possibility to receive Renewable Energy Reserve credits under the Acid Rain Program discussed in Section 6.

10.9. STATE PROGRAMS

Voluntary programs based on agreements between industry and environmental authorities have also been implemented on the state level. This subsection briefly describes two programs in Massachusetts and Texas before concluding with a discussion of adopt-a-highway schemes in place in several states.

10.9.1. Massachusetts Recycled Newsprint Program[20]

As described in Section VI, Wisconsin has imposed recycled content requirements on newspaper publishers and fees on those failing to meet the requirements. By contrast, Massachusetts has developed a voluntary newsprint recycling program. 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 recycled content targets were set: 13% by December 1993, 23% by December 1995, 31% by December 1997, and 40% by December 2000.

The publishers agreed to give preference to newsprint recycled within the state. They are exempt from the targets above 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 available to the publishers. It also agreed to oppose recycled content mandates or penalties for the use of virgin newsprint and to facilitate private investment in the publishing industry.

10.9.2. Texas Clean Industries 2000

Under this voluntary program, companies in Texas agree to reduce 1987 levels of hazardous wastes and/or toxic releases at their facilities by at least 50% by the year 2000. Participating companies must also implement an internal environmental review and management program to verify compliance with state and federal regulations, create a citizen communication program, and provide financial or in-kind support for at least one community environmental project.

Clean Industries 2000 membership applications must include projections of waste generation and toxic releases. These projections are later compared with the results of participants' mandatory annual reports to ensure compliance. Membership is renewed for companies that appear to be on schedule. Facilities can abandon their plans for a year in case of financial hardship.

By participating in Clean Industries 2000, companies can lower waste disposal costs and receive positive publicity. Another advantage of the program is that instead of dictating control technology standards, it gives industry the flexibility to meet the reduction targets in more cost-effective ways. A collection of pollution prevention case studies compiled by the Texas Natural Resource Conservation Commission (TNRCC), which oversees the program, shows that Clean Industries 2000 members have used a variety of techniques to reduce waste, including input changes, segregation of hazardous and non-hazardous wastes, and waste recovery and reuse.[21]

Clean Industries 2000 members have three options for meeting citizen communication program requirements: citizens' advisory committees, community or neighborhood meetings or open houses, and ombudsman programs. In ombudsman programs, companies designate a permanent ombudsman with direct access to senior management to respond to citizen questions and concerns. Over 75 facilities have implemented citizens' advisory committees, which appear to be the most popular option. 17 facilities chose ombudsman programs, and 16 chose open house meetings. Several facilities have implemented more than one type of program. In Freeport, for example, BASF holds monthly Industrial Community Awareness and Emergency Response meetings. It also has a Community Advisory Panel that meets once a month and educates the community on the chemical industry, emergency preparedness, environmental and safety concerns, and social commitments. Another element of the citizen communication program is guided tours of the facility.[22]

The community environmental projects required of Clean Industries 2000 members can be any of the following types: nature preserve / habitat restoration, environmental quality monitoring, environmental councils / committees, household hazardous waste, recycling, Earth Day activities, scholarships / donations, and cleanups. Union Carbide, for example, sponsored a paper / cardboard recycling program for the 15 schools of the Texas City / La Marque Independent School Districts. Initiated in 1993, the program included educational materials for teachers and students and recovered 11 tons of recyclable paper and cardboard during its first year.[23]

As of March 1995, the 132 Clean Industries 2000 members had made commitments to reduce their 1987 baseline levels of hazardous waste generation by 57% and toxic releases by 64% by the year 2000. These percentages correspond to reductions of 29 million tons of hazardous waste and 268 million pounds of toxic emissions.[24] In 1993, the first year of the program, member facilities reduced hazardous waste generation by 17% and toxic releases by 9.5%.[25] By March 1996, 147 industrial facilities had joined Clean Industries 2000.[26]

(March 1995 TNRCC press releases on Clean Industries 2000:
www.tnrcc.state.tx.us/pub/bbs1/press/clean.txt
www.tnrcc.state.tx.us/pub/bbs1/press/tri.txt)

10.9.3. Adopt-a-Highway[27]

In adopt-a-highway programs, volunteers agree to periodically clean up selected stretches of roadside. Although such programs vary from state to state, they typically involve agreements by organizations to clean up a stretch of roadside approximately two miles long, two to seven times a year, for one to three years. The state usually offers trash bags, safety vests and other gear. Perhaps most important for businesses that participate, the state also usually provides at least one sign to be placed on the adopted roadside indicating 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 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 generate positive publicity for businesses and other adopting organizations.

Although there is no federal adopt-a-highway activity, 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 programs. According to the same survey, 121,700 adopting groups composed of 1.3 million volunteers were participating in programs, and over 200,000 miles of roadside had been adopted.

In Virginia, for example, which has one of the largest programs in the country, families, churches, businesses, and other groups and individuals can adopt a highway. Adopting organizations agree to clean up a stretch of road that is generally two miles long, four times a year, for two years. The State Department of Transportation (VDOT) provides trash bags and bright orange vests and collects and disposes of bagged trash. Adopting organizations also have the right to recycle the trash. VDOT also provides signs with the name of the adopting organization at both ends of the adopted stretch of road. According to VDOT, "Adopt-a-Highway volunteers clean over 14,300 miles of state highways -- about 25% of the state's available roads -- and have provided the equivalent of more than $6.3 million in litter-control services to the state."[28]

Similar voluntary cleanup programs have been created in various parts of the United States. The 1994 survey identified 19 states with adopt-a-river, 11 with adopt-a-lake, and 15 with beach cleanup programs. Parks, schools, and trails have also been included in such programs.

Endnotes for Section 10

1. EPA (Spring 1996).

2. *DEN*, June 23, 1995, p. E9.

3. Arora and Cason (1995), p. 2. www.rff.org/dpapers/abstract/9538.htm

4. Arora and Cason (1995), pp. 3-4.

5. Membership data provided by Amanda Ferguson, EPA. Data on building space committed by December 1993 and associated savings and pollution reductions provided by EPA (August 1994a), *The Climate is Right for Action*, p. 4. Figure on building space committed by 1994 provided by EPA (June 1995), p. 14.

6. Data based on the Energy Star Buildings upgrade of a 7-story, 196,000 square foot office building in Washington, DC.

7. EPA (June 1995), p. 26.

8. *DEN*, November 1, 1995, p. A5.

9. The 1994 release and transfer data were provided by *1994 Toxics Release Inventory*. All other information on the 33/50 program was provided by Arora and Cason (1995).

10. The 33/50 chemicals are cadmium and compounds, chromium and compounds, lead and compounds, mercury and compounds, nickel and compounds, benzene, methyl ethyl ketone, methyl isobutyl ketone, toluene, xylenes, carbon tetrachloride, chloroform, dicholormethane (methylene chloride), tetrachloroethylene, trichloroethane, trichloroethylene, and cyanides.

11. *DEN*, November 27, 1995, p. AA2.

12. *DEN*, November 6, 1995, pp. AA1-2.

13. *DEN*, June 23, 1995, p. E10.

14. *DEN*, November 27, 1995, pp. AA1-3.

15. *DEN*, June 23, 1995, p. E11.

16. EPA (September 1994).

17. John Flowers, EPA, personal communication, 1996.

18. Ibid, p. E11.

19. EPA (April 1994b), p. 2.

21. TNRCC (March 1996), *Pollution Prevention Ideas from Texas Industries*.

22. TNRCC (March 1996), *Clean Industries 2000: Citizen Communication Programs*, p. 11.

23. TNRCC (March 1995), *Clean Industries 2000: Community Environmental Programs*, p. 138.

24. TNRCC (March 1995), *A Report to the 74th Texas Legislature*, p. 10.

25. TNRCC press releases, March 20 and March 27, 1995. www.tnrcc.state.tx.us/pub/bbs1/press/clean.txt and www.tnrcc.state.tx.us/pub/bbs1/press/tri.txt

26. TNRCC (March 25, 1996), "Clean Industries 2000 Fact Sheet."

27. Throughout this subsection, the 1994 survey cited is an "Adopt-a-Highway National Survey" conducted by the Oklahoma Department of Transportation.

28. Virginia Department of Transportation (April 1996).

11. FOREIGN EXPERIENCES WITH INCENTIVE SYSTEMS

Numerous economic incentives have been used in environmental management in foreign countries, including several mechanisms little known in the United States. Although a detailed description and assessment of each of these incentives is beyond the scope of this report, this Section does contain an overview of charges, deposit-refund systems, subsidies, product labeling schemes, and market-based permit systems used as environmental policy instruments in foreign countries to provide perspective on the U.S. experience. While this Section in general does not include incentive mechanisms that have been proposed but not implemented, it does describe a few proposals whose acceptance appears imminent. The incentives are described under the same general headings as in earlier sections.

Table 11-1 highlights a few noteworthy incentive mechanisms used in foreign countries. This report does not endorse any of these mechanisms. They are included in the table because they appear to either differ significantly from incentives used in the United States or have significant impacts on behavior. More information on these and other incentives used outside the United States can be found in the rest of this Section.

Table 11-1: NOTEWORTHY INCENTIVE MECHANISMS OUTSIDE THE UNITED STATES

Mechanism	Where applied	Observations
Environmental labeling	Virtually all industrialized and numerous less industrialized countries	Govt. programs to promote environmentally friendly products. Credited with decreasing VOC and other emissions in Germany and increasing recycled paper use in Korea.
Noise pollution charges	Belgium, France, Germany, Japan, the Netherlands, Norway, and Switzerland	Not used in U.S.
Effluent charges	Several countries	Evidence of incentive effects in Germany, the Netherlands, and Malaysia.
Water extraction charges	Several countries	Incentive effects noted in several Asian countries and projected in the Netherlands.

Mechanism	Where applied	Observations
Carbon/energy taxes	Denmark, Finland, the Netherlands, Norway, and Sweden	Not used in the U.S. Incentive effects noted in Sweden and Finland and projected effects in the Netherlands.
Deposit systems	Numerous countries, including Austria, Greece, Korea, Norway, and Sweden	Differ from U.S.: Korea requires deposits from producers, links refunds to proper post-consumer disposal, includes motor oil, other products. Austria includes light bulbs. Greece, Norway, and Sweden include car hulks, note incentive effects.
Fertilizer and pesticide charges	Austria, Belgium, Scandinavian countries	Higher than fees in U.S. states. Incentive effects noted in Austria and Sweden
Other product charges	Various countries (e.g., Belgium's disposables tax, Italy's plastic bag tax, Korea's taxes on various products, Germany's industry-imposed packaging fees.)	More products than in U.S. incentive effects noted or projected for some of these charges.
Livestock and manure charges	Belgium and the Netherlands	Little if any use in the U.S.
Motor vehicle quota system	Singapore	Not used in U.S. incentive effects noted.
Congestion pricing	France, Norway, and Singapore	Use just beginning in U.S. Incentive effects noted in all three countries.
Motor fuel taxation	Various countries	Higher than U.S. taxes. Unleaded tax preference differs from U.S. credit approach. Sweden taxes diesel according to emissions. Incentive effects noted in differential taxation.

Mechanism	Where applied	Observations
NO_x emissions charges	France and Sweden	Little used in the U.S. (except California). Incentive effects noted in Sweden.
SO_2 emissions charges	France, Japan, other countries	Differs from U.S. approach of tradable allowances under acid rain program.

11.1. FEES, CHARGES, AND TAXES

The different types of fees, charges, and taxes were described in Section 4. As in that Section, the terms "fee," "charge," and "tax" are used interchangeably throughout this Section.

As in the United States, many of the environmental charges found in foreign countries exist in addition to command-and-control pollution regulations and are used to raise revenue as well as encourage environmentally friendly behavior. The revenue-raising effect is often stronger than the incentive effect.

11.1.1. Waste

A 1994 OECD study of economic instruments reports that municipal waste user charges are levied in 18 of the 21 industrialized countries (all but New Zealand, Portugal, and the United Kingdom) that it surveyed.[1] The charges are usually (but not always) flat rates for households and unit rates for commercial generators. Unit rates are more likely to have an incentive effect than flat rates that are independent of quantities of waste generated. The charges usually fund waste collection and/or disposal.

Denmark, for example, levies taxes of 195 DK ($34) per metric ton on waste delivered to landfills and 160 DK ($28) per metric ton on waste delivered to incineration facilities. These taxes raised 527.6 million DK ($92.6 million) in 1993.[2] Since the tax was introduced in 1987, the quantity of waste registered at disposal facilities has dropped and the reuse of building waste as filling material for road construction and other purposes has increased. There has also been a slight increase in illegal waste disposal. However, it is unclear to what extent these phenomena can be attributed to the waste tax.[3]

In the Netherlands, a tax on landfill disposal of waste came into effect January 1, 1995 as part of a broader environmental tax law. The tax was set at 29.2 Dfl ($17.8) per metric ton and is expected to generate annual revenues of approximately 275 million Dfl ($167 million). The main purpose of the tax is to raise revenue for the national budget, but a secondary purpose is to discourage waste generation. To promote incineration as a disposal method, incineration is exempt from the tax. The size of the tax relative to the average waste treatment costs of 82 Dfl ($50) per metric ton suggests that the tax could have significant incentive impact.[4]

In the United Kingdom, a landfill tax is scheduled to come into effect on October 1, 1996. The tax rate will be 2 £ ($3) per metric ton for inactive waste such as bricks and 7 £ ($10.7) per metric ton for other waste. Landfill operators will pay the tax but will be able to increase their fees. The British Customs and Excise office said that the tax is "designed to use market forces to protect the environment by making the disposal of waste in landfill sites more expensive." Businesses' national insurance contributions will be cut to compensate for the effect of the tax on business.[5]

Outside the OECD, South Korea introduced a system in 1995 under which household waste can be disposed of only in standardized bags sold in officially designated places. As shown in table 11-2, bag prices in the metropolitan areas of the capital city of Seoul range from 60-80 won ($0.08-0.1) for five-liter bags to 1,090-1,450 won ($1.41-$1.88) for 100-liter bags. Prices are determined by local governments and vary slightly from area to area. The amount of waste sent to landfills was approximately 40% lower during the six months after implementation of the system. Unfortunately, a large quantity of the decrease was attributable not to recycling but rather to uncontrolled incineration or private disposal. (Perhaps six months is too short a period for viable recycling options to be created.) Other problems are that the plastic bags themselves are not biodegradable and thus pose disposal problems and that the bag fees are too low to cover waste disposal costs.[6]

In 1994, Turkey introduced an Environmental Cleanup Tax on waste to raise revenue and to discourage waste generation. The monthly rate was set at 25,000 TL ($0.37) to 100,000 TL ($1.47) for households and 25,000 TL ($0.37) to 5,000,000 TL ($295) for other generators. The Cleanup Tax was also imposed on waste water.[7]

Australia, Austria, Belgium, Finland, France, and several German states impose charges on hazardous waste disposal. Austria's tax of 200 S ($19) per metric ton is used to fund the cleanup of contaminated land.[8] France has imposed a tax on the disposal of "special industrial wastes," a category including asbestos, chrome, lead, solvents, and other specified substances. The tax is rising progressively from 20 F ($4) per metric ton in 1994 to 40 F ($8) per metric ton in 1998.[9] It is unclear whether these charges have a significant incentive effect.

The Netherlands and the Flanders region of Belgium impose charges on animal manure disposal to limit soil pollution. In the Netherlands, individuals are permitted to dump the manure equivalent of 125 kg of phosphate per hectare per year free of charge. Quantities between 125 and 200 kg are subject to a charge of 0.25 Dfl ($0.15) for every kg over 125 kg, and quantities over 200 kg to a charge of 0.5 Dfl ($0.3) per kg.[10]

Table 11-2: WASTE DISPOSAL BAG PRICES IN SEOUL METROPOLITAN AREA
(as of January 12, 1995)

Bag size	Price (in won)	Price (in $US)
For households		
5 liters	60-80	0.08-0.10
10 liters	110-150	0.14-0.19
20 liters	210-280	0.27-0.36
50 liters	510-720	0.66-0.93
For businesses		
20 liters	230-290	0.30-0.38
50 liters	550-730	0.71-0.95
75 liters	820-1,090	1.06-1.41
100 liters	1,090-1,450	1.41-1.88

Source: Rhee (1995), "Waste-Collection Fee and Sustainable Consumption."

Waste charges have also been levied in a number of less industrialized countries, including the Czech Republic, China, Estonia, Hungary, Poland, Russia, and the Slovak Republic. Municipal waste charges for households and businesses in the Czech Republic, which have been in place since before World War II, were significantly increased in 1992. Municipalities determine prices: In Prague, for example, the rate was 14.53 ECU ($18.2) per metric ton in 1993, and other municipalities charge fees within 60% of Prague's rate. One problem with the increased charges is that they appear to have led to an increase in illegal dumping.[11]

Since 1992, the Czech Republic has also levied two types of charges on landfill operators. The first charge, imposed on all landfill operators, generates revenue for the municipality where the landfill is located to finance environmental protection activities. The second charge is imposed only on those landfills that do not adhere to specified waste disposal standards. One report indicates that the charge "very positively motivated the establishment of new dumps in accordance with the strict required criteria concerning the safe storing of waste." As shown in table #, the amounts of both charges vary significantly according to the type of waste, the highest being 5,000 Kc ($184) per metric ton for dangerous waste. The Slovak Republic has similar charges.[12]

Table 11-3: CHARGES ON LANDFILL OPERATORS IN THE CZECH REPUBLIC
(in Kc per metric ton in 1994, $=27.196 kc)

Waste category	Charge I	Charge II
Earth and organic matter	0	6
Other waste	10	140
Municipal waste	20	210
Special waste (not in categories 3 or 5)	40	640
Dangerous waste	250	5,000

Source: Regional Environmental Center for Central and Eastern Europe (1995), p. 11.

In much of Eastern Europe and the former Soviet Union, charges on waste as well as air and water pollution are higher for quantities in excess of permitted levels or for improperly handled quantities. These higher incremental rates for levels in excess of standards could be looked upon as non-compliance fees.[13]

11.1.2. Air

Canada, France, Japan, Norway, Portugal, Sweden, and several less industrialized countries have imposed emission charges on various air pollutants. France, for example, introduced a charge on emissions of hydrochloric acid, sulfur-containing compounds, nitrogen oxide-containing compounds, non-methane hydrocarbons, solvents, and other volatile organic compounds. The tax rates and base were expanded in 1990. The fee, 150 F ($30) per metric ton, has been imposed on combustion facilities with a maximum thermal power of at least 20 MW, waste incineration facilities with a capacity of three metric tons per hour, and facilities emitting more than 150 metric tons per year of taxable pollutants. Approximately 1,400 facilities have been subject to the tax, which generated revenues of 197 million F ($39 million) in 1993 and 169 million F ($33.5 million) in 1994. These charges are intended primarily to raise revenues to fund pollution abatement expenses at the charged facilities.

Japan has levied sulfur emissions charges to generate revenues to compensate victims of pollution-related diseases. (Since SO_2 was believed to be the main cause of such disease, it was chosen for the tax.) Both stationary and mobile sources are charged, the latter in the form of differential taxation dependent on vehicle weight. Since mobile sources are thought to generate about 20% of NO_x and SO_2 emissions, the tax ratio between stationary and mobile sources is 4:1. For stationary sources, tax rates vary from \$0.625 to \$56.25 per Nm^3, depending on whether the source is located in a designated area. Since many diseases date back to the 1980s, there is also a levy of \$0.82 per Nm^3

based on SO_2 emissions between 1982 and 1986. Ambient SO_2 concentration levels have fallen significantly in Japan, but it is unclear to what extent this decrease is due to the tax.

Korea introduced air emissions charges in 1991. Facilities are charged based on the type and amount of fuel they use and on the region in which they are located. Revenues are deposited into an Environmental Pollution Control Fund (EPCF) to finance the development and installation of environmental technology.

