Market-Based Environmental Management: Issues in Implementation

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MARKET-BASED ENVIRONMENTAL MANAGEMENT: ISSUES IN IMPLEMENTATION

SUMMARY

The acid rain title of the 1990 Clean Air Act Amendments authorizes the first nationwide system for trading the regional location and method of pollution control. This market-type mechanism, if successfully implemented, could reduce the cost of compliance of meeting new limits on sulfur dioxide emissions, the main precursor of acid rain.

Successful passage of the sulfur dioxide trading mechanism has invigorated efforts to add similar mechanisms to the regulatory regimes for other environmental management areas. Limitations of current regulatory approaches, complexity of remaining and emerging environmental problems, and the attack on the Federal budget deficit make greater use of incentive-type approaches to environmental management an attractive option, in some cases.

While existing regulatory systems have made measurable reductions in common air and water pollutants, most observers agree that they have been less successful against complex problems caused by toxics and by transformed or transported pollutants. As supplements to established regulatory systems, market-based options often offer cost saving potentials, enhanced flexibility, and increased effectiveness. Options include trading of permitted discharges or other types of resource constraints or over control credits among sources; pollution taxes, fees, and charges; deposits and refunds; and liability assignment and information disclosure. Particularly in situations where total pollution loadings or other resource management objectives rather than ambient health standards are the issue, greater consideration of regulatory financial burdens may be warranted. More importantly, many environmental problems are too intertwined with everyday economic activities to be managed effectively through highly centralized regulatory systems.

Proposals by the Clinton Administration for market-based environmental protection build on the earlier efforts of Congress and the Bush Administration. The 103rd Congress is considering market-based approaches in reauthorization for the Clean Water Act. Some in Congress also propose market-type mechanisms for dealing with the potential threats of global warming, for encouraging the recycling of solid waste, and for improving management of some natural resources.

As attractive as these mechanisms may be in concept, their implementation occurs within a well established regulatory context involving all three levels of government, international treaty obligations, agency capabilities, and the private sector. It is the implementation concerns that will largely shape the debate in Congress and help determine which innovations ultimately become public policy. For example, the political consensus for taxing pollution rests more on raising
revenue than on any attempt to charge for the external costs of pollution. Similarly, emission reduction credit or allowance trading systems may offer politically attractive ways to share the financial burdens of policy changes while also reducing compliance costs.

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MARKET-BASED ENVIRONMENTAL MANAGEMENT: ISSUES IN IMPLEMENTATION

INTRODUCTION AND FINDINGS

AN EMERGING DOUBLE BIND IN ENVIRONMENTAL MANAGEMENT

Increasingly, efforts to protect integral features of the natural environment that are essential to human well being face a double challenge.

First, the magnitude of some conventional and emerging threats to environmental quality is growing, despite solid progress in controlling some causes. This is particularly the concern on a global scale in terms of atmospheric changes and loss of biological diversity.

Second, easily-implemented uniform control methods using feasible technologies or other direct regulatory approaches are already in place for many pollution and resource management problems in the United States. Additional progress with so-called command and control policies can be expensive and disruptive, and thus counter productive to overall economic well being. This type of dilemma is common where environmental deterioration results from diffuse and complex causes inherent in technically-advanced high-consumption industrial societies such as the U.S. Solutions to these types of environmental problems are complicated by the diffuse benefits which obscures the net gains of additional controls that have concentrated and highly visible costs.

Given this double bind, many policy analysts and academics have for years advocated more cost-effective and flexible approaches relying on market forces to further some environmental management objectives. Although market-based theory and practical environmental policy are still far apart, the incremental approach to environmental policymaking since the late seventies has resulted in some market-type innovations within traditional regulatory frameworks at all levels of government. The most prominent examples are the Environmental Protection Agency's (EPA) air emissions trading program and the recently enacted sulfur dioxide allowance trading program under the 1990 Clean Air Act Amendments.

BEGINNINGS OF A CHANGE IN ENVIRONMENTAL REGULATION

In enacting environmental legislation, Congress has continually tried to ensure adequate regulatory and technical controls on individual sources of air, water, and land pollution in order to protect public health and ecological values. The cost of these controls, while significant in some cases, had been small enough in the context of the overall economy that through the late 1980s, no viable consensus emerged for specific refinements or shifts in the various laws and implementing regulations governing environment and natural resources management. This status quo began to change in 1989 with the push for Clean Air Act Amendments by the Bush Administration. The need to project low national costs and market-oriented Administration

policy led to the enactment in 1990 Clean Air Act Amendments (CAAA) of the first nationwide system for trading the location and method for controlling a pollutant (sulfur dioxide).

IMPLEMENTATION AS THE PRIMARY CONCERN IN REGULATORY INNOVATION

Some argue that the sulfur dioxide trading mechanism marks a new era in environmental management. Its successful implementation, however, faces significant challenges at the State level and in the private sector. Other current and proposed market-type innovations face similar implementation issues.

Since implementation is often the litmus test in assessing the merits of public policy innovations, this report focuses primarily on the potentials and institutional challenges facing market-based mechanisms for environmental management within the Federal system.

THE OUTLOOK

The Federal budget situation and the nature of emerging environmental problems are becoming the factors that focus attention on more active use of incentive approaches for environmental protection. Expanding the use of fees to finance environmental protection programs and greater reliance on trading to shift pollution reduction towards lower cost control points is already done within EPA and State environmental protection programs. Experience to date suggests a number of directions for the use of these mechanisms including:

- Large direct taxes on pollution, while likely to be effective in the longer term, raise concerns about U.S. international cost competitiveness, the administrative capability to implement such techniques, and the political difficulties of applying them in a targeted way.

- A more modest role for environmental taxes is one in which they serve multiple purposes such as the proposed Btu tax or the recently-passed gasoline tax. The use of taxes in these circumstances may serve several objectives not necessarily related to environmental protection, but may possibly modify behavior sufficiently to produce some reduction in pollution. Such taxes may raise general or dedicated revenue, send a signal on level of consumption, possibly be used to offset other revenue sources, or serve as a way of capturing windfall gains when other regulations drive up prices.

- Credit or permit trading is emerging as an acceptable means for easing transitions in certain situations where strict location of compliance is not a concern. Such systems can be used to ease the financial burden and opposition to strict local standards for uniformly distributed environmental problems such as severe ozone nonattainment, as is the goal in the Los Angeles basin; to lessen economic disruption by allowing regulated entities to find some other related way to meet a standard or market constraint as with acid rain control; and to create transitional efficiencies when a substance or activity is being phased out or substantially reduced in scope, as with CFCs.

- Deposit refund approaches are gaining favor in some States for disposal problems other than beverage containers. The most common target for this approach is lead acid batteries, with 10 States operating some type of program. More innovative uses of this technique, such as management of some toxic substances, remains an untested proposal.

- Information and other market conditioning policies, while indirect and hard to evaluate, may be one of the more powerful ways to change consumer and business behavior regarding environmental quality. Anecdotal evidence suggests that the toxic chemical disclosure requirements of the 1986 Superfund Amendments (Right-to Know) are leading many corporations to modify practices in order to avoid adverse publicity even when no legal violations are present.

REPORT CONTENTS AND FOCUS

This report is a revision and update of an earlier CRS report on the same subject. [1] This version looks explicitly at issues of implementation for both existing and proposed market-based mechanisms. As such, the report is divided into several overlapping sections written to the interests of various readers. Focus of each major section is:

1) Findings - presents an integration of major points in the report.

2) Context for Market-Based Approaches - presents the range of actual and proposed mechanisms, their relation to current regulatory systems, and their general strengths and weaknesses.

3) Institutional Considerations in Implementation - discusses how each of the generic market-based approaches works, its range of applicability, and the challenges to implementation within the public sector authorities and capabilities.

4) Current U.S. Approaches - assesses U.S. experience with actual market-based approaches to-date, focusing on lessons and outcomes relative to expectations.

5) Proposals for New Approaches - assesses some of the major options that are currently under debate either in Congress or in various policy communities.

FINDINGS

Growing Interest and Experience

With the passage of the trading system for sulfur dioxide, the interest in market-based refinements among environmental advocacy groups and within Congress has increased for at least three reasons.

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[1] U.S. Library of Congress. Congressional Research Service. *Using Incentives for Environmental Protection: An Overview*. 89-360 ENR. Washington, 1989.

- The country is facing a new round of major pollution control programs -- programs dealing with possible CO_2 reductions, urban ozone reductions, recycling and waste reduction requirements, nonpoint source water pollution reduction as well as already enacted efforts to deal with phase out of CFCs and acid rain control. These initiatives could increase total direct costs of pollution abatement from the historical 2% of the Gross National Product, where it has remained for nearly 15 years. Facing these potential cost increases, more efficient control mechanisms begin to look more attractive. In addition, solutions to some of these problems (such as CO_2, stratospheric ozone depletion, and acid rain), may be more amenable to cost and efficiency considerations since total regional, national or even international pollution loadings are involved rather than local ambient concentrations. These circumstances seem to loosen potential solutions from strict consideration of uniform restraints, allowing consideration of differences in incremental benefits and costs among differing circumstances to shape how pollution reduction is accomplished, while still protecting human health.

- Existing regulatory approaches appear inadequate or simply inappropriate for managing some of the diffuse and more complex pollution problems that are increasingly apparent -- from toxics and pesticides to global concerns about stratospheric ozone depletion and climate change. By levying charges or taxes on pollution, polluting activities or products, or by providing other market incentives, one may be able to augment existing regulatory and enforcement mechanisms without resorting to more burdensome and costly methods.

- Because of the Federal budget deficit, it is difficult for Congress to authorize and appropriate monies for new programs to address emerging environmental problems. Some market-based approaches serve both as potential revenue sources as well as incentives to modify polluting activities.

Options

Incentive or market-based options give the regulated community a financial reason to reduce pollution or change other behavior, usually without directives as how such changes should be made. Although proposals vary, most proponents see incentive approaches as supplemental to or refining existing environmental regulatory structures rather than replacing them. Major options include:

- Taxes or charges - levied on either polluting outputs, polluting inputs, or polluting products at a sufficiently high level to make it financially desirable to reduce or even eliminate pollution;

- Fees - levied on pollution discharge permits or other activities and intended generally to finance regulatory programs;

- Tradeable Discharge Permits or Pollution Allowances - various arrangements where permits or allowances for a fixed amount of pollution can be shifted among pollution sources through the buying and selling of pollution allowances that concentrate abatement at the points of lowest cost;

- Tradeable Credits - where businesses which over perform in meeting an industry-wide constraint or objective (removing lead from gasoline, increasing recycled paper content in newsprint, etc.) are allowed to sell the excess produced to businesses who cannot meet the objective efficiently thereby achieving gains from trade and lower compliance costs;

- Other - including deposits and refunds; the explicit provision of information; the assignment of liability; the levying of noncompliance fines or taxes; guidelines; zoning; cross compliance; and subsidies and tax concessions.

Potentials Versus the Pragmatic

Case studies of potential savings from possible incentive-based systems, usually tradeable discharge permits, often generate estimates in the tens of billions of dollars. Such results are usually predicated on unconstrained shifting of pollution reduction requirements to the lowest incremental-cost points of abatement. As such, these studies ignore existing regulations based on broader policy concerns and the fact that industries have already spent considerable amounts on abatement. Estimates of savings from EPA's air emissions trading program suggest industry savings of several billions of dollars since the beginning of the program in the mid-seventies. The EPA estimates that the SO_2 allowance trading may save $0.7 to $1.0 billion per year over the course of the program depending on State public utility regulation and the participation of utilities.[2]

Besides direct cost saving potentials, there are at least two more subtle, but equally important considerations. First, proponents argue that incentive-based systems provide financial motivation for long run innovations that may go beyond traditional regulatory approaches in solving environmental problems. Second, even if incentive systems do not produce greater reductions in pollution or improvements in resource management than traditional approaches, they offer the advantage of flexibility in timing the decisions and methods for meeting environmental goals, not an insignificant factor in managing private sector activities.

Cases in Point

The EPA's air emissions and SO_2 allowance trading program are the most prominent examples of market-based mechanisms, but several other programs or plans use incentive-type approaches.

- For the SO_2 allowance trading program under the acid rain control provisions of the 1990 CAAA, it is too soon to tell whether initial expectations on cost savings will be realized. Phase I which begins in 1995 requires an intermediate level of reduction in emissions which many utilities may be able to meet through internal changes. The exchange of allowances in a market context seems more likely for phase II allowances which cover emissions of SO_2 after the year 2000 and require more stringent reductions from more sources. Full realization of the potentials of the

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[2] Carlin, Alan. *The United States Experience with Economic Incentives to Control Environmental Pollution*. United States Environmental Protection Agency. 230-R-92-001 July 1992. p. 5-7.

program will depend, in part, on State public utility commissions' policies, support from State legislatures, and judicial interpretation of State laws.

- The 1990 CAAA also contain several provisions that will be implemented in later years such as fees of $5,000 per ton of excess emissions of volatile organic compounds; an oxygenated gasoline credit program; and a low emission vehicle credit program.

- For air emissions trading under various EPA mechanisms (netting, bubbling, offsets, and banking) the results have been mixed, due in part to uncertainties and the reluctance by regulators and industry to apply these techniques. The most active "markets" are in Southern California, where stringent pollution limitations on new industry had been in force prior to the 1990 CAAA and there had been strong industrial growth. Much of this activity, however, had been credits generated from plant closings (shut down credits). With the passage of the 1990 Clean Air Act Amendments, trading activity in Southern California and other areas may be facilitated by the Act's comprehensive permit program and increasing sanctions for noncompliance by industry.

- Lead phase-down in gasoline was implemented by EPA using a lead rights trading program among refiners who had differing technical capabilities to remove lead. The program was generally viewed as successful in reducing the overall industry costs of complying with stricter lead standards. Some argue that lower costs for marginal suppliers resulted in lower gasoline prices and thus lower overall industry profits, while benefitting consumers.

- In Colorado, two local governments have established programs for accommodating future economic growth by allowing water pollution sources with high treatment costs to "buy" comparable or greater abatement from lower-cost sources, usually diffuse nonpoint polluters. The program is beginning to be used and is being studied as a possibility for areas with similar water pollution problems.

- Wisconsin has established a statewide discharge permit trading program whose sole application to date is on the Fox River in order to help achieve regional water quality standards that had not been met even after dischargers had installed required pollution control equipment. It appears that limitations on what constitutes tradeable rights, lengthy approval processes, and other restrictions are the reasons that there has been virtually no trading within this program.

- North Carolina has set an overall limit on nitrogen and phosphorus effluent for one basin with charges for pollution sources to meet short term goals. In the long-term, lower discharge limits will probably be imposed through control of nonpoint sources. Dischargers can offset their effluents with credits issued by a program that controls agricultural runoff with the most effective management practices.

- Most States as well as the Federal government use various forms of permit fees or taxes to help finance regulatory programs, or in the case of the Federal Superfund to pay for cleanup of past problems. Such fees are seldom large enough to create an

economic incentive for abatement, though some argue that permit fees for air emissions in some areas may be high enough to have some incentive effect.

- Underlying incentive approaches is the role of better information. Both the Federal government and various States have made disclosure of pollution information an explicit requirement for certain types of environmental releases. For example, the 1986 Superfund amendments require that manufacturing companies report annually on releases of specified hazardous chemicals. New Jersey and California also have enacted strict disclosure requirements for hazardous substances.

Concerns and Limitations

While incentive-based approaches may be appealing as a refinement to current regulatory systems, their application in specific situations raises important concerns:

- Total pollution control costs could be greater for industry in some cases than traditional command and control systems, even though abatement expenditures may be reduced through incentive approaches. This is especially the case where pollution taxes or auctions of pollution permits would be involved. In this case, industry must both either pay for all of its pollution or pay for partial cleanup and permits and/or taxes on the rest. On the other hand, where tradeable permits are grandfathered as they were with the SO_2 allowance trading program, questions of equitable allocations based on differences in past control have to be addressed. To a large extent, the working out of an allocation of permits to existing and new sources may involve complexities and politics as challenging as some aspects of command and control systems.

- Government revenue from an incentive approach (say from pollution taxes or auctioned permits) would not be recycled to polluters under most proposals. For example, earlier proposals for a Btu tax (partly justified on environmental and energy security grounds) would have gone for deficit reduction, as does the increase in the gasoline tax that was part of the final budget package. There are also a number of proposals for substantial tax increases on various pollution sources or other problems such as auto-related congestion with some of the revenue going to reduce income taxes. However, some advocate earmarking revenues for environmental programs or to subsidize abatement for vulnerable industry segments. This approach seems to be popular in Europe.

- Incentive systems -- because they allow greater latitude in how and where reductions occur -- may increase the need for detailed monitoring and enforcement, either at government or industry (ultimately consumer) expense.

- Complexity of both sources and pollutants in the toxics and hazardous waste area probably confines incentive approaches to areas such as long-run technical change, recycling, and restraint on quantity used. For example, deposit and refund systems for some types of toxics have appeal. Information disclosure along with shifting of the burden of proof may be an effective strategy for motivating non-regulatory compliance. Taxing polluting inputs may also provide incentives for development

of safer new products or substitution towards less harmful alternatives, as well as raising product price which reduces the amount demanded.

- In situations where environmental deterioration is severe, the relative advantages of incentive approaches may be small. In these circumstances, every feasible means of technical control may be needed to achieve environmental standards, if major lifestyle changes are to be avoided.

- To use market-based approaches assumes that markets will not have major imperfections. Too few buyers and sellers, hoarding, lack of adequate information, and uncertainty about security of investments in overcontrol are all concerns that surround trading proposals.

- Other potential problems include conflicting objectives between governmental bodies (e.g., environmental program officials' goals to reduce emissions versus State public utility commissions' goals on service reliability and cost); and geographic inequities where different jurisdictions might impose different approaches with different costs; and potential interstate conflict.

- In some cases, there may be an inherent conflict between equitable protection of individual health and the goal of greater latitude in reducing pollutants.

THE CONTEXT FOR MARKET-BASED APPROACHES

As noted in the introduction, the growing emphasis on market-based approaches seems to be driven by three trends:

- Rising costs from traditional regulatory approaches;
- The growing complexity of diffuse sources of environmental deterioration including nonsustainable pressures on many renewable resources; and
- The perceived urgency to reduce the Federal deficit, thus increasing the attractiveness of environmental taxes and fees as a revenue source.[3]

Whether these forces will accelerate changes in Federal environmental protection and resource management policy is unclear, but the thrust of the Administration's early proposals is toward market-based techniques. In many cases, market-based mechanisms can potentially ease the transition to more sustainable but controversial environmental and resource management standards.

In any assessment of current market-based approaches or proposals for change, the policy and regulatory setting within which techniques are or may be implemented is the necessary starting point. This section develops that context as background for later discussions of specific market-based mechanisms. The section covers:

- The current regulatory system and its perceived strengths and weaknesses;
- The pressures for change;
- Current examples of market-based approaches and proposals for new approaches;
- The advantages of greater reliance on market-based options;
- The concerns about market-based approaches.

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[3] Some even advocate using pollution taxes as a revenue source to shift tax burdens away from the income tax while also creating incentives to reduce pollution. See for example: 1) Oates, Wallace E. *Taxing Pollution: An Idea Whose Time has Come?* Resources. Spring 1988. Resources For the Future. Washington, D.C. pp 5-7; and 2) Repetto, Robert, et. al. *Green Fees: How a Tax Shift Can Work for the Environment and the Economy.* World Resources Institute. Washington, D.C. November, 1992.

THE CURRENT SYSTEM: ITS STRENGTHS AND WEAKNESSES

Today Federal, State, and local efforts to control environmental deterioration involve a complex mix of requirements that, taken together, are frequently termed a "command-and-control" approach. Typical components of this regulatory structure that was developed mostly in the 1970s include (1) health- or ecology-based standards that are not supposed to be violated, (2) technology-based or performance-based standards for discharges to the environment, and (3) permit approval and enforcement procedures for facilities. Liability assignment and fines can also be important features.

For example, the Clean Water Act establishes technology-based standards for discharges to water, provides for water quality standards to ensure that remaining discharges adequately protect water uses, and provides for permits and enforcement. The Clean Air Act establishes technology-based or performance-based standards for emissions from new sources, establishes Federal ambient air quality standards which States must develop plans to meet, and creates elaborate permitting processes that can result in differential requirements depending on whether the source is new or old and whether it is located (or would be built) in an area complying with or violating air quality standards. Various provisions of the 1990 Clean Air Act Amendments, discussed at several points later in this report, modify the command and control nature of the Clean Air Act by adding new or expanded market-based policies. The acid rain control title which authorizes the establishment of a trading system for new limitations on sulfur dioxide emissions, is the most comprehensive attempt to-date at a market-based solution to a national environmental problem. In contrast, the Air Toxics title of the 1990 Clean Air Act Amendments is probably one of the most "command and control" provisions in environmental law calling for technology standards on almost 200 different toxic chemicals.

For toxic materials, there are some regulatory variations: for hazardous wastes, the Solid Waste Disposal Act creates a manifest system for tracking wastes from cradle to an approved grave; for toxic substances generally, the Toxic Substances Control Act establishes procedures by which EPA can require firms to test chemicals and, depending on the results, EPA can impose various restrictions on use, handling, disposal, etc.; and for pesticides, the Federal Insecticide, Fungicide, and Rodenticide Act provides for Federal registration of individual pesticides, with labels specifying permitted uses and restrictions.

Strengths

The current system of regulations has provided administrators with some assurance that technically and economically feasible actions are being taken to abate specific pollutants, and provides a basis for enforcement in cases of noncompliance. Regulation in each of the media (air, water, and land disposal) attempts to assure that a variety of standards will be met. In some cases (i.e. water and new stationary air pollution sources), generally uniform technology is required on a national basis. In other cases (i.e., existing plants for air pollution sources), State or local requirements must lead to compliance with national environmental quality standards set by the Federal government.

This mix of technology requirements, performance standards, and ambient standards provides regulators with a reasonable degree of predictability in how much pollution levels will be reduced. The regulatory system has also generally protected the competitive positions of competing facilities by requiring uniform abatement technology across the country for new

facilities (in air), or by industrial class regardless of facility age (in water); for existing plants emitting air pollution, requirements are related to imperatives imposed by ambient conditions.

Placing strictest controls on new plants has been based on the assumption that it is cheaper for new sources to incorporate pollution control and that economic growth will result in the eventual replacement of older, dirtier facilities. Slower growth and structural change in manufacturing and electric power sectors since the mid-seventies has tended to work against these initial assumptions. This approach has also increased the incentive to keep old facilities in operation longer, further weakening the intended environmental benefits of new source controls.

Current regulatory policies, however, have scored notable successes. Water bodies have much less organic pollution compared to thirty years ago. Urban air quality in terms of lead, sulfur dioxide, and particulate matter is much improved today over the late sixties.[4]

Weaknesses

In spite of notable progress on some fronts, the system enacted during the seventies has been unable to achieve several mandatory standards and deadlines established in the authorizing legislation. Nonattainment of ozone and carbon monoxide ambient air quality standards in dozens of urban areas is a good example and led to substantial new requirements in the Clean Air Act Amendments of 1990. Similarly, many water bodies still do not approach their mandated quality objectives. Proponents of change argue that in such cases ambient standards and deadlines should be tailored to differences in regional conditions. Regardless of the merits of that argument, critics contend that more flexible market-based approaches could help achieve statutory goals in a more timely and less costly way.

There are also many emerging problems where traditional command and control approaches may not be practical at an acceptable cost. Examples include nonpoint source pollution of surface and ground water; solid waste disposal; and pesticide and toxics buildup in land, water, and air. Management of some combustion byproducts and other industrial chemicals affecting global climate change may be the ultimate environmental challenge for which treatment technologies would be infeasible regardless of the scale of investment and deployment. A system based on demand restraint (such as taxes) or quantity restraints (credits) may be more effective and practical for many current environmental management problems than extending detailed command and control systems.

PRESSURES FOR GREATER USE OF INCENTIVES

Legislators, regulators, industry, and environmental interest groups until the last few years provided little support for market-based systems as an acceptable option for dealing with the

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[4] For trend data and references see: *Environmental Quality: The Twenty-third Annual Report of the Council on Environmental Quality. Part II: Environmental Data Trends* . January, 1993. For more specific data see *National Air Quality and Emission Trends Report*, 1992. EPA-454/R-93-031. U.S. EPA Office of Air Quality Planning and Standards. October, 1993.

Nation's environmental management problems. In spite of major criticisms, the various interests involved with environmental protection largely supported the current regulatory system. For conventional pollutants, at least, it had done an acceptable job of meeting the concerns of equity, administrative manageability, public sector cost, and enforceability.

Whether the nineties see a dramatic increase in the use of market-based approaches is a matter of speculation. There are, however, growing forces that may make some types of market-based techniques more attractive in the context of broader international, national, state, and local policy needs. Interrelated policy needs that seem to be promoting a convergence of interests around greater use of market-based alternatives include:

- **Cost, finance, and management effectiveness**; i.e. the need to deal with growing control costs, fiscal pressures, and overuse of some resources and environmental infrastructure;

- **Indirect mechanisms for complex environmental problems** ; i.e.; the need to find some common ground between strong competing interests in dealing with the intractability of many environmental problems. (Progress on many environmental and natural resource problems will require fundamental, equitable, and long term system and technical changes which may only be possible through indirect changes in the incentives facing businesses and consumers); and

- **International obligations**; i.e. the prominent role the U.S. plays as both an example of solutions and as a significant contributor to some global environmental threats placing the U.S. in potentially difficult positions in international treaty and political negotiations.

All three needs point in the direction of greater use of market-based policies because such policies tend to be less intrusive economically than reliance on direct regulation.

Cost, Finance, and Management Effectiveness

Given the double bind facing environmental management - the growing complexity of many environmental problems and rising control costs - the cost-effectiveness with which programs can be implemented will help determine how much "environmental protection" can be had for a given level of public and private expenditures. Also, tying environmental management and protection costs more explicitly to the beneficiaries using environmental resources can both serve to cover public sector management costs and act as a signal to users to economize on use.

Cost

While improving environmental quality produces both monetary benefits -such as reduced corrosion of materials - and nonmonetary benefits - such as healthier ecosystems, the only comprehensive economic accounting of the effects of environmental protection efforts is the measurement of control expenditures as part of GNP. The Environmental Protection Agency estimates that in 1990 the Nation spent just over 2% of its GNP on all forms of environmental

protection.[5] There is no corresponding national measure of the value of benefits produced from such expenditures, since many are nonmonetary, extremely difficult to quantify, or masked in other areas of GNP accounting. Thus the fraction and rate of growth of "nonproductive" environmental protection expenditures becomes a source of concern to those focusing on the costs of production and distribution. The EPA projects that these costs could rise close to 3% of GNP by the year 2000.

Expenditures on environmental protection ultimately affect product prices, wage rates, and returns on capital. Costs of products and services have gone up as a result of pollution abatement requirements, and environmental control costs have also contributed to decisions to close marginal plants, especially during business slumps.[6]

Direct increases in the cost of doing business are not the only concern, however. By increasing private sector uncertainty and delay, some regulatory approaches may also contribute to slower economic growth. It has been argued that regulatory requirements for multiple permits and the additional delays caused by judicial appeals may slow the introduction of new technologies and reduce flexibility to adapt to changing business conditions.[7]

Thus, major extensions of the existing environmental regulatory approach may raise increasing objections because of the perception of unnecessary costs it may impose. The challenge is its practicality for managing the environmental quality needs of a technically complex and growing economy and population.[8]

Finance

Beyond the question of escalating control costs under traditional regulatory approaches, persistent Federal and State budget concerns elevate the environmental area as a revenue source.[9]

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[5]Environmental Protection Agency. *Environmental Investments: The Cost of a Clean Environment,* Report of the Administrator of the EPA to Congress of the U.S. [EPA-230-11-90-083] (Washington, D.C.: 1990), Tables 8-18.

[6] For a comprehensive discussion of the potential economic effects of various Federal environmental regulations, see: Rusin, Michael et. al. *Managing the Environment: A Review of Present Programs and Their Goals and Methods* . Discussion Paper #057. American Petroleum Institute. Washington, D.C. February 1989.

[7]Denison, Edward F. *Explanations of Declining Productivity Growth.* Survey of Current Business. V. 59. August, 1979. p. 10.

[8] For a discussion of the tension between environmental and economic policy objectives, see: Blodgett, John E. U.S. Library of Congress. Congressional Research Service. *Economic and Environmental Policymaking: Two-Stepping to a Waltz.* Report No. 93-264ENR. Washington, D.C., 1993.

[9] Oates, Wallace E. *Taxing Pollution: An Idea Whose Time has Come. Loc. Cit* . and Repetto, Robert et. al. *Green Fees: How a Tax Shift Can Work for the Environment and the Economy*. *Loc. Cit*.

Two revenue options are possible. One is the fees currently used by States and Federal agencies to fund environmental programs; i.e., fee for service. The other is the explicit use of taxes on pollutants or polluting activities. This latter option is discussed in the next chapter. The concern here is the legal status of fees and taxes in terms of their potential use.[10]

Fees. Federal and State agencies assess a variety of fees associated with pollution discharge permits, harmful inputs, or with some waste volumes. Such fees are largely designed to raise revenue to cover environmental regulation, research, or other related activities such as restoration. These fees are usually set at levels that do not create incentives for polluters to modify their operations; in other words, the fees are significantly less than the cost of any actions the business or consumer can take to avoid paying the assessment.

A 1986 partial survey of States by the Congressional Budget Office found that for air, water, and hazardous waste permits, only seven States did not use some form of environmental fee in their regulatory programs.[11] States use a wide variety of permit-fee structures including: uniform fees; fees that vary by size of output of the polluting facility; fees that vary by the type of facility; fees that vary by the type of permit; fees that vary by the volume of pollution emissions; fees that vary by the toxicity of the discharge or the type of pollutant; and fees that vary with the destination of discharge.

At the Federal level, certain types of fees may be set by an administrative agency to cover regulatory or program costs.[12] The legislative authority for agency fees comes from one of several sources: 1) specific provisions in an authorizing statute; 2) authorization provided in appropriations legislation; and 3) fee collection authority derived from the Independent Offices Appropriation Act of 1951. In the latter case, fees cannot in reality be a tax; e.g., they must be proportional to value or service obtained from the groups subject to the fees. Also, receipts go to the general fund unless Congress specifies otherwise in authorizations or appropriations language. These and other restrictions in the 1951 Act are intended to preserve the exclusive power of Congress to levy taxes and to oversee and limit agency growth not authorized by Congress.

Taxes. An alternative to fees is taxation of polluting activities or substances. Using taxation as opposed to fees allows greater flexibility in selecting bases and rates and in using the tax to raise large amounts of revenue. Taxes, if high enough, will also potentially affect polluting behavior.

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[10] One other fiscal option affecting resource and environmental management is below-cost pricing policies for some publicly-owned resources. While change in these policies has both environmental and fiscal implications, this report focuses only on the direct use of market-type mechanisms rather than long standing public sector policies which use resource pricing to foster economic development or maintain community stability in rural areas.

[11] U.S. Congressional Budget Office. *Environmental Charges*. August 1987.

[12] U.S. Congressional Budget Office. *The Growth of Federal User Charges*. Washington, D.C. August, 1993.

There are two other important contrasts between environmental taxes and program fees. First, the only restrictions on environmentally oriented taxes are constitutional considerations of due process and equal protection. However, the constitutional requirement that Federal taxes be uniform throughout the United States may have implications for some types of incentive-based approaches. Another distinction noted by CBO is the basing of taxes on market values (sales, income, or assets), whereas fees are based on non market actions such as licenses, permits, and government services.

Management Effectiveness

In some cases, rates of use of certain renewable natural resources may exceed the long term carrying capacity of the resource base under current authorities, institutional arrangements, and behavior of vested interests. In other cases, an environmental objective may be very costly to reach through across-the-board requirements on all actors.

Under these general circumstances, trading of the location or method of compliance often allows the private sector to respond more quickly at less cost to the economy as a whole. The mechanism involves public intervention to establish a total constraint on total pollution, resource use, or on other characteristics. Regulated entities are then allowed to trade the location and method of compliance to their own economic advantage.

Indirect Mechanisms for Complex Environmental Problems

Increasingly, the environmental degradation affecting air, water, and land are the result of pervasive activities for which traditional "end of the pipe" technologies or command and control regulations may be neither affordable nor practical. Toxic substances, CO_2, pesticides, and nonpoint source water pollution are examples typically cited. These types of degradation are often linked with growing material standards of living; growing population; and the technology of everyday agricultural, industrial, transportation, and consumer products and processes. Although conventional pollutants are also associated with economic and population growth, their emissions levels can still be further reduced with reasonably available technologies.

The seeming intractability of dealing with toxics and pesticide pollution problems arises from the sheer number of substances, their volumes and diffusion, and the resources and time demands for evaluating the safety of each one.[13] Evaluation difficulties arise for several reasons: these substances may be biologically active at extremely low concentrations; some of them may magnify in the food chain; they may cause diverse, subtle, and delayed effects in the form of cancer or neurological and gene damage; and they may have the potential for accumulation, cycling in the food chain, and transformation to more harmful substances in the environment.

Congress has passed several major acts directed at toxic substances and pesticides. Requirements of these acts include testing and evaluation of relative risks and benefits, registration, application requirements, and substance tracking. Specific requirements for toxics

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[13] In contrast to the limited number of conventional pollutants, more than 60,000 chemical products and 1,200 active pesticide ingredients used in over 35,000 formulations give rise to potential human and ecological hazards.

include regulations on discharge and disposal methods, liability assignment, and fee-supported cleanup and insurance funds.

Given the complexity and consequences of toxic and other hazardous substances, few dispute the need for strengthening and improving regulatory approaches. In spite of progress in dealing with toxics and pesticides, however, the sheer volume and complexity of these substances present EPA with an enormous information and management burden, and are considered possible causes in the major delays in meeting various statutory goals. In total, the EPA estimates that there are over 650,000 generators of hazardous wastes, a figure which does not include the pesticides used on over two million farms. Annual disposal of toxic wastes in all media may be as much as one billion tons.[14]

The fact that so many businesses and individuals use and dispose of hazardous and toxic substances suggests that future progress in dealing with this problem may require greater use of flexible and decentralized approaches. In this context, proponents argue that supplemental market-oriented approaches, such as taxes or deposits and refunds, may be worth considering. These would provide incentives to reduce the volumes of hazardous products, to encourage recycling and proper disposal, or ultimately to design less harmful products.

Nonpoint source contamination of surface and groundwater presents similar problems. Diffuse urban and rural sources of organics, sediment, toxic chemicals, pesticides, and other contaminants contribute an estimated fifty percent of remaining surface water pollution loadings; and the dispersed land disposal of wastes and use of agrichemicals pose problems of groundwater contamination as well. Education on best management practices can help reduce these problems, but the practicality of technical controls is limited and extending strict regulatory approaches would present enormous enforcement costs, and problems of political acceptability. Often the polluting activity or substance is a small part of operational cost but yields large financial returns. Cases in point include nitrogen fertilizers and many pesticides used in agriculture. Liberal application of these substances may seem wasteful and is ultimately harmful to the environment, but to use them more precisely seldom makes sense financially to individuals and businesses. At current prices and with current technology, wiser use, in an environmental sense, may require too much management, labor, and information. Again in this context, proponents of new directions often propose fees or taxes on these substances to help modify individual business and consumer behavior.

Perhaps the most complex environmental challenge is the role combustion byproducts and other man-made substances may be playing in global climate modification. Although this topic is fraught with major uncertainties, proponents of accelerating government actions typically call for a range of incentive-oriented approaches, including both taxes and trading of the location of controls

International Obligations

The United States along with other members of the international community have created or are creating treaty mechanisms to begin efforts to cope with perceived global environmental

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[14] Office of Technology Assessment. *From Pollution to Prevention: A Progress Report on Waste Reduction.* Washington, D.C. U.S. Government Printing Office. 1987. p. 19

threats. These threats to long term environmental quality include loss of species diversity and habitat, loss of forested areas, atmospheric changes (greenhouse gas buildup and stratospheric ozone depletion), and growing depletion of ocean and terrestrial wildlife resources shared among nations.

Part of this growing international imperative is an increasing emphasis on the concept of "sustainable development." Though ill-defined, it symbolizes the longer term norms proponents of change seek in technology, institutions, and economic systems in order to move toward a complementary relationship between human use of the environment on the one hand and maintenance of life support systems and biological richness on the other.

Given this international context, the U.S. is in a somewhat unique and difficult diplomatic position. As a world leader, we have often been on the forefront of environmental treaties to protect the common world interest, the case in point being stratospheric ozone protection. On the other hand, we are also a significant contributor to some of the long term negative environmental trends because of the relative size of our economy and our extensive use of fossil fuels. Thus our stake in the methods proposed for long term changes is indeed large. For that reason, market-based options which typically provide flexibility and decentralized response, are often proposed as a less intrusive way to meet potential obligations to future international agreements.

CURRENT AND PROPOSED APPROACHES

In the mid-seventies, Federal and State agencies began using some incentive-type strategies, primarily as mechanisms to support the basic "command-and-control" requirements. Though limited in scope, these strategies typically involve trading of allowed air emissions among sources through offsets, netting, or bubble arrangements. Other examples include the noncompliance penalties in the Clean Air Act. The sulfur dioxide allowance trading system in the 1990 Clean Air Act Amendments builds on this earlier experience.

Legislative proposals in the current and recent Congresses for incentive or market-based policy tools are outgrowths of these earlier refinements to environmental regulations. Proposals, in reauthorization efforts for the Clean Water Act and the Resource Conservation and Recovery Act, for pollution charges or tradeable recycled materials credits are examples. A number of bills directed at committing the United States to actions to slow emissions of greenhouse gases have included market-based approaches such as a carbon tax or various forms of carbon dioxide emissions trading.

Current Examples

At the Federal level, statutory authorities and regulatory implementation in a few areas now incorporate market-based approaches. Table 1 based on a recent EPA report summarizes the

variety of mechanisms currently operational or authorized by recent changes in the law.[15] EPA groups current examples under the following headings:

- Fees, Charges, and Taxes;
- Deposit-Refund Systems;
- Trading Systems;
- Emissions Averaging;
- Others such as information provision and liability assignment.

States and the Federal government rely to varying degrees on permit and other fees as a revenue source for environmental programs and related activities. While these fees typically have not been sufficiently large to provide incentives to modify polluting activities, their use raises the possibilities of future extension to more incentive-oriented environmental charges. Indeed, the Clean Air Act Amendments include authorization in cases of future noncompliance for permit fees that may exceed the incremental cost of abatement. A few examples of fees at the State level include New York's fee system for hazardous waste disposal, Iowa's nonpoint source fee on pesticides, fees under the State and Federal Superfunds, and State oil spill funds. Other innovations at the State/local level include making the incremental cost of environmental services more explicit to the user. Charging on a per-bag basis for municipal trash collection is one example. Volume or time-differentiated water or sewer charges are another.

Refundable deposits for beverage containers and for lead acid batteries are now being used in several States to reduce litter and disposal problems. Deposit-refund systems have also been proposed for certain toxic and hazardous substances management.

Trading systems have become a feature of environmental policy at all levels of government. For example, the 1990 Amendments to the Clean Air Act addressed the

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[15] Carlin, Alan. *The United States Experience with Economic Incentives to Control Environmental Pollution.* United States Environmental Protection Agency. 230-R-92-OO1. Washington, D.C. July, 1992.

TABLE 1. CURRENT MARKET-TYPE MECHANISMS IN OPERATION

FEES, CHARGES AND TAXES

Permit Fees

- National Pollution Discharge Elimination System -- State permit system for water pollution discharges under the 1972 Federal Water Pollution Control Act. Some States differentiate fees based on volume and toxicity of effluent.
- Publicly-Owned Sewage Treatment Plant User fees -- Charges on industrial facilities and households discharging into their systems. Fees may have some effect on large industrial dischargers.
- Municipal Solid Waste Disposal Charges -- At least 2,000 jurisdictions base charges on volume. In addition, most private collectors impose volume-based charges.
- Air Emission Fees --
  - -- State permit fees for administrative costs with California highest in the Nation at $300-$600 per ton of pollutant. Even these rates are below incremental control costs.
  - -- Federal Nonattainment Area Fees under the Clean Air Act Amendments. Some provisions allow recovery of administrative costs over a 20 year period. Failure to achieve reduction of excess emissions in extreme ozone nonattainment areas will subject stationary sources to a $5,000 per ton (adjusted for inflation) annual fee for each ton of volatile organic compound emitted. Fees in the form of highway tolls are also allowed to reduce pollution and congestion.
- Industrial Solid and Hazardous Waste Charges -- Private waste disposal firms charge based on the number of containers emptied and content.
- Product Charges --
  - -- Fertilizer taxes by States to help pay for programs for environmental protection and research.
  - -- Automobile Tire Taxes -- State and county taxes with revenue marked for used tire recycling and disposal.
  - -- Motor Oil Taxes -- Rhode Island imposes a fee earmarked for used oil collection costs.
  - -- Superfund Feedstock Taxes on domestic crude oil production, crude oil and petroleum product imports, and petrochemical feedstocks to finance in part program costs.
  - -- Chlorofluorocarbon taxes under the Budget Reconciliation Act of 1989 to accelerate reduction in the use of ozone-depleting chemicals.
- Wetland Compensation Fees -- Maryland and New Jersey allow payments for unavoidable wetlands loss with proceeds available for wetland enhancement and restoration.