11.1.2.1. Sweden's Nitrogen Oxide Charge

Sweden's nitrogen oxide emission charge of 40 SEK ($5.9) per kg ($5,400 per short ton) imposed in 1992 on energy producers with a capacity in excess of 10 MW and production of over 50 GwH is intended to have a significant incentive effect. Some 120 heating plants and industrial facilities, with about 180 boilers, are subject to the tax.

One interesting aspect of this tax is that revenues are rebated to taxpayers based on their energy generation. At the beginning of every year, facilities report their NO_x emissions and energy production for the previous year to the Swedish Environmental Protection Agency (SEPA). On the basis of these reports, SEPA calculates total revenues and refunds per generated MwH. Those facilities facing a net charge must pay by October, and those entitled to rebates receive them in December. The charge system in effect transfers income from high-emitting to low-emitting plants. In 1992, for example, approximately 15,300 metric tons on NO_x emissions were subject to the charge, generating about 610 million SEK ($90 million). As a result of the revenue and rebate calculations, over 100 million SEK ($15 million) was transferred from high-emitting to low-emitting facilities.

Most facilities subject to the taxes have installed measuring equipment so that the tax can be properly assessed. The annual cost of such equipment is estimated at 300,000 SEK ($44,000). For facilities that either have no measuring equipment or whose equipment is temporarily out of order, a standard of approximately 1.5 times the average emission level applies. This standard rate, 600 mg NO_x/MJ for gas turbines and 250 mg NO_x/MJ for other installations, gives polluters a strong incentive to install measuring equipment. Measuring equipment must be inspected once a year by an accredited laboratory. Measuring and reporting are monitored by SEPA.

Since other factors, including the planned introduction of tighter emissions standards in 1995, can influence NO_x emissions in Sweden, it is difficult to determine the effect of the NO_x charge. However, emission reductions appear to have been greater than they would have been without the charge. Incentive effects were evident as early as 1990 when many plants took measures to reduce emissions in anticipation of the charge. In 1992, the first year in which the charge was in effect, emissions from taxed plants were 15,300 metric tons, down 36% from their 1990 level of 24,000 metric tons. This decrease was not due to a decrease in energy consumption: emissions per mega-joule fell from 150 mg NO_x/MJ in

1990 to 99 mg NO_x/MJ in 1992. Some plants have even linked staff compensation with emissions reductions.

The charge was set at 40 SEK ($5.9) per kg because studies by the Swedish Environmental Protection Agency (SEPA) had indicated that control costs varied from 20 to 80 SEK ($2.9-11.8) per kg. SEPA has stated that the value of NO_x emission reductions is at least as high as the amount of the charge. The taxed plants were able to reduce emissions at an average cost per kg of approximately 10 SEK ($1.5) in 1992. Costs have ranged from 5 to 20 SEK ($0.7-2.9) per kg. Since these costs are significantly lower than the 40 SEK per kg charge, rational facilities will probably implement more abatement options in future years. Abatement measures used since the introduction of the charge include not only investments in new equipment but also measures to limit emissions by optimizing combustion.

Table 11-4 shows SEPA's estimates of the net benefit of the NO_x charge for the 1992 emissions reductions. It is not clear how the benefit of at least 40 SEK per kg ($5,400 per short ton) was estimated. Annual administrative costs of the charge are approximately 2 million SEK ($290,000) for SEPA and 300,000 SEK ($44,000) for each firm using measurement equipment. (SEPA appears not to have included its 2 million SEK administrative cost in its cost-benefit table, but this exclusion does not have a significant effect on the conclusions of its analysis.) Assuming 2 million SEK in administrative costs for SEPA and 18 million SEK ($2.6 million) in measurement costs for those taxed facilities that have installed measuring equipment, the annual monitoring and administrative costs amount to 20 million SEK ($3 million), or roughly 3% of charge revenue.

Table 11-4: SEPA ESTIMATES OF THE NET BENEFIT OF THE NO_x CHARGE
(for 1992 reductions of 9,000 metric tons)

Type of benefit or cost	SEK per kg reduced	Total (in SEK)
Environmental benefit	> 40	> 360 million
Abatement cost	- 10	- 90 million
Measurement cost	- 2	- 18 million
Net societal benefit	> 28	> 250 million

Source: Swedish Ministry of the Environment and Natural Resources (1995), p. 47.

One limitation of the charge is that it reportedly covers only about 6.5% of total NO_x emissions, partly due to some energy producers' tendency to supply just under 50 GwH to avoid the tax. (Because of the 50 GwH threshold, the marginal taxation of quantities of energy just over 50 GwH is high.) The threshold will be lowered gradually to 25 GwH by January 1, 1997. Another potential problem is that the charge on NO_x may cause some plants to increase emissions of other substances, but other control standards are in place to limit such emissions.[14]

11.1.2.2. Charges in Less Industrialized Countries

Several Eastern European and Central Asian countries have more air emission charges than industrialized countries. In many of these countries, higher units fees are charged for emissions in excess of permitted levels. In some countries, there are no fees for emissions within permitted levels. Charges assessed only on emissions in excess of permitted levels could be regarded as non-compliance fees.

In the Czech Republic, thermal units with an energy capacity of 0.2 MW or greater are scheduled to be subject to the charges shown in Table 11-5. (Class I includes asbestos, cadmium, mercury, and benzene; class II includes arsenic, chlorine, phenol, and tin; and class III includes ammonia, acetone, and toluene.) These rates are being gradually phased in from 30% of their full level in 1992-1993 to 100% in 1997. Facilities that exceed emissions standards are subject to higher unit rates. The polluters are responsible for monitoring, but random inspections are conducted by a state control body. Revenues go to the state environment fund to control air pollution. The incentive effects are unclear. The administrative costs of the charges have been estimated at 1% of revenues collected.

A separate charge system exists for thermal sources of less than 0.2 MW. These charges range from zero for coke, gas, and fire wood to as high as $365 for 100-200 Kw facilities using slurry. Implementation of these charges is optional and left to the discretion of municipalities. Revenues are used for municipal environmental activities.

Russia also levies air emissions charges for approximately 300 substances. Polluters' charges depend on the type and quantity of emissions and the socioeconomic and environmental situation in the areas where they are located. Regional authorities grant exemptions to some firms based on their pollution control investments.[15]

Charge revenues in most countries in Eastern Europe and the former Soviet Union go to environmental funds. In many of these countries, however, the incentive and revenue-raising effects of these charges have been diminished by lack of enforcement and/or erosion of real charge rates by inflation. One study points out that the charges in Russia are much more vulnerable to inflation than the value-added and profit taxes because they do not rise automatically with increases in the general price level.[16] Since non-compliance fines are significantly higher (ten times higher for Poland's SO_2 and NO_x charges), they are more likely to have incentive impact, but even these are sometimes too low to influence polluters.

In February 1996, China announced the introduction of a charge on SO_2 emissions by industry. Officials stated that a charge of 2¢/kilogram implemented on a trial basis in southern China resulted in a 30% decline in SO_2 emissions.[17]

Table 11-5: AIR POLLUTION CHARGES IN EASTERN EUROPE[18]

Country	Charge base and rate	Revenues
Czech Republic (larger industrial sources)	Roughly 80 pollutants included. Rates per metric ton: PM $109, SO_2 $37, NO_x $29, CO $22, hydrocarbons $73, Class I pollutants $730, Class II pollutants $365, Class III pollutants $37	1992: $27 million 1993: $29 million
Czech Republic (smaller sources, <0.2 MW)	Vary according to heat source and output. Maximum annual rate $365	Unknown (implementation optional for municipalities)
Slovak Republic	Similar to Czech charges for smaller and larger sources.	Larger source: $3.1 million in 1992 and $7.9 million in 1993. Smaller source revenue unknown.
Poland	SO_2 and NO_x: $66 / metric ton CO_2: $0.05 / metric ton Over 50 other pollutants charged up to $44,132 / metric ton.	1992: SO_2:$89.2 million NO_x:$28.6 million 1993: SO_2:$149 million NO_x:$28.6 million Revenue for other charges unknown.
Bulgaria, Czech Republic, Hungary, Poland, Romania, Slovakia	Charges for emissions in excess of permitted amounts. Amounts vary.	Revenues vary.

Source: Regional Environmental Center for Central and Eastern Europe (1995), p. 10.

11.1.3. Water

As noted in Section IV, economic incentives in water policy include user fees for groundwater, surface water, or for drinking water supplied by waterworks and fees for direct or indirect effluent discharges. For many water consumers discharging into sewage, effluent charges are included in water user fees.

11.1.3.1. User fees

A number of countries levy water service fees. Eighteen of 21 industrialized countries surveyed by OECD (all but Austria, Iceland, and Japan) reported user fees for water, sewerage and sewage treatment. Rates in most OECD countries are higher than those in the United States.[19] In the case of industrial users, water fees are usually based on quantities of water consumed. Water charges for residential consumers are set at flat rates in some areas and based on amounts consumed in others. To the extent that municipal water charges include sewage service, they are also indirect effluent charges.

Consumption-based rates are more likely to influence water use than flat rates, but relatively large price increases might be needed to induce changes in consumer behavior. A number of studies have found water consumption to be negatively related to unit-based prices. In 1982, for example, the Hunter and District Water Board in Australia replaced its fixed-rate pricing system with a pay-for-use system. Water consumption subsequently declined by 20-30%, a decline that allowed the deferral of water supply construction projects.[20] Briassoulis (1994) found that increases in water prices in Athens in 1990 led to significant decreases in water use. Although some of the decreases have been attributed to public education campaigns, the price increases have also been credited with significant incentive effect. Hansen (1996) found price elasticity of water demand in Denmark to be -0.1 or smaller. In the Czech and Slovak Republics, increases in water charges since 1991 have led to significant falls in water consumption.[21] In Bogor, Indonesia, water rates were increased by 200-300% in 1988 and a conservation campaign was implemented in 1989. Domestic and commercial water use fell by 30% within nine months.[22] This implies a price elasticity of demand of -0.10 to -0.15.

Charges on surface and groundwater use differ from the water supply charges described above in that they can be regarded as taxes on the use of a natural resource rather than payments for services provided. Charges on surface and groundwater use have been imposed in several countries. On January 1, 1995, for example, the Netherlands introduced a ground water tax of 0.34 Dfl ($0.21) per cubic meter for drinking water companies and 0.17 Dfl ($0.10) per cubic meter for other companies. For surface water infiltrated and extracted as ground water, rebates are offered so that the net tax is 0.055 Dfl ($0.033) per cubic meter. Although the primary objective of the tax is to raise revenue, the Netherlands Ministry of Housing, Spatial Planning, and the Environment predicts, on the basis of current water prices and estimated elasticities of demand of -0.05 to -0.30, that water use will decline by 1.3% to 12.6% for drinking water consumers and by 5.7% to 51% for industrial and agricultural consumers who extract their own groundwater. The tax of 0.34 Dfl is equal to about 35% of current water prices for drinking water, and the tax of 0.17 Dfl is over twice as high as current prices for self-extraction. To promote recycling, groundwater used to rinse reusable packaging such as beverage containers is exempt from the tax.[23] An official with the Netherlands Waterworks Association opposed to the tax said that the higher rates for tap water and tax exemptions for the first 100,000 cubic meters of self-extracted water would lead farmers to dig more wells, thereby increasing their use of groundwater.[24]

Most Eastern European countries charge fees for groundwater and surface water use, but the fees tend to be too small and to include too many exemptions to have significant incentive effect. Agricultural water use has been subjected to fees in many countries, but it has been asserted that these fees are generally too low to promote efficient water use. In Central Asia, extensive agricultural diversion of water has resulted in a significant decrease in water levels in the Aral Sea and severe salinization problems. Several countries in the region recently introduced charges on surface water use. Kazakhstan charges farmers about 0.2¢ per m^3, and Uzbekistan charges some (but not all) farmers about 0.1¢ per m^3. Elsewhere in Asia, the introduction of groundwater extraction fees in Jakarta, Bangkok, and Cebu (Philippines) reduced groundwater depletion.[25]

11.1.3.2. Effluent Charges

As noted above, indirect charges into sewage are imposed in a number of countries, often as part of water supply bills. Less common are charges on direct discharges of effluent into surface or ground water. Australia, Belgium, parts of Canada, China, France, Germany, the Netherlands, Poland, Portugal, and Spain are among the many countries in which direct effluent charges have been levied. In most countries, charges on indirect discharges differ from those on direct discharges. One notable exception is the Netherlands, whose effluent charges are explained below.

Schoot Uiterkamp, J.F.J, Leek, and de Savornin Lohman (1995) studied indirect and direct effluent charges in 12 European Union countries.[26] Some of the findings of their survey are summarized in Table 11-6 and Figure 11-1.

Table 11-6 summarizes the characteristics of effluent charges imposed on industry in the European Union. Not included in this table are indirect effluent charges in effect in Germany and Spain but on which little data are available. The six countries with direct effluent charges on industry (Belgium, France, Germany, the Netherlands, Spain, and United Kingdom) have imposed similar charges on municipal treatment plants.

Table 11-6: INDUSTRIAL EFFLUENT CHARGES IN THE EUROPEAN UNION

Country or region	Pollution parameters	Pollution assess-ment	Direct or indi-rect	Polluters covered
Belgium: Flanders	SS, ORG, MET, P, N	COEF, (MES)	BOTH	>500m^3 cons./year or pump rate >5 m^3/day
Belgium: Wallonia	SS, ORG, MET, P, N, TEMP	COEF, (MES)	BOTH	>7 employees
Denmark	ORG, P, N	PERM	INDIR	High amount of SS, P, N
France	SS, ORG, MET, P, N, TOX, AOX, SOL	COEF, (MES)	BOTH	Discharges > 200 i.e.
Germany	ORG, MET, P, N, TOX, AOX	PERM, (MES)	DIR	Licensed polluters
Greece	NA	NA	INDIR	NA
Ireland	SS, ORG	PERM	INDIR	Licensed polluters
Italy	SS, ORG	PERM	INDIR	Licensed polluters
Luxem-bourg	None	CONS	INDIR	NA
Nether-lands (I)	ORG, MET, N	MES	BOTH	> 1000 p.u.
Nether-lands (II)	ORG, MET, N	COEF, (MES)	BOTH	5-1000 p.u.
Portugal	SS, ORG	NA	INDIR	NA
Spain	BAND	PERM	DIR	Licensed polluters
UK (I)	BAND	PERM	DIR	Consented discharges
UK (II)	SS, ORG	PERM	INDIR	Consented discharges

Pollution parameter symbols:

SS	suspended solids	TOX	toxicity indicator
ORG	organics (BOD and/or COD)	AOX	halogenated hydrocarbons
MET	heavy metals	SOL	soluble salts
P	phosphorus	TEMP	temperature
N	nitrogen	BAND	discharge classed into bands to which value is attached

Pollution assessment symbols:

MES based on actual measurement
COEF based on sector-specific coefficients
CONS based on water consumption
(MES) actual measurement as basis is optional
PERM based on values specified in permit

Source: Schoot Uiterkamp, Leek, and de Savornin Lohman (1995), Part 1, p. 33.

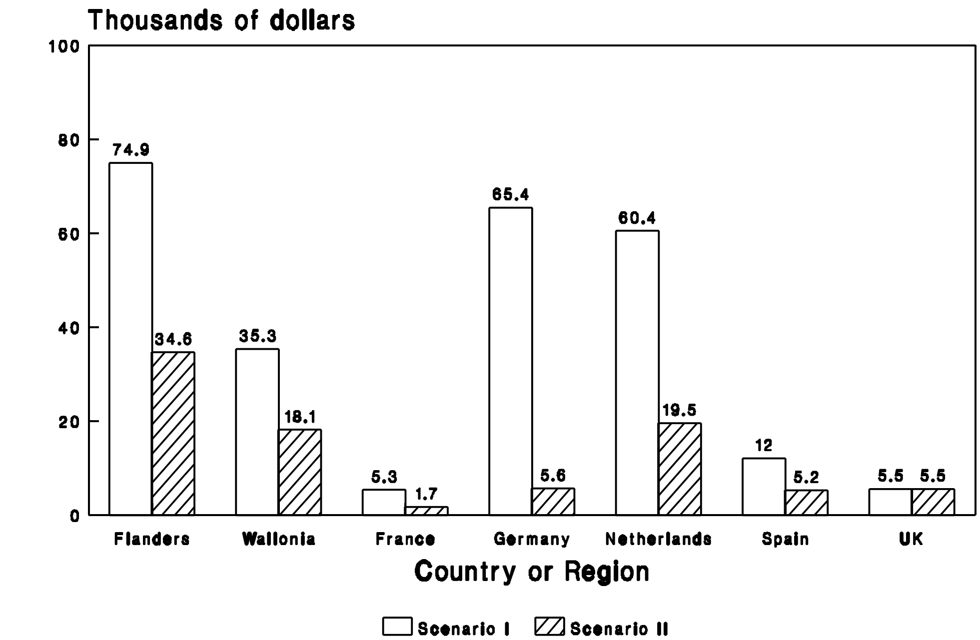
Because of differences in pollution parameters, assessment methods, and polluters covered, effluent charge levels are difficult to compare across countries. Figure 11-1 shows comparisons by Schoot Uiterkamp et al. of charge levels for two discharge scenarios for a chemical industry in the countries for which sufficient charge rate data are available. In scenario I, the industry subjects its waste water to only basic treatment, whereas in scenario II, it applies more advanced treatment techniques. In both scenarios, daily flow is 500 m^3. Table 11-7 shows the discharge levels for the two scenarios.

Table 11-7: DISCHARGE SCENARIOS FOR FIGURE 11-1
(mg/liter)

Parameter	I	II	Parameter	I	II
COD	400	100	AOX	1	0.1
BOD	100	20	Zinc	2	1
SS	40	20	Nickel	1	0.5
total N	20	10	Copper	1	0.5
reduced N	10	5	Lead	1	0.5
total P	1	0.5	Chromium	0.1	0.01

As shown in Figure 11-1, the absolute difference in charge levels between the two scenarios is largest in Belgium, Germany, and the Netherlands. The incentive effect appears to be strongest in these three countries. However, another set of scenarios considering the impact of differences in flow amounts on charge payments could yield different results. In the case of the United Kingdom, for example, a polluter could halve its payments by reducing its daily flow amount from 500 m^3 to under 100 m^3. Three illustrative charge systems are discussed in greater detail here. .

Figure 11-1: ANNUAL CHARGE PAYMENTS FOR HYPOTHETICAL INDUSTRIAL DISCHARGE

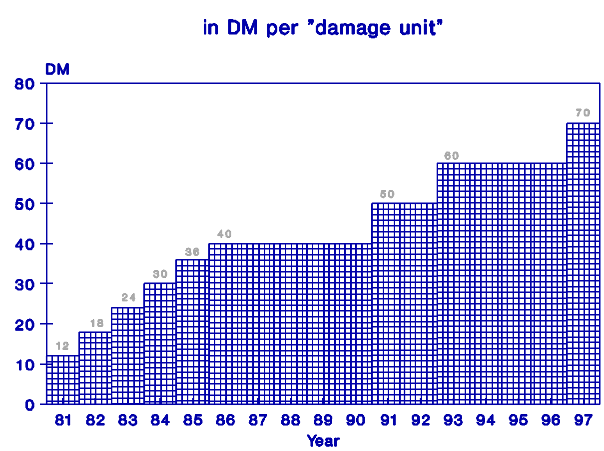


Source: Schoot Uiterkamp et al. (1995), Part 1, p. 51.