TABLE I (continued)
DEPOSIT-REFUND SYSTEMS

- Beverage Container Deposits in 10 States resulting in sharp reduction in litter.
- Battery Deposits required in at least 10 States. A $5 to $10 deposit at point of sale is required and deposits are refundable if an old battery is returned within a specified period. In addition, retailers increasingly are using deposits to insure that used batteries are returned in jurisdictions without formal deposit legislation.
- Pesticide container deposits required by Maine to promote triple rinsing and return of commercial containers.

TRADING SYSTEMS

Inter-Firm Non-Approval Trading

- Acid Rain Allowance Trading under Title IV of the 1990 Clean Air Act Amendments -- Allowing coal burning utilities to trade the location and method of SO_2 reductions mandated by the law.
- Oxygenated Gasoline Credit Program under Title II of the Clean Air Act Amendments -- Requires gasoline in certain cities to contain 2% oxygen and allows refiners, blenders or importers who produce greater than 2% oxygenated gasoline to sell credits to refiners who are unable to meet the 2% requirement. Only the Philadelphia region has established a trading program, and activity has been minimal to date.
- Low Emission Vehicle Credit Program under the 1990 CAAA -- Authorizes California to offer marketable credits to auto manufacturers that sell more low emission vehicles than are required under the pilot test program for clean-fuel vehicles and alternative fuels.
- Chlorofluorocarbon Production Allowance Trading -- In response to the 1988 Montreal Protocol and the 1990 CAAA on phaseout of CFCs, EPA established rules apportioning baseline allowances, providing for gradual reduction in allowances and permitting the transfer of allowances among firms.
- Lead trading as part of the last part of lead phaseout in gasoline -- Refiners that removed greater amounts of lead than were required could trade credits to those who were above the limit.
- Transferable Development Rights -- Whereby local jurisdictions downzone environmentally sensitive areas and then require areas of higher land use density to purchase development rights from the downzoned area. Examples include Montgomery and Talbot Counties, Maryland and the Pinelands, New Jersey.
- Fireplace and Wood Stove Permit Trading -- To reduce particulate matter and carbon monoxide. This program to reduce local air pollution in Teluride, Colorado uses a combination of performance standards for existing stoves, a time-limited $750 rebate for conversion to natural gas, and a ban on fireplaces in new construction unless the developer bought two permits surrendered by existing users.

TABLE I (continued)
Inter-Firm Approval Trading

Air Emission Rights

- Trading of Air Emissions Rights (EPA) -- Bubbles allowing firms to treat multiple emission points as one source for control purposes.
- Offsets (EPA) -- Allowing new plants locating in an area that violates air quality standards to buy reduction in emissions to insure that air quality does not deteriorate.
- Banking (EPA) -- Allows saving or banking of emission reduction credits for later use or sale.
- Netting (EPA) -- Allows plant expansion that avoids stricter, new source standards so long as plant wide emissions do not increase significantly.

Water Effluent Reduction Trading

- Wisconsin -- Allowing industrial plants that reduce biological oxygen demand below the standards to trade the excess reductions to other sources.
- Dillon Reservoir, Colorado -- Allowing high cost point sources of nutrients discharge to the reservoir to buy lower cost reductions from nonpoint sources.
- Cherry Creek Reservoir, Colorado -- Allows publicly-owned wastewater treatment plants to earn reduction credits by purchasing control of nonpoint phosphorous discharges after these sources have made reduction of 50% on their own.
- Tar Pemlico Basin, North Carolina -- The State sets an overall limit on nitrogen and phosphorous effluent with the possibility of charges for failure by effluent sources to meet short-term goals. In the long-term, lower discharge limits will probably be imposed through control of nonpoint sources. Dischargers are creating a fund to pay for nonpoint source control.
- Steel Industry Effluent Bubble (EPA) -- Allowing steel plants to treat multiple sources in one treatment system.
- Wetland Mitigation Banking (U.S. Fish and Wildlife Service) -- Involving creation of new wetlands and mitigation credits available to developers to meet State-imposed mitigation requirements.

EMISSIONS AVERAGING

This is equivalent to emissions trading within a plant or firm and is used to meet Reasonably Available Control Technology (RACT) standards. Examples include RACT requirements, Heavy Duty Truck Engine Emissions, California Motor Fuel Characteristics, and Hazardous Air Pollutants Early Reduction Program.

OTHER METHODS

Several other methods using incentives and other market conditioning techniques have been implemented in recent years. These include traditional inducements to change behavior or operations such as tax concessions or subsidies; assignment of liability for prescribed categories of damages or negligence; and the provision of information on risks, product characteristics, or other operational or site data that facilitates or improves business and consumer decision making.

Source: U.S. Environmental Protection Agency. *The United States Experience with Economic Incentives to Control Environmental Pollution*. 230-R-92-001. July 1992.

acid rain problem by giving new authority to EPA to use a market-based approach for achieving targeted reductions in sulfur dioxide emissions. The Amendments authorized EPA to establish a nationwide system for trading the location of sulfur dioxide (SO_2) reductions among emission sources with differing reduction costs. This innovation may have the effect of lowering the long run compliance costs of electric utilities in meeting legislated targets for reductions in SO_2. At the regulatory level, EPA has since the late seventies allowed various forms of air emission trading for stationary sources within narrowly prescribed circumstances. EPA also implemented a credit trading program to ease the transitional costs for refiners in phasing out lead in gasoline during the 1980s. The goal in all of these cases has been to help reduce the cost to industry of meeting environmental standards.

State and regional-level innovations have often been within implementation responsibilities under Federal environmental statutes such as the Clean Air Act. For example, the South Coast Air Quality Management District in California used a negotiated rule-making process to introduce emission trading between facilities as a cost-effective way to reduce the costs of meeting strict health-based ozone standards. In other examples, States have implemented plans and trading programs, but limited trading has occurred to date. These include two watersheds in Colorado to reduce future nonpoint source problems and Wisconsin's Fox River waste load allocation program to attain regional water quality goals. North Carolina also has a similar mechanism in place for one river system. Locally, communities have applied trading as a way to reduce pollution from excessive fireplace use in Colorado, for example.

As indicated in the table, other mechanisms include emissions averaging, plants or firms can average overall emissions to meet a standard; liability assignment in which findings of damages to third parties carry specified financial compensation; the provision of various types of information to improve knowledge of risks, both for consumer and business decision making; and the use of subsidies or tax concessions to induce changes in operation or behavior deemed to be in the public interest.

Some other types of incentive programs in operation also bear on environmental quality. For example, at the Federal level, the schedule of fees imposed on continued ocean dumping after 1991 and the economic-based noncompliance penalties under the Clean Air Act both serve as incentives to meet environmental standards.

Proposals for Change

While academic economists have long been the major proponents of market-oriented changes in environmental regulation, these concepts are now actively debated by many in the policy arena. For example, Table 2 presents some of the types of recent proposals including those based mainly on two projects sponsored by Senator Wirth and the late Senator Heinz which

have been a focal point for further studies and debate.[16] Generic and specific examples of the various mechanisms in Table 2 are discussed in subsequent sections.

As the table suggests, many of the proposals for greater use of market-based mechanisms focus on tradeable overcontrol or overperformance on some form of management objective. The other recurring theme is the more direct use of taxes on polluting activities or products, such as the Btu tax initially included in the Administration's plan for reducing the Federal budget deficit.

ADVANTAGES: POTENTIAL COST SAVINGS AND INNOVATION

Proponents of decentralized or market-based policies cite the potential cost savings and efficiency of these alternatives. The general argument is that systems of environmental regulation which allow flexible responses, or abatement trading among sources with differing reduction costs, save money. Proponents see such alternatives as both a supplement to traditional regulatory approaches and as a cost-effective way of attacking emerging problems.

Although proponents talk about market or incentive approaches to environmental protection, this does not imply markets in the form of daily price quotes and frequent exchanges of products or property. Rather, proposed approaches would act to increase the flexibility of meeting environmental or resource management objectives (usually limitations on total pollution over some broader geographic area) through greater latitude in when, where, and how adjustments in technology, fuel, materials, or rates of resource use are implemented.

The hoped for objective is less costly management of environmental quality and natural resources than can be done by trying to extend traditional regulatory methods. In essence, these types of mechanisms help to focus decision making by making the cost of environmental management more explicit to both businesses and consumers. This in turn creates reasons to be innovative to make the cost of compliance as low as possible, thus rationing the absorptive capacity of the environment similar to the way markets serve to ration any scarce good or service through the price mechanism.

For the major market-based tools, taxes and tradeable overcontrol of pollution or other standards, cost savings to society may result for two related reasons. First, flexibility in method, location, degree of abatement, and contracting arrangements within the regulated community can lead to less resources expended to meet environmental management objectives. Control is concentrated at the most cost-effective locations as a result of self-interested trading among the regulated community, assuming that local environmental standards are met. Second, with both taxes and tradeable overcontrol, a continuing motivation exists to innovate to avoid the taxes or create overcontrol that can be sold. If this type of incentive remains a constant and predictable part of the business or consumer environment, and there are few, if any restraints on how

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[16] *Project 88 -- Round II, Incentives for Action: Designing Market-Based Environmental Strategies.* A Public Policy Study sponsored by Senator Timothy E. Wirth, Colorado and Senator John Heinz, Pennsylvania. Washington, D.C. May 1991. See also the earlier version of this report sponsored by the same Senators - *Project 88, Harnessing Market Forces to Protect our Environment: Initiatives for the New President.* A Public Policy Study. John F. Kennedy School of Government, Harvard University. Cambridge, MA. December, 1988.

compliance is achieved, then, proponents argue, longer term cost savings are likely through innovation and substitution compared to the stereotypical command and control system.

While total cost to society for meeting environmental standards can be less in theory, under some market-based options total industry compliance costs can be much higher, since regulated entities must not only pay to use the waste disposal capacity of the environment (through purchased permits or pollution taxes), but also pay for any abatement they undertake to avoid taxes or the need to buy overcontrol from somebody else. While expenditures on taxes or overcontrol are considered transfers within society not affecting the real resource cost of compliance, they raise the direct compliance cost to industry. Opposition by industry to such mechanisms, is in part, based on this type of concern.

TABLE 2. PROPOSALS FOR MARKET-BASED ENVIRONMENTAL PROTECTION

ENVIRONMENTAL PROBLEM	MARKET-TYPE PROPOSALS
Air Pollution	
Major Stationary Urban Sources	Comprehensive Tradable Permits • requires baseline inventory • special credit for previous reductions • progressive reduction in permit amounts • fines exceeding market value of permits
Mobile Sources	Taxes and Emissions Charges • taxes on low-mileage cars • charges for automobile use • tax on gasoline
Radon(indoor air pollution)	Mandatory Information • require certification of radon "free" status of house to qualify for FHA financing
Water	
Point Source	Watershed Limitations • tradable permits -- similar to air programs
Nonpoint Source	
Surface	Point-Nonpoint Source Swaps • Point sources buy reductions in nonpoint sources in order to meet water quality goals (two for one exchange to assure actual reductions) • directed toward nitrogen and phosphorus loadings Broaden Conservation Reserve Program
Groundwater	Conservation Easements • swap farm debt for use restrictions
Pesticides	Taxes on most damaging products

TABLE 2 (continued)

ENVIRONMENTAL PROBLEM	MARKET-TYPE PROPOSALS
Municipal Wastes	
	Recycling Targets and Tradeable Credits • Establish recycling content regulations and allow purchase or sale of over compliance/under compliance between firms.
	Unit Pricing • Charge by volume of residential waste
	Retail Disposal Charges • Surcharges on sale of goods to reflect disposal costs
	Virgin Materials Charges • Charges on virgin materials to reflect eventual disposal costs and stimulate use of secondary (recycled) materials
Hazardous Substances	
Toxics	Deposit and Refund System on Containerizable Hazardous Wastes
Greenhouse Effect	
New-Major $C0_2$ Sources	Offset Policy where New Sources Buy Comparable reductions in CO_2 • from energy conservation • from plant retirement • from mass transit investments • from reforestation joint ventures
	Taxes on Major Sources of Carbon Emissions • Carbon tax • Btu tax • Gasoline tax
Deforestation Mitigation	• from Conservation Reserve Program • from international forest for debt swaps

Studies of Cost Saving Potentials

Several earlier studies have looked at this theoretical potential for less costly abatement approaches through market-based approaches, mainly permit trading.[17,18,19] In almost all cases, these estimates are achieved from simulation models in which current regulations and past abatement expenditures are not considered. As such, these types of studies will overstate what might actually be saved from the use of permit trading starting from conditions and regulations as they currently exist. For example, an earlier survey of several region-specific case studies suggests that the cost of attaining air quality standards might have been reduced in the range of fifty percent between 1981 and 1990 if least-cost control had been achieved through unconstrained emissions trading.[20] This would have amounted to tens of billions in savings. Hester and Hahn, on the other hand, suggest that savings from the current air emissions trading program have been a few billion.[21]

In looking at theoretical or simulation type studies, the extent to which regulatory constraints on local environmental quality have been excluded from the analysis must also be considered when evaluating potential savings from emissions trading; that is, if dirty high-cost facilities would not be allowed to violate local quality standards even if total regional pollution could be reduced more cheaply through some form of trade, then theoretical savings will be diminished. In addition, the regulatory approaches may promote values other than cost-effectiveness, such as equity and energy policy considerations, among others.

This potential for major cost savings underlying most of the modelling studies is due to the often large differences in pollution control costs among sources. These potential cost variations among similar sources are the result of differences in scale, age, technology, cost and ease of substituting inputs, management practices, and location, among other factors. For example, studies show that average cost effectiveness across control measures for volatile organic compounds (VOCs) may range from about $500 per ton for limits on fuel volatility to about

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[17]United States General Accounting Office. *A Market Approach to Air Pollution Control Could Reduce Compliance Costs Without Jeopardizing Clean Air Goals*. PAD-82-15. March, 1982.

[18] ICF Resources Incorporated. *Economic, Environmental, and Coal Market Impacts of SO_2 Emissions Trading Under Alternative Acid Rain Control Proposals.* Prepared for the U.S. Environmental Protection Agency and the U.S. Department of the Interior by ICF Resources Inc. March, 1989.

[19] Hahn, Robert W. and Hester, Gordon L. *Where Did All the Markets Go? An Analysis of EPA's Emissions Trading Program* . Yale Journal on Regulation. Vol. 6, Winter 1989. pp.109-153

[20] Tietenberg, T. Emissions Trading: *An Exercise in Reforming Public Policy*. Resources for the Future. Washington, D.C. pp. 42-43.

[21] Hahn and Hester. Loc. Cit. p. 63.

$39,000 per ton for using methanol.[22] Typical control costs for VOCs are in the range of $1,000 to $7,000 per ton. Other types of pollutants may have less extreme, but none the less significant, differences in incremental reduction costs. For example, a series of water pollution control studies suggested potential saving with least-cost approaches of 20 to 70 percent compared to equal-proportional treatment of pollution sources.[23]

Even though major cost variations may hold promise for more cost-effective pollution control, realizing the savings may not always be practical using extensions of the current system. For example, most large, low cost sources of pollution abatement are already making pollution reductions under current regulations. Many of the remaining sources with low incremental reduction costs may be small individual contributors. Such small activities probably cannot bear the cost of expensive control technology, but could reduce emissions through changes in management practices or other operational adjustments. Applying market-based approaches to these types of problems, however, may involve approaches that are not likely to be administratively practical, such as taxing inputs or complex polluting byproducts. The latter implies a very high degree of monitoring or self reporting, both of which have drawbacks.

Another consideration is the stringency of control necessary to achieve environmental standards. In an area with significant violations of environmental standards (e.g., air in Los Angeles), virtually every significant pollution source of ozone precursors and of carbon monoxide may require maximum feasible reductions if ambient standards are to be approached. Under these circumstances, market-based approaches may reduce inefficiencies in timing and location of controls, facilitating the implementation of strict standards and reducing indirect costs, but not appreciably affect total costs.[24]

A Stimulus for Innovation

Incentive-based approaches may promote lower cost abatement where existing sources of environmental degradation are required to make major changes. However, a more subtle, but equally relevant point is the stimulus that market signals can provide for long-term innovations that might change entire pollution generating products and activities. Incentive systems also offer important flexibility in timing, important to private sector investment decision-making.

While it has not been demonstrated that current regulatory systems inhibit innovation and technical advance in environmental protection, proponents argue that incentive systems reduce the risk that such inhibition will occur. For example, most current environmental regulation is directed to the removal or transformation of pollutants from industrial, municipal, and mobile sources or to the control of harmful products entering the environment such as pesticides and toxics. Solutions to environmental management problems consequently tend to focus on "end of the pipe" treatment technologies and on disposal practices.[25]

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[22] Office of Technology Assessment. *Urban Ozone and the Clean Air Act: Problems and Proposals for Change.* April 1989. Washington, D.C. pp. 106-108.

[23] Tietenberg, T.H. Op. Cit., p. 46.

[24] Tietenberg, T.H. Op. Cit., pp. 45-47.

[25] Although the use of "best available control technology" and new source performance (continued...)

This is not to say that current regulatory systems do not create pressures for cleaning-up as well as avoiding polluting activities. Adjustments in internal combustion engine technology along with installation of catalytic converters is a case in point.

The costs of meeting permit conditions, engaging in possible litigation, or paying fines do provide indirect incentives to engage in avoidance strategies that may reduce pollution. However, these types of adjustments to regulatory requirements are often in the form of delay, uncertainty, transactions costs, shutdowns, and decisions that may later prove to be inadequate or misguided. Where avoidance of regulatory burdens takes a positive form, it may be through adjusting production processes, changing product lines or inputs, or taking other pollution reducing activities.

Proponents of incentive systems argue that cost signals should be more explicitly focused on the polluting substance or activity if we want to do a better job of long-run environmental management. They argue that there may be any number of ways of reducing the level of pollutants ultimately reaching environmental media. Having the incentives and flexibility to be able to choose how and where to make changes can reduce the need for costly removal technologies. For example, if the impacts on employment in vulnerable segments of the high-sulfur coal industry were ignored, an unrestrained incentive-based system would likely lead to large scale shifting to low sulfur coal. This would be a market-based outcome, since using low-sulfur coal is generally a much less expensive option than installing scrubbers.[26] In passing the acid rain portion of the 1990 Clean Air Act Amendments, however, Congress chose to design the sulfur dioxide allowance trading system in way that gives some incentives to use scrubbers that may give some protection to high sulfur coal miners, while still creating the most potentially comprehensive market-based approach to date.

CHALLENGES TO IMPLEMENTATION

The preceding alludes to some of the institutional challenges in implementing market-based systems. General concerns include political acceptability, geographical equity, and practicability. In particular, affected parties may be very reluctant to accept incentive approaches. There are, moreover, several specific and interrelated policy concerns that accompany proposals for incentive-oriented policies.

Specific problems include lack of certainty in attaining environmental goals; third party and local environmental compliance; measurement and monitoring costs; boundary inequities; institutional capability and authority; market imperfections; compliance versus abatement costs; complexity in pollution sources; and cross-media effects.

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[25](...continued)
standards were supposed to encourage and even "force" new technology.

[26] See for example: 1) Streets, David G. and Veselka, Thomas D. *Economic Incentives for the Reduction of Sulfur Dioxide Emissions.* Energy Systems and Policy. Vol. 11, pp. 39-59, 1987. 2) Harrington, Winston. *Breaking the Deadlock on Acid Rain Control.* Resources. Fall, 1988. Resources for the Future. Washington, D.C.

The various incentive approaches discussed in the next chapter are subject in varying degrees to these specific policy problems. Also, the current command and control system confronts many of the same concerns.

Uncertainty in Meeting Environmental Goals

Raising the cost of polluting activities or products through charges or taxes can be expected to lead to reduced pollution levels over some difficult to predict time period. This will happen so long as the costs of reduction for some businesses or consumers are less than the charges associated with the polluting activity. However, in a complex economy, it is difficult to predict accurately how much reduction will occur, how fast it will occur, and what combination of short and long run alternatives the private sector may use to make reductions.

Thus, if regulators were to add incentive-oriented modifications to current regulatory systems, the resulting pace of improvement toward environmental goals or standards might or might not be considered acceptable. Proponents believe that charge adjustments could fine tune these systems based on initial response. However, frequent changes to adjust the incentive structure would doubtless lead to criticisms similar to those made of the current system where numerous changes make private sector response more difficult and inefficient. A further complication arises if incentive fees also serve to finance the regulatory program. If successful in reducing the polluting activity, the financing base would be reduced.

Tradeable permits may offer regulators an incentive option with less uncertainty than taxes or fees. Since permits are for a fixed amount of pollution or other compliance goal, enforcing compliance with the permit terms should, in total, meet specified standards.

Uncertainty would also affect the private sector's response. If permit conditions and amounts were not firm or were subject to future change, trading and markets would be retarded. Similarly, lengthy processes, hearings, intervention points, and possibilities of lawsuits typically retard or eliminate potentials for cost-saving exchanges.

Third Party Effects and Local Environmental Compliance

Any market-based approach that would result in the shifting of pollution location or in the potential introduction of unpredictability in regional environmental conditions would require explicit safeguards. That is, for example, if waste water discharges were transferred between two different locations as part of permit trading, safeguards would be needed to protect the interests of persons living along or using the water affected. If various types of interregional emissions trading are allowed, safeguards would be needed to assure that applicable local environmental standards continued to be met. Hence, even a market-based system requires a regulatory framework in order to function and thus is supplemental to such command and control requirements.

Moral Opposition to Local Changes in Pollution

Closely related to the above, some environmental groups have opposed market approaches on the grounds that any potentially damaging emissions should be eliminated. Thus there shouldn't be a "right" to pollute which can be bought or sold. They argue that if it is possible to reduce emissions at a given source, the source should not be allowed to buy emission rights from some other source located in a different area, since the local area would continue to bear

avoidable pollution. On the other hand, regulations give one the "right" to pollute also by meeting the given standard.

Measurement and Monitoring

A major technical and cost challenge for greater reliance on incentives is monitoring of compliance, particularly for the cases of tradeable permits and less so for taxes on effluents or emissions. By focusing on performance rather than on what hardware a company has installed, enforcement difficulties increase.

Systems of monitoring are both necessary and likely to be more complex and expensive than for a performance- or technology-based approach. With the latter, regulators know approximately what abatement levels are being achieved and where. To actually measure pollution levels from specific sources in order to impose charges requires regular monitoring or self-reporting with periodic verification. For air emissions, for example, most sources do not have continuous emissions monitoring, nor are all potentially controlled pollutants monitored. Such monitoring is only required on new sources and coal burning utilities for sulfur dioxide control purposes. For existing sources, compliance is generally determined by ambient concentrations as measured by ground monitors. Individual stack monitors would be imperative to comprehensively monitor compliance with an emissions tax or for systems of potentially widely-traded emissions. For the SO_2 allowance trading system under the Clean Air Act Amendments, continuous emissions monitoring is a requirement.

On the other hand, taxes on inputs (such as carbon content of coal) do not require any extensive monitoring or administrative systems.

Complexity Of Nonconventional Pollutants

The complexity of nonconventional pollutants (i.e., toxics, pesticides, etc.) as well as the complexity of their sources likely renders tax or charge systems for other than revenue purposes an extreme challenge in most situations, since authorities would have to set charges for and monitor a vast number of pollutants and sources. Taxing substances on the input side presents fewer problems, particularly since companies would normally have transaction data on which to base charges. For example, proposals for reauthorization of the Clean Water Act include charges on certain types of toxic chemicals based on a rating of their degree of toxicity.

Institutional Capability and Authority

As stated above, the Federal government has the potential legal authority to use taxes as a policy tool for influencing private-sector behavior. Some environmental statutes, specifically the recently amended Clean Air Act, and less so the Clean Water Act, also contain varying degrees of encouragement or limitations on use of market-type approaches. Beyond the legal question, Federal, State, and local governments would likely require additional resources, experience, and capabilities to structure, manage, and enforce certain types of market-based approaches.

Specifically, capabilities would be needed to structure and facilitate market-type transactions while avoiding the chilling effect of excessive regulations, oversight, and third party intervention. Monitoring systems, inter jurisdictional coordination, enforcement authority and capability, technical analytic staffs, among other resources would be important in supporting less centralized, market-oriented management systems.

Market Imperfections

The potential for trading overcontrol of pollution or credits to facilitate environmental management requires well organized markets for trading. If buyers and sellers are few, information is limited, property rights are not well-defined, transaction rules are cumbersome and time-consuming, if the public can intervene at multiple points in the decision process, or a few large organizations can manipulate availability and price of permits, then the potential for trading is unlikely to be realized or to improve environmental management.

Thus, for pollution or credit trading programs, information and exchange mechanisms (public or private) would need to evolve quickly to help bring interested parties together. In many situations, responsible agencies would have to have the capability to monitor market development and to deal with possible problems of market dominance by very large organizations or other serious noncompetitive actions.

Regional Definitions and Boundaries

A difficult problem for many of the incentive options is inequities at jurisdictional boundaries, though this problem also holds for many current environmental regulations. For example, if input taxes on polluting substances were used, strong incentives exist for avoiding the cost by doing business in neighboring jurisdictions not using similar programs. Differences in administrative and legal requirements across jurisdictional lines may also reduce the appeal and potentials of some of these approaches.

Compliance Versus Abatement Costs

One of the major concerns with some of these approaches is the cost burden on companies. Systems that involve government auctioning of tradeable permits or payment of effluent charges particularly raise this problem.

While auction of permits or pollution taxes theoretically achieve the least cost allocation of pollution abatement expenditures, companies would also pay for the market costs of permits or pay pollution charges on unabated pollution. This money is paid to the government and is considered a transfer within society from a social or economic perspective. However, for companies the combination of spending on pollution abatement as well as permits or effluent taxes is usually more costly than meeting the requirements for uniform treatment Understandably, options having this result are vigorously opposed by industry.

Cross-Media Effects

Raising the cost of one means of waste disposal or disposal of one particular pollutant can often result in diversion of pollutants to other untaxed or uncontrolled environmental media. As with current regulatory systems, anything less than a comprehensive approach, particularly with toxic or hazardous substances, invites diversion to other media or even illegal dumping.

INSTITUTIONAL CONSIDERATIONS IN IMPLEMENTATION

The beginning of market-based approaches to environmental protection in the United States is accompanied by a growing number of proposals for greater use of these types of policy tools. Such options are now solidly on the environmental agenda, even though they face significant institutional and practical obstacles to early or easy application. The challenge to adoption of such techniques is the extent to which these mechanisms can be at odds with other important imperatives, authorities, jurisdictions, and practical implementation and management needs.

THE ROLE FOR MARKET APPROACHES IN A REGULATORY CONTEXT

The extent to which market-based mechanisms might ultimately become a major feature of environmental management policy is subject to a wide range of debate. Such mechanisms do, however, offer a pragmatic vehicle for accomplishing several things effectively, either as a supplement to prescriptive regulatory systems or as freestanding systems. These systems offer at least the following general features which can allow for incremental refinements in existing environment and resource management systems:

- Regulatory Efficiencies - Introduction of flexibility in meeting some facility emission standards or regional ambient quality standards resulting in lower direct compliance costs or lower indirect costs due to a less cumbersome compliance process;

- Phase out or Phase Down Mechanisms - Introduction of flexibility and cost savings in meeting a national or regional pollution constraint where trading of emission sources does not create local violation of health-based standards;

- A Way for Internalizing External Costs - Signalling a societal desire for reduction in the overall consumption of environmentally damaging substances or activities by raising their costs to the user in situations where other forms of environmental control are impractical, too costly, less effective, or counter to other values such as individual freedoms. Taxing cigarettes or alcohol are cases in point at a personal level. Part of the motivation for a gasoline tax seems to fall in this category.

Not unrelated to these features is the potential for revenue to pay for environmental protection efforts or to serve other fiscal needs.

The possibilities for less costly or more effective environmental management from adopting these types of innovations are widely argued and illustrated in academic and other policy literature. What is less often examined are the issues for implementation within both the legislative process and the institutional constraints of the Federal system. This section looks at general implementation issues for three generic approaches and their variations. It also briefly reviews other market- conditioning mechanisms such as information requirements, liability assignment, best management practices, and pricing polices.

The approaches include:

1) Taxing pollution, polluting activities, or polluting inputs;

2) Allowing businesses to trade a set amount of pollution or other constraint on business activity (a fixed amount of sulfur dioxide emissions, recycled paper content in newsprint, etc.) among themselves in order to achieve gains from trade and thus achieve lower compliance costs;

3) Using a deposit-refund mechanism to create incentives to recycle or properly dispose of containers, and some hazardous substances or contaminated equipment;

4) Changing how individuals and businesses approach market transactions that may affect the environment by increasing available information, by internalizing risks through liability assignment, by pricing policies, and by means such as contracts or other types of agreements.

TAXING POLLUTION

The concept of taxing pollution is simple. The political and management reality of "pure" pollution taxes, however, is far from simple. Indeed, the pragmatic side of pollution taxes suggests only limited circumstances where convergent interests, policy needs, and institutional capability may make some variation of this approach a part of environmental management. [27] As discussed below, it is the variations on the theme that may hold more policy interest than the conceptual case proposed by some.

The General Case

Pollution damages important human values (health, aesthetics, materials, or the functioning of ecosystems indirectly necessary for human welfare). Thus, not all of the costs (both monetary and nonmonetary) of polluting activities are reflected in the prices of the respective goods or service. This means that damages to other values could be reduced or avoided if less of the good or service were produced, the production or consumption involved more benign technology, or defensive efforts were made to counter the pollution.

In these circumstances, economists recommend a tax on the pollution from the activity or product which causes damages to other values so that price signals the full social cost to the user (private cost of production plus monetary value of external damages). The level of the tax is set so that enough economic units (producers or consumers) modify their various behavior (consumption, fuel choice, technology, chemical use or design, etc.) to just balance the incremental value of the reduction in external damages from pollution with the incremental costs of reduction. In this scheme, those who find it cheaper to reduce pollution than pay taxes do so. They pay taxes on any remaining pollution their activity causes. Those who find it more expensive to make changes than pay the tax do so and thus continue polluting.

In theory, a tax set at the proper level will result in a reduction in pollution where costs of reduction are balanced with the benefits of such reductions, that is, where incremental costs of reduction and incremental benefits of reduction are just equal. Such an arrangement implies a great deal of information on polluting activities, the damages such activities may cause, and how

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[27] For example, see: U.S. General Accounting Office. *Environmental Protection: Implications of Using Pollution taxes for Supplement Regulation* . GAO/RCED-93-13. Washington, D.C., 1993.

individuals value those damages. Such information would be used by public authorities to structure and administer pollution taxes.

Implementing Pollution Taxes

While some countries have used variations of pollution taxes to help manage water quality for some river systems, no pollution tax conceived as a method of balancing incremental control costs with incremental social benefits has been attempted to date. There are good reasons for this and include the following considerations:

Credibility of Information

Estimates of monetary benefits necessary to justify tax levels cannot be developed in a practical and systematically defendable way. Economists have methods for estimating willingness to pay to reduce pollution, but such methods are experimental at best and not operational in terms of governmental obligations for protecting public health and other environmental values. Thus, there is no publicly acceptable way to measure the monetary benefits of most forms of pollution reduction that would allow defendable methods for setting a tax. Instead, where taxes have been proposed as an alternative to direct regulation, it has been more along the lines of how high should a tax be to induce incremental expenditures by industries in order to achieve a desired reduction in pollution with the tax.

Limited Applicability

The type of pollutants for which optimal taxes are usually proposed tend to be those that do not have long term or irreversible human or environmental consequences. The standard case is organic forms of water pollution which can be assimilated and broken down by normal bacterial processes. The more complex pollution problems, however, relate to certain toxics and pesticides which are long lasting, bioaccumulate and cycle in the environment. These pollutants have diffuse and often hard to understand consequences, which often show up first in aquatic and related ecosystems. Using optimal taxes to manage the myriad compounds that are potentially damaging presupposes immense analytical, monitoring and enforcement capability which is not currently the case.

Use of Tax Revenues

The disposition of revenues from taxes on pollution raises several difficult practical issues. If pollution is taxed in some way (pollutants, inputs, activity) to bring about its overall reduction, three questions arise. First, who receives the revenue? Second, what happens as revenue from the tax declines as pollution declines?; i.e., what happens to the revenue base? Third, how are taxes adjusted for inflation to keep the economic incentive constant in real terms? While these questions can be easily answered in concept, answers within the Federal system pose significant problems. Interests affected by taxes typically like to see benefits from such taxes, for example the highway gasoline tax going for highway construction. Answers also affect the macroeconomic impacts of such taxes.

Data Availability

Taxing pollution assumes the availability of comprehensive and precise monitoring systems which do not currently exist and would be expensive to install, maintain, and verify. Unless self reporting is used or more readily measurable entities such as inputs (for example, high sulfur coal

rather than sulfur emissions) are taxed, taxes would require expensive monitoring in order to ensure accurate reporting.

Other Ways of Using Taxes

Accepting the practical difficulties of using taxes to precisely manage environmental quality on a location specific-basis, there are other roles that taxes, charges, or fees can play.

Fees already serve as a basis for partial or complete financing of some environmental protection programs. Fees are levied on regulated entities to recover some or all of the costs of administering Federal, State, or local environmental protection programs. The level of fees must reflect the cost of administrative services performed meaning that fees seldom will provide any strong incentive for reducing pollution beyond the regulatory requirements.

Between the financing of environmental protection programs with fees and the precise taxing of pollution to achieve an essentially unknowable optimal reduction probably lies a more pragmatic role for taxes in implementing already determined social goals. This role evolves from using taxes to implement a policy for which a consensus on achieving a specific reduction target has been obtained. For example, the acid rain control program could have had a tax imposed that achieved a 10 million ton reduction in SO_2, but a permit program was chosen instead.

The use of taxes in these circumstances may have several purposes not necessarily related to environmental protection but possibly modifying behavior sufficiently to produce some reduction in polluting activity. Such taxes may raise general or dedicated revenue, send a signal on level of consumption, possibly be used to offset other revenue sources, or serve other purposes such as capture of windfall gains where other environmental regulations are driving up product prices.

The tax on chlorofluorocarbons (CFCs) and proposals for an increase in the Federal gasoline tax are primary examples of how taxes are or could be applied as part of broader policy packages. In the case of CFCs, the tax adds incentive to find substitutes and speed phase-out, but most observers see its imposition as much as a way to capture some of the price runup due to phase-out and to raise revenue. Proposals for large increases in the gasoline tax are packaged with any number of motivations including deficit reduction; increased energy security through reduced consumption of oil and long run incentives to increase equipment efficiency; as a general premium to signal the social costs of auto use including air pollution, congestion, and accidents; and as an incentive to shift toward alternative fuels, among others.

A tax on carbon dioxide or more precisely, a tax on carbon content of fuel, has also been proposed as one possible response to forthcoming treaty commitments by the United States on global climate change. The level of such a tax would not be set based on an unknowable value of marginal damages from future climate change. Rather, a target for reduction would need to be related to incremental costs of reduction and the tax set at the incremental reduction cost. A large amount of revenue would be raised which opens the possibility of offsetting other taxes or spending areas so as to minimize the immediate economic impact. The Clinton Administration and the Rio Declaration at the 1992 Earth Summit have committed the country to stabilization of greenhouse gases at 1990 levels by the year 2000. A carbon equivalent tax could be set at the marginal cost of achieving that policy goal. Other possibilities for energy-based taxes related to climate change include a tax on Btu content of fuel, which shifts the initial costs away from fuels such as coal and may spread the distributional consequences.

In contrast to a precise pollution tax based on balancing regional environmental benefits and control costs, a broad based tax serving multiple objectives is likely to have widespread and highly visible equity or distributional consequences. To the extent that such taxes have environmental purposes, the objective is to affect levels of consumption and possibly long run technology or product design and function. In most cases, making consumption more expensive will disproportionately burden lower income individuals. Opposition to a generalized gasoline tax is partially along these lines. As with all taxes, some relief to lower income individuals can be realized through refundable credits or means tests, though the administrative burden increases. Proposed gasoline taxes fall into this category. Impacts from a carbon tax would be more concentrated initially on coal producing regions, rail transportation, and coal using utilities in terms of income and employment loss. The tax would also quickly be reflected in the rates of coal-consuming electricity utilities, currently about sixty percent of total electric generation.

TRADING OF POLLUTION REDUCTION OR OTHER RESOURCE MANAGEMENT CONSTRAINTS

Another way to potentially reduce the costs of achieving environmental standards or other resource management constraints is to allow regulated sources to trade the location and nature of compliance among themselves. This is already done to some degree through EPA's air emissions trading program and is a central feature of the acid rain control provisions of the 1990 Clean Air Act Amendments.

This type of mechanism is usually applicable only where the pollutant mixes uniformly and is damaging over a broad geographical area. Under those circumstances, the point of control is less important than is putting a limit on the total amount of pollution. As long as local health-based standards are met, where in the region pollution is reduced is not important to overall regional environmental quality.

The General Case

As with taxes, the economic logic of tradeable over control of pollution (or other compliance obligations like recycled material content) within a binding limit on total emissions is compelling. If reductions can be concentrated at those sources with the lowest costs, the total economic cost will be less than if sources with differing costs are required to achieve equal reductions. This least cost outcome is possible if each source is required to control damaging activity at the specified rate of reduction, but then allowed to sell over control to or buy over control from other enterprises. For those with low (incremental) costs of reduction, it pays to over control and sell the excess reduction to enterprises that have high (incremental) costs, who then are allowed to continue emitting pollutants. The end result is control at the required total level of reduction. If site specific shifts in the source of damaging activity is not an issue, this type of mechanism can be a cost-effective way to meet a variety of environmental and natural resource management goals.

Implementing Tradeable Pollution or Other Compliance Requirements

Implementing any tradeable pollution system requires consideration of several important institutional needs. These include:

Protecting Private Transactions

For there to be a market for pollution or other compliance over control, there has to be security of underlying private obligations. This leads to two very strong necessary conditions for development of a trading system. First, over control is essentially an investment and as such must be viewed as "property" that belongs to the investing enterprise if there is to be any reasonable incentive for trading. Government recognition and protection of that property is essential for markets to develop. Second, government can facilitate market development by minimizing the transactions costs of trading. The less encumbered with oversight and potential vetoes by government authorities or other parties, the more likely that trading and cost saving potentials will be realized.[28]

Meeting Public Purposes

On the other side of the coin, there also has to be accountability for the public purpose being served. Thus, most "open-market" trading systems would have to be monitored and regulated possibly more than traditional technology or performance-based command and control systems.[29]

This level of information is necessary in order to verify that over control has occurred and can be sold to other emission sources or third parties (for example brokers or middlemen). Advances in technology may make this feature less costly over time and there are surrogate ways for estimating how much control is achieved. Nonetheless, operation of a trading system necessarily must be information intensive if authorities are to meet statutorily mandated goals.

While voluntary reporting of reductions and trades is possible, it may invite bogus transactions and program failure. Any voluntary reporting system would require consistent random auditing or monitoring to verify reported transactions. Such a system might also invite lawsuits from environmental groups challenging lack of progress or performance by responsible State or local implementing agencies.

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[28]For an excellent discussion of the transactions and enforcement issues facing these types of trading programs see: Dwyer, John P. *The Use of Market Incentives in Controlling Air Pollution: California's Marketable Permits Program.* Ecology Law Quarterly. Vol. 20, No. 1, 1993. pp. 103-117.

[29]Implementation of the sulfur dioxide allowance trading system under the 1990 Clean Air Act Amendments may have annual costs other than direct compliance between of $1 to $1.5 billion which is 15 to 25 percent of estimated annual compliance costs. These noncompliance costs include the mandated continuous emissions monitors for all regulated sources as well as other transactions and tracking costs, permit fees, and various sales costs. For a full discussion of these issues see: U.S. Library of Congress. Congressional Research Service.*Implementing SO_2 Allowance Trading: Implications of Transaction Costs and Taxes.* Report No. 93-313 ENR, by Larry B. Parker and Donald W. Keifer. Washington, 1993.