11.1.3.3. Effluent Charges in Germany

Based on the 1976 Federal Effluent Charge Law, effluent charges have been collected by German states (Länder) since 1981. Although collection is left to the states, the charge calculation rules, charge amounts, and damage unit parameters are determined at the federal level. German states do not have the autonomy to set effluent charges that U.S. states have in setting the NPDES permit fees discussed in Section 4.

Figure 11-2: POINT SOURCE EFFLUENT CHARGES IN GERMANY



Effluent charges for point sources are based on "damage units" dependent on quantities and types of pollutants. One damage unit is defined as 50 kg organic matter (COD), 3 kg phosphorus, 25 kg inorganic nitrogen, 2 kg halogenated hydrocarbons (AOX), 20 g mercury (and compounds), 100 g cadmium (and compounds), 500 g chromium, nickel or lead (and compounds), 1 kg copper (and compounds), or 3,000 m^3 of wastewater divided by T(f), where T(f) is the dilution factor by which the waste water must be diluted in order to lose its acute toxic effect on fish. Separate assessment methods are used for stormwater and for discharges from inhabitants not connected to the sewage system. As shown in Figure 11-2, the charge amounts per damage unit have increased from 12 DM at the introduction of the charge to a current level of 60 DM and are scheduled to reach 70 DM in 1997.[27]

Charge assessment is based on discharges allowed in state-issued permits. Dischargers without permits or with permits lacking discharge limits pay charges based on their declared discharges. If permitted discharge limits are surpassed, charges are raised accordingly. Most monitoring is left to polluters with random spot checks by the authorities. However, if a polluter declares in advance that its discharge levels will be at least 20% below levels allowed in its permit over a period of at least three months, the charge is assessed on the basis of the projected reduced discharge level.

The charge amounts in Figure 11-2 can be reduced in several ways. If a discharger uses Best Available Technology for hazardous pollutants and Generally Agreed Technology Standards for non-hazardous pollutants, its charge per damage unit is reduced by 75%.

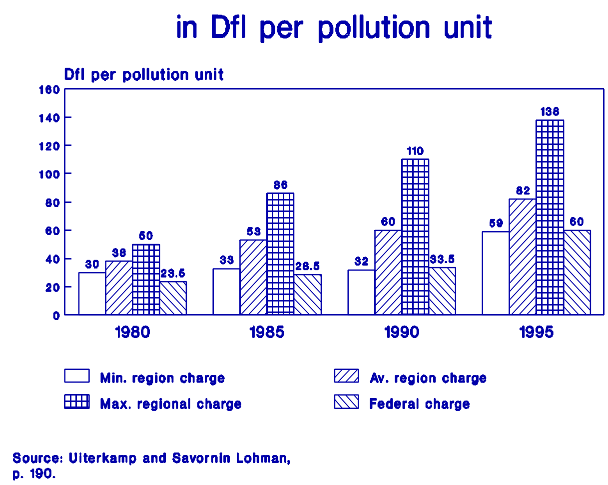
In addition, investments in treatment facilities are rewarded by reduced charges for a period of three years prior to completion of the new facility, provided that the facility will reduce pollution by at least 20%. The reduced charges are based on the discharge levels anticipated after completion of the facility. If the facility is not completed and operated as planned, the polluter must pay back the charge reductions. Municipal authorities expanding or constructing sewage treatment facilities are eligible for a 3-year charge exemption provided that the new plant will meet public sewage treatment standards.

Effluent charge revenues fell from 426 million DM in 1988 to 350 million DM in 1992, despite a 25% rise in the charge rate during this period. The Federal Ministry of the Environment estimates that about 60% of the revenues are paid by communities and 40% by industry. According to Smith (1995), administrative expenses associated with the charge system consume roughly 15% of charge revenues.[28] Together with indirect discharge fees, the remaining wastewater charge revenues cover all the costs of operating treatment facilities, but only about half the costs of constructing them. The other half comes from Government funds. However, the contribution of effluent charge revenues to treatment facilities is small compared to that of indirect discharge (sewerage) fees, which generated about 10 billion DM in 1991.[29]

In the period 1977-1987, industrial discharges of waste water (to surface waters and to sewerage) in Germany declined in volume by 14% while industrial production increased by 14%.[30] Although it is difficult to determine the extent to which this decrease was caused by effluent charges, the charges appear to have incentive effects. Brown and Johnson (1984) showed that the chemical company BASF achieved unit abatement costs that were lower than the charge level. BASF instituted an internal incentive system under which individual branches received accounting charges per unit of effluent. This system resulted in significant voluntary discharge decreases through recycling, product changes, and other measures.[31]

Two surveys of dischargers in the late 1970s (after the announcement of the charges but before their adoption) found acceleration of abatement measures at affected facilities. In at least some cases, the authors linked the abatement measures to the charges. One of the survey authors, however, claims that the close links of the charge system with federal abatement technology standards has lessened the potential efficiency of the charge system. The significant reductions (currently 75%) for compliance with technology standards could be interpreted to mean that the full charges are essentially non-compliance fees.[32] Another survey found that for municipal wastewater treatment facilities paying the reduced rates, charges make up only 1-2% of total wastewater treatment costs, whereas in one case of non-compliance, charges account for about 10% of total costs.[33]

Figure 11-3: EFFLUENT CHARGES IN THE NETHERLANDS



11.1.3.4. Effluent Charges in the Netherlands

Introduced in the 1970 Pollution of Surface Waters Act, effluent charges in the Netherlands are believed to have significant incentive effect on polluters. For discharges into federal waters, charges are imposed and collected by the federal government. For discharges into regional waters and into sewerage, charges are imposed and collected by regional water boards, which are also responsible for building and operating wastewater treatment plants. Regional charges are the same for indirect as for direct discharges. As shown in Figure 11-3, regional charges vary. The main reason for the variation is not regional differences in impacts of pollution but rather differences in costs associated with wastewater treatment.

Figure 11-4: EFFLUENT CHARGE REVENUES IN THE NETHERLANDS

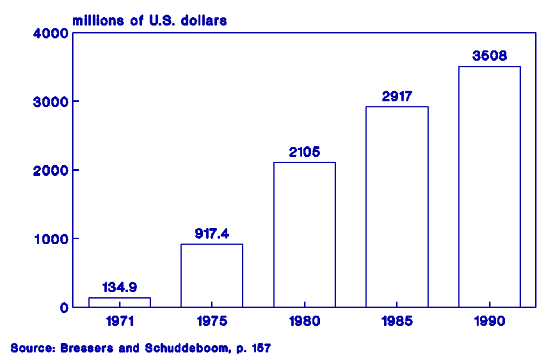


Figure 11-4 shows that charge revenues have risen significantly since they were first introduced. The revenues cover nearly all public wastewater treatment plant construction and operation costs. Charge administration costs have been estimated at 3.5% of revenues.

Charges are based on pollution units. For oxygen-consuming substances, a pollution unit is defined as the average amount of oxygen-consuming material produced by one person in one day, which is further defined as 136 g of oxygen-producing material. For heavy metals discharged into federal waters, one pollution unit is defined as 100 g of the sum of mercury, cadmium and arsenic, and 1,000 g of the sum of copper, zinc, lead, nickel and chromium. For discharges to sewerage and regional waters, arsenic discharges are included in the latter group. The government planned to add halogenated hydrocarbons to the charge base in 1996.

For charge assessment purposes, there are three groups of dischargers:

1. For households and businesses generating fewer than 5 pollution units per day, charges are usually fixed at 3 pollution units. This group accounts for about 65% of charge revenues.

2. For dischargers of 5 to 1,000 pollution units (in some industries, the maximum is 100 pollution units) of organic pollutants per day, charges are determined by combining an industry coefficient with easily obtainable data such as water use and amounts of raw materials. Facilities that believe they are being overcharged can, at their own expense, conduct sampling and measurement and be charged according to the findings. This group contributes approximately 15% of charge revenues.

3. Industrial facilities and municipal treatment plants discharging over 1,000 (or in some industries 100) pollution units per day of organic pollutants or over 10 pollution units per day of heavy metals are charged according to actual pollution amounts that they are required to measure. Municipal treatment plants, however, are not charged for discharges into regional waters and pay reduced charges (30% of full charge in 1995 and 50% in 1996 and thereafter) for discharges into federal waters. This group accounts for about 20% of charge revenues.

Since group 1 pays fixed charges and group 2 pays charges according to its industry and inputs rather than its actual pollution, the charges are likely to have little effect on these groups' pollution control. (One possible effect of the group 2 charges, however, is to promote water conservation.) For group 3 facilities, however, charges are directly linked to pollution.[34]

At least one study has found that effluent charges in the Netherlands have caused a significant fall in discharges. Bressers (1994) performed three statistical analyses on the effects of the charges: One cross-industry analysis examined organic pollution decreases by industrial sector as a function of the ratio of effluent to production value. (The study refers to this ratio as the "charge factor.") Two other cross-region analyses examined the "relative success of abatement" for heavy metals and organic pollution as a function of effluent charges. The relative success of abatement was "calculated as the difference between the actual percentage of abatement and the percentage of abatement expected in view of the industrial structure of the region."

In the first analysis, which included 14 industries accounting for 90% of industrial organic water discharges in 1969, the charge factor was highly correlated with pollution decreases, with r=.73. The same analysis was conducted excluding two industries, potato-starch and animal husbandry. The former industry had been allowed to pay reduced fees and the latter consisted of thousands of small farms that were rarely charged on the basis of actual pollution. For the charge factor in this reduced analysis, r=.84.

The second analysis found that 96% of the decrease in organic water pollution in a given region could be explained statistically by "the decrease to be expected as a result of the differences in the regional structure of industry" and the increase in effluent charges. The increase in the rate charged during 1974-80 was strongly correlated with the relative abatement success, r=.86. Excluding the two water quality districts (out of 15 in the full sample) that had the most and the least relative abatement success, r=.92. The third analysis, focusing on the 13 regions that imposed heavy metal effluent charges, found that the relationship between charges and relative abatement success was significant but not as strong as for organic pollution, r=.65.

The study also included the results of questionnaires sent to regional water board administrators to obtain their opinion of the factors behind falls in discharges. "In general," the study concluded, "the results [of the questionnaires] correspond with those of the statistical analyses, at least as far as the main points are concerned." In the case of organic pollution, those questioned believed that charges were the most important factor behind the fall in discharges. For heavy metals, however, the administrators attached equal importance to other policy instruments, such as informal negotiation. The study pointed out that such negotiation and charges appeared to complement each other.

11.1.3.5. Effluent Charges in France[35]

France's six river basin authorities, each with a committee and an agency, have been levying effluent charges since 1968. Each river basin's committee functions like a parliament, while each agency serves as an executive body. Each river basin board sets its own charge rates annually, subject to approval by the basin committee.

The original basis for assessment was weight of suspended matter and weight of organic matter, since these two pollutants were relatively easy to detect and control. Charges parameters were later expanded to include salinity (1973), toxicity (1974), nitrogen and phosphorus (1982), and halogenated hydrocarbons, toxics, and other metals (1992). Discharges are estimated based on the emissions class and activity level of the discharger or, in the case of municipalities, on the basis of population and daily discharge per inhabitant. The basin authorities and dischargers may request actual measurement, the costs of which are borne by whoever makes the request.

The charge applies to all municipalities with more than 400 inhabitants and to all non-municipal facilities discharging at least 200 population equivalents a year. For facilities connected to a public sewage system, the charge applies only if discharges exceed 6,000 m^3 per year.

It is not clear to what extent the charges have discouraged pollution. OECD (1994) concluded that the charges could be considered primarily as revenue-raising instruments. Charge levels are based not on perceived environmental costs of discharges but rather on the revenue needs of the river basin authority. The effluent charges, as well as fees for extracting ground and surface water, generate revenues that are used mainly to finance water pollution control investments by farmers, industry, and municipalities. Some of the assistance takes the form of low-interest loans, but most of it is grants that usually cover 30-50% of the total cost of a given investment. During the period 1982-1991, $6 billion in assistance was provided for projects totalling $14 billion in expenditures. The 1992-96 action plan provides for $6.5 billion in assistance for projects expected to total $15 billion.

11.1.3.6. Effluent Charges in Less Industrialized Countries

As shown in Table 11-8, several Eastern European countries have imposed effluent fees. These countries, as well as China and most of the former Soviet Union, impose non-compliance charges that are far higher for pollution in excess of certain specified amounts. Revenues from most of these charges are used to fund environmental protection activities, but Slovenia's charge generates revenues for the general federal budget.

Table 11-8: WATER EFFLUENT CHARGES IN EASTERN EUROPE[36]

Country	Charge base and rate	1993 revenues
Czech Republic	Formula based on BOD5, undissolvable substances, crude oil substances, evident alkalinity and acidity, dissolved inorganic salts[37]	$47 million
Slovak Republic	Same as for Czech charges	$10 million
Poland	BOD5: $538/ton COD: $397/ton suspended solids: $48/ton heavy metals: $5,536/ton chloride and sulfate ions: $30/ton	$75 million
Romania	Oxygen-consuming substances: $2.3/ton Suspended substances in solution: $0.58/ton	Unknown
Slovenia	$3 per population equivalent[38]	$6 million

Source: Regional Environmental Center for Central and Eastern Europe (1995), p. 14.

Like other environmental charges in Eastern Europe and the former Soviet Union, many of the effluent charges in Table 11-8 are limited in their effectiveness by problems such as weak enforcement, polluters' inability or unwillingness to pay, and inflation. In

1993, for example, Poland's charge collection rate was only 53%. Slovak charge revenue fell in local currency by 28% from 1992 to 1993 because of polluters' financial hardships and recession. Lack of widespread interest in environmental issues, limited experience with incentive mechanisms, and complicated charge mechanisms have also been cited as problems with charges in Eastern Europe.

Four states in Brazil have introduced (or begun to introduce) charges for industrial sewage treatment based on pollution content. As shown in Table 11-9, sewage charges in Sao Paulo state based on pollution content have been found to have a significant impact on pollution. The study indicated that the reductions had been achieved through changes in production methods, use of cleaner inputs, and recycling. Having significantly underestimated the responsiveness of polluters to increased charges, the state sewage treatment company now suffers from overcapacity at a treatment plant.[39]

Table 11-9: IMPACT OF SEWAGE CHARGES ON POLLUTION IN SAO PAULO STATE, BRAZIL

(% reduction in unit pollution coefficient, 1980-82)

Industry	BOD	Suspended solids
Pharmaceutical	30	46
Food	42	43
Milk derivatives	57	55

Source: Margulis (1994), p. 111.

China, India, Korea, Malaysia, the Philippines, and Thailand are among the Asian countries to have imposed effluent fees. For example, palm oil and rubber factories in Malaysia have been subject to effluent fees since 1978. The fee was originally set at M$ 100 ($39) per metric ton of the BOD load in excess of 500 ppm, and an additional license fee was set at M$ 100 per metric ton of BOD load. Firms could obtain waivers by conducting research on waste treatment. The effluent fee scheme has been credited with lowering effluent to the target level of 100 mg per liter.[40]

11.1.4. Noise

Noise pollution charges have been levied at airports in Belgium, France, Germany, Japan, the Netherlands, Norway, and Switzerland. In Switzerland, planes are taxed from 0 to 400 SF ($337) per take-off depending on their noise class.[41] In Germany, the percentage of aircraft conforming with stricter noise standards increased in the late 1980s, but it is unclear whether this increase was due to noise pollution charges.[42]

11.1.5. Charges on Environmentally Damaging Products and Activities

Levied in numerous industrialized countries, product charges are imposed either on a product or some characteristic of that product. Although some of these charges may discourage consumption, many of them are advance disposal fees intended to finance the proper disposal of the products after their use. Products on which charges have been imposed include automotive air conditioners (Canada), batteries (Canada, Denmark, Portugal, and Sweden), beverage containers (Belgium, Finland, Norway, and Sweden), building materials (Denmark), CFCs (Australia and Denmark), fertilizers (Austria, Finland, Norway, and Sweden), light bulbs (Denmark and Korea), lubricating oil (Finland, France, Italy, Norway, and Spain), packaging (Belgium and Germany), pesticides (Belgium, Denmark, Norway, and Sweden), plastic and paper bags (Italy, Iceland, and Denmark), sulfur in oil (Finland, Norway, and Sweden), and tires (Taiwan and Canada).

In 1993, South Korea imposed advance disposal fees on several products that are difficult to treat or recycle. As shown in Table 11-10, a large number of products are subject to the fees, but the amounts are rather low.

11.1.5.1. Charges on Agricultural Inputs

Several countries have imposed product charges on pesticides and fertilizers. Estimates of price elasticity of demand for these products vary widely, depending perhaps on the time period studied, crops, geographic area, and other factors. However, some of these charges are more likely to have incentive impact than the relatively low charges imposed on these products by U.S. states.

Norway has levied charges on fertilizers and pesticides since 1988. The fertilizer taxes are NKr 1.17 ($0.18) per kg of nitrogen and Nkr 2.23 ($0.35) per kg of phosphorous, resulting in average taxation of approximately 7% of the wholesale price. The pesticide tax is 13% of the purchase price. In Finland, charges of Mk. 1.5 ($0.32) per kg were imposed on phosphate fertilizers in 1990. Relatively low charges on fertilizers in Austria, which are no longer in effect, are reported to have had a significant impact on fertilizer use.

In Denmark, retail sales of pesticides are subject to a 20% tax. Dubgaard estimated price elasticity of demand for pesticides in Denmark at -0.3. This estimate suggests that the 20% tax results in a reduction in pesticide use of roughly 7%.[43]

As shown in Table 11-11, Sweden imposed two different charges on fertilizers in the 1980s. At their highest level, in 1991, the charges equaled 30-35% of the sales price of phosphate and nitrogen. Figure 11-5 suggests that the charges have had a significant impact on fertilizer use. The amount of land under cultivation has also decreased but not in the same proportion as fertilizer use. The reduction in use appears to be most significant during the period when the tax was at its highest.[44] The Swedish Board of Agriculture administers the charge. Its annual administrative costs associated with the charge have been estimated at 500,000 SEK ($74,000), roughly 0.4% of total annual charge revenues of approximately 130 million SEK ($19 million).

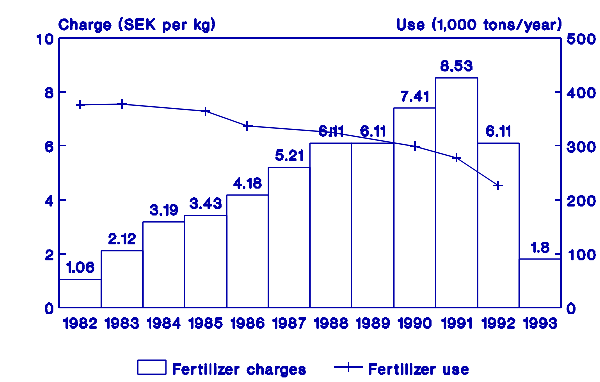
Table 11-10: ADVANCE DISPOSAL FEES IN SOUTH KOREA[45]

Product	Fee amount ($=780 won)
Insecticide / toxics container: <500 ml >500 ml Butane gas container	5 won 11 won 6 won
Glass cosmetics bottle: <100 ml >100 ml Metal cosmetics container: spray others	2 won 3 won 6 won 4 won
Candy containers: more than 3 pieces more than 4 pieces	5 won 10 won
Batteries (lithium, nickel-cadmium, manganese, manganese alkalide)	1.5 won
Anti-freeze solution	20 won
Fluorescent light bulbs	5 won
Chewing gum	0.25% of price
Paper diaper	1 won
Plastics	0.7% of price

Source: Rhee (1994), "The Use of Economic Instruments in Environmental Protection in Korea," p. 104.

Revenues from the price regulation charge have been used to subsidize agriculture, while revenues from the environmental charge have been used to promote sustainable agriculture, including investments in manure management and research and educational programs. Some of the reductions in fertilizer use depicted in Figure 11-5 can probably be attributed to the educational activities funded by the environmental charge.[46]

Figure 11-5: FERTILIZER CHARGES AND USE IN SWEDEN



Source: The Swedish Experience: Taxes and Charges in Environmental Policy

Table 11-11: FERTILIZER CHARGES IN SWEDEN
(in SEK per kg)

Date	Price Regulation Charge			Environmental Charge		Total charge		
	N	P	K	N	P	N	P	K
7/82	0.3	0.58	0.18			0.30	0.58	0.18
7/83	0.6	1.16	0.36			0.60	1.16	0.36
7/84	0.65	1.25	0.39	0.30	0.60	0.95	1.85	0.39
1/85	0.72	1.38	0.43	0.30	0.60	1.02	1.98	0.43
7/85	0.93	1.79	0.56	0.30	0.60	1.23	2.39	0.56
7/86	1.12	2.43	0.76	0.30	0.60	1.42	3.03	0.76
7/88	1.12	2.43	0.76	0.60	1.20	1.72	3.63	0.76
11/90	1.46	3.16	0.99	0.60	1.20	2.06	4.36	0.99
3/91	1.75	3.79	1.19	0.60	1.20	2.35	4.99	1.19
7/92	1.12	2.43	0.76	0.60	1.20	1.72	3.63	0.76
12/92	0	0	0	0.60	1.20	0.60	1.20	0

Source: Swedish Ministry of the Environment and Natural Resources (1995), p. 12.

11.1.5.2. Energy/carbon Taxes

Energy taxes can be considered product charges. One type of energy tax that has become a frequent topic of discussion in environmental protection is a carbon tax. Levied on fuels based on their carbon content and intended to limit emissions of carbon dioxide, carbon taxes have been adopted in Denmark, Finland, the Netherlands, Norway, and Sweden. As noted above, Poland also has a small tax on CO_2 emissions that amounts to a carbon tax. Carbon taxes are generally small relative to other fuel taxes, although the relative size of the carbon tax varies according to the type of fuel. Rates often vary depending on the sector or use of the fuel. In Finland and the Netherlands, the taxes are assessed partly on carbon content and partly on energy content. The taxes are summarized in Table 11-12.

In 1990, Finland became the first country to adopt a carbon tax, setting its level at Mk 6.66 ($1.45) per metric ton of CO_2. The tax was raised to Mk 13.59 ($2.96) in 1993 and to Mk 38.3 ($8.34) in 1995. It is no longer based purely on carbon content but rather 60/40 on carbon/energy content, the energy content portion being 3.5 Mk per MwH ($0.21 per gigajoule). Products used as raw materials for industrial production or as fuel for planes and certain other vessels are exempt from the tax.[47] Energy produced from peat is also exempt. According to Finnish government studies, CO_2 emissions are five percent lower than they would be without the tax. The government says that the tax has stimulated investment in renewable energy technology such as biomass gasification. However, industry representatives claim "that this tax is just another way to increase budget revenues."[48]

Table 11-12: ENERGY/CARBON TAXES[49]

(in $ per ton of CO_2 unless otherwise stated)

Country	Year Adopted	Rate	Annual Revenue	Observations
Denmark	1992	$9-$18	$560 million (1993)	Gasoline, natural gas, and biofuels exempt. Aviation, shipping, and refinery gas exempt. 50% rebate for larger businesses.
Finland	1990	$8 + 21¢/gjoule	$314 million (1994)	Industry raw materials and fuel for planes and certain vessels exempt. 60/40 carbon/energy content.
Netherlands	1990	$16.4 + 91¢/giga-joule	$850 million (1995)	Full rate not phased in until 1998. 50/50 carbon/energy content.
Norway	1991	$15-$47	$900 million (1994)	Coal used in industry exempt.
Sweden	1991	$27-55	$1.7 billion (FY93-4)	Effective 7/1/96, industry pays 50% of full rate. Uses other than heating or motor fuels and fuel for ships, planes, train locomotives, and electricity generation exempt.

Sources: Muller, "Mitigating Climate Change," p. 17; OECD (1996), *Implementation Strategies for Environmental Taxes*, pp. 89-94; Netherlands Ministry of Housing, Spatial Planning and Environment.

In Denmark, a tax of 100 DK ($17.6) per metric ton of CO_2 was adopted in 1992 as part of a broader energy tax and subsidy package. Table 11-13 shows several features of this tax common in carbon taxes in other countries as well. First, the amount of the tax differs according to the type of fuel, specifically its carbon content. The carbon tax is 242 DK ($42.5) per metric ton on coal but only 178 DK ($31.3) per metric ton on lignite. Second, the amount of the carbon tax is relatively small compared to other taxes on energy, constituting less than a third of taxes on petroleum coke, 26% of taxes on electricity, and 12% of taxes on gas used as motor fuel. Third, there are numerous carbon tax exemptions.

Gasoline (but not diesel), natural gas, and biofuels are exempt, and value added tax registered businesses generally receive 50% rebates on their payments. Such rebates are intended to assist large, energy-intensive businesses. Households, however, receive no rebates. Carbon taxes on electricity generated by renewable energies and fuels are offset by subsidies of 0.10-0.17 DK (1.76-3¢) per Kwh.

Table 11-13: 1994 ENERGY TAXES IN DENMARK[50]
(not including 25% value added tax)

Energy source	Unit	Excise tax	CO_2 tax
Unleaded petrol	DK/liter	2.45	exempt
Leaded petrol	DK/liter	3.10	exempt
Light diesel oil	DK/liter	1.67	0.27
Ordinary diesel oil	DK/liter	1.77	0.27
Light fuel oil	DK/liter	1.49	0.27
Heavy fuel oil	DK/kg	1.66	0.32
Fuel tar	DK/kg	1.50	0.28
Kerosine, heating	DK/liter	1.49	0.27
Kerosine	DK/liter	1.77	0.27
Coal	DK/metric ton	690	242
Petroleum coke	DK/metric ton	690	323
Lignite	DK/metric ton	505	178
Gas used as motor fuel	DK/liter	1.18	0.16
Other gas (LPG)	DK/kg	2.00	0.30
Refinery gas	DK/kg	2.00	0.29
Electricity	DK/Kwh	0.30	0.10
Electricity, heating	DK/Kwh	0.27	0.10

Source: OECD (1996), p. 90.

Sweden introduced a carbon tax of 250 SEK ($36.8) per metric ton in 1991 as part of a broader tax system reform in which general energy taxes were reduced and the value added tax was extended to energy. In 1993, the carbon tax for industry was lowered to 80 SEK ($12) per metric ton but raised to 320 SEK ($47.2) per metric ton for other consumers, and the general energy tax was abolished for manufacturing industry and commercial horticulture. Several energy-intensive industries were entitled to further carbon tax reductions. The rate has risen every year to 370 SEK ($50.1) per metric ton in 1996, with industry paying 25% of the full rate. In general, the tax applies only to motor and heating fuels. Biofuels and fuels used for electricity generation are exempt, as are fuels for ships, planes, and train locomotives.[51]

According to a study by the Swedish Ministry of the Environment and Natural Resources, the carbon tax has influenced energy consumption patterns. Some plant owners who have shifted their energy sources from fuel oil to biofuels claim that the carbon tax was a decisive factor in their shift. In the six months after the carbon tax was reduced for industry in 1993, heavy fuel oil consumption rose by about 20% compared to the same period of the previous year. The preferential rate for industry also led some facilities to sell their biobased by-products to heating plants, which were taxed at the full rate and thus eager to use biofuels.[52]

Effective July 1, 1996, industry's 75% reduction was lowered to 50%, up to a level equivalent to 0.8% of annual turnover. For additional amounts beyond the 0.8% turnover threshold, companies pay 12% of the full rate. Several energy-intensive companies—mostly in the chemical, cement, lime, and glass sectors—have their payments capped at 1.2% of turnover. A Confederation of Swedish Industries representative stated that the tax increase would cause Swedish firms to lose market share to foreign competitors generating more emissions and characterized the measure as "completely counter-productive from the point of view of the environment, employment growth and future investment." It has been suggested that industry in Sweden is not opposed to carbon taxation provided that other countries adopt similar taxes. One problem with carbon taxes and other measures to limit CO_2 emissions is that they must be implemented in a sufficient number of countries to effectively address climate change.[53]

The Netherlands first adopted a carbon tax in 1990 but replaced it with a 50/50 carbon/energy tax in 1992. This tax is referred to as the Environmental Tax on Fuels. Another carbon/energy tax, the Regulatory Tax on Energy, entered into effect on January 1, 1996. As shown in Table 11-14, the carbon/energy tax of the environmental levy is 5.16 Dfl per metric ton of CO_2 and 0.3906 Dfl per gigajoule, and the carbon/energy tax of the regulatory tax is 27.00 Dfl ($16.4) per metric ton CO_2 and 1.506 Dfl ($0.91) per gigajoule.

Table 11-14: CARBON/ENERGY TAXES IN THE NETHERLANDS
(in Dfl)

	Environmental tax	Regulatory tax	Total
Carbon (per metric ton CO_2)	5.16	27.00	32.16
Energy (per gigajoule)	0.3906	1.506	1.8966

Sources: Netherlands Ministry of Housing, Spatial Planning and Environment, "The Netherlands Environmental Tax on Fuels" and "The Netherlands Regulatory Tax on Energy."

Table 11-15 shows the two taxes as applied to different types of fuel as of January 1, 1996. As in other countries, the carbon / energy taxes are not the only levies on fuel. The various levies have different purposes. The excise and environmental taxes are intended primarily to raise revenue, and the COVA levy finances strategic oil reserve maintenance. The regulatory tax was introduced to influence behavior, with revenue generation as a secondary objective. Not included in this table is the value added tax of 17.5% on all fuel types and on the taxes paid on them.

As can be seen in table 11-15, the carbon / energy taxes have not been uniformly applied to all fuels. Some fuels are exempt from either the environmental or the regulatory tax. The rate for natural gas depends on the amount used by the consumer subject to the tax. The appropriate rate for electricity was determined based on estimates of the amounts of electrical energy generated by different types of sources.

The regulatory tax targets small-scale energy consumers. The government maintains that other policies are already encouraging large consumers to save energy and that large additional energy taxes would put industrial energy users at a disadvantage compared to competitors in other countries without such taxes.

As noted above, the regulatory tax is considered an incentive mechanism with only secondary revenue-raising objectives. Tax revenues are being recycled back to the economy through corresponding reductions in personal and corporate income taxes. The regulatory tax introduction and income tax reductions were legislatively bound to each other. According to an official source, the revenue recycling is "in line with the government's aim of shifting the tax burden away from labor and capital based income and towards use of the environment."

The government believes that the regulatory tax will reduce CO_2 emissions by 1.7 to 2.7 million metric tons per year (1.5% of total CO_2 emissions in the Netherlands) by the year 2000. Groups targeted by the tax are expected to reduce CO_2 emissions by 5%.[54]

11.1.5.3. Preferential Taxation of Environmentally Friendly Products

One type of economic incentive similar to product charges is the preferential taxation of environmentally friendly products. For example, Australia, Mexico, New Zealand, Singapore, Taiwan, Thailand, and most European countries have taxed leaded gasoline at a higher rate than unleaded gasoline. Foreign countries appear to have learned from the U.S. experience in this area. Motorists in the U.S. often misfueled their vehicles with leaded fuel because it was cheaper than unleaded. Not only did the use of leaded fuel release lead into the environment, it also caused releases of other emissions by damaging catalytic converters. Preferential taxation measures in other countries have given motorists an incentive to use unleaded fuel, thereby contributing to an increase in its market share. As shown in Table 11-16, the differential is usually limited to 10% of the price of unleaded fuel.

Table 11-15: CARBON/ENERGY TAXES APPLIED TO FUELS IN THE NETHERLANDS[55]
(in Dfl)

Product	Unit	Excises	Environmental tax	COVA	Regulatory tax[56]
leaded gasoline	1000 liters	1246.10	25.10	13.50	n/a
unleaded gasoline	1000 liters	1105.30	25.10	13.50	n/a
light fuel oil	1000 liters	102.60	27.50	13.50	84.60
gasoil	1000 liters	102.60	27.70	13.50	85.30
diesel	1000 liters	649.20	27.70	13.50	n/a
heavy fuel oil	metric ton	34.24	32.33	0.00	n/a
coal	metric ton	n/a	23.38	n/a	n/a
LPG[57]	metric ton	78.72	33.08	n/a	100.9
natural gas	m^3	n/a	<10 million: 0.02155 >10 million: 0.1410	n/a	<170,000: 0.0953
process gas	1,000 gjoule	n/a	236.82	n/a	n/a
petrocoke residuals	metric ton	n/a	32.47	n/a	n/a
liquid residuals	metric ton	n/a	32.33	n/a	n/a
gaseous residuals	1,000 gjoule	n/a	236.82	n/a	n/a
electricity	Kwh	n/a	n/a	n/a	0.0295

Source: Netherlands Ministry of Housing, Spatial Planning and Environment, "The Netherlands' Regulatory Tax on Energy," p. 10.

In addition to taxing leaded gasoline at higher rates than unleaded, Sweden has used several other taxation mechanisms in an effort to promote the use of cleaner fuels. In 1991, a tax was imposed on diesel (as well as peat and coal) based on its sulfur content. The tax was set at 27 SEK ($4) per m^3 oil for each tenth of percentage weight of sulfur, an amount corresponding to 30 SEK ($4.4) per kg sulfur. Fuels with a sulfur content no higher than 0.1% are exempt. Rebates are also available for facilities that control sulfur emissions. Norway has a similar tax on sulfur in fuel.

The Swedish Environmental Protection Agency credited the sulfur tax with lowering the sulfur content of diesel fuel from 0.15% in 1990 to 0.1% in 1992. In an effort to encourage the use of even cleaner fuels, Sweden classified diesel fuels into three different classes and instituted tax rebates for the two cleanest classes. The tax discount was first set at 350 SEK ($51.6) per cubic meter for class I and 150 SEK ($22.1) per cubic meter for class II in 1991. In 1992, the discounts were increased by an additional 100 SEK ($14.7). The rebates have since been changed several more times. In 1995, they were 490 SEK ($72.2) per m^3 for class I and 270 SEK ($40) per m^3 for class II.

When the tax rebates were increased in 1992, the standards for the two cleaner fuel classes were also changed. The original standards concerned only sulfur and aromatics content and distillation range. The new standards lowered the sulfur standard for class II fuel to 0.005% and added several parameters. The 1992 standards for the two cleaner fuel classes are shown in Table 11-17.

As shown in Figure 11-6, the percent age of diesel in classes I and II rose from a combined total of under 1% to 60% for class II and 15% for class I after the introduction of this tax differentiation. After initially relying on imports to obtain the cleaner fuels, oil companies then made significant investments to increase their capacities to produce class I and II diesel fuel, partly because of the differential taxation but also because of lower than expected production costs for class I and II. One factor that lowered costs was a downturn in the market for jet oil, which is similar to the cleaner classes of diesel subject to rebates. The downturn freed up capacity for the production of class I and II diesel. Since the extra cost is estimated at 300 SEK ($44.2) per cubic meter for class I and 170 SEK ($25) per cubic meter for class II, producers have a strong interest in producing the cleaner classes. Moreover, the tax differentiation increased public awareness of diesel fuels, leading many consumers to use only I and II and many communities to ban the sale of class III. However, some consumers are skeptical about the cleaner fuels, believing that they may be harmful to engines.

Figure 11-6: SALES OF DIFFERENT CLASSES OF DIESEL FUEL IN SWEDEN

(as % of total)

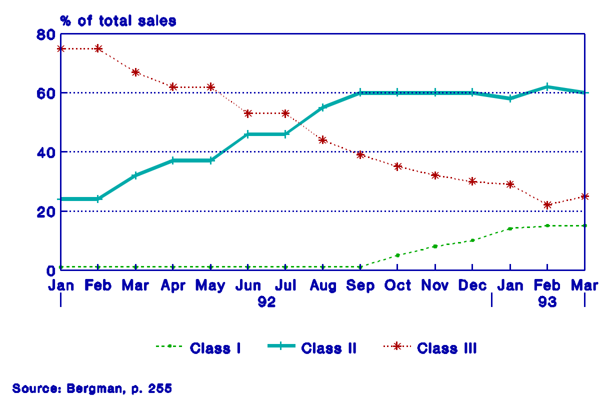


Table 11-16: DIFFERENTIAL TAXATION OF LEADED GASOLINE
($/liter in 1994)

Country	Leaded fuel price	Tax differential
Belgium	1.02	0.099
Denmark	0.89	0.034
France	1.011	0.07
Germany	1.042	0.073
Greece	0.827	0.071
Ireland	0.891	0.049
Italy	1.05	0.078
Luxembourg	0.807	0.092
Netherlands	1.132	0.09
New Zealand	0.563	0.016
Norway	1.17	0.014
Portugal	0.931	0.046
Spain	0.813	0.04
Sweden	1.017	0.077
Switzerland	0.911	0.063
Turkey	0.547	0.015
United Kingdom	0.871	0.086

Source: IEA, *Energy Prices and Taxes*, 3rd Quarter 1995.

SEPA believes that it is difficult to determine the net benefits or cost-effectiveness of the differential taxation, but that a command-and-control approach would have cost more and taken longer to achieve the desired result and that emissions reductions resulting from the system have led to more health benefits in cities than abatement investments at large point sources. Moreover, administrative costs are low, as the rebate was built into an existing tax.

Table 11-17: 1992 CLASSIFICATION OF DIESEL FUELS AND TAX REBATES IN SWEDEN

Parameters	Class I	Class II
Sulfur, max. %	0.001	0.005
Aromatics, max. %	5	20
PAH, max. %	0	0.1
Cetane index	50	47
Density, kg/m_3	800-820	800-820
Initial boiling point	180 C	180 C
Max.Temp. at 95% recovery	285 C	295 C
1993 tax rebate (SEK per liter)	0.535	0.25
1995 tax rebate (SEK per liter)	0.49	0.27

Sources: Bergman (1994), p. 253; OECD (1996), p. 94.

One problem has been determining appropriate rebate amounts. At their original levels, the rebates had little effect on the diesel fuel market. However, the 1992 rebate increases combined with developments on the oil market caused a rapid rise in cleaner fuel use. At their current level, the rebates might be higher than socially desirable. SEPA maintains that class I is sufficiently expensive to produce that it should be used mainly in urban areas, but it is apparently used in other areas as well. The cleaner fuels have also been employed for other relatively inefficient uses such as domestic heating. However, frequent changes in rebates in response to technological and market developments would create uncertainty for companies making investments necessary to produce the cleaner fuels.[58]

In December 1994, Sweden introduced a similar differentiation system for two classes of unleaded gasoline. The cleanest class (based on its sulfur, lead, benzene, and phosphorus content and vapor pressure) was taxed at 3.22 SEK ($0.47) per liter in 1995, whereas the other class was taxed at 3.28 SEK ($0.48) per liter.[59]

In Belgium, Finland, Germany, Greece, Hungary, Japan, the Netherlands, Norway, and Sweden, motor vehicle taxes have been positively related to pollutant emissions. Austria and Germany base annual vehicle ownership taxes on emissions. Japan imposes lower sales tax on cars powered by methanol, electricity, and solar power than on gasoline-powered cars.