Achieving Equity

Implementing a trading system on top of existing command and control systems raises challenges as to how much credit each entity should receive for past efforts. Inequities arise quickly where differing degrees of control have been previously achieved. Giving each source a percentage of its remaining emissions is inherently unfair to those who have already invested in control, or who have very modern facilities with low emissions by design. The fairest system probably involves distributing emission rights in proportion to pre-control emissions levels. This covers the situation where sources have made equipment or fuel changes and are cleaner than the new requirements because it gives them over control to sell. It still leaves an inequity when new low-pollution technology has been built into an industrial system for a variety of reasons, the source has no pre-control baseline, and is cleaner than the new standards require. Sources in such situations could be forced to buy emissions rights to expand operations when they are already cleaner than any other source.

Thus, implementing emission trading systems requires political decisions and regulatory machinery not unlike current programs. Title IV of the 1990 Clean Air Act Amendments establishing the sulfur dioxide allowance trading system for coal-burning electric utilities illustrates this concern. Passage required complex allocation systems to accommodate concerns over regional cost burdens and equity as well as operational flexibility. Some of the allocation formulas reflect site-specific concerns (e.g., local politics). This as yet untested national trading system, however, may not be a representative test since it is being implemented within the State-regulated electric utility system. At a minimum, the oversight of State regulatory commissions on profit oriented utility activities raises questions about the degree of innovation and flexibility the SO_2 allowance trading mechanism will ultimately show.[30]

Taxing Profits

If contracting parties agree to an exchange of over control or over compliance, income is generated by the seller and costs are incurred by the buyer. How these buying and selling transactions are treated for tax purposes by the IRS will have an important bearing on the strength of the incentive to invest in over control and on the incentive to buy over control as opposed to controlling to the required standard. If net income generated by selling over control is taxed at the marginal corporate rate, then the amount of over control forthcoming will be reduced in total since marginal investments in over control must stand a rate of return test against other corporate investments. How over control is achieved may also have a bearing on whether a depreciable asset or an expensable cost is being offered to other parties. If the over control bought by a purchasing enterprise is treated as a service regardless of the method by which it is generated, no differential incentive is created. On the other hand, if over control is treated as a depreciable capital expense purchased for its useful or physical life, allowed rates of depreciation may affect the choices made. In particular, allowing a faster write-off than the actual annual use would create a financial advantage because the early recovery of the investment could shelter other income from taxes.[31]

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[30] For a discussion of experience, pro and con, with the allowance trading system to date see: U.S. Senate Committee on Environment and Public Works. *Three Years Later: Report Card on the 1990 Clean Air Act Amendments.* Washington, D.C. November 15, 1993.

[31] See for example: Parker, Larry B. et. al. *Clean Air Act Allowance Trading.* (continued...)

Ways of Using Tradeable Permits or Other Over Performance on Standards

The contractual nature of pollution trading and the oversight nature of all levels of government in assuring adherence to environmental requirements, other jurisdictional needs, or political requirements suggests that trading is likely to be more practical in some circumstances than others. From experience and trends to date some of these general circumstances may include the following:

Creating Regional Bubbles

Current air emissions trading mechanisms operate within tightly drawn rules which limit how and where trades of uniformly mixing air pollutants can take place. While the SO_2 allowance trading system is designed to be national in scope, whether it moves much beyond bilateral trades under State public utility commission supervision remains to be seen. Because over control involves private investment decisions that essentially create property rights and because the obligation of local and State governments to avoid third party effects caused by changing the location of specific pollution sources, most pollution trading seems likely to be tied closely in location. If this is the direction of tradeable pollution control, it is a logical extension of the bubble approach now used for individual plants.

Creating Cross-Trading

Cross trades involve buying environmental controls in an activity different from the pollution source in order to create the right of the buying entity to avoid its own more costly control expenditures.[32] Examples include reforestation as CO_2 offsets or buying up old cars to reduce urban air pollution rather than controlling stationary sources. Although only a limited number of cross-trades have been authorized or attempted to date, they are a frequent option in proposals ranging from carbon dioxide control to solid waste recycling. Factors which will probably determine which options have potential for implementation include:

- Unimportance of the specific location of reduction within a control region;
- Ease of verification of compliance, both for public sector purposes and for purposes of private contractual arrangements;
- Large enough cost differentials to offset additional monitoring and contractual costs for control outside of the buying entity; and

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[31](...continued)
Environmental Law. Vol. 21, No. 4II, 1991. pp. 2051-2053; and Parker, Larry B. and Kiefer, Donald W. *Implementing SO_2 Allowance Trading: Implications of Transactions Costs and Taxes*. U.S. Library of Congress. Congressional Research Service. CRS Report 93-313 ENR. March 1993. pp. 6-8.

[32]See for example The U.S. Library of Congress. Congressional Research Service. *Coal Market Effects of CO_2 Control Strategies as Embodied in H.R. 1086 and H.R. 2663*. Report No. 91-883 ENR, by (name redacted), Washington, December, 1991.

- Lack of other more cost-effective options to meet pollution standards for regulated sources.

Achieving Cost-Sharing

Tradeable permits can serve to share the cost burden where pollution generation occurs in one area with environmental damages occurring in a geographically different area. The sulfur dioxide allowance trading mechanism under the Amendments gives regions that would benefit from reduced acid rain, mainly the Northeast, long run reasons to buy allowances from coal burning electric utilities in the Midwest. Through such financial exchanges, the costs of over control in the Midwest ultimately may be reduced and the costs of compliance in the Northeast raised, helping to spread the financial burden more evenly between the regions. However, in the near term, there has been no activity along these lines.

Circumstances for implementing such broad scale cost sharing may be unique to problems such as acid rain, but that example does point to several general conditions necessary for successful programs. These include:

- A significant one-way contribution of total pollution in the receiving region from the other region, based on prevailing weather or hydrologic conditions;

- Pollutants or other attributes that are not an immediate threat to human health;

- Emission sources that already operate under permit or could readily be put under permit systems for the pollutant;

- Relatively similar levels of economic activity between the regions but with differences in the cost structure for controlling pollution; e.g., large economies of scale with low incremental abatement costs for industry in the generating region and more diffuse, high incremental cost sources in the receiving region;

- A cap on total damaging activity between the two regions that is significantly below current or expected levels due to growth.

Despite the early hopes for the allowance trading program, the initial phase has seen only a handful of trades, mainly among Midwest utilities. The first auction of allowances resulted in purchases of all allowances offered by the EPA but few takers for allowances offered by utilities.[33] Thus the ideal circumstances listed above for broad scale interregional permit trading raise some important questions in the operational world of most large scale industrial sectors.

Creating Transitional or Phase-out Efficiencies

Trading of permits for industries which must eliminate a substance can ease the transition and costs. Trading of timing or location of compliance is appropriate where elements within the industry have widely differing phase-out costs. The often-cited example is the phase-down of lead in gasoline accomplished through a tradeable lead credit program between refiners. Refiners

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[33] For a general discussion of these issues see: Parker, Larry. *Implementing Acid Rain Legislation*. CRS Issue Brief 91035. Congressional Research Service. U.S. Library of Congress. Updated regularly

who had very high phase-out costs were able to buy credits from refiners who were able to accelerate the phase-out at a low cost. This type of trading could serve under circumstances similar to the refinery sector given the following conditions:

- The potential for or history of cooperation and coordination of some operations within the industry;
- A long lead time so that planning for phase-out can be coordinated with other planning needs;
- Substantial differences in production costs and size between firms or plants.

DEPOSIT/REFUND

Beyond refundable deposits on beverage containers, many have proposed using this mechanism for certain diffuse pollution sources where return for proper disposal or recycling is environmentally important, but hard to achieve through traditional regulatory means.

This type of mechanism is applicable where the item of concern is durable or can be contained and has some salvage or reuse value. Alternately, some are proposing that strong incentives be created for recycling or proper disposal of certain types of hazardous materials by requiring refundable deposits.[34]

The General Case

The success in reducing litter through deposit-refunds for beverage containers in several States demonstrates the effectiveness for this mechanism to solve certain types of environmental problems. Unlike tradeable permits, this mechanism is straight forward in concept and initial implementation for three reasons. First, the goals and the method are easily understood by the public. If the deposit is large enough relative to the purchase price of the product, the user or others have strong incentives to return containers. Second, once enacted, implementing a deposit-refund system is largely up to the private sector. While business practices must be altered and some manufacturing employment may be lost, recycling and other transactions jobs are created under these types of programs. Third, the types of products where this is applicable are typically not adulterated or contaminated by use nor are the containers of high enough value to induce counterfeiting or large scale fraud in order to capture refunds.

Thus, for standard recyclable products such as beverage containers, the State-by-State implementation that has occurred, by most reports has not caused major dislocations in container manufacturing or disruptions in retail distribution and has therefore been credited with measurable improvements in litter problems and increased levels of recycling.

Implementing Deposit Refund Systems

Extending deposit-refund systems to materials other than beverage containers, as some propose, raises several practical challenges. The severity of these challenges pose depends on the type of product or material under consideration, and in particular, the engineering and material requirements for either recycling or disposing of reclaimed materials. Though each area has its own unique concerns, several implementing issues hold to varying degrees for all of the various candidates for deposit and refunds. These include:

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[34] For example see: Macauley, Molly K. et. al. *Using Economic Incentives to Regulate Toxic Substances*. Resources for the Future. Washington, D.C. 1992.

Durability

The durability or containability of the item or material - The lower the additional effort (expenses and labor or personal time) to store, collect, handle, transport, and reprocess or dispose of the material, the more attractive this mechanism becomes. Beverage containers would be at one end of a continuum with some hazardous chemicals at the other. In between are problem items such as batteries, tires, and pesticide containers to name current examples.

Cost-Competitive Recycling

The existence of, or strong potential for, cost-competitive recycling - The greater the existing infrastructure for using or reprocessing the product or material, the more the fundamental economics will drive implementation. Deposit refund coupled with marketable recycling quotas could provide double incentives in some situations as would deposit-refund coupled with a product tax on new materials.

Existing Information Systems

The existence of well-developed information management and tracking systems to which deposit-refund information needs can be easily added - The more fully developed product information is, the less disruptive additional record keeping is likely to be, making that part of implementation less costly.

Economies of Scale

The existence of economies of scale in treatment and disposal of hazardous materials - The greater the cost-economies that can be captured through centralized treatment, the more likely a market-based deposit-refund approach would be attractive compared to other more restrictive control programs.

Ease of Verification

The capability to distinguish on a cost-effective basis qualifying returns from counterfeits in order to avoid exploitation of the system. This is particularly necessary where hard-to-analyze hazardous waste would be involved or where imports from other jurisdictions or countries could be used to capture refund monies.

Strength of Monetary and Nonmonetary Incentives

The inconvenience issues in deposit-refund systems can be a greater issue for users than the need to pay deposits - While deposit-refund systems may appear as a cost-effective way to achieve some types of environmental management objectives, time costs and inconvenience for those affected must also be considered in any comprehensive appraisal. The acceptance and success of any systems that rely on voluntary compliance will likely depend on three factors:

- The size of the deposit relative to the value of the product; the larger the deposit, the greater the likely rate of redemption by either initial purchasers or secondary markets that collect and return for income purposes;

- The size of expenses incurred in storing and returning containers;

- The degree of inconvenience and time incurred (including disruption of normal routines; time needed to collect, clean, handle, and transport containers; intrusion on storage and space management needs of homes and businesses; and administrative and record keeping changes that may be at odds with existing practices).

Ways of Using Deposit-Refund

A number of proposals for using deposit-refund suggest the potentials for this mechanism and also illustrate the challenges to effective implementation. Applications discussed in several recent studies include lead acid batteries, lubricating oil, industrial solvents, and pesticide containers among others. The major motivation behind deposit-refund proposals for these types of products is local environmental management problems that current disposal practices may pose, in particular significant contributions to nonpoint source water pollution and solid waste management. Because the types of activities contributing to these environmental problems are diffuse and numerous, the reach of traditional regulatory tools is often limited or unduly burdensome, leading some to advocate market-based approaches such as deposit-refund. The few operational examples of these types of mechanisms and several proposed options allow some general observations about circumstances for possible application of these tools. These examples are discussed in detail later in the report and general cases are discussed here.

High Volume Nonhazardous Materials with Recycling Potential Beyond beverage containers, there may be other household containers which consumers could conveniently bring back to a retail outlet and which might have the potential for a deposit-refund approach. Since most non beverage containers are not associated with littering problems, use of this approach would be a way to accelerate the rate of recycling for potentially valuable materials. In practice, use of this tool would probably only be practical at a State or national level as a supplement to reduce demands on landfill or other disposal capacity.

Highly Toxic Low Volume Materials with High Treatment Costs

Many of the proposals for extending deposit-refund deal with categories of chemicals that pose special disposal problems. Such chemicals may be treated most efficiently in large sophisticated disposal systems requiring economies of scale in order to be cost-effective. Short of mandating use of such facilities by regulated industries, a less intrusive way of increasing the control on special types of toxic chemicals could be to require large deposits at the point of sale. These deposits would be refunded upon return of certifiable spent chemicals or their byproducts to a regional disposal facility. Such chemicals would have to be used in reasonably closed industrial processes or be readily managed for final containerization and return to a disposal facility. Verification of purchase would be necessary to avoid problems of counterfeit returns.

Contaminated Products or Equipment With High Disposal Costs

Similar to the above, products such as used lead acid batteries, other electrical equipment, and contaminated containers are being or could be included in deposit-refund systems. These products often pose landfill and other disposal problems and are hard to regulate because the products are so widely used. In contrast to counterfeiting issues for containerized toxics, a key issue for this type is the incentive for theft if the deposit is too high relative to the product price. This potential raises the need for accurate documentation which in turn increases the inconvenience cost to participants. Also challenging are the product handling concerns where consumers may be disinclined to transport used equipment very far, necessitating numerous

pickup points. Final disposal of such contaminated products implies treatment capability as with the above example.

Widely Used Substances with No Acceptable On-site Disposal Methods

Used motor oil is the main example in this category. This type of approach could be used for high-volume substances that are used in equipment but not consumed in the process; that are potentially harmful to the environment; and that are prone to widespread improper disposal to land, water, or air. Chlorofluorocarbons used in cooling equipment would be an example. While deposit refund could be one tool for bringing improper CFC disposal under control, phase-out and product taxation are the methods Congress has chosen for dealing with this area.

Major challenges for this use of deposit-refund, both for used motor oil and any other proposed substances, exist both at the user end and in the ultimate market for reuse and recycling. At the user end, unless the deposit is large, the inconvenience of collection, storage, and transport to a receiving station may work against significant compliance. As with other deposit-refund substances, final use depends on the physical recycling potential, market conditions for such materials, in particular price relative to virgin materials, and the degree of contamination of the materials which may render them useless or require an extensive infrastructure for processing.

OTHER MARKET STRENGTHENING ACTIONS

Beyond proposed market-based mechanisms such as those above, Federal and State governments have strengthened information and liability requirements for certain products and disposal activities in order to improve environmental management. Also, education on best management practices can be a cost-effective way of improving resource management.

Specific examples of these more traditional methods for guiding profit-oriented economic activity towards more broadly desirable outcomes are described at various points later in the report. Some general issues of implementation are identified briefly below.

Information

A traditional role played by government is the provision of information to in order to inform and ideally improve consumer and business decision-making. Provision of a variety of economic statistics is an obvious example. A century of support to farm management through Federal extension services is another.

By giving consumers, businesses, and organized interest groups more accurate information about products or activities that affect the environment or human health, both the private sector and the political process ideally can make better informed decisions. This type of government activity is typically undertaken on the premise that some kinds of broadly beneficial information is a public good which profit-oriented enterprises do not provide because full costs cannot be recovered or because it may be counter to their commercial interests.

In the environmental area, government is involved in both education as well as mandatory disclosure of various types of use, disposal, or resource-status information accompanying either products, processes, chemicals, or sometimes asset sales. Both the Federal and State governments have passed laws broadening industry information disclosure requirements. For example, Section 313 of Title III of the Superfund Amendments and Reauthorization Act (P.L. 99-499) requires manufacturers and users of toxic chemicals to provide detailed information to

the public on the amounts of such chemicals stored on-site and released to the environment. Proposition 65 in California by direct voter initiative uses mandatory information provision along with regulation to help reduce an individual's exposure to potentially harmful substances. New Jersey's Environmental Cleanup Responsibility Act requires facilities dealing with hazardous wastes to either verify sites are clean or submit a cleanup plan to the State when the property is sold or transferred.

In mandating information disclosure, several implementation issues bear on the efficacy of such requirements and the impacts they may have on business and consumer decisions.

Factors that may affect the usefulness of additional publicly available information can include:

- The complexity of the subject, particularly where significant scientific uncertainty exists making risk or hazard characterizations difficult and time-consuming for users to interpret;

- The potential for abuse of such information for political purposes, causing damage to product or business reputations; and

- The credibility of the information source.

Factors that may affect business and consumer decisions can include:

- The cost of producing reliable information on health or environmental risks from products or substances;

- The risk to business from disclosure of trade or competitively-sensitive information;

- The increased awareness of communities to potential risks and adverse environmental effects which may increase the effect of moral suasion or public pressure on business decision-making.

On the latter point, according to some in industry, mandatory information disclosure provisions may be a more powerful force for inducing changes in some industry practices than any of the current trading or tax mechanisms. This perception is reinforced by a recent study suggesting that the SARA Title III disclosure requirements are a strong force for industries to improve their management of hazardous chemicals.[35,36]

Liability Assignment

The establishment of liability rules acts as an explicit incentive to businesses (or individuals) to modify their operations or behavior in order to avoid paying judgements to parties who may be damaged as a result of failures to meet standards or other regulations. This tool has

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[35]Carlin, Alan. Op. Cit. p 6-5.

[36]For the industry study see: Baram, Michael S., Dillon, Patricia S., and Ruffle, Betsy. *Managing Chemical Risks: Corporate Response to Sara Title III.* The Center for Environmental Management, Tufts University. May 1990.

been used extensively for disposers of hazardous chemicals under the financial responsibility provisions of both Superfund and the Resource Conservation and Recovery Act. At the State level, an example is Connecticut's 1982 Potable Drinking Water law which follows the principle of strict liability for groundwater contamination.

While this tool has been used aggressively in recent years, it typically does not require the innovation and institution building that the mechanisms described above do. As such, liability assignments impose contingent costs on businesses in order to induce behavioral changes to avoid such costs. Liability assignment can thus serve as an alternative to more direct intervention.

The implementation issues in liability assignment are complex and the subject of extensive analysis in the legal and economic professions. General issues in implementation may include:

- How favorable the conditions are for a commercial insurance market to develop in order for regulated businesses to balance risk minimization with affordable financial protection in the event of an accident. In particular, thin markets with limited risk experience may limit the availability of commercial insurance, which would create especially difficult compliance problems for smaller businesses which cannot self-insure.

- How much the liability exposure is to financial risks beyond financially feasible preventive and insurance capabilities;

- How targeted the liability assignment is to aspects of a business which will produce improvements in environmental management;

- How detectable violations of standards are that would trigger enforcement and liability obligations.

Best Management Practices

One other market-conditioning tool is best management practices, used most often in conjunction with farm programs. These are attempts to educate users on operational practices that minimize wastage and that promote broader land use or environmental benefits. Some environmental management issues - particularly in the area of nonpoint source water pollution related to fertilizers, toxics, and pesticides - stem, in part, from relatively low input costs compared to the value added by their use. Under circumstances where labor is expensive and such inputs are cheap, there is little incentive to manage the use of such substances precisely. This is particularly the case if such changes increase labor costs and competitors do not follow suit. Ideally, education on best management practices can produce operational savings that more than offset additional costs or inconvenience of such changes. Without that incentive, operational changes that reduce the use of environmentally harmful substances or that alter other operational practices are not likely to be accepted voluntarily.

CURRENT U.S. APPROACHES

Experience with market based programs to this point reflects efforts to fit practical approaches to evolving environmental and natural resource management problems. Most current environmental protection policy, as reflected in the main Federal laws, is based foremost on protection of public health; on use of existing administrative structures and facility permitting processes; on predictability in implementation; and on reasonable consistency of effort for similar classes of regulated entities.