In Belgium, a number of charges designed to reduce waste generation and promote reusable products came into effect on February 1, 1996. These include a 10 BF ($0.33) tax on disposable razors and a 300 BF ($9.9) tax on disposable cameras (if not recycled). Paper and cardboard used in packaging, newspapers, and toilet paper are subject to a tax of 10 BF ($0.33) per kilo unless they contain a certain percentage of recycled fibers by specified dates. For paper and cardboard made from non-chlorine bleached pulp, the tax is 5 BF ($0.16) per kilo. Taxes have also been imposed on pesticides in non-agricultural products and on batteries. A policy advisor for the Belgian Ministry of Environment said that the Ministry did not consider these taxes as revenue-raising measures but rather as incentive mechanisms.[60]

A 6-7% tax on disposable diapers has been imposed in parts of Canada.[61] Several countries impose higher charges on disposable beverage containers to encourage the use of refillables.[62]

In Germany, many manufacturers and distributors participate in a packaging recycling system managed by the company Duales System Deutschland (DSD). To fund DSD's activities, participating companies pay fees on packaging depending on the type and weight of the packaging materials. Fees range from 0.16 DM ($0.11) per kg for glass (an easy material to sort) to 3 DM ($2) per kg for plastics (difficult to sort). Although these fees are not government-imposed product charges, they have a similar effect. Industry set up the DSD system to comply with the German Packaging Ordinance obliging producers to take back and recycle their packaging materials.[63]

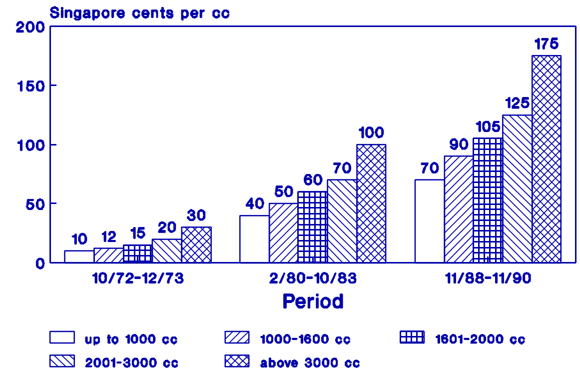
11.1.5.4. Road User Fees

Several countries levy taxes to reduce road use. Germany, Belgium, Luxembourg, the Netherlands, and Denmark signed an accord in 1994 imposing a tax on trucks using their roads. Annual tax rates were set at 750 ECU ($599) for trucks with three axles or less and 1,250 ECU ($998) for trucks with four axles or more. Daily, weekly, and monthly rates are reduced. Germany, which has the most roads and road usage by trucks in the European Union and which led the initiative to introduce the tax, intends for the tax revenue to finance investments in rail transportation infrastructure.[64] These taxes could be considered environmental charges to the extent that truck transportation contributes to pollution.

Austria has imposed on mountain roads linking Germany and Italy in an effort to limit the damage to its forests caused by vehicle emissions. These tolls have been a significant source of conflict between Austria and neighboring countries, and the European Union has threatened legal action against Austria over the tolls.[65]

Authorities in several countries have attempted to use fees to address the problem of traffic congestion. The Norwegian cities of Oslo, Bergen, and Trondheim have implemented congestion pricing schemes. In Trondheim, Norway's third largest city with a population of 140,000, motorists are charged rates ranging from $0.62 to $1.56 to enter the city between 6 am and 5 pm. Rates are highest during the morning rush hour, between 6 and 10 am. The city has a system of 12 toll stations, all but two of which are unattended. Motorists can pay the fees either by subscribing to the system and receiving a transponder tag or by paying at toll stations with coins or a magnetic strip card. Since the toll ring began operation in 1991, inbound traffic during the toll period has declined by 10%, while traffic during the non-toll period has increased by 9%. Weekday bus travel has increased by 7%. Revenues are 5 times as high as toll capital and operating expenses.

Figure 11-7: SINGAPORE ANNUAL ROAD TAX



Source: Chia and Phang, p. 8

Experiences in France also suggest that congestion pricing has incentive effects. In April 1992, peak-period surcharges were imposed on the highway connecting Paris and Lille. Sunday afternoon peak rates were set 25-50% higher than base rates, while off-peak rates were reduced by 25-50%. Despite an overall rise in weekend traffic since 1992, the tolls decreased congestion by spreading out traffic over a much longer peak period. Moreover, peak period tolls on a congested road from Paris to a popular ski resort diverted a significant amount of traffic to a longer, alternative road where the toll was lower.[66]

Authorities in Vancouver are considering congestion pricing. A study revealed that a C$3 ($2.2) fee charged on vehicles entering the downtown area during the morning peak would decrease the number of automobiles by 19.1% during that period and that a C$6 ($4.4) fee would result in a 31.3% decrease.[67]

11.1.5.5. Singapore Road and Vehicle Taxation[68]

Congestion tolls are among various road and vehicle taxes that Singapore has imple mented in an effort to prevent congestion problems such as those affecting large urban areas in neighboring countries. For convenience, the incentive measures can be classified as ownership or use taxes in the following manner:

Vehicle ownership: Import duty, two registration fees, annual road tax, and Certificates of Entitlement;

Vehicle use: Fuel tax, Area Licensing Fees, parking fees.

In addition to import duties of 45% and registration fees of S$1,000 ($710), Singapore imposes an Additional Registration Fee (ARF) based on the market value of the vehicle. The ARF rose from 15% in 1968 to 175% in 1983, before falling to 150% in 1991. The annual road tax is based on the engine capacity of the vehicle. As shown in Figure 11-7, these rates have risen significantly since the early 1970s. The ARF is reduced if an old vehicle is scrapped when a new one is purchased. The intention of this Preferential

Additional Registration Fee (PARF) is to discourage ownership of older, high-emitting vehicles and to limit the used car market.

In 1990, Singapore implemented a quota scheme under which vehicle owners are required to have Certificates of Entitlement (COEs). COEs are valid for ten years and can be obtained in public auctions held monthly by the Registry of Vehicles. Owners of vehicles more than ten years old are required to pay the prevailing quota price. The COE requirement enables the government to determine the total number of vehicles in circulation based on the country's road capacity. This program could be considered a trading system such as those discussed below and in Section VI but is included here because it is part of Singapore's package of measures to limit congestion. COE prices have increased rapidly: For cars with a capacity over 2,000 cc, they have risen from S$528 ($375) when they were introduced in 1990 to S$17,600 ($12,500) in 1992 to over S$100,000 ($70,000) in 1994.

An element of congestion pricing was built into the COE system in 1991 with the creation of the Weekend Car scheme under which a separate category of Weekend Car COEs was created. Buyers of Weekend COEs enjoyed tax rebates on the registration fee, import duty and COE premium, up to a maximum of S$15,000 ($10,700). They were also entitled to 70% reductions in road tax. Weekend cars could be used only on Sundays and public holidays and during off-peak hours (between 7 pm and 7 am on weekdays and after 3 pm on Saturdays). Weekend vehicles were clearly marked by red number plates that had to be welded onto the vehicle and sealed by an authorized inspection center. To drive the vehicle outside the authorized times, a S$20 ($14) day license had to be displayed on the windshield. Owners had the right to five free day licenses a year.

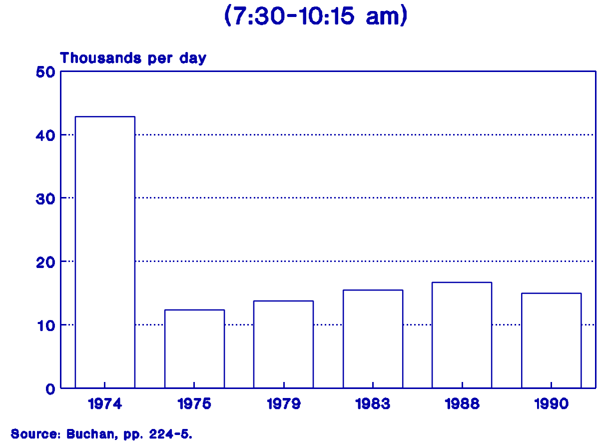
One problem with the Weekend Car scheme was that many owners of large vehicles found it cheaper to purchase Weekend COEs but use their vehicles during peak periods, paying the S$20 daily license. To stop this practice, the Weekend Car scheme was replaced by an Off-Peak Car Scheme on October 1, 1994. This scheme operates like the Weekend scheme except that there is no separate category of COEs, the tax rebates have been raised from S$15,000 to S$17,000 ($12,000), and the annual road tax reduction has been set at S$800 ($570).

Like most other countries, Singapore taxes motor fuels. The unleaded gasoline tax is the higher of S$0.6 ($0.43) per liter or 50% of pump prices (including taxes). Leaded gasoline is taxed an additional S$0.15 ($0.11) per liter. Diesel is taxed at S$0.08 ($0.06) per liter. One problem that arose as a result of these taxes was that motorists purchased fuel in neighboring Malaysia, where a liter of gasoline was about S$0.5 ($0.35) cheaper. Singapore countered this practice by requiring all vehicles leaving the country to have their gasoline tanks at least half full in 1989. In 1991, the tank requirement was raised to 3/4 full.

As the main operator of parking facilities, the government also imposes relatively high parking fees. Parking charges within the Central Business District (CBD) are S$0.9 ($0.64) per half hour during office hours. Outside the CBD, charges are S$0.45 ($0.32) per half hour.

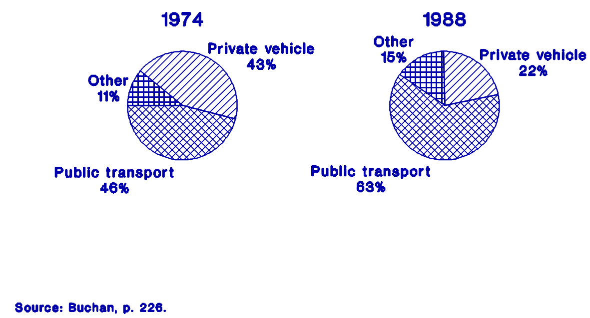
The Area Licensing Scheme (ALS) was adopted in 1975 to reduce congestion in the CBD during peak morning hours (7:30-10:15). Cars entering the CBD with fewer than four persons were required to pay a fee that rose from S$3 ($2.1) in 1975 to S$4 ($2.8) in 1976 to S$5 ($3.6) in 1980. When the fee hours were extended to the evening peak period (4:30-6:30) in 1989, the fee was lowered to S$3. Company cars pay twice this rate. The exemption for cars with at least four persons was removed in 1989. Motorcycles pay S$1 ($0.7) per day.

Figure 11-8: PRIVATE CARS ENTERING SINGAPORE CENTRAL BUSINESS DISTRICT



Although officials found that the fees limited vehicle use during peak hours, traffic problems between peak periods increased. As a result, the ALS was significantly modified in 1994 to include two types of licenses: a part-day license at S$2 ($1.4) for entry into the CBD during off-peak hours (10:15 am-4:30 pm) and a whole-day license of S$3 to be used between 7:15 am and 6:30 pm.

Figure 11-9: MODES OF TRANSPORTATION IN SINGAPORE



As shown in Figure 11-8, the ALS had a large impact on peak-hour traffic, resulting by the end of 1975 in a 71.1% decrease in the number of private vehicles entering the restricted zone between 7:30 and 10:15. Figure 11-9 shows that public transportation became preferred mode of transportation after the introduction of the ALS. The 1989 expansion of the system to evening peak hours resulted in further traffic decreases and increases in average speeds of 10.8% in morning peak hours and 30.4% during the evening peak period.

The COE and other measures are credited with significantly limiting the number of vehicles in Singapore. It has been estimated that without vehicle ownership and use disincentives, the number of vehicles in Singapore would have been 400,000 by 1992 instead of the actual number of 274,000. The U.S. Federal Highway Administration, which has gathered information on traffic management in Singapore and other countries, concluded in a recent article, "The road pricing program, combined with other charges on vehicles ownership, has dramatically reduced traffic and eliminated peak-period congestion in the downtown area. In addition, air pollution has been significantly reduced, and business activities and rents in the downtown area have not suffered." These achievements are in stark contrast to severe traffic problems in other southeast Asian cities, such as Bangkok and Jakarta.

Singapore's vehicle taxes have also raised significant revenues for the government. By 1992, they accounted for 23% of total government tax revenue.

Singapore intends to convert its current manual scheme to an electronic road pricing system by 1997. Electronic tolls will deduct credits from vehicle transponders and notify the authorities of vehicles in violation of toll rules. The same transponder cards will perhaps be usable for public phone calls and other purchases. Toll charges will vary according to type of vehicle and time of day. The government plans to later extend the system to its entire road system.

11.1.5.6. Other Measures to Curb Congestion

Mexico opted for a different method of limiting congestion in Mexico City. In 1989, regulations were enacted to take 20% of the vehicle fleet out of circulation each working day. Vehicles were assigned their prohibition day based on the last digit of their license plate. Such a system has a large command-and-control element but could create incentives to carpool or use public transportation. Although the program initially lowered traffic volume and gasoline consumption in the city, these reductions were subsequently nullified by the measure's unintended effect of encouraging motorists to use other vehicles on days when their new vehicles were prohibited. In 1990, the increase in the number of vehicles registered was twice the number of cars sold, implying that large numbers of used vehicles were brought into circulation. A survey revealed that 39% of car owners had obtained another (often older) vehicle to avoid being without a car on the vehicle prohibition day. The increased number of older vehicles resulted in increased pollution levels. Moreover, the availability of a second vehicle led family members to reduce their use of public transportation. Similar vehicle restrictions were recently adopted in Manila, in the Philippines. Thailand's Deputy Prime Minister has proposed banning new cars from Bangkok during the period 1997-2000. Owners of old cars would be allowed to transfer their use rights to new cars.[69]

11.2. DEPOSIT-REFUND MECHANISMS

The most common application of deposit-refund mechanisms is beverage containers (see Table 11-18). Numerous countries have deposit systems for glass bottles. Less widespread, but expanding rapidly, are deposit systems for plastic containers, which are now found in at least 11 countries. Deposit sizes reach nearly 50% of the purchase price of the beverage in Denmark and the Netherlands. In some cases, deposit mechanisms are required by law; in others, they are conducted voluntarily by industry. Sweden, Portugal, and parts of Canada and Australia have deposit systems for metal cans. In most places where beverage container deposit systems have been implemented, the percentage of containers returned is over 50%, and it is often near 100%. In some countries, the percentage of containers returned appears to be positively related to the magnitude of the deposit relative to the price of the beverage.[70]

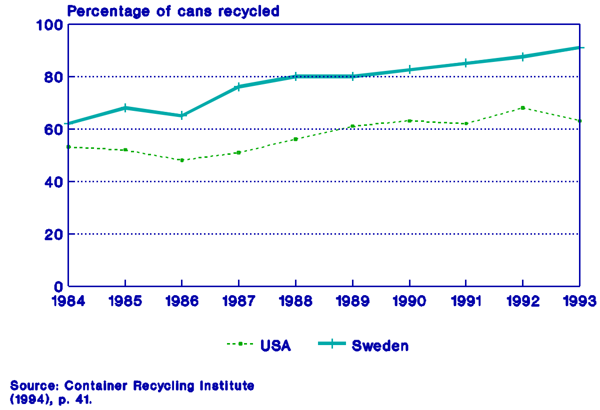
Table 11-18: BEVERAGE CONTAINER DEPOSITS IN SELECTED COUNTRIES[71]

Country	Containers Covered	Deposit Amount
Australia (regions)	Beer, Soft drinks. Cans, plastic, bottles	Cans and PET: 2.5¢ Refill. glass: 6-13¢; One-way glass: 2.5¢
Austria	REFPET bottles; beer, soft drinks, mineral water, juice, wine, liquor, milk	40¢ for REFPET, other rates for refillable glass
Belgium	Beer, soft drinks, soda water. As of 1998, wine and liquor	<50cl:12¢ >50cl:24¢
Canada (regions)	Beer, wine, liquor, soft drinks	Cans: 4-14¢, Plastic: 4-6¢, Glass: 4-29¢
Czech Republic	Glass bottles (beer, wine, and soft drinks)	1l soft drinks: 15¢ Others: 11¢
Denmark	Beer, soft drinks	Glass <99cl:27¢, >99cl:78¢ REFPET:78¢
Finland	One-way beer and soft drinks (metal, glass, plastic)	Small: 11¢, Large: 45¢
Hungary	Glass bottles	0.5l: 6¢, 0.7l: 9¢, 1l: 14-23¢
Iceland	Plastic and glass	Plastic and glass (alcoholic beverages): 9¢ Mineral water: 23¢
Nether-lands	Soft drinks, mineral water (glass and plastic)	<0.5l:16¢, >0.5l:72¢ REFPET:64¢
Norway	Beer, wine, liquor, carbonated and non-carbonated drinks	<0.5l:16¢ >0.5l:40¢
Poland	Plastic and glass	0.5-0.7l glass: 8¢ 2l plastic: 5¢
Sweden	Cans, bottles, PET	Cans:7¢ One-way PET:14-24¢ REFPET:56¢
Switzer-land	Beer, soft drink, and mineral water	Glass<.6l:16¢, >.6l:40¢ PET:40¢

Sources: Container Recycling Institute; Regional Environmental Center for Central and Eastern Europe (1995), p. 14; OECD (1994a), pp. 83-5.

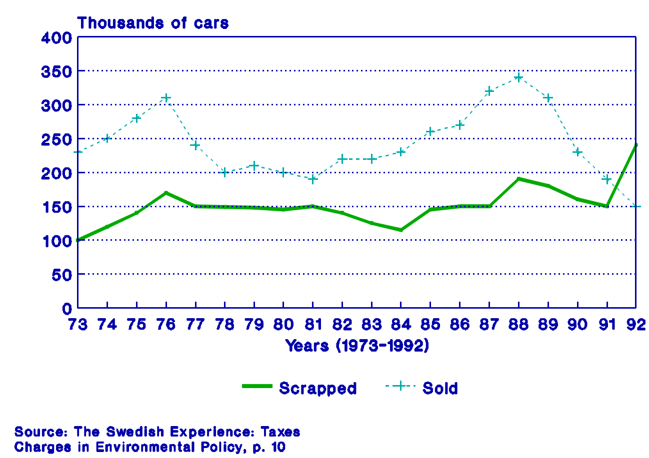
Sweden's deposit on aluminum cans is voluntarily implemented by industry in response to 1982 governmental legislation stipulating that aluminum cans would be banned unless a 75% recycling rate was attained. In 1994, the mandatory rate was raised to 90%. Industry created a corporation to recover the cans. The deposit was initially set at 0.25 SEK ($0.037) per can but was later raised to 0.5 SEK ($0.074) per can. A fee of approximately 1¢ per can has helped make the system self-financing. As shown in Figure 11-10, the recovery rate has risen to over 90%, the highest percentage in the world and nearly 30 percentage points higher than in the U.S. A similar system was recently established for PET bottles.[72]

Figure 11-10: ALUMINUM CAN RECYCLING RATES



Greece, Norway, and Sweden have mandatory deposit-refund systems for car hulks.[73] Under the Swedish system created in 1975, mandatory deposits on new cars finance payments to individuals who return old cars to authorized scrap businesses. Originally, the deposit was 250 SEK ($37) and the refund was 300 SEK ($44), but in 1988, the deposit was raised to 300 SEK ($44) and the refund to 500 SEK ($74). In 1992, the deposit was increased to 500 SEK and the refund was set at 1,500 SEK ($221) for cars returned within nine months of an inspection and 500 SEK ($74) for other cars. The purpose of the differentiation was to encourage the scrapping of older cars emitting more pollutants. As shown in Figure 11-11, the ratio of cars sold to cars scrapped has increased, especially after the system was adopted in 1975 and the refund amounts were increased in 1988 and 1992. Although the scrap car refunds have lowered the number of abandoned cars, the incentive effect has been reduced by deductions of some motorists' unpaid taxes and fines from their refund payments and by their desire to keep old cars for spare parts. Administrative costs of this system are relatively low at approximately 2% of revenues.[74] The deposit-refund system in Greece, under which motorists must purchase a new vehicle with a catalytic converter to qualify for a refund, has significantly increased the prevalence of catalytic converters.[75]

Figure 11-11: CARS SOLD AND SCRAPPED IN SWEDEN



Germany has mandated deposit-refund mechanisms for packaging if recycling targets are not met voluntarily by industry.[76] The mandate led German companies to create the Duales System Deutschland described above. Austria requires deposits of 12 S ($11.6) for fluorescent light bulbs.[77] The percentage of light bulbs returned is 60-80%.[78]

After revising its Waste Disposal Act in 1988, Taiwan implemented a deposit-refund program for PET bottles. The amount of the deposit is NT$2 (8¢) per bottle. Collectors delivering bottles to recycling plants receive NT$0.50 (2¢) per bottle. As shown in Figure 11-12, recycling rates have risen significantly since adoption of the program.