There are any number of ways to classify the various current market-type approaches. However, the public-sector management perspective described previously offers a framework that bears on what has ultimately been authorized by Congress and implemented by the responsible agencies. Current market-based programs are grouped here by the following policy objectives:

- Achieving Regional/Local Regulatory Efficiency;
- Meeting National Pollution Reduction or Phase-Out Requirements Through Trading; and,
- Internalizing Social Costs Through Nonregulatory Means.

ACHIEVING REGIONAL/LOCAL REGULATORY EFFICIENCY

Examples in this category include various refinements to the implementing regulations under the Clean Air and Clean Water Acts. These refinements serve to ease the burden on industry by increasing the flexibility of compliance. The Environmental Protection Agency's air emissions trading program is the most often cited-example in the U.S. In the water area, programs for the Fox River in Wisconsin and Dillon Reservoir in Colorado have been established.

Emissions Trading Program

Within the command-and-control structure of the Clean Air Act (CAA), EPA has attempted over the years to introduce some flexibility to the implementation process. Before passage of the 1990 Amendments, EPA developed four market-based schemes to assist polluters in meeting the requirements of the CAA at less cost. These are referred to as offsets, bubbles, banking, and netting.

- *Offsets*. The offset policy resulted from the pending failure of many regions to achieve the National Ambient Air Quality Standards (NAAQS) by 1977. In 1976, EPA, faced with the prospect of placing a construction ban on new sources in nonattainment areas, proposed to allow new sources to be located in a nonattainment area if the new sources installed Best Available Control Technology (BACT) and obtained offsets from other facilities in the area so that the area's aggregate emissions of the offending pollutant declined. In effect, the policy reduces pollution at existing sources by making the owners of prospective new facilities pay for the reduction.

Placing the cost burden on new clean facilities rather than on existing sources which are polluting is one criticism of the offset policy. By making new facilities more expensive, modernization and technological advancement is impeded. In this manner, the offset policy does not reverse the regulatory system's bias against new sources as manifested in the New Source Performance Standards (NSPS).

- *Bubbling*. In 1979, EPA proposed a bubble scheme. Bubbling permits a facility with multiple emission sources to sum those sources and treat them as a single source. Hence, the owners are free to achieve necessary reductions at any combination of the facility's emission sources as long as the aggregate reduction is achieved. The bubble is generally applicable only to existing sources, and no interpollutant bubbling is allowed. (Proposals to expand bubbles, for example between plants or between new and old sources, are highly controversial.)

- *Banking*. In 1979, EPA promulgated regulations to bring the offset policy in conformity with the 1977 Amendments. A third emissions trading scheme, banking, was included in the regulations. Banking permits an emission source to save or "bank" any emission reductions that were in excess of its regulatory requirement. These banked reductions, called emission reduction credits, can be used by the facility at a later date, or sold. In permitting the buying and selling of emission reduction credits, banking facilitates the use of the first two trading schemes--offsets and bubbles.

  Previous to the 1977 Amendments, EPA attempts to introduce banking were declared illegal; confiscation of emission reduction credits not used immediately was considered a more rapid means of achieving the National Ambient Air Quality Standards (NAAQS). The specific guidance given areas by the 1977 Amendments was declared compatible with banking.

  Banking is important because it provides a mechanism for polluters to effectively use the offset and bubbling schemes discussed above. Also, banking provides some incentive to "overcontrol"; that is, to control emissions more than the minimum legal requirement. Opponents of banking feel that, in a nonattainment area, maximum reductions should be mandated until compliance is achieved. Therefore, there should be no excess reductions to bank.

- *Netting*. Most analyses of trading schemes indicate that netting has resulted in the greatest cost saving to industry. Netting began in 1974 and permits an existing source to undergo a major modification without invoking the NSPS requirement if the facility's aggregate emissions do not increase. Since under NSPS, new or major modified sources must meet stringent requirements, netting's ability to reduce a potentially significant control cost can result in significant savings to a facility's owner.

The development and implementation of trading schemes in the U.S. have had a rocky road for a variety of reasons.[37] The Clean Air Act is focused on protecting human health with an adequate margin of safety, and achieving this goal as rapidly as possible. The Act's primary concession to economics is only requiring NSPS uniformly for new sources, and not requiring such stringent controls on existing sources in attainment areas.

In some highly polluted areas, these health standards require very substantial pollutant reductions which, coupled with the tight deadlines, leave little room for flexibility, and, therefore, involve the greatest cost. It could be argued that, in nonattainment areas, if additional reductions can be found at a source to offset emissions at another source, then the first source should be required to meet that lower emission level and no offset granted; the urgency of the problem requires maximum reductions. Indeed, the courts used variations on this argument to prevent bubbling and netting in nonattainment areas previous to the 1977 Amendments.

A summary of emission trading activity is shown in table 3. As indicated, netting has provided the bulk of estimated cost savings resulting from the various trading schemes. This is not surprising because, by netting, a facility is avoiding NSPS--generally the most expensive control method--compared with obtaining reductions from existing sources which could use means other than NSPS to achieve reductions.

Offset Experience in Southern California

Southern California is often cited as having the most well developed emissions trading market under the offsets program. As noted by Dwyer, however, only a small number of firms completed trades with each other annually and such trades have been only a small part of stationary source control programs.[38] The Southern California experience is instructive for understanding what may facilitate or hinder effective implementation of these types of programs.

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[37]For example for a criticism of the experience with EPA's bubble program see: Doniger, David D. *The Dark Side of the Bubble.* The Environmental Forum. July, 1985. Also a series of opposing views on emissions trading in the March 1986 Environmental Forum (pp. 28-34).

[38]Dwyer, John P. *The Use of Market Incentives in Controlling Air Pollution: California's Marketable Permits Program*. Ecology Law Quarterly. Vol. 20, No. 1, 1993. p. 108.

Table 3. Summary of Emissions Trading Activity*

Scheme	Estimated Internal Transactions	Number of External Transactions	Estimated Cost Savings (Millions$)
Netting	5,000-12,000	0	Permit Costs: $25-$300 Control Cost: $500-$12,000
Offsets	1,800	200	0
Bubbles:			
Federal	40	2	$300
State	89	0	$135
Banking	<100	<20	Small

*Covering the mid-1970s through the mid-1980s

Source: Data from Hahn and Hester, 1986.

In 1976, the South Coast Air Quality Management District (SCAQMD) enacted Regulation XII to require review of new stationary sources of air pollution. Emission reduction credits (ERCs) were granted to companies that could prove real, permanent, quantifiable, enforceable, and surplus emission reductions of reactive organic gasses (ROG), commonly known as volatile organic compounds (VOCs), and nitrogen oxides (NO_x). Originally, Regulation XII included a contemporaneous reduction requirement specifying that offsetting credits must be used within 90 days of being generated. Although the timeframe for using credits was restrictive, there were no geographical restrictions on where credits could be traded within the District. Many ERCs were generated when plants shut down operations. Some were granted for achieving reductions beyond that which were required by State and Federal standards. Between 1983 and 1990, 59 ERCs were issued to firms in the South Coast air basin; 31 were due to permanent shutdowns and 28 were issued for process changes that decreased emissions. During this period, 24 ERCs were purchased and an additional 15 ERCs were used for offsetting increased emissions by the same owner's facility.[39]

District Regulation XII was amended in June 1990. As a result of the amendments, ERC activity increased. The contemporaneous emission reduction requirement was deleted and new provisions were added to prevent excessive emissions in any single area from creating "hot spots" of unhealthy air. The amendments established sensitive zones where increased emissions were prohibited, and only allowed trades to downwind areas.

To assist small businesses, SCAQMD created a community bank of ERCs available to firms that require offsets of less than two tons per year. These small air pollution sources may

[39]Marketable Permits Program Working Paper #1, South Coast Air Quality Management District, May 1991, p. 1-4.

apply for no-cost credits held in the community bank. The bank is partially funded by emissions reductions from old shutdowns that were never claimed. Although the bank's deposits are currently sufficient to cover requests for credits from small businesses, it is possible that requests could exceed deposits.

The Federal new source review program now requires all increases in emissions to be offset by emissions decreases that are 20 percent greater than the corresponding increase (offset requirements of 1.2:1). The 1990 amendments to the District regulations required that all holders of ERCs return them to SCAQMD for a review of company emissions records. After the review, the ERCs were reissued, but often devalued. For example, credits that were granted for equipment shutdowns were reduced in value by 80 percent. However, the total number of credits actually increased, because many firms did not know they were eligible to receive credits. Credits representing almost 2,000 tons of air emissions have been traded since implementing the 1990 amendments to the SCAQMD program.[40]

As discussed later in the report, the increasing sanctions for noncompliance in the 1990 Clean Air Act Amendments and its comprehensive permit program appear to have increased the attractiveness of the emissions market to industry.[41] Experience with the offset program, as Dwyer observes, provides valuable insights for efforts to establish a more effective emissions trading market in southern California. He notes that the efforts to mix command and control regulations with emissions trading in the offset program reduced supply and demand, increased transactions costs, and increased uncertainty about the security of the "property right" to overcompliance.[42]

Other examples of attempts at regulatory efficiency gains through trading are presented briefly in the summary discussion and tables below, based on an earlier report by Hahn and Hester.[43]

Direct Discharge Permit Trading

As described in Table 4, this trading system for paper mills and other dischargers in Wisconsin has been effect since 1981. It initially appeared to hold promise for reducing waste treatment costs of paper mills and municipal wastewater treatment plants for meeting river water quality standards. However, control costs proved to be lower than expected and with one exception, no trades have taken place.[44] Restrictions on trading, the time required to get State approval, and the uncertain tenure of the discharge rights apparently have all worked against potential trades among companies.

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[40]Personal communication, Tracy Goss, South Coast Air Quality Management District, February 2, 1993.

[41]Dwyer, John P. Op. Cit. p. 112.

[42]Ibid.

[43]Hahn, Robert W. and Hester, Gordon L. *Marketable Permits: Lessons for Theory and Practice*. Ecology Law Quarterly. Vol. 16, May 1989. pp. 361-406.

[44]Carlin, Alan. Op. Cit. p. 5-15.

Point-Nonpoint Sources Trading

Two states, Colorado and North Carolina, have established programs for reducing nutrient discharges to water supply reservoirs in the one case and a river basin, in the other.

Colorado

In Colorado, two local governments in the Denver area have established programs for accommodating future economic growth by allowing dischargers of phosphorus loadings with high treatment costs to "buy" comparable or greater abatement from lower-cost sources, usually diffuse nonpoint polluters.

Dillon Reservoir. This trading system for the Dillon Reservoir in Colorado is designed to allow point sources credit for reduced phosphorus loadings by paying for reductions in nonpoint sources. Table 5 describes the features of this program. Rising control costs to meet strict discharge limits for point sources and substantially lower incremental control costs for nonpoint sources is the rationale for this trading system. While only a few trades have taken place to date, the structure of the trading options and cost differences between sources looks promising for reducing future compliance costs.

Cherry Creek Reservoir. This system started in 1984 by Summit County uses a trading ratio of 2 to 1 between point and nonpoint sources to provide a margin for new growth. [45] As noted by EPA, slowdown in regional growth and improved treatment efficiencies have decreased the need for trades. Interestingly, some discussion of trades between nonpoint sources has occurred which was not expected as part of the program.

The Tar-Pamlico River Nutrient Strategy (North Carolina)

The newest example of a trading system for water quality control purposes is being undertaken in the Tar-Pamlico River basin of North Carolina. A nutrient management strategy is being pursued in this region to address
accelerated eutrophication problems. The goal of the strategy is to implement the concept of nutrient trading to accomplish an overall reduction in phosphorus and nitrogen by allowing certain point source dischargers to contribute cost-sharing funds to reduce loadings from agricultural runoff.

In September 1989 the North Carolina Environmental Management Commission classified the Tar-Pamlico as a nutrient-sensitive water (NSW), based on assessments of low dissolved oxygen levels, decreased aquatic
vegetation, loss of wetlands, and presence of algal blooms. The Commission subsequently proposed a number of regulatory steps to improve water quality and recommended a nutrient reduction goal of 206,000 kilograms per year from point sources discharging into the river basin. To allow for anticipated increased flows to wastewater treatment plants in the basin by 1995, meeting this reduction goal would have required those point sources to reduce nutrient discharges below 1986 levels and incur significant capital and operating expenses in the process.

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[45]Carlin, Op.Cit. p. 5-16.

Instead, a proposal was developed to allow facilities to achieve the original nutrient reduction goal by substituting other, more cost-effective measures. In December 1989 the State, the Environmental Defense Fund, and a local environmental group entered into a point-nonpoint source trading agreement with a coalition of one private and 13 municipal dischargers, the Tar-Pamlico Basin Association. Under the terms of the agreement, point source dischargers that are members of the Association are jointly responsible for meeting a steadily decreasing total nutrient limit over a five-year period, rather than having individual nutrient permit limits enforced.

Association members may achieve this overall nutrient limit by reducing their own effluent levels, by trading individual discharge levels among themselves, or by paying a fixed cost ($56 per kilogram) to a fund that implements nonpoint source controls through the State's agricultural cost-share program. The fixed cost amount is based on the average nonpoint source control cost in the Tar-Pamlico area and includes a safety factor of 3:1 for cropland control measures and 2:1 for confined animal operations.[46] A safety factor is incorporated at least until actual reductions from nonpoint source controls are better quantified.

The major responsibility for implementing the Strategy is assigned to the Association through three broad requirements. It must:

- Provide funding (approximately $400,000) for the development of a nutrient model for the river to better define the relationship between nutrient loading and water quality.

[46]Hall, John C., Ciannat M. Howett. *The Tar-Pamlico Watershed: A Case Study in the Use of Pollution Credits Trading to Reduce Point Source Control Costs and Enhance Non-Point Source Regulation*. Undated. 5 p.

TABLE 4. WATER POLLUTION PERMIT TRADING (FOX RIVER, WISCONSIN)

PURPOSE

- To help achieve water quality standards for the Fox River, a waterway heavily used for waste disposal by several dozen paper mills, where required abatement technology had not brought the river up to regional quality goals

HISTORY

- 1972- Water Pollution Control Act authorized EPA to set standards for water quality, with States establishing permit systems for individual discharges
- 1981- Wisconsin established a program to allow point sources of wastes which cause biological oxygen demand on the Fox River to trade discharge rights

MECHANISM

- State discharge permits which established the initial allocation of discharge rights set limits for the entire plant, rather than individual sources within the plant
- Trading is allowed only if the facility buying the rights is new, is expanding production, or cannot meet the discharge limits in its permit even with use of the required abatement technology
- Acquiring firm must demonstrate to the State that the additional discharge is needed
- Traded rights must be effective for a minimum of one year and cannot be effective for more than the remaining term of the sellers discharge permit which is five years
- For trades to be approved, permits for both parties must be modified, which can take a minimum of 175 days.
- When permits are renewed, there is no guarantee that discharge rights which were sold will be reassigned to a permit holder
- Trades for which the sole justification is cost savings are prohibited

RESULTS

- Only one trade has taken place between a paper mill which shut down its treatment operation and traded the discharge permit to a municipal wastewater treatment facility which then began taking the mill's waste water
- While there has been some interest in trades between mills, no additional exchanges have occurred

CONDITIONS AFFECTING THE PROGRAM

- Difference between life of traded permits (maximum of five years) and the normal life of capital investments in treatment facilities reduces incentives for trading
- Minimum of one year on trades also limits seasonal flexibility further reducing incentives for potential exchanges
- Lengthy permit process further reduces the value of potential trades

TABLE 5. WATER POLLUTION RIGHTS TRADING (DILLION RESERVOIR, COLORADO)

PURPOSE:

- To help reduce the cost of abatement and thus achieve greater reduction in phosphorus to the reservoir by allowing point sources(e.g., municipal treatment plants) to trade discharges among themselves or also pay for reduction of nonpoint sources
- To allow the area to avoid treatment capacity constraints on local economic growth

HISTORY

- Dillon Reservoir was becoming eutrophic (overenriched) in the early eighties due to discharges from sewage treatment plants and from nonpoint sources (septic systems and urban runoff)
- Even if point sources could be reduced to zero, phosphorus from nonpoint sources would still result in eutrophication
- The reservoir is both a major source of water supply for Denver and is also important to Summit County as part of its recreation-based economy
- In 1984, a coalition of governments and private interests adopted a plan requiring that advanced treatment techniques be applied to point sources and that nonpoint sources new after 1984 be required to use controls to minimize phosphorus waste loads
- The plan included provisions which allow trading of rights to discharge phosphorus among various sources
- Generally, cost of reductions for nonpoint sources are lower than for point sources (for example, the incremental cost for removing one pound of phosphorus at a wastewater treatment plant in Summit County is estimated to be $860 compared to $119 for nonpoint sources)

TRADING MECHANISMS

- Point sources are allowed to acquire discharge rights in excess of the amounts allowed under the plan
- Rights can be acquired from point sources or from nonpoint sources existing before 1984
- Trading ratios are 1 to 1 for point sources and 2 to 1 for point sources acquiring rights from nonpoint sources (to provide a margin of safety in light of uncertainty about nonpoint sources controls)
- To implement the "trade" between point and nonpoint sources, point sources agree to pay for and install phosphorus reductions at nonpoint sources, acquiring a property right by the credit they get for phosphorus reduction

RESULTS

- One trade to date involving a developer paying for sewering of some septic systems
- Waste load allocations set in the 1984 plan have growth margins for point sources thought to be sufficient through 1990, after which trading for reductions from nonpoint sources will be the only way to accommodate future municipal waste loads
- Cost savings are uncertain, but trading will allow continued economic growth

CONDITIONS AFFECTING THE PROGRAM

- Few apparent restrictions on trading, though transaction costs are not yet known
- A long term concern is proper maintenance of measures involved in trades, especially nonpoint source controls

- Provide funding ($13.3 million over five years) for implementation of agricultural Best Management Practices (BMPs). This represents the amount needed to achieve the entire nutrient reduction goal by three municipalities (Greenville, Pinetops, and Rocky Mount) which are expected to expand prior to 1995.

- Provide $150,000 to the State for the Division of Soil and Water Conservation to administer implementation of the BMPs. The State will enter into contracts with farmers to carry out designated BMPs.

In addition, dischargers in the Association were required to perform engineering evaluations at their plants to determine operational or minor capital improvements that could meet desired nutrient levels. Ironically, this initial step led the Association members to stay below the State's nutrient limits every year since the agreement was signed by means of making relatively inexpensive operational changes instead of additional capital investments. Thus, because the point sources dischargers have been able to reduce their own pollution discharges at relatively low cost, they have not yet had a need to formally trade for nonpoint source credits.[47] However, as facility growth occurs, the need for trading is likely to become more important, and funding has been contributed for the agricultural BMPs, in anticipation of that happening.

As an incentive for all point source dischargers to join the Association, the 1989 agreement provides that if the Association fails to meet any of its requirements, then *all* existing dischargers with design flows greater than 100,000 gallons per day will be required to meet stringent effluent limitations.

In developing the program thus far, a number of issues have arisen, including State resource constraints and the initial lack of information: the Association agreed to fund a nutrient model for the river basin largely because none had previously existed and because the State lacked expert resources to produce a model that would identify nonpoint sources, quantify their impact, and determine the relative effectiveness of controls.[48]

Generic implementation issues faced in this case included how to establish the price for the trading system (i.e., the trading ratio of nonpoint source controls that a point source discharger must undertake in order to obtain a credit and the price of such a credit); overcoming the reluctance in some to deviate from traditional command-and-control regulation, even though trading offered the opportunity for a more cost-effective and environmentally appropriate program; and ensuring enforceability of agricultural BMPs in contracts between the State and farmers.

Even in its early stage and even though trades have not yet occurred, the Tar-Pamlico agreement is believed to be working well as a means of achieving
water quality goals at lower total cost. Through an unusual partnership of State officials, environmentalists, and municipal and industrial dischargers, a new approach to water quality control has been developed. The agreement is expected to reduce nutrient pollution to the Tar-

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[47]Ibid., p. 3.

[48]Personal communication, John C. Hall, Kirkland & Cody, April 27, 1993.

Pamlico watershed by the same amount as a traditional regulatory approach, but at an estimated tens of millions of dollars in cost savings.[49]

MEETING NATIONAL POLLUTION REDUCTION OR PHASE-OUT REQUIREMENTS THROUGH TRADING

The three programs in this category represent widely varying scope and implementation experience.