Under a 1991 amendment to its Solid Waste Management Act, South Korea has introduced a deposit program including a much larger number of products than those countries discussed above.[79] The products affected by the system and the deposit amounts are shown in Table 11-19. Producers and importers of the listed products pay the deposits but can receive refunds as they collect the resulting post-consumer waste. During the first year of operation, deposits amounted to 24.5 billion won ($31.4 million), but refunds were only 1.9 billion won ($2.4 million), indicating an 8% refund rate. This relatively low refund rate could indicate that deposit amounts are too low to significantly influence behavior. The largest deposit applies to large tires and amounts to about $0.50.

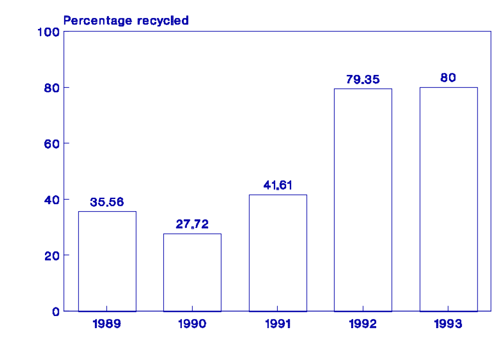
As discussed in Section 5, another type of deposit mechanism is an environmental performance bond. Individuals or companies pay such bonds to responsible authorities but are refunded to the extent that they avoid causing environmental damage or remedy any damage they do cause.

Indonesia has used performance bonds for forestry. Under a scheme initiated in the late 1980s, loggers paid deposits of $\$4/m^3$ of extracted timber and could obtain refunds through reforestation. One problem with this system was that the fee was far lower than replanting costs, giving logging companies insufficient incentive to reforest. Another problem was that the bonds created incentives to clear cut forests to start plantations to qualify for refunds.[80] Similar forestry bonds of approximately $400 per hectare have been introduced in the Philippines. Since reforestation costs have been estimated at $500 per hectare, the Philippines' deposit may be too low to encourage sufficient reforestation.[81]

Malaysia has used deposits since 1960 to encourage the rehabilitation of mined areas. Amounts range from M$1,000-5,000 ($400-2,000) per acre.[82] Other countries in which mining deposits have been used include Canada and Australia.

In January 1996, China announced a scheme to require land developers to pay "reclamation guarantee fees." The State Land Administration said that the fee could cost the equivalent of $1,800 per hectare. The scheme seeks to counter land degradation caused by industry. Accord-

Figure 11-12: PET BOTTLE RECYCLING RATE IN TAIWAN



ing to SLA, "persistent damage to farm land has already become a major factor restricting the development of some local economies."[83]

Table 11-19: DEPOSITS IN SOUTH KOREA

Product		Deposit amount ($=780 won)
Paper pack:	less than 250 ml	0.2 won
	greater than 250 ml	0.4 won
Metal can:	lid attached	2 won
	lid separated	4 won
Glass bottle:	less than 100 ml	1.5 won
	less than 350 ml	2 won
	over 350 ml	3 won
PET bottle:	less than 500 ml	3 won
	less than 1,500 ml	5 won
	over 1,500 ml	7 won
Batteries:	mercury	100 won
	silver oxide	50 won
Tires:	large	400 won
	medium	100 won
	motorcycle	40 won
Lubricating oil		20 won
Televisions		30 won
Washing machines		30 won
Air conditioners		30 won

Source: Rhee (1994), "The Use of Economic Instruments in Environmental Protection in Korea," p. 103.

11.3. MARKETABLE PERMIT SYSTEMS

Although marketable permit systems have been considered in several countries, their use remains much more common in the United States than elsewhere. Systems have been established on a limited scale in Germany, Canada, Chile, and several other countries to reduce air pollution, in Australia to reduce water pollution, and in several countries to limit water use. Singapore and Mexico have used permit systems to lower the use of ozone-depleting substances.

Singapore's Certificate of Entitlements for motor vehicle ownership also constitute a market-based permit system. This quota system is discussed earlier in this section in the sub-section on vehicle taxation. In addition, three Central Asian countries recently announced a trading scheme involving energy and water.

11.3.1. Air Pollution

Under the terms of Germany's 1985 Federal Immision Control Law and 1986 Technical Instructions on Air Quality Control, new sources of air pollution can be established in areas with especially poor air quality provided that pollution from nearby sources is lowered so that total emissions in the area are lower after construction of the new facility. This rule allows polluters to negotiate to determine who will reduce emissions and by how much. Under another scheme in effect until 1994, an existing facility could obtain a temporary exemption from tighter emissions abatement standards if it and nearby polluters achieved significant combined emissions reductions.

The impact of these offset provisions has been minimal. For existing facilities, trading opportunities were severely limited by a number of factors:

1. The deadline for submitting detailed trading plans to the authorities was one year, whereas the deadline for individual plant improvements was three years. Not only did plans have to be developed within a year, they had to be implemented within 2-5 years.

2. Facilities involved in trading had to be very near each other. In one case, two facilities within 2.5 km of each other were prevented from trading because they did not share a common pollution impact area as determined by law. Intra-firm trading is usually the only viable option.

3. Businesses could not use emissions reductions from newer facilities as credits. Facility operators say including such sources into the program would have significantly increased trading possibilities.

4. Reductions resulting from facility shutdowns could not be counted for trading purposes.

5. The vagueness of the requirement that "technical measures" be undertaken to achieve reductions caused uncertainty.

6. Differences between actual emissions and allowable maximum emissions under clean air laws could not be counted for offsets. Moreover, trading schemes had to result in emission reductions below what would be achieved through individual plant improvements.

7. Trading could occur only for a given substance or between substances with the same health and environmental effects. The question of whether certain substances have the same pollution effects proved difficult to resolve in a timely manner.

8. In the best of cases, the trading scheme allowed firms to delay (until the 1994 deadline) rather than avoid pollution abatement investment at old facilities.

Out of roughly 17,000 pollution abatement initiatives in Federal Environment Office statistics for 1991 and 1992, fewer than 50 involved offsets.[84]

According to the German Industries Association (BDI), the new source offset provisions, much like those for old sources, have involved almost exclusively intra-firm trading. The most common application appears to be the creation of a new source alongside an existing one that it will eventually replace. One recent inter-firm initiative involved several fluoride-emitting ceramics factories concentrated in the Koblenz region. The factories sought to negotiate an arrangement under which only the larger ones would install abatement equipment while the smaller ones would help them pay for it. However, this initiative failed.[85]

Canada's acid rain and CFC reduction programs make limited use of trading rights. The Province of Ontario's electric utility is allowed to trade emissions between its power stations, and the Province allows trading between SO_2 and NO_x emissions. CFC producers are allowed to trade production rights between facilities and to trade between different types of CFCs. Inter-business trading is not allowed under this system. There has been little trading under these programs.

In Santiago, Chile, an air pollution commission has introduced a tradable permit scheme for industrial sources of particulate whose emissions exceed 1,000 m^3/hour. As in the United States, new sources are allowed only if their emissions can be offset by reductions from existing sources. Trading also takes place between sources exceeding their emissions allowances and those emitting less than their allocated amount. Maximum daily emissions (and allowances for each source) are gradually being reduced to a target level to be attained by 1997.[86]

Poland experimented with tradable air pollution permits in the Chorzow area. According to an Eastern European study of incentives in environmental policy, this experiment "proved extremely successful in bringing visible improvements more rapidly and at a lower cost than attainable through traditional instruments." Lack of legal basis for tradable permits has prevented the use of such schemes elsewhere in the country. An environmental protection bill has been proposed including language that would provide a legal framework for trading schemes.[87]

A 1993 revision of Taiwan's Air Pollution Control Act included provisions under which individual sources may be exempted from emission standards if they can control sufficient amounts of the same types of emissions elsewhere in the same air pollution control region. It is not clear how widely these provisions have been applied.[88]

The U.S. Agency for International Development has worked with at least two other countries, the Czech Republic and Kazakhstan, to create air emissions trading programs. As of early 1996, the Czech program was still in a developmental stage.[89] In late 1996, the first trade occurred in Kazakstan when one source gave a package of future rights to emit 10 pollutants to a second source in exchange for rights to emit 6 mostly different pollutants plus a modest cash payment. In both cases the rights were unused permitted amounts. With this trade, air quality is expected to decline since total emissions will increase.

Like the United States and Canada, Mexico and Singapore sought to ease the phaseout of CFCs through marketable production quotas. In Singapore, CFC use permits were allocated quarterly, half on the basis of historical use and half through sealed bids. In registering to participate in the bidding, users and importers specified the quantity of CFCs they wanted and their offer price. The lowest winning bid price served as the price for all allocations, including those based on historical use. This system gave firms a strong incentive to substitute other products for CFCs or adopt other measures to limit CFC use.[90]

11.3.2. Water Pollution

Three states in Australia take part in the Murray-Darling Basin Commission, which manages water resources for an area in which over half of Australia's agricultural output is produced. The basin system is naturally saline, with some stream inflows saltier than the sea. Extensive irrigation activities in the upstream states of New South Wales and Victoria, encouraged by the sale of irrigation water to farmers at low prices, increased the flow of salt into the river system, reducing water quantity and quality to the downstream state of South Australia. Irrigation activity in South Australia further added to salinity levels of the water before it reached downstream urban users.

Under the Commission's salinity and drainage strategy, each state is responsible for its actions affecting river salinity and no actions are permitted that increase overall river salinity. Credits can be earned for investments that limit the entry of salt into the river system offset. The credits are used to offset debits for drainage into the system.[91] These credits are transferable between states but not between individuals and businesses.[92]

11.3.3. Water Use Rights

The Murray-Darling Basin also has periodic water allocation auctions. These allocations are tradable. Volumes traded, although small compared to total water allocations, have increased steadily. "Since temporary trading, or leasing of water entitlements was introduced in 1989 in the Goulburn Murray Irrigation District of Victoria the volume traded each year has increased from 21927 ML to 206872 ML or 8% of total water use during the drought of 1994."[93] In New Zealand, water use permits may be transferred to another site provided that both sites are in the same catchment area, the transfer is allowed by a regional plan, and the transfer application has been approved by the permitting authority.

Under Chile's 1981 Water Code, water use rights are completely separate from land use rights and can be purchased, transferred, or sold. New water rights are awarded by competitive bidding. Between April 1993 and April 1994, 587 sales transactions involving 720 liters of water per second were recorded in the Santiago water registry for a total estimated value of $366,050. Partly because most water rights (perhaps 50%-65%) are traditional but not legally recognized, water leases are far more common than sales. In one area north of Santiago, the price of a three-month lease was estimated at $90-120 per liter per second. Transaction costs are said to be relatively high because of the need for infrastructure investments to transfer water, the need for approval from government authorities, and the lack of legally recognized water rights. In general, however, the system appears to promote efficient water allocation.[94] Intra- and intersectoral gains-from-trade of water use rights have been significant.[95]

Water trading takes places in other countries, but no comprehensive list of such initiatives was identified during the course of the research for this report.

11.3.4. Water-energy Trading

In April 1996, the Central Asian republics of Kyrgyzstan, Uzbekistan, and Kazakhstan announced an agreement intended to address the region's water and energy supply problems. Relying on hydroelectric power from the Syr Darya River for its heating needs, Kyrgyzstan stores water in spring and summer to have sufficient supply flowing through its hydroelectric dams in winter. The diversion of water in spring and summer has deprived Uzbekistan and Kazakhstan of water supplies during cotton irrigation season and contributed to a significant fall in the water level of the Aral Sea. Under the agreement, Kyrgyzstan will supply hydroelectricity and ensure sufficient flow of water through the Syr Darya River in return for gas from Uzbekistan and coal from Kazakhstan. While it is too early to assess the effectiveness of this trading scheme, it is patterned after historic water and energy transfers that took place when the entire region was centrally managed as part of the Soviet Union.[96]

11.4. SUBSIDIES

Loosely defined as government financial support of activities believed to be environmentally friendly, subsidies have been used in environmental policy in numerous countries. They take various forms, including grants, low-interest loans, and tax incentives. Although they are far too numerous and varied to be covered comprehensively in this report, a few examples are provided below.

In some cases, subsidies are financed by advance disposal fees and other charges such as those described above. For example, Italy's aforementioned product charges on batteries, plastic beverage containers, and lubricating oil finance the otherwise unprofitable activities of collecting used products. The charge revenue covers the difference between the cost of collecting these used products and their reuse value. Several other countries, including Finland, France, and Spain, rely on charges on lubricating oil to subsidize used oil collection, and Taiwan has used taxes on bottles and tires to subsidize the collection and reuse of these products. In several European countries, water effluent charges fund subsidies for water pollution abatement.

Loans can be a form of environmental subsidy. Germany, for example, has used large portions of its European Recovery Program (ERP) low-interest loan fund to finance environmental protection activities. In 1995, the German government issued over 2,600 loans totaling DM 4.5 billion ($3.1 billion) to companies for environmental purposes under the ERP, including DM 1.8 billion ($1.2 billion) for energy conservation, DM 1.1 billion

($750 million) for air and noise pollution, DM 1.3 billion ($880 million) for waste management, and DM 300 million ($200 million) for water purification. The government-owned Deutsche Ausgleichsbank administers the loans.[97]

In most countries in Eastern Europe and the former Soviet Union, environmental funds have been set up to provide grants and loans for environmental protection initiatives. These funds are financed primarily by pollution charges. One of the largest is Poland's National Fund for Environmental Protection and Water Management, which had revenues of $284.0 million and expenditures of $198.5 million in 1993. Of the expenditures, 47% were for air, 35% for water, and 18% for other environmental protection activities.[98]

Environmental funds are also common in East Asia.[99] As noted earlier in this section, taxes have been imposed on sulfur emissions in Japan to generate revenues for a fund to compensate victims of pollution-related diseases. This fund is administered by the Pollution-Related Health Damage Compensation and Prevention Association. Japan also has a 50 billion yen ($470 million) fund to finance air pollution prevention activities. Fund capital is provided 80% by polluting industries and 20% by government, and fund profits finance a wide range of "health damage prevention project" activities.

Established in 1993, Korea's Environmental Pollution Prevention Fund is financed by pollution fines and charges as well as government contributions. Administered by the semi-governmental Environmental Management Corporation, the fund has provided long-term, low-interest loans for pollution control investments and compensation of pollution victims. As of 1990, the fund contained 11.6 billion won ($14.8 million).

Thailand created a 5 billion baht ($190 million) Environment Fund in October 1991. The fund was initially financed entirely by government and is intended to finance pollution control investments by small- and medium-size enterprises. Indonesia's Pollution Abatement Fund was created to provide $300 million to banks to lend to businesses for pollution control investments and environmental assistance.

According to a study by the American Council for Capital Formation Center for Policy Research, several countries in Eastern Europe, Asia, and Latin America offer substantial tax advantages for investments in pollution control technology. The most common type of tax advantage in foreign countries is accelerated depreciation of pollution control equipment, but tax credits are also offered in some cases. In general, the report found, such tax advantages are significantly less generous in the United States than in the ten foreign countries included in the study.[100]

11.4.1. Subsidies for Environmentally Friendly Agriculture and Land Management

Numerous countries use subsidies to promote environmentally friendly agriculture.[101] Germany, Finland, Norway, and Sweden offer grants to farmers who convert from traditional to organic farming. Canada's provinces subsidize farmers' efforts to comply with codes of acceptable environmental practices, and the country's Land Management Assistance Program provides a variety of land management subsidies. In the Province of New Brunswick, for example, the Ministry of Agriculture offers payments for practices that increase the organic content of soil and reduce soil erosion, including payments of C$15 ($11) per acre for winter catch crops and of C$50 ($30.5) per acre for green manure crops.

The United Kingdom is one of several European countries that reward farmers for not spraying around the edge of crops. Studies show that the crop-edge program in the U.K. has enhanced bird and butterfly populations while having minimal impact on crop yields. Under Germany's Nature Conservation Act, farmers are rewarded for adopting environmental management practices such as reducing fertilizer use, refraining from converting grasslands into cropland, and refraining from using meadows while insects are hatching.

The European Union's Common Agricultural Policy requires member countries to offer financial assistance to farmers for recommended practices in environmentally sensitive areas such as water protection zones. In nitrate-sensitive areas of the United Kingdom, farmers can receive annual per hectare payments for limiting their use of nitrogenous fertilizers and animal manure, establishing crop cover to avoid bare land in the fall, and keeping hedges and woodland.

Faced with serious manure waste problems, Hong Kong introduced a program in the late 1980s to pay allowances to farmers if they stopped maintaining livestock.[102] Several Alpine countries subsidize sustainable agriculture and animal husbandry activities in mountainous areas to prevent environmental degradation.[103]

Belgium is one of a number of countries subsidizing reforestation activities. In the Belgian region of Flanders, private forest owners can obtain subsidies for reforestation, granting access to the public, and forest grouping.[104] In 1994, Finland announced revisions in its tax structure for forests. Under the revised system, forest reserved for non-commercial purposes and designated in officially approved management plans will not be taxed based on its prospective yield as before, but rather will remain tax-free for a 13-year transition period.[105] The United Kingdom provides grants for the planting of trees and hedges on agricultural land.[106] In Portugal, farmers can obtain subsidies and concessional loans for reforestation and creation of permanent pastures, and Spain and Turkey offer grants for afforestation and other land restoration activities. In Japan, forest owners can receive grants, low-interest loans, and favorable tax treatment in return for observing specified land management practices.[107]

11.4.1.1. Subsidies to Reduce Vehicle Emissions

Many countries have used subsidies to attempt to reduce vehicle emissions. France adopted a law in October 1995 that provides for payments of 5,000 F ($1,000) to 7,000 F ($1,400) for the scrapping of old cars in exchange for new ones. The cars must be at least eight years old and must be disposed of by authorized scrapping firms to qualify for the payments. Payments of 5,000 F are offered for buyers of compact cars and of 7,000 F for buyers of larger models. The offer expires September 30, 1996.[108] Purchasers of electric vehicles are eligible for payments of 5,000 F from the French Government and 10,000 F from the French national electricity company. These payments are equal to approximately 8-10% of the price of an electric vehicle.[109]

In the Canadian province of British Columbia, car owners receive payments of C$750 ($550) to retire older vehicles. Jointly funded by the oil industry and automobile dealers, with support from the public electric and transit companies, the B.C. Scrap-it Program was introduced in April 1996. It is expected to retire up to 1,100 vehicles in its first year and to reduce over 10,000 tons of pollution over the next five years. To qualify for the program, a vehicle must have been manufactured prior to 1983, be driven more than 5,000 kilometers annually, and fail the province's mandatory emissions test. A 1995 study by the B.C. Lung Association found that vehicle scrapping programs were among the most cost-effective emission reduction initiatives. According to the B.C. Automobile Dealers Association President, 40% of vehicles in circulation account for only 25% of distance traveled but 75% of automobile emissions.[110]

Japan plans to assign 10-20 low-emission vehicles (powered by natural gas, methanol, or electricity) to municipalities in 1996. The central government will share maintenance, fuel, and other costs with the municipalities.[111] In Austria, low-noise trucks receive favorable tax treatment.[112] In the Netherlands, public transportation commuters receive tax advantages.[113]

In January 1996, the government of Thailand announced incentives for manufacturers of four-stroke motorcycle engines in an effort to provide alternatives to the two-stroke motorcycles currently common in major Thai cities. According to a 1993 World Bank report, the older design two-stroke engines discharge up to ten times as much pollution per kilometer as the newer four-stroke engines. Manufacturers of four-stroke engines will benefit from 90 percent reductions in import duties for raw materials. Manufacturers who locate in Zone 3 areas (i.e., outside the Bangkok area and the surrounding 15 provinces) will also receive exemptions of machinery import duties, corporate income tax (for eight years), and double tax deductions for electricity, water, and transportation costs. These location incentives could help limit congestion and the strain it imposes on the environment in the Bangkok area.[114]

11.4.2. Subsidies for Resource Conservation

Another area where subsidies have been used extensively is the promotion of resource conservation. Denmark has offered grants for activities such as renewable energy source power generation, energy-saving measures, and used oil collection and exempted energy-efficient light bulbs from the aforementioned product charge on bulbs.[115] The Netherlands has exempted recycling wastes from its recently imposed waste tax and exempted water used to wash recyclable beverage containers from its new groundwater tax. Both of these taxes were described above.