- The **lead trading** system was implemented within the refinery sector which regularly trades product among companies. By most accounts, the program facilitated the phase-out of lead in gasoline by easing the transition costs for smaller, less technically advanced, refineries.

- The **sulfur dioxide allowance trading** system potentially could involve hundreds of utilities (on a mandatory basis) and other industrial facilities (on a voluntary basis) in exchanges which may reduce the costs of a mandatory sharp reduction in sulfur dioxide emissions by the year 2000. In contrast to the lead trading program, this exchange mechanism will involve State regulatory bodies, the regulated utility sector, other stationary sources, possibly financial institutions, as well as the Federal EPA. Its complexity and long lead time allow only speculation as to whether it will meet its initial cost-saving expectations and open market trading potentials.

- The **chlorofluorocarbon production allowance trading** system is intended to ease the phase-out of CFCs by allowing the half a dozen manufacturers to trade decreasing quotas among themselves prior to final phase-out. To date, this system has seen little if any use, in part because supply of CFCs has exceeded demand for a variety of economic and regulatory reasons.

Lead Trading

Of the various examples of trading, EPA's program for phase-down in the lead content of gasoline is generally considered a success in reducing the costs of environmental compliance. As summarized in Table 6, the trading program worked because of previous industry experience in trading products and additives, because of minimal administrative requirements for trading, and because of the ability to "bank" (for future use or trading) lead reductions exceeding EPA standards. Not only did trading lower the compliance costs to refiners, it resulted, according to some analysts, in even greater savings to retail gasoline consumers, as it lowered the costs of marginal suppliers in a highly concentrated industry, resulting in lower gasoline prices.

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[49]Hall and Howett, Op. Cit., p. 5.

TABLE 6. EPA LEAD TRADING AND BANKING

PURPOSE

- To facilitate the transition to a more stringent standard for lead in gasoline
- To provide a degree of flexibility for those refiners, usually smaller ones, that might have technical difficulties in meeting tighter standards

TRADING MECHANISM

- Amount of leaded gasoline produced by the firm determined quantity of lead rights
- Refiners adding less lead to gasoline than allowed by EPA allowed to trade lead rights equal in volume to the difference between actual and permitted lead levels
- Refiners desiring to add more lead than allowed required to buy rights from refiners adding less lead than the EPA standards

HISTORY

- 1973/78 Required reduction of average lead content starting in 1975 but delayed until 1978 because of litigation
- 1974 - EPA required that unleaded gasoline be available to avoid poisoning catalytic converters
- 1978 - Lead designated as a criteria air pollutant under the Clean Air Act
- 1982 - Lowered limits slightly on gasoline lead content and allowed trading in "lead rights"
- 1985 - Further tightened standards and announced that banking would be allowed at the beginning of 1986
- 1985 - Allowed carryover or "banking" of lead rights between quarters retroactive to the beginning of 1985 (previously rights expired at the end of each quarter). Rights could be exercised in any quarter through 1987.

RESPONSE

- Market in lead rights was very active, increasing throughout the life of the program
- Sharp increase beginning in 1986 reflected an extensive use of banked rights
- Most large refiners and one-third of small refiners created and banked rights during 1985
- Roughly equal proportions of small refiners bought and sold lead rights, suggesting that not all small refiners had difficulty meeting the EPA standards
- Large refiners used the program more extensively than small refiners, though small refiners did benefit both by banking and by purchasing banked rights from large refiners

IMPACTS ON COSTS AND THE ENVIRONMENT

- The percent of lead rights traded as a percent of all lead used increased from under 10% in 1983 to almost 60% by the end of 1987
- Cost savings to refiners estimated by EPA prior to beginning of the program of over $200 million based on forecast from a linear programming model assuming optimal behavior and ignoring increased monitoring costs
- No apparent adverse effect on the environment with the shifting of allowed lead use among refiners. On the other hand, the number of violations of lead content went up

CONDITIONS AFFECTING THE PROGRAM

- Introduction of banking seemed to stimulate trading
- Limited restrictions and administrative requirements on trades including equal treatment of banked and currently used rights
- Heavy reliance on self monitoring and reporting by refineries
- Already well established market in refinery feedstocks and products so that personnel used to trading with each other already were in place

Sulfur Dioxide Allowance Trading

The new acid rain control program authorized by the 1990 Clean Air Act Amendments is based on a comprehensive permit and emission allowance system. An allowance is a limited authorization to emit a ton of SO_2. Facilities receive allowances based on specific formulas contained in the law. These allowances may be traded or banked for future use or sale. Allowances sales and auctions are to be held to ensure liquidity in the allowance market. If an affected unit does not have sufficient allowances to cover its SO_2 emissions, it is subject to an excess emission penalty of $2,000 per ton and must reduce an additional ton of pollutant the next year for each ton of excess pollutant emitted. The law also contains special provisions (additional allowances and/or extended deadlines) for phase 1 powerplants (under a 1995 deadline) that choose to install control technology achieving a 90% reduction of SO_2 and for powerplants choosing to repower with clean coal technology during Phase 2 which begins in the year 2000.

EPA promulgated several of the important implementing regulations for the allowance system in late 1992 and is currently facing various challenges in further promulgation of regulations. These rules involve costs both to the participants and to the government (including State and national entities). With the release of the Environmental Protection Agency's (EPA) regulatory impact statement (RIA)[50] and the Internal Revenue Service (IRS) allowance guidance document, the magnitude of these costs are becoming more clear. According to the RIA, the implementing cost of Title IV could run between 15 and 25 percent of the total cost of the program. Although the combined reduction/ implementation costs are substantially below the cost of the reductions without any market-based or flexible implementation scheme, they are significant.

The estimated costs of the acid rain control program annualized over the eighteen year period 1993-2010 are presented in Table 7. Because the costs are annualized over eighteen years, the estimates presented generally overstate the annual costs during the early years of the program (Phase 1) and understate the costs in the out years. As indicated, the major implementation costs for the control program are the transaction and tracking costs (particularly if commission rates are higher than ICF assumed), and the monitoring costs.

The transactions costs could be particularly important in determining the numbers of trades conducted. Several projections of transactions and savings were based on "knife-edge" decisions--decisions which did not include either transactions costs or tax implications. [51] If either, or both, of these factors entail significant costs, trading activity could be retarded.

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[50]ICF Incorporated. *Regulatory Impact Analysis of the Proposed Acid Rain Implementation Regulations*. Prepared for Office of Atmospheric and Indoor Air Programs, Acid Rain Division, U.S. Environmental Protection Agency. July 30, 1992.

[51]On tax implications of allowance holding and trading, see Internal Revenue Service. *Rev. Proc. 92-91*. Internal Revenue Bulletin 1992-46, November 19, 1992.

Table 7. Implementation Costs by Cost Category (Annualized costs, 1993-2010, 1990$)

Cost Category	Incremental Annualized Cost (1993-2010, millions of 1990 dollars)	Percentage of Total Annualized Cost of Program
SO_2 Reduction Costs	$700-$1,300	76%-85%
Transaction and Tracking Costs	$14.8-$29.5*	2%
Auctions, Direct Sales, and IPP Guarantee Costs	$0.1-$0.6	<.1%
Conservation/ Renewable Fund Costs	$0.1	<.1%
Monitoring (CEM) Costs	$203.5	22%-13%
Permits	$3.5	<1%
Total	$922-1,537	100%

* This estimate assumes a commission rate of 1.5% on transactions. ICF also calculates a 6% commission rate scenario as an upper-bound case. In that case, the transaction and tracking costs range to roughly $59-$118 million annually. This cost would raise transaction and tracking costs to 6%-8% of total costs and reduce direct reductions costs to 72%-80% of total costs.

Source: ICF Incorporated, p. ES-7.

In terms of tax treatment, the IRS has held that the costs of acquiring or holding an allowance must be capitalized and that allowances may not be depreciated. In terms of cost recovery on the sale or exchange of allowances, the utility will realize capital gains or losses on the difference between the amount realized and the utility's adjusted basis in the allowance. This tax situation will also figure into the calculus of any trading decision.

Two years after enactment of the acid rain control title, few trades have been announced. The few that have are the result of bilateral negotiations with undisclosed prices as shown in Table 8. If this continues, the program could go the path of EPA's bubble policy in producing considerably less savings than expected, particularly in phase 1.[52]

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[52]For the possibility that allowance trading may be sequential and bilateral (at least initially), see Parker, Larry B., Poling, Robert D., and Moore, John L. *Clean Air Act Allowance Trading.* 21 Environmental Law, no. 4, 1991 (part II). pp. 2021-2068; for bilateral and sequential trading being a problem with the bubbling policy, see Atkinson & Tietenberg, *Market Failure in Incentive-Based Regulation: The Case of Emission Trading* , 21 Journal of Environmental Economics and Management, 1991. p. 19

The development of an active market in allowances is more likely to occur in phase 2, since new sources will have to find allowances from existing sources, and there should be an ample supply of allowances from several overcontrol options such as low-sulfur coal, oil and gas, utilization shifts, retrofit scrubbing, and sorbent injection. The components necessary for such an effective trading system to emerge include a broad-based spot and futures market, and brokering systems for longer term contracts that will likely be the bulk of allowance transactions.

One encouraging development is the decision by the Chicago Board of Trade in July 1991 to undertake allowance futures trading. To date, this proposal has not been implemented. The Chicago Board of Trade also conducted EPA's first allowance auction in March of 1993. While EPA sold all of the allowances it offered, few of the allowances offered by utilities were taken. Observers suggest that utilities stayed out of the market because their needs are not pressing at this time. Thus, early transactions in allowances have not yet revealed the potential for this trading mechanism.

On the negative side, the first sulfur dioxide transaction, in which the Tennessee Valley Authority (TVA) bought 10,000 allowances from Wisconsin Power and Light Company in July of 1992, has apparently run into significant local opposition.[53] Local environmental groups charged that TVA was buying the right to pollute. Reportedly, a TVA official suggested that this type of local response may make cautious utilities even more reluctant to trade. Other factors affecting early trading may be slow response by the Environmental Protection Agency and by several State public utility commissions in finalizing
rules and cost recovery principles for trading. The tendency of some States to protect the local coal industry also may be an important concern.[54]

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[53] Lobsenz, George. *"Malec Pens Gloomy Assessment of SO_2 Trading Opportunities."* The Energy Daily. Vol. 21, No. 133, July 14, 1993. p 1.

[54] Ibid.

Table 8. Transactions in Sulfur Dioxide Allowances

Buyer	Seller	Date	No. of One-Ton Credits	Price Per Credit
Tennessee Valley Authority	Wisconsin Power & Light	Spring 1992	10,000	$250-$300
Duquesne Light	Wisconsin Power & Light	Spring 1992	15,000 (with 10,000 more optional)	About $300
Ohio Edison	Alcoa Generating	Summer 1992	25,000 (5,000 a year for 5 years)	About $300
Illinois Power	Central Illinois Power Service	Spring 1993	80,000 (16,000 a year for 5 years)	About $200
Illinois Power	Pacific Corp.	Spring 1993	50,000 (10,000 a year for 5 years)	About $200
Illinois Power	Wisconsin Electric Power	Spring 1993	750,000 (15,000 a year for 5 years)	About $200

Source: Wall Street Journal*CBOT Plan for Pollution-Rights Market is Encountering Plenty of Competition,* by Jeffrey Taylor. August 24, 1993. P. C1

Chlorofluorocarbon Production Allowance Trading

In response to both domestic law (the Clean Air Act as amended) and international agreement (The Montreal Protocol on Substances that Deplete the Ozone Layer), the United States is well down the road toward complete phase-out by 1996 of production of chlorofluorocarbons (CFCs) and other ozone depleting substances. [55] For most

[55] Chlorofluorocarbons (CFCs) have been indicted scientifically as responsible for an ongoing depletion of the ozone content of the stratosphere. The indictment was handed down in 1973; the societal response has come in stages. First, the United States and several other countries banned the use of CFCs in aerosol products. This occurred in 1978 and led to an abrupt, though temporary, drop in CFC usage around the world.

Secondly, through intensive international negotiations under the guiding hand of the United Nations Environmental Program (UNEP), a series of international agreements has been hammered out. In 1985, a Convention for the Protection of the Ozone Layer was agreed to by 20 countries. The Convention provided a mechanism for further negotiations. In 1987, 47 countries signed on to the Montreal Protocol on Substances that Deplete the Ozone Layer. Under the terms of this Protocol, CFC production was to be capped at 1986 levels one year after it came into force (which turned out to be Jan. 1, 1989), followed by a 20% cut over 3 years and an

(continued...)

uses, the phase-out will probably not cause severe economic impacts. For air conditioning and refrigeration equipment, however, shortages of refrigerant in 1996 and thereafter could cause sharp increases in refrigerant prices and shortages of equipment able to use the new generation of refrigerants. Despite this possibility, there is no current program or even program plan to cushion the transition.

To implement the requirements of the Montreal Protocol, EPA issued regulations in 1988 and a temporary final rule in 1991 governing production cuts. Title VI of the Clean Air Act Amendments of 1990 provided for statutory recognition of the Protocol production phase-out. In addition, the amendments called for a comprehensive set of regulatory requirements covering recovery, recycling, and disposal of CFCs when equipment containing them is serviced or discarded.

The EPA in 1991 established a phase-out system which includes tradeable production allowances.[56] In implementing the system, EPA apportioned baseline allowances, established a gradual reduction in allowances, and allowed the transfer of allowances among firms. Production allowances that are transferred reduce the firm's production base proportionally plus an additional one percent of the amount transferred.

To date, little activity has taken place under this trading system. Where there have been exchanges, it is not clear from data available to EPA whether these are normal product exchanges at the plant level between competitors or participation in the CFC production allowance trading system.[57] As designed, the trading system grandfathered production allowances to the half-dozen producers but did not give other parties such as large consumers opportunity to bid for the decreasing supply of CFCs. In designing the program, EPA considered an auction system but rejected this broader mechanism for a variety of reasons including concerns about its legality. Lack of activity in the trading program may also be the result of the imposition of tax on CFCs as discussed below. In fact, the production allowance has never been fully used. In addition to

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[55](...continued)
additional 30% by 1999. Five CFCs and three halons (bromine-containing substances) were listed.

In 1990, with over 70 countries now involved, the Protocol was strengthened to require a 100% phase-out by 2000 and by adding two chlorine-containing non-CFC solvents -- methyl chloroform and carbon tetrachloride -- to the phase-out schedule. A phase-out schedule for a set of first generation substitutes -- hydrochlorofluorocarbons (HCFCs) -- was also set, with an ultimate target date of no later than 2040. In 1992, the Protocol was strengthened again. CFCs, methyl chloroform, and carbon tetrachloride are to be phased out by the end of 1995, with an interim goal of 75% by 1994. HCFCs are to be 90% phased out by 2015 and completely phased out by 2030.

[56] Carlin, Alan. Loc. Cit. p 5-7.

[57]Personal Communication, Willard Smith, Office of Policy Analysis, Air Policy Branch, Environmental Protection Agency, Washington, D.C., July 15, 1993

the effect of the tax, a slower growing economy and rapid expansion of substitutes may have contributed to a surplus of production over market needs.[58]

A further complicating factor in the allowance trading system would have been DuPont's follow-through on its recent announcement that it would stop producing all CFCs a year ahead of the required January 1, 1996 deadline. Since DuPont's production represents half of remaining new supply, the early phase-out would have added to the difficult problem of maintaining the existing stock of air conditioning and refrigerating equipment. After considerable agonizing and internal debate, EPA asked DuPont to continue to produce its allowance in order to help generate enough stocks to cushion the impact of the phase-out. Dupont agreed, with reluctance, to produce whatever quantities up to its allowance, were ordered from it.

INTERNALIZING SOCIAL COSTS THROUGH NONREGULATORY MEANS

Some indirect market-based approaches offer ways to lessen intrusive and costly regulations while meeting environmental management objectives. In practice, however, such techniques have been tried sparingly to date or applied for reasons other than environmental protection.

CFC Tax

The tax on CFCs is the only current example of taxation of a pollutant at sufficient levels to cause apparent change in behavior. While observers suggest that the tax has had an effect on CFC phase-out pace, most see the tax more as a way to capture windfall revenue in a situation of tightening supply.[59]

After a several-year-long debate on whether an auction system or a fee or tax would be preferable, a tax was first placed on CFCs[60] in 1990 (Omnibus Budget Reconciliation Act [OBRA] of 1989), revised and extended in 1991 by the OBRA of 1990, and revised upward in 1993 by the Energy Policy Act of 1992. Starting in 1990, as a result, CFCs became subject to both a production quota (decreasing over time) and a tax (increasing over time).

The mandated phased decreases in production volumes for products whose markets have been growing at up to 10% per year has led to increased CFC prices. CFCs cost about 60 cents per pound before the phasedown began; they now cost about $2 per pound prior to application of tax. The tax began in 1990 at $1.37 per pound (multiplied by the ozone depleting factor [ODF] which for CFC's is either 1.0 or close to it). It is now $3.35 per pound, scheduled to rise

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[58] For an overview discussion of the CFC phase-out see: Congressional Research Service. U.S. Library of Congress. *Stratospheric Ozone Depletion: Regulatory Issues.* CRS Issue Brief IB89021, by David E. Gushee. Updated regularly.

[59] Ibid.

[60] For simplicity's sake, the term "CFC" will be used hereafter in this section to encompass all Class I controlled substances, including halons, methyl chloroform, and carbon tetrachloride, unless noted otherwise.

to $4.35 per pound in 1994 and $5.35 per pound in 1995. Purchase prices about tripled in 1990 and are currently up to about 10 times their pre-regulation prices.[61]

By the end of 1991, CFC production was down to 60% of 1986 levels; by the end of 1992, it was down to under 50% of 1986 levels. Looking back on this history from the vantage point of 1993, this rapid a phasedown of production is remarkable given the perception in 1987 that the best that could be done was 50% by 1999. Clearly, both government and industry have been aggressive in forcing change in a number of CFC-dependent industrial sectors which thought, until the ozone depletion concern arose, that they had found and were using cheap, safe, high-performance products.

The role of the CFC tax in causing this major change to happen appears to have been more important in some industrial sectors than others. Its impact has been greatest where the CFC cost is itself the major cost factor, with decreasing impact where capital cost of the CFC-using equipment or of the manufacturing facilities where CFC-using equipment is produced is large. Other factors are cost and availability of effective substitutes, cost of design changes needed to convert to the substitutes when the needed design changes are known, and the cost, complexity, and development time when the knowledge needed for design changes must be developed.

For example, when CFCs cost 60 cents per pound, most substitute foam-blowing agents were more costly. The rising costs of CFCs has made these substitutes competitive. Processing equipment changes needed are relatively minor. In some electronics and other cleaning operations, water-based solvents can be made effective enough at costs below those of CFCs, methyl chloroform, or carbon tetrachloride including the tax. There appears to be little doubt that the tax has accelerated the adoption of substitutes in many of these applications and is a positive factor in looking forward to the likelihood that the production phaseout by 1996 will not cause major sectoral dislocations.

Where CFC-using equipment is being serviced, the combination of impending regulations, technician training programs, and increasing CFC cost has led to rapid penetration of CFC-capturing equipment. Examples are auto and building air conditioning service operations. CFCs are still used, but eventually perhaps half to two thirds of the volumes needed will be generated through recovery, reclaiming, and recycling. The tax has provided a cost basis for the creation of some reclaiming operations sooner than would the price rises through production phasedown alone. However, the regulatory program is the primary driving force, as evidenced by the rising cost of service. Not only are the make-up refrigerants more expensive but the recovery equipment must also be paid for.

Where CFC-using equipment is being produced (refrigerators and air conditioners, for example), producers are required to redesign the equipment and develop new lubricants to be compatible with the substitute refrigerants. The process of developing the refrigerants and testing out the design changes is critical in these applications; the tax is not as important as the CFC production phaseout schedule in accelerating the development schedule. Another delaying factor here, however, is the pressure against HCFCs, whose limited future life-spans limit their entry into some equipment lines, while other substitutes' futures are clouded by, among other considerations, uncertainties in the EPA process of granting approval. It is not certain that, for

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[61]Taxes in some applications are not applied in full. Rigid foam applications are an example.

refrigerators and room air conditioners in particular, there will be a smooth transition to alternatives when the phaseout deadline passes.

Where CFC-using equipment is currently in use, the CFC price (including tax) is not high enough to force retrofit to non-CFC products following any individual need for a service call. There appears to be minimal impact from the tax. Examples are chillers in grocery stores, building air conditioners, auto air conditioners, and refrigerators. In these uses, the CFC price would have to be a great deal higher than it now is to force economics-based decisions to retrofit. A more critical driving force in favor of retrofit is the cost of finding slow leaks and the growing unwillingness of service companies to "top off" rather than find the leak.

Some companies with multiple pieces of equipment and on replacement schedules as part of their preventive maintenance (PM) programs are replacing CFC-using equipment when its scheduled life has expired with non-CFC-using equipment (currently mostly using HCFC-22) and banking the salvaged CFCs. This is not tax-driven, however, but "prudence-driven", since the PM schedules have long time horizons which incorporate post-phaseout years when supplies of CFCs needed for servicing may well not be available at any price.

Private citizens, commercial building operators, and small businesses, however, do not appear to be thinking in such long time frames. For them, the current CFC price, even though perhaps 10 times as high as it was five years ago, is not high enough in itself or as a signal of things to come, to cause action. The tendency of these groups to resist retrofit today in favor of the hope that there will be no penalty tomorrow is causing some observers to predict a state of near-chaos in late 1995 and the first several years after the phasedown is complete. The tax on CFCs would have to be significantly higher today than it is to affect this posture, according to those actively involved in trying to accelerate retrofit. A higher tax, on the other hand, might lead to increases in prices for substitutes and thus an economic drag rather than an increase in driving force for retrofit.

In sum, 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. The tax has also achieved one other purpose. It has increased U.S. Treasury revenues. Cumulative Treasury revenue from the tax is currently estimated to be about $4.6 billion.

Permit Fees

Most States use permit fees to partially or completely fund their environmental regulation and management programs. Dealing with air pollution, for example, the California South Coast Air Quality Management District charges annual permit fees for stationary sources ranging from a few dollars per ton for carbon monoxide to over $200 per ton for volatile organic compounds.[62] While several hundred dollars per ton may have some disincentive effect for some sources, incremental abatement costs for that region are several thousand dollars per ton for major pollutants. Thus fees in this case serve to finance regulatory programs, as they do in many other States, and do not serve as abatement incentives per se.

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[62] South Coast Air Quality Management District. *Form C: Summary of Emissions and Determination of Fees for Plant Premises for Calendar Year 1987*. Los Angeles, California.

Permit fees are generally considered a means of enabling regulatory agencies (generally States) to obtain a stable, predictable source of revenues to support permitting, planning, standard setting, enforcement and other environmental program responsibilities. Permit fee systems vary widely, but they tend more to represent "fee for service" mechanisms than market-based measures to internalize the societal costs of pollution or to supplement traditional regulatory systems.

At the State level, fee systems are an important source of revenue to supplement or replace Federal funds and to cover program administration costs not supported by general revenues. In the area of State solid waste management, 21 States use permit fees, but many assess fees only to cover the cost of administering the permit program or the costs of engineering review for a permit application. Differences in scale and scope are reflected by two States. Colorado uses permit fees to fund a minimal program involving review of permit applications and inspections, while New Jersey has a wide-ranging program of permit, product, and other special fees that includes regulation of medical waste, closure of landfills, litter control, recycling permits, and others.[63]

More than 30 States use fees to finance water quality activities, with almost 80 percent of the revenues coming from water permit fees, water rights applications, and training and certification fees for water management personnel. [64] While many States impose lump sum charges or flat fees for permit applications and review, a number of them charge for discharge permits based on volume, toxicity, or other characteristics of wastes discharged. California's wastewater fee schedule, for example, is a sliding scale based on the type of waste and the volume. New York States's pollutant discharge fee system is split into private/commercial/industrial, industrial, and municipal, with each having a separate fee schedule based on a facility's average daily discharge.[65]

At the Federal level, there is recent and growing interest in enacting permit fee requirements to ensure that States will have available the funding needed to administer Federal environmental laws. In 1990 amendments to the Clean Air Act (P.L. 101-549), Congress directed States to establish comprehensive permit programs and to collect fees sufficient to cover the direct and indirect costs of administering the new program.

Building on that enactment, legislation in the 103rd Congress (S. 1114) would impose a similar permit fee requirement for water quality management programs. The Clean Water Act already has a comprehensive permit program as a fundamental tool of compliance and enforcement. The pending legislation would require States to collect permit fees from industrial and municipal point sources in amounts adequate to recover 60 percent of the costs of administering the point source elements of a State's water quality programs, including permit

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[63] New York State Department of Environmental Conservation, Division of Solid Waste. *Survey of State Funding for Solid Waste Management Programs.* June 1991. p. 5.

[64] Shields, Evelyn. *Funding Environmental Programs: An Examination of Alternatives.* National Governors' Association. 1989. p. 22-24.

[65] Anderson, Robert C., Lisa A. Hofmann, Michael Rusin. *The Use of Economic Incentive Mechanisms in Environmental Management.* The American Petroleum Institute, Research Paper #051. 1990. pp. 37-38.

review, enforcement, water quality monitoring, preparing regulations, and developing and administering sewage sludge disposal and pretreatment programs.

Input Fees

Some State and Federal agencies use fees on potentially damaging substances as part of program administration. These fees are not for the purpose of incentives, though they offer the beginnings of that type of policy. Two examples are the feedstock taxes used in the Superfund and a variety of agricultural fees as part of nonpoint source water pollution control programs.

Superfund Feedstock Tax

The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended in 1986, provided for several taxes to support the program. A feedstock tax on 42 different petrochemicals, at a rate between $0.22 per ton and $4.87 per ton, is one of three taxes. Tax rate differences between feedstocks were based on estimates of the amounts of hazardous wastes generated from each specific feedstock. The law also provided for a tax on all domestic and imported crude oil and a corporate environmental tax.[66]

The main purpose of these taxes is to help finance a portion of the Superfund program. However, the tax rates are not sufficiently high to have any measurable incentive effect on either the production or disposition of hazardous wastes.[67] Thus, as with most other Federal and State taxes or fees in the environmental area, the tax helps to spread the cost of the current Superfund program broadly without affecting the decisions that lead to the generation and disposal of hazardous wastes.

Agricultural Nonpoint Source Control

Agricultural sources of nonpoint source water pollution are now widely recognized as a major--if not the major--problem in abating pollution of both surface waters and groundwaters. Attention is focused on several pollutants, particularly sediments, nutrients, and pesticides. Long-standing programs are in place to conserve soil, which reduces not only sediment loss to surface waters, but also phosphates and those pesticides which tend to adsorb on soil particles. More recently, primary concern has turned to those pollutants which are soluble in water and which may be transported to contaminate groundwater--particularly nitrates and various pesticides, including alachlor, aldicarb, DBCP, and atrazine. A nationwide EPA survey of groundwater contamination by pesticides and nitrates indicates that a small proportion of

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[66] U.S. Library of Congress. Congressional Research Service. *Summaries of Laws Administered by the Environmental Protection Agency*. Report No. 93-53 ENR. Washington, 1993.

[67] Carlson, J. Lon and Bausell, Charles W. *Financing Superfund: An Evaluation of Alternative Tax Mechanisms*. Natural Resources Journal. Winter, 1987. p. 117

drinking water wells exceed health standards.[68] But within these national averages are some much higher rates of contamination in local areas.[69]

Developing methods for controlling agricultural sources of nonpoint source pollution has proved elusive, however. For several reasons, established regulatory approaches that have been more or less successful in controlling point sources of water pollution do not translate easily to this area of concern: sources are numerous compared to most categories of point sources; site-specific variables mean that a practice in one field may cause water pollution while the same practice in an adjacent field does not; the pollutants are not wastes so much as unutilized inputs intentionally dispersed into the environment; the agricultural sector's relationship to government and the economy differs from industry's, and so on. The special circumstances of agricultural nonpoint source pollution and the problematic effectiveness of controlling it through regulation have directed attention to alternative approaches for controlling this problem: these alternatives include government encouragement of ``Best Management Practices'' (BMPs), an approach analogous to soil conservation programs; land use controls, normally at the local level; and economic incentives and disincentives.

Economic Incentives and Disincentives. Several concepts of using economic incentives and disincentives in programs to abate agricultural sources of nonpoint source pollution have emerged:

- in the traditional economic sense, using taxes or fees to internalize the costs of pollution to the users of fertilizers and pesticides;

- using taxes or fees to generate funds to support research and development on more efficient, less-polluting use of fertilizers and pesticides, to share the cost of farmers' adoption of such practices, and/or to compensate farmers for restrictions on pesticide or fertilize use or on land use; and

- making various governmental benefits, such as price supports, contingent on a farmer's complying with particular management practices or pollution control requirements.

Internalizing Nonpoint Source Pollution Costs through Pollution Taxes. The idea of taxing agrichemicals with the intent of reducing use to avoid external costs has received theoretical attention, but little practical application. For theoreticians, a key problem has been

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[68] Environmental Protection Agency. *National Survey of Pesticides in Drinking Water Wells*, EPA 570/9-90-015. 1990.

[69] For example, an Iowa survey documents extensive contamination of shallow aquifers by nitrate. Approximately 18 percent of Iowa's private, rural drinking water wells contain nitrate concentrations above the recommended health advisory level, and and in certain southern and western areas of the State, where dependence on shallow wells is high (deeper aquifers are naturally saline), over 30 percent of the wells exceed the standard. Burton C. Kross, et al. ``The Nitrate Contamination of Private Well Water in Iowa,'' *American Journal of Public Health*. Vol. 83, no. 2. February, 1993. pp. 270-272. Similarly, localized instances of pesticides in groundwater have led to local bans or restrictions on pesticide use (e.g., aldicarb use is prohibited on Long Island).

evaluating the external costs of agrichemical use, a necessary step in assessing costs and benefits in order to determine an appropriate level of taxation.[70] But many practical problems have also intervened. Aside from political considerations, [71] objections to using taxes or fees at levels necessary to reduce agrichemical pollution include (1) that higher fertilizer and pesticides costs would hurt farmers already using them efficiently; (2) that there would not be any necessary geographic correlation between reductions in their use and pollution problems; and (3) that the demand for fertilizers (and probably pesticides) is quite inelastic (one estimate suggests that a 100% tax on fertilizer would be required to reduce fertilizer use 40%[72]). A British study came to similar conclusions--that ``high levels of taxation (two to three times the original price level) are necessary to induce large cutbacks in [nitrogen] fertilizer use and that accompanying reductions in farm income would be very large--up to 50%." The authors of the British study concluded that ``a tax or levy on fertilizers is unlikely to have a major influence on nitrate leaching [and] ... such a tax applied to the UK alone could damage the country's competitive position."[73]

A recent article compared five basic options, including taxes, for controlling nitrogen fertilizer use to protect groundwater.[74] Table 9 summarizes the pros and cons of the alternatives and indicates that taxes rate high on cost and
enforcement, but low in responsiveness to local problems and political viability. Variations designed to improve the targeting and effectiveness of agrichemical taxes have been proposed: for example, a graduated fertilizer tax might be effective since high application rates would normally pose the greatest risks to groundwater, or rebates could be paid to farmers who employ BMPs; such variations have yet to receive much formal analysis. Whether more attention to economic incentives/disincentives, combined with government revenue needs, might make agrichemical taxes more politically viable remains problematic.

Agrichemical Use Fees. While proposals to tax agrichemicals at levels designed to reduce their use remain largely academic, some modest fees have been imposed on fertilizers and pesticides in order to raise revenues to support agrichemical-related governmental activities.

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[70] Smith, V. Kerry. *Environmental Costing for Agriculture: Will It Be Standard Fare in the Farm Bill for 2000?* Resources for the Future. Discussion Paper QE92-22. (August 1992).

[71] The political context in which controlling agriculture nonpoint source pollution occurs is discussed in David R. Lighthall and Rebecca S. Roberts. ``Agricultural Chemicals and Groundwater Quality: The Political Economy of Policy Responses." *The Environmental Professional*. Vol. 10, no. 3. 1988. pp. 211-222. See also D.D. Francis. ``Control Mechanisms to Reduce Fertilizer Nitrogen Movement into Groundwater.", *J. of Soil and Water Conservation*. Nov.-Dec. 1992. pp. 444-448.

[72] Fleming, Malcolm H. ``Agricultural Chemicals in Groundwater: Preventing Contamination by Removing Barriers against Low-Input Farm Management."*American Journal of Alternative Agriculture*. Vol. I, no. 3. p. 129.

[73] Department of the Environment. *Nitrate in Water*. Pollution Paper No. 26. Her Majesty's Stationery Office. London, 1986. pp. 59-60.

[74] D.D. Francis.

Potential uses of such fees include financing regulatory activities, such as registration or setting of tolerances for pesticides; supporting research into alternative production technologies, supplementing farm income supports, and providing financial incentives to catalyze the transition of Midwestern agriculture to a more diversified and profitable system;[75] funding an "insurance program" to protect farmers from diminished yields as they fine-tune use of fertilizers and pesticides and paying for research and extension services;[76] ``subsidiz[ing] provision of drinking water supplies on farms and in rural towns";[77] and subsidizing water treatment.[78]

As of January, 1993, 46 States impose some kind of fee on fertilizers.[79] The fees vary, but typically are less than $1.00 per ton (in 1991 the farm price for nitrogen was in the $150-200 per ton range); in 4 States fees ranged from $1.00 to $3.10 per ton. Over 30 States dedicated all or part of these revenues to inspection, 9 to unspecified research, 7 to `general fund,' 4 to groundwater, 2 to cleanup, 1 to `State water plan,' and 1 to alternative agriculture programs.

TABLE 9. RELATIVE COMPARISON OF FIVE BASIC OPTIONS FOR CONTROLLING N FERTILIZER USE

Control Options	Cost*	Enforcement	Responsiveness to Local Problems	Political Viability	Producer Income	Equity Among Producers
Excise Tax	Low	Easy	Low	Low	Reduce	High
Rights to purchase	Moderate	Difficult	Low	Low	Reduce	High
Applications restrictions	High	Difficult	Variable	High	Maintain or Reduce	Low
Zoning Regulations	High	Difficult	High	High	Reduce	Low
Voluntary BMPs	Low	NA**	Variable	High	Maintain	High

* Relative cost to implement, administer, and enforce.
** Not applicable unless governmental agencies restrict timing of BMPs etc.

[75] Lighthall and Roberts, p. 219.

[76] Nipp, Terry. ``Water Quality and Agricultural Production Issues and Research Needs." *Memorandum* to Charles Benbrook, Executive Director, Board on Agriculture. August 8, 1988. p. 3.

[77] Caulfield, Henry P. Jr. ``The Federal Environmental Legislative Process." *in* V. Novotny, ed., *Nonpoint Pollution: 1988 - Policy, Economy, Management, and Appropriate Technology*. American Water Resources Association. 1988.

[78] Department of the Environment. *Nitrate in Water*. p. 60.

[79] Data compiled by The Fertilizer Institute.

Iowa illustrates the use of such levies. The State's 1987 Groundwater Protection Act creates a Groundwater Protection Fund, supported by a series of fees, which include a nitrogen fertilizer tax of $0.75 per ton, based on an 82%-Nitrogen solution. These receipts are deposited in an Agricultural Management Account of the Fund. The Act specifies that these funds shall be used to "develop nonregulatory programs to implement integrated farm management of farm chemicals for environmental protection, energy conservation, and farm profitability; interactive public and farmer education; and applied studies on best appropriate technology for chemical use efficiency and reduction." The original form of the legislation would also have imposed a 1% tax on pesticides sales as a revenue source for research. In the end, the legislation increased the registration fee for pesticides and dealer licensing fees, with the revenues going also to the Agricultural Management Account. It has been suggested that the resistance to the tax reflected a fear that it would place Iowa's farmers at a competitive disadvantage, implying that this policy should be considered at the national level.[80]

In late 1993 an expert panel examining opportunities to manage farming systems so as to protect soil and water recommended research directed at the design of market-based incentives to protect soil and water quality.[81] More specifically, observing that increased funding would be needed to support initiatives to comprehensively address soil and water problems, the report urged exploration of ``taxes on agricultural chemicals, fuel, heavy tractors, moldboard plows, irrigation water, and other inputs that can be related to soil and water quality degradation from agricultural production practices....''[82] ``Relatively low taxes on nutrient and pesticide inputs'' would substantially augment current programs, says the report: ``One percent ($128 million) of the annual 1990 expenditures of $12.8 billion on pesticides and fertilizers, for example, is more than 65 percent of the total 1992 expenditures on cost-sharing under the Agricultural Conservation Program, and more than 18 times the total 1992 expenditures on the Water Quality Incentive Program.''[83]

Federal Agricultural Support Programs. The level and distribution of use of agrichemicals is strongly influenced by national agricultural policies and programs.[84] For example, price support programs can discourage multi-year crop rotations that would diminish the use of pesticides, because of requirements to maintain base acreages in supported crops like corn that require intensive agrichemical use; and, by keeping support prices high on such crops as corn, higher rates of fertilizer use become economic than at lower crop prices.

The initial steps to reconcile goals occurred in the 1985 Farm Bill. It included provisions for "compliance," which make certain subsidies contingent on farmers not cultivating wetlands or highly erodible lands. In effect, these provisions make farmers' subsidies contingent on

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[80] Lighthall and Roberts, pp. 216-217.

[81] Committee on Long-Range Soil and Water Conservation, Board on Agriculture, National Research Council. *Soil and Water Quality: An Agenda for Agriculture*. Washington, D.C. National Academy Press, 1993. p. 16.

[82] Ibid., p. 142.

[83] Ibid.

[84] See Fleming, and Lighthall and Roberts.

farmers' adopting environmentally desirable practices. Provisions in the 1990 Farm Bill reaffirmed the general structure and direction of compliance, while adding a number of new programs that could provide related environmental benefits, especially improved water quality.

Current compliance requirements do not specify practices designed to protect groundwater, but some are suggesting movement in that direction and new conservation planning requirements could strongly reinforce this movement. Another option, which may be discussed in future farm bill debates, is removing (or reducing) price supports, which would tend to remove (or diminish) one
incentive for farmers to maintain high agrichemical use.[85] The concept behind this and related proposals would be to change agricultural economics in ways that encourage farmers' to choose--in response to price signals or income expectations--management practices for agrichemicals that are more efficient and result in less intensive agrichemical use. However, if subsidies are reduced, incentives to be in compliance will also decline, suggesting the need of alternative tools.[86]

Wetlands Mitigation Banking

Wetlands provide significant benefits to society in the form of fish and wildlife habitat, water quality protection, and water flow regulation. However, the Nation continues to lose wetlands at an estimated rate of 290,000 acres per year. While a portion of these losses results from natural forces, the largest share results from man's activities.

Protection of wetlands from development impacts has been implemented through regulation at the Federal and State levels. Compensatory mitigation has been required of developers whose projects cause unavoidable adverse impacts. Developers have complained about both the costs associated with compensatory mitigation and about costly delays resulting from regulatory and permit programs. Wetlands mitigation banking is a relatively new natural resource management concept which provides for the advanced compensation of unavoidable wetland losses due to developmental activities through more cost-efficient and potentially more publicly beneficial means.

Mitigation banks are established by formal agreement between jurisdictional resource agencies and a mitigation bank sponsor, generally a private landowner or public agency. The sponsor creates, restores, or enhances wetlands or wetland functions and in return receives credits for the habitat enhancement or other public benefits which are determined to result from that work. These credits may be drawn upon (hence, debiting the account) in order to fulfill wetland mitigation requirements for development impacts at other locations, generally within the same hydrologic unit or habitat area. The credits may be used by the sponsor or sold to other permit applicants. In general, banks fit into two categories: dedicated banks, whose principal objectives

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[85] Fleming, pp. 128-129.

[86] It has been observed that in the U.S., given current cropping and agrichemical use patterns, about 40% of the revenues of any general agrichemical tax would be paid by corn farmers--leading one analyst to conclude, ``Since the Corn Belt suffers from widespread ground water contamination, and since corn farmers also receive a large portion of government support payments, a tax on agrichemicals may help solve several problems at once'' [Fleming, p. 129.].

are compensation of wetland losses associated with discrete types of construction activity and which generally are sponsored by single construction entities; and commercial banks, which are established by private entrepreneurs and whose wetland credits are available for purchase on the open market.

By mid-1992, an inventory of banks identified 37 banks in active operation and another 64 in various stages of planning, and reported that the number of active banks had more than tripled in four years' time.[87] Approximately two-thirds were located in coastal areas where both development pressures and wetlands losses have recently been significant. Of the active banks, 19 were sponsored by State highway