In the Australian community of Kalgoorlie-Boulder, where water is supplied by a 550-km pipeline, a $2.6 million (US$2.0 million) campaign has been initiated with the goal of reducing water use from 7,700 ML / year to 6,700 ML / year. The campaign includes water consumption audits of businesses provided at 50% of cost, a $300,000 (US$232,000) revolving loan fund to finance water- efficient technologies, and a mail-order package of domestic water savings options with the possibility of subsidized replacement of less water-efficient appliances.[116]

In Switzerland, individuals may deduct energy-saving improvements from their taxable income, and businesses' expenditures on energy-efficient equipment, solar power, and other similar investments are subject to accelerated depreciation. Australia exempts certain recycled paper products, solar power equipment, and alternative fuel technology from its Wholesale Tax.[117]

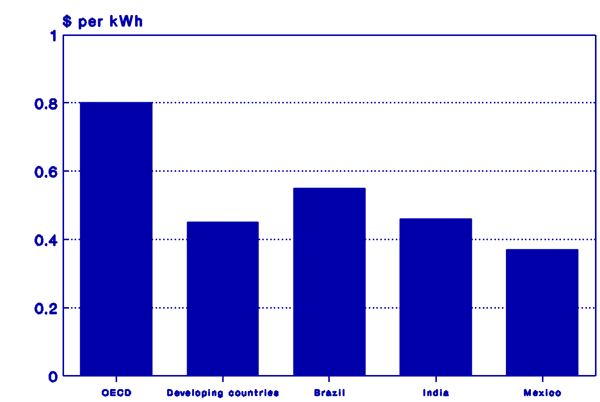
11.4.3. Environmentally Harmful Subsidies

Section 7 described a number of subsidies found in the United States that are believed to be detrimental to the environment. Such subsidies are also common in other countries but cannot be described in detail here.

For example, it has been estimated that tax benefits for businesses contributed to 5% of the total area deforested in the Brazilian Amazon.[118] In much of the world, forest resources, waste collection, water, and electricity are priced far below their value. Fertilizers and pesticides, which are taxed in several European countries, are subsidized in parts of Asia.[119] In much of the world, forest resources, waste collection, water, and electricity are priced far below their value.

As shown in Figure 11-13, electricity is far cheaper in developing countries than in OECD countries. While marginal supply costs in developing countries are generally at least 10¢ per Kwh, energy prices are below 6¢ per Kwh. These countries use about 20% more electricity than they would if consumers paid the true marginal cost of supply.[120]

Figure 11-13: ELECTRIC POWER PRICES, 1988



Source: World Bank (1992), p. 117

11.5. PRODUCT LABELING

The role of product labeling in environmental policy is to inform consumers of the influence of products on the environment. Products that are thought to have environmental advantages could bear labels indicating that they are environmentally friendly. Products that are believed to be harmful to the environment could bear labels indicating that they are environmentally unfriendly.

As noted in Section 9, labeling schemes in the United States have all been either private or limited to certain products or specific product attributes. As shown in Table 11-20, however, governments in numerous other countries have adopted official seal of approval labeling initiatives. In addition, a few multi-national labeling systems have been developed, including the Nordic Council label for Finland, Sweden, Norway, and Iceland and the European Union eco-label for EU member countries. Several private international labeling schemes were discussed in Section 9. The Green Dot placed on packaging of products managed by the Duales System Deutschland described above is also a form of environmental labeling that can influence consumer behavior. These labeling systems vary in extent and in criteria used to determine products' environmental friendliness.

Table 11-20: ENVIRONMENTAL LABELS IN SELECTED COUNTRIES

Country or Organization	Label Name
Australia	Environmental Choice
Canada	Environmental Choice
France	NF-Environnement
Germany	Blue Angel
India	Ecomark
Japan	Eco-Mark
Korea	Eco-Mark
Netherlands	Milieukeur (Environmental Review Foundation)
New Zealand	Environmental Choice
Singapore	Green Label
Sweden	Bra Miljöval (Good Environmental Choice)
Thailand	Green Label
European Union	Ecolabel
Nordic Council (Norway, Iceland, Finland, Sweden)	White Swan

Source: EPA (September 1993), p. 41.

One of the oldest environmental labeling programs is Germany's Blue Angel. Since the creation of this program in 1977, over 4,000 products, including non-CFC spray cans and retread tires, have received approval from the German Environmental Agency to use the Blue Angel. A jury of representatives from industry, environmental groups, public authorities, and others rates label candidates based on their use of resources, greenhouse gas emissions, and other criteria.[121]

The Blue Angel program appears to be well known and to have had significant incentive effects on German businesses. A 1988 survey found that 79% of German consumers were familiar with the label and that 68% linked it with environmental protection.[122] The German government says that the label allowed the tightening of oil and gas heating appliance emissions standards by over 30% in a few years. It also credits the label with increasing the market for paints, lacquers, and varnishes low in VOC content, resulting in reductions of solvent air releases of 40,000 tons. One potential problem is that some firms have been reluctant to seek the label for certain products because they fear that it will discourage consumers from purchasing their non-labeled products.[123]

Under a program introduced in 1989, the Japan Environmental Association, an affiliate of the Environmental Agency, has authorized approximately 2,500 products in 61 categories to bear the Eco-Mark environmental friendliness label. However, a 1993 report found that only 30% of the Japanese population purchased eco-friendly products. Authorities attributed this low percentage in part to lack of education on such products and are working with industry to publicize the benefits of environmentally friendly products.[124]

Canada's Environmental Choice label is awarded to products made or offered in a manner that improves energy efficiency, reduces hazardous by-products, or uses recycled materials. Since the introduction of the label in 1988, guidelines have been developed for about 30 product types, and more than 1,400 products have been approved.

Anecdotal evidence suggests that Canada's label has had incentive impacts. A Canadian envelope company reported that the share of recycled paper envelopes in its sales rose from 10% before it became the first envelope to receive the label in 1990 to more than 40% two years later. A 1993 survey found that 51% of the Canadian public was aware of the label. A 1992 survey of companies licensed to use the label found that 71% "agreed" or "strongly agreed" that it was "a good business investment" and that 80% had used the label in their advertising.

Korea initiated its Eco-Mark labeling program in June 1992.[125] Unlike many other labeling schemes, Korea's program has focused on "defining the single most important criterion for each product category." This practice stems from the belief "that the large data requirements for the life cycle approach are difficult to meet in practice." Table 11-21 shows that the labeling criteria for thefirst 12 product categories approved under the program are far simpler than the life cycle assessment criteria employed in several other countries.

The program appears to have had incentive effects. Sales of recycled paper increased by 30% after the introduction of the program. As of 1993, however, there was no evidence that the label had an effect on sales in other product categories.[126]

In 1992, the European Communities (now referred to as the European Union) created an EU-wide eco-label award scheme to "promote the design, production, marketing and use of products which have a reduced environmental impact during their entire life cycle" and "provide consumers with better information on the environmental impact of products, without, however, compromising product or workers' safety or significantly affecting the properties which make a product fit for use." Criteria are developed for each product group before products can be considered for the label. One source reports that the EU has the most thorough product assessment standards of any labeling program and that the rigorous standards have the possible disadvantages of causing delays and high costs.

Table 11-21: KOREAN ECO-MARK PRODUCT CRITERIA

Product category	Criteria
Products made with reused paper	> 50% reused paper
Tissues made with reused paper	> 50% reused paper
Reused plastics	> 60% plastics
Aerosol sprays without CFCs	0% CFCs
Reusable diapers	100% cotton
Non-asbestos brake lining	0% asbestos
Aluminum cans with stoppers	Should use aluminum
Filter for kitchen sinks	Holes no larger than 1.5 mm diameter
Non-bleached and un-dyed towels	Made without dyes or bleach
Water valves	Water should not run after valve is closed.
Packaging materials using wastes	Made with 100% wastes
Soap made with waste edible oil	Made with >50% waste edible oil

Source: EPA (September 1993), p. 92.

Applications are submitted to individual member states and are subject to an application fee that must be between 400 ECU ($500) and 600 ECU ($750). Annual fees for label holders must be between 0.12% and 0.18% of annual sales of the product.[127] The EU labeling scheme has experienced significant implementation delays. As of December 1995, only one company, a washing machine manufacturer, had applied and been approved for the label.[128] In February 1996, the EU Environment Commissioner called the eco-labeling program a failure and announced that it would be overhauled.[129]

As noted in Section 9, environmental labeling schemes need not be national or international in scope. In parts of Australia, for example, the authorities have rated shower systems on their water use efficiency. Consumers are then informed of the ratings so that they can purchase water-efficient systems if they so choose.[130]

11.6. INFORMATION DISCLOSURE REQUIREMENTS

Requirements that firms examine and report on their environmental performance to government and the public, such as the Toxic Release Inventory requirement in the United States, give polluters an incentive to behave in an environmentally responsible manner. Other factors being equal, businesses with relatively strong environmental performances might be able to attract more customers than their competitors.

In November 1995, the OECD agreed to a Council Act recommendation proposed by the United States that each member country develop a pollution release and transfer database.[131] In February 1996, the OECD ministerial Environment Policy Committee endorsed this initiative as "an important step towards better informing citizens about pollution sources and risks in their communities."[132] Canada, the United Kingdom, and the Netherlands already have such databases, and several other countries are creating them. The European Union is reviewing integrated pollution prevention legislation that is expected to include a database provision.[133]

At least two international organizations, the International Standards Organization and the European Union, have prepared guidelines for environmental performance auditing in businesses. In both of these cases, however, the guidelines are voluntary. The European standards-setting body, CEN, has prepared a document that attempts to help companies bridge the gap between the two sets of guidelines.

The European Union's eco-management and audit scheme (EMAS) was created by Council Regulation No. 1836/93 of June 29, 1993. Although it is voluntary, it may still have a significant incentive effect. A company's mere decision on whether to participate in such a program could influence the public. Moreover, experiences with such programs could lead the EU or some of its member states to either make the program mandatory or create additional incentives for participation. One incentive the EU intends to consider is the introduction of a logo for participating companies.

In line with the spirit of the EMAS, the Ministers of Environment and Water Management in the Netherlands submitted a proposal in January 1996 that would require about 300 industrial firms to report on their environmental performance to the government and the public. The reports would have to include the effects of a company's activities on the atmosphere, soil, and surface waters, the environmental protection measures taken by the company, and the results expected from the measures. Companies already participating in the EMAS would be exempted from the new Dutch requirements.[134]

In Indonesia, the Environmental Impact Management Agency rates numerous factories on their compliance with national environmental standards and their implementation of environmental management systems. The first of these surveys in June 1995 rated 187 factories and the second in December 1995 rated 213. Five color categories were used to rate environmental performance: gold for firms that use best technology, green for firms that exceed national standards, blue for compliance with national standards, red for firms that fail to meet national standards, and black for those without environmental management systems. Evidence suggests that this system could already be influencing behavior: the percentage of factories in the bottom two categories dropped from more than 60% in the first survey to 56% in the second survey, and three of the six factories rated as black in the first survey improved their performance.[135]

Environmental impact assessments (EIAs), which appear to have been initiated in the United States, have since become common in numerous other countries. Canada, Australia, and the Netherlands adopted EIA requirements in 1973, 1974, and 1981, respectively. OECD issued recommendations on conducting EIAs in 1974 and 1979. The

European Communities (now the EU) issued a directive in 1985 requiring member countries to assess the environmental impacts of certain public and private projects. Several East Asian countries, including Japan, Korea, Indonesia, Taiwan, and Thailand, also required EIAs. The types of projects subject to the requirements and the degree of public participation varies.[136] The Slovak Republic has required EIAs since 1992. As noted in Section 9, the information generated by EIAs can influence behavior, especially if the public is well informed.

11.7. VOLUNTARY PROGRAMS

As discussed in Section 10, voluntary programs have played a role in addressing numerous environmental problems in the United States. Among the incentives to undertake voluntary initiatives are the possibility of generating positive publicity and of avoiding more onerous regulations that environmental authorities might otherwise impose. In addition, some governments provide free or subsidized technical assistance under voluntary programs. The large number of programs in various countries rules out comprehensive coverage here.

The Netherlands' use of covenants, agreements between industry and government, to address environmental problems has attracted considerable attention in recent years. Covenants generally have the legal status of private law agreements, allowing the authorities to seek legal recourse for enforcement. As of 1995, 26 environmental covenants have been signed between industry and the government concerning products, packaging, waste, and other matters. In the field of air pollution, covenants have been concluded on the reduction of SO_2 and NO_x from power plants, the reduction of VOC emissions from industry, small businesses, and households, and the phaseout of CFCs.[137]

In Japan, voluntary pollution control agreements date back to the 1950s. As of September 1991, about 37,000 agreements were in effect. Of the 2,553 agreements concluded over the previous 12 months, 476 involved local citizen participation, of which 259 were reached directly between citizens and businesses.

Under Indonesia's PROKASIH (or Clean Rivers Program), the largest polluters are encouraged to sign agreements to reduce pollution by specific amounts over a specific time period. In the first 2 1/2 years after the start of the program, about 1,000 polluters signed agreements, the majority of which took measures to reduce pollution. The government has released information on which signatories have complied and which have not and encouraged press coverage of signatories' performance under the program.[138]

11.8. DEBT-FOR-NATURE SWAPS AND JOINT IMPLEMENTATION

Under debt-for-nature swaps, partial debt forgiveness is granted to less-developed countries (LDCs) on the condition that they fund environmental programs. One rationale behind such swaps is that indebtedness and environmental degradation are often linked. Once indebted, LDCs frequently subordinate the environment to more immediate problems and exploit their natural resources in an unsustainable manner to generate revenue for debt servicing.

Since the amount of debt forgiven is usually smaller than the cost the LDC incurs for the conditional environmental program, the LDC has an incentive to accept such swap offers. Since a lot of the environmental degradation and pollution in LDCs, such as emissions of CO_2 and CFCs and destruction of rain forests, has negative repercussions throughout the world, wealthier creditor nations gain from debt-for-nature swaps as well. Swaps can also improve commercial banks' debt portfolios by discounting bad debt.[139]

As described in Section 6, joint implementation (JI) refers to a process under which organizations in one country undertake mitigation and sequestration of greenhouse gas emissions in another. Other countries have not carried out JI activities to the same extent as the United States. However, Japan is asking businesses to participate in JI projects. It plans to set up an "APEC environment technology exchange virtual center" to promote the transfer of Japanese carbon dioxide emission containment technologies to members of the Asia-Pacific Economic Cooperation Forum.[140]

Biotechnology development agreements concluded between landowners and biotechnology businesses have the potential to create incentives for biodiversity preservation by allowing landowners to sell genetic resource found on their land.[141] An agreement of this nature between the pharmaceutical company Merck and the National Biodiversity Institute (INBio-Instituto Nacional de Biodiversidad) in Costa Rica has attracted considerable attention. Under the terms of this agreement, INBio received a $1 million payment, over $100,000 worth of equipment, and staff training locally and at Merck facilities. INBio is also entitled to a percentage of royalty payments for discoveries made by Merck and must share its percentage with the Costa Rica Ministry of Natural Resources. Merck has first rights to patent discoveries.

Frisvold and Condon (1994) concluded that the Merck agreement "provides only modest incentives for biodiversity preservation," incentives that "are small not only in absolute terms, but, more importantly, they are small relative to incentives for conversion created by existing agricultural policies." Such agreements, they find, "can play only a limited role in a comprehensive strategy to increase incentives for biodiversity conversation." However, Blum (1993) maintains, "Merck/INBiolike agreements represent a profitable alternative to deforestation and provide nations with a greater incentive to preserve their biodiversity than is provided by any type of legislative action or regulation."[142]

11.9. TREND OF INCREASING USE OF ECONOMIC INSTRUMENTS IN FOREIGN COUNTRIES

To provide insight into trends in the use of economic incentives, the 1994 OECD report compared the extent of incentives in eight countries (Finland, France, Germany, Italy, Netherlands, Norway, Sweden, and the United States) in 1987 and 1992. (These were the only eight countries for which data had been collected for both years of the comparison.) Because the 1987 survey studied subsidies and other mechanisms not studied in 1992 and because the 1992 survey included more data sources, the comparison of the two years is difficult. In general, however, the report concluded that increases had been "minor in France, Germany, and Italy, moderate in the Netherlands and Norway and extensive in Finland, Sweden and the USA."[143]

Examining the countries not included in the OECD comparison and the period since the comparison, the trend remains. Many of the incentive mechanisms described above had not been implemented at the time of publication of the previous version of this report (1992). New incentive mechanisms appear to far outnumber the mechanisms that have been eliminated.

Further evidence of the trend of increased use of economic instruments is found in the European Union's recent environmental policy statements. The Union's fifth environmental action program adopted in 1992 stated that the "traditional regulatory approach would be continued but supplemented with a wider range of instruments such as the use of economic and fiscal measures (i.e. 'market-based' instruments)." In 1994, the Union "published a new framework of controls over the availability of state aid for environmental purposes." In 1995, the Union prepared a proposal for a Council Directive introducing a tax on carbon dioxide emissions and energy.[144] (However, the Union stopped short of adopting a carbon tax directive.) The Union's initiatives on eco-labeling and eco-management and auditing were discussed above.

The Organization for Economic Cooperation and Development has also expressed interest in increasing the use of economic incentives. The Communiqué from the OECD Environment Policy Committee Meeting held on February 19-20, 1996 stated, "[OECD environment] Ministers welcomed the expanding use of market-based instruments within OECD countries both to improve efficiency and to address dispersed sources of pollution, which are difficult and costly to manage through regulation alone." The ministers urged the OECD to conduct within two years "a wide-ranging analysis of the effects of subsidies and tax disincentives to sound environmental practices in various economic sectors, and the costs and benefits of their elimination or reform, as proposed by the G-7 Environment Ministers in May 1995" and by 1997 "a further examination of the potential for environmental (or "green") tax reform."[145]

The United Nations has also expressed increased interest in economic instruments. After a two-week session of the U.N. Commission on Sustainable Development in April and May of 1996, the Commission chairman said that economic incentives for businesses to protect the environment would be a major goal of a 1997 U.N. General Assembly meeting.[146]

A related trend is several countries' incorporation of environmental considerations into the design of their taxation system in an attempt to shift the tax burden from labor and capital to the use of natural resources and the environment. This principle played a role in recent tax reforms in the Netherlands, Denmark, Norway, Sweden, and Finland. Even in some other countries that have introduced environmental taxes outside the context of major tax reforms, the environmental tax revenues have sometimes been recycled back to the population or compensated by reductions in other taxes. Indicative of this trend, Table 11-22 shows that the percentage of total tax revenues derived from environmental taxes has risen in many countries.

Table 11-22: SHARE OF ENVIRONMENTAL TAXES IN TOTAL TAX REVENUES IN OECD COUNTRIES

Country	1990 (%)	1993 (%)
Austria	4.00	4.35
Belgium	3.83	4.49
Canada	2.87	3.44
Denmark	7.08	7.30
Finland	4.72	5.40
France	4.88	4.92
Germany	5.46	6.12
Greece	7.43	11.85
Ireland	10.35	8.98
Italy	7.82	6.52
Japan	5.11	5.49
Netherlands	5.12	6.12
New Zealand	5.08	4.76
Norway	9.40	10.75
Portugal	10.63	11.52
Spain	5.82	7.54
Sweden	5.77	6.34
Switzerland	4.26	4.65
United Kingdom	7.35	8.23
United States	2.88	3.24
Unweighted Average	6.02	6.67

Source: Morgenstern (1995), p. 12.

Less developed countries have also implemented many economic incentives and expressed interest in adding new ones and improving the existing ones. In 1994, for example, China launched a comprehensive two-year study of its charge system with the intention of expanding and enhancing it.[147]

11.10. CONCLUSIONS

1. The use of economic incentives in environmental management appears to be increasing throughout the world. The available information suggests that this trend holds for every type of economic incentive discussed in this section. Numerous countries have recently implemented a range of economic incentives and are considering others.

2. Among the incentives more widely used in foreign countries than in the United States are environmental product labeling, differential taxation of motor fuels, noise pollution charges, and carbon taxes.

3. Most industrialized countries have user fees for municipal waste and water/sewage and deposit-refund systems for beverage containers. Water user fees are lower in the United States than in most other OECD countries.

4. Market-based permit systems are more common in the United States than elsewhere. To address the problems of SO_2 emissions and leaded gasoline, for example, the United States has used market-based permits, whereas other OECD countries such as France, Japan, Portugal, and Sweden have opted for taxes.

5. Most countries have imposed taxes on gasoline, including higher tax rates for leaded gasoline. These rates are significantly lower in the United States than in all other OECD countries.

6. Taxation of pollution control investments appears to be more generous in most industrialized countries than in the United States.

7. Product charges tend to be revenue-raising instruments with little incentive effect. The lack of incentive can be attributed primarily to the low level of the charges. Moreover, some charges are not closely linked to waste generation or product consumption. However, some of the product charges described in this section, such as fertilizer taxes and the preferential taxation of cleaner motor fuels, do appear to have significant incentive effects.

8. As evidenced by experiences in France, Norway, and Singapore, congestion-based tolls appear to have the potential to significantly reduce traffic during peak hours.

9. Several user and pollution charges appear to have incentive effects. Examples include Sweden's NO_x emission charge, water effluent charges in Germany and the Netherlands, waste charges in Denmark and Korea, and water user or extraction charges in Australia and several Asian countries. However, many user and pollution charges are primarily revenue-raising.

10. Several countries, including Denmark, Finland, the Netherlands, Norway, and Sweden, have attempted to incorporate environmental considerations into the design of their taxation systems in an effort to shift the tax burden from labor and capital to the use of natural resources. In other countries that have introduced environmental taxes outside

the context of major tax reforms, the taxes have sometimes been recycled back to the population or compensated by reductions in other taxes.

11. Deposit-refund systems for car hulks and beverage containers appear to have significant incentive effects. The strength of the effect depends on the relative magnitude of the deposit and refund.

12. Newly industrialized and less developed countries are making extensive use of economic incentives for environmental protection. Deposit-refund systems and user fees appear to be the most common incentives in these countries, but waste and emissions charges are very common in Eastern Europe and the former Soviet Union.

Endnotes for Section 11

1. OECD (1994a), p. 97.

2. OECD (1995b), p. 95. Unless otherwise stated, all national currencies are converted into U.S. dollars at the exchange rates of March 14, 1996, as listed in the *Wall Street Journal* of March 15, 1996.

3. OECD (1994a), p. 64.

4. Netherlands Ministry of Housing, Spatial Planning and the Environment, "The Netherlands' Environmental Tax on Waste: Questions and Answers," p. 2.

5. *IER*, December 13, 1995, p. 953.

6. Rhee (1995). The currency conversions are taken from this article.

7. OECD (1995b), pp. 14, 98.

8. *Landesabfallabgabengesetz*, Article 4.

9. OECD (1995b), p. 96 and *DEN*, October 12, 1995, p. B-3.

10. *IER*, June 19, 1991, p. 350.

11. RECCEE (1995), p. 11.

12. Ibid, pp. 59-60, 154-5.

13. See OECD (1994a), Chapter 6.

14. Swedish Ministry of the Environment and Natural Resources (1995), pp. 44-49, and OECD (1994a), p. 59.

15. Palmisano (1994), pp. 362-6.

16. Ibid, p. 366.

17. *IER*, May 15, 1996, p. 406.

18. RECCEE (1995), p. 10. The source stated all charges in ECU, which have been converted to U.S. dollars according to procedure described above.

19. *DEN*, February 13, 1996, p. A-8.

20. Langford (1995).

21. RECCEE (1995), pp. 57-8, 152-3.

22. Steele and Ozdemiroglu (1993), p. 198.

23. Netherlands Ministry of Housing, Spatial Planning and the Environment, "The Netherlands' Environmental Tax on Groundwater: Questions and Answers," pp. 2-4.

24. *IER*, February 8, 1995, p. 106.

25. Steele and Ozdemiroglu (1993), p. 198.

26. The twelve countries studied are Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, and the United Kingdom. These were the only European Communities (now called the European Union) member states at the time of the research. Since water pollution control policy is the responsibility of regions in Belgium, the survey provides separate coverage of charge systems in Flanders and Wallonia, the largest of the country's three regions. In the United Kingdom, the survey is limited to England and Wales.

27. The charge amounts in figure # and the damage unit parameters are specified in the Effluent Charge Law (*Abwasserabgabengesetz*).

28. Stephen Smith (1995), *"Green" Taxes and Charges: Policy and Practice in Britain and Germany*, p. 28.

29. User fee and effluent charge revenue figures and shares paid by industry and government obtained from Schoot Uiterkamp, Leek, and de Savornin Lohman (1995), *Waste Water Charge Schemes in the European Union, Part 2: Country Descriptions*, pp. 107-109.

30. M.S. Andersen (1993), *Governancy by Green Taxes - Implementing Clean Water Policies in Denmark, France, Germany, and the Netherlands 1979-1990*, PhD dissertation, Institute of Political Science, Aarhus University, as cited in Schoot Uiterkamp, Leek, and de Savornin Lohman (1995), Part 2, p. 112.

31. Magda Lovei, "Environmental Financing: The Experience of OECD Countries and Implications for Transition Economies," in Centre for Co-operation with the Economies in Transition, *Environmental Funds in Economies in Transition*, OECD, Paris, p. 72.

32. The two surveys and other information on incentive effects of German effluent charges are discussed in Smith (1995), pp. 29-31.

33. Andersen (1994), as cited in Schoot Uiterkamp et al. (1995), Part 2, p. 110.

34. Unless otherwise stated, the information above on effluent charges in the Netherlands was provided by Schoot Uiterkamp et al. (1995).

35. The information on France's effluent charges is based on Cadiou and Duc (1994) and OECD (1994a).

36. Regional Environmental Center for Central and Eastern Europe (1995), p. 14. BOD5 refers to biological oxygen demand during the first five days.

37. For more information on this formula, see ibid, pp. 55-6.

38. Population equivalent is based on quantity of pollutants multiplied by pollution coefficients that vary according to the type of production. For more information, see ibid, p. 165.

39. Margulis (1994).

40. Steele and Ozdemiroglu (1993), p. 218.

41. OECD (1995b), p. 94.

42. OECD (1994a), p. 59.

43. OECD Environment Monograph #89 (1994b), pp. 55-6.

44. The charge shown in figure 5 is the sum of charges on nitrogen, phosphate, and potassium. The amounts of these three substances in fertilizers varies.

45. Rhee (1994), p. 104.

46. Swedish Ministry of the Environment and Natural Resources (1995), pp. 11-14.

47. OECD (1996), p. 91

48. *IER*, February 8, 1995, p. 104.

49. The table draws upon information from Muller (1996), p. 17 and OECD (1996), pp. 89-94. The tax rates for Norway were expressed in dollars by Muller. The rates for the other four countries and all the revenue estimates were converted into dollars following the practice noted under note 2.

50. OECD (1996), p. 90.

51. Ibid, pp. 93-4.

52. Swedish Ministry of the Environment and Natural Resources (1995), pp. 24-31.

53. *Financial Times*, March 20, 1996, p. 10.

54. Information on energy/carbon taxes in the Netherlands provided by two unpublished Netherlands Ministry of Housing, Spatial Planning and Environment documents: "The Netherlands' Environmental Tax on Fuels" and "The Netherlands' Regulatory Tax on Energy."

55. With the exception of the regulatory tax, these are the rates as of January 1, 1996. As explained below, the regulatory tax on light fuel oil, gasoil, LPG, and natural gas is being phased in three roughly equal increments between 1996 and 1998.

56. This is the full rate which will be in effect in 1998. For all products except electricity, the 1996 rate is roughly 1/3 and the 1997 roughly 2/3 of the full rate. For electricity, the full rate was imposed on January 1, 1996.

57. LPG used as motor fuel is exempt from the regulatory tax, whereas LPG used for heating is exempt from the excise duty.

58. Information on differential taxation of diesel fuel in Sweden based on Bergman (1994) and Ministry of the Environment and Natural Resources (1995).

59. OECD (1996), p. 94.

60. *IER*, February 7, 1996, p. 95.

61. OECD (1994a), p. 81

62. OECD (1995b), pp. 86-9.

63. German Information Center (1995). Internet: www.germany-info.org/close-up/environ.htm.

64. *IER*, February 23, 1994, pp. 163-4.

65. *IER*, April 17, 1996, p. 301.

66. Federal Highway Administration, "Congestion Pricing News," Spring 1996, p. 7.

67. Gavin Davidson, Congestion Pricing Forum.

68. Information in this subsection is based on Buchan (1994) and Chia and Phang (1994).

69. Information on the Mexico City vehicle restrictions was provided by Ocampo (1994). The Thai proposal was discussed in *Financial Times*, July 8, 1996.

70. OECD (1994a), pp. 83-6, 121.

71. Information on most countries provided by Container Recycling Institute. Information on Australia, Canada, and Iceland provided by OECD (1994a), pp. 83-5. Information on Czech Republic, Hungary, and Poland provided by Regional Environmental Center for Central and Eastern Europe (1995), p. 16. CRI amounts stated in $US. OECD and RECCEE amounts stated in ECU but converted to $US by authors.

72. Container Recycling Institute (1994), pp. 29-32.

73. OECD (1994a), p. 83.

74. Swedish Ministry of the Environment and Natural Resources (1995), pp. 9-11.

75. OECD (1994a), p. 71.

76. OECD (1994a), p. 86.

77. Helmut Wagner, Commercial Counselor, Embassy of Austria, personal communication, 1996.

78. OECD (1994), p. 86.

79. Ruffing (1995).

80. O'Connor (1994), p. 130.

81. Steele and Ozdemiroglu (1993), p. 177.

82. Ibid, p. 173.

83. DEN, January 17, 1996, p. A3.

84. Schärer (1995), p. 256. The limitations of Germany's trading provisions for old sources are described in Kalmbach and Troge (1989), pp. 30-35.

85. Dittman and Sander, Bundesverband der Deutschen Industrie, personal communication, May 1996.

86. Margulis (1994), p. 116.

87. RECCEE (1995), p. 102.

88. Pan (1994), p. 85.

89. Harvard Institute for International Development, "Highlights in Environmental Economics & Policy," p. 4.

90. O'Connor (1994), p. 132.

91. Musgrave (1995).

92. OECD (1994a), p. 89.

93. Langford (1995).

94. Brehm and Quiroz (1995). Figures stated in U.S. dollars in the source.

95. Hearne and Easter (1995).

96. *Financial Times*, April 9, 1996.

97. *IER*, May 1, 1996, p. 370.

98. Francis (1995), pp. 43-4.

99. Information on these funds based on O'Connor (1994), pp. 127-8.

100. Thorning (1992), pp. 1-3.

101. Most of the information on environmental subsidies for agriculture is taken from Rolfe (1993), "Using Subsidies to Promote Environmental Protection in Agriculture: A Review of Programs in North America and Europe."

102. *International Environment Reporter Resource File: Hong Kong*, p. 164.

103. *IER*, February 7, 1996, pp. 103-4.

104. Lust, "The Forest Incentive System in Belgium."

105. *IER*, February 8, 1995, p. 105.

106. Rolfe, p. 13.

107. OECD (1994b), pp. 58-9.

108. *Décret 95-1119.*

109. French Ministry of Foreign Affairs (1995).

110. *IER*, May 1, 1996, p. 367.

111. *DEN*, September 6, 1995, p. A-5.

112. OECD (1995b), p. 90.

113. Ibid, p. 69.

114. *IER*, February 7, 1996, pp. 100-1.

115. OECD (1995b), p. 93.

116. Langford (1995).

117. OECD (1995b), pp. 90, 92.

118. Margulis (1994), p. 110.

119. Steele and Ozdemiroglu (1993), pp. 213-4.

120. World Bank (1992), p. 117.

121. Information on Germany's Blue Angel, France's NF Environnement, and Canada's Environmental Choice labels was obtained from the Canadian Department of Environment internet site: www.ns.doe.ca.

122. EPA (1993), p. 44.

123. EPA (1994a), pp. 23-4.

124. *DEN*, February 15, 1996, pp. B2-3.

125. Unless otherwise stated, information on Korea's Eco-Mark program based on EPA (1993), pp. 90-2.

126. EPA (1994a), p. 22.

127. Council Regulation No. 880/92, March 23, 1992 on a Community Eco-label Award Scheme, and Commission Decision No. 93/326, May 13, 1993 Establishing Indicative Guidelines for the Fixing of Costs and Fees in Connection with the Community Eco-label. The quotation is from Article 1 of the Regulation. The fees are set in Articles 2 and 3 of the Decision.

128. IER, December 13, 1995, p. 940.

129. IER, March 6, 1996, p. 154.

130. Langford (1995).

131. *DEN*, December 11, 1995, p. A1.

132. *DEN*, February 21, 1996, p. E4.

133. *DEN*, December 11, 1995, p. A1.

134. *DEN*, January 25, 1996, pp. B3-4.

135. Ibid, p. B3.

136. O'Connor (1994), pp. 149-56.

137. OECD (1994a), *Environmental Performance Reviews: The Netherlands*, pp. 66, 130-1.

138. O'Connor (1994), pp. 134-5.

139. USDA Forest Service (September 1994).

140. *DEN*, December 1, 1995, p. A4.

141. Unless otherwise stated, all information on biotechnology development agreements provided by Frisvold and Condon (1994).

142. Quoted in Frisvold and Condon.

143. OECD (1994a), p. 106.

144. Chance (1995).

145. *DEN*, February 21, 1996, E5-6.

146. *IER*, May 15, 1996, p. 392.

147. Potier (1995), p. 18.

At least 100 different economic incentive mechanisms are currently being used in the United States, up from approximately 40 in 1992 when EPA's first survey was conducted. Economic incentives are being used at many levels of government from individual towns to the federal government. Some of them have multiple applications in different states or cities. Although it would be desirable to be able to summarize the cost savings from the use of each of these instruments, the financial consequences to individual economic sectors, the impacts on technical change and innovation in pollution control, and the environmental effects of each of these mechanisms, few have been studied in such detail.

Approximately 30 quantitative comparative studies now exist, all of which indicate that economic incentives should be more economically efficient than command-and-control approaches for controlling environmental pollution. The predicted efficiency gains can quite large, but it must be kept in mind that retrospective studies have found that the savings actually realized fall well short of the potential, particularly so for many of the trading mechanisms. There is relatively little information available on the environmental effects of economic incentives. Although incentives are being increasingly used, they have not always been implemented in the ways advocated by economists. Not surprisingly, therefore, the results have sometimes fallen short of what economists hoped for. A review of the principal types of incentives suggest several reasons for this result.

Fees and charges, with few exceptions, have not been set equal to marginal treatment cost, let alone the theoretically more defensible and generally higher values determined by the marginal damages the pollution causes. Rather, revenue goals have been the principal drving force behind many of the charge-based incentive mechanisms and fees and charges generally have been too low to have a true incentive effect. In situations where fees and charges approximate marginal treatment cost, such as the Swedish NO_x charge and water pollution charges in the Netherlands, the impacts on technical change and innovation are large, as is the measured environmental improvement. Additional study of the impact of pollution taxes and charges that approximate marginal abatement costs is likely to be instructive; potential subject areas include (1) the impact of POTW user fees on industrial users' discharge, (2) the impact of existing pricing mechanisms for commercial and industrial generators of solid and hazardous waste, and (3) further studies on unit pricing of household waste disposal.[1]

Among the market-based trading systems with which there is experience, only the lead phase down, wood stove permit and acid rain examples can be termed a full success and even in these programs there are numerous instances where potentially profitable trades were not completed. Other emission and effluent trading systems are subject to severe regulatory constraints that have raised barriers to trading. In nearly every case, actual cost savings have fallen far short of originally projected amounts. If, as seems likely, the United States will want to expand the opportunities for market-based trading of pollution reduction credits or allowances, it is important that unnecessary constraints not be imposed in future applications and that transactions costs be minimized.

Deposit-refund systems are used for several products at the state level and in Europe. Beverage container deposits appear to be effective in reducing litter. With the exception of beverage container deposits, however, there is only limited knowledge of impact and virtually no analysis of costs and benefits. Lead-acid battery deposits are largely a private sector initiative, though some states also require deposits. The near-universal application of this incentive, whether private or public, and the very high rates of recycling that it achieves, make it worthy of further examination. What special features allow it to thrive where other deposit systems engender controversy and high cost?

Several programs that act solely to provide information appear to be having great impact. Many firms have made public announcements of a corporate commitment to reduce pollution voluntarily in response to reports filed under SARA Title III. One attractive feature of information requirements is that response is highly flexible; corporations are free to do nothing or to seek pollution reductions as they see fit. Where pollution reduction can be achieved at reasonable cost, many corporations see it in their self interest to make those efforts.

Liability mechanisms can and do act as incentives. Structuring liability rules to internalize the cost of pollution, without deviating from this objective by a wide margin, may be difficult to accomplish, if the experience with hazardous waste cleanup and natural resource damage assessment are any guide.

Subsidies have both positive and negative effects on the environment. Economists generally do not favor subsidies, believing that there are superior mechanisms to improve the environment. Economists would favor elimination of environmentally-unfriendly subsidies.

Voluntary programs have a mixed record, with several not meeting initial expectations. The lack of a statutory basis for the programs, different expectations on the part of EPA and program participants, and in some cases mistrust, have slowed progress with many programs.

Finally, a review of the use of economic incentives outside the United States suggests a somewhat different mix of incentive mechanisms but generally similar conclusions as to their effectiveness and efficiency as in the United States. The United States uses many more marketable permit systems than European countries, but much less environmental labeling. Although charges and fees are used more widely in Europe, they also tend to be revenue-raising instruments with few incentive impacts, as in the United States. The lack of incentive impact of charges is due primarily to their low magnitude and because a number of the charges are not closely linked to waste generation or product consumption. As in the United States, however, official interest in economic incentives appears to be increasing in Europe and indeed throughout much of the world.

Endnotes for Section 12

1. It should be noted that the EPA Office of Water is examining effluent fees and various pollutant trading systems to support the Clean Water Act reauthorization process.

APPENDIX A. BIBLIOGRAPHY

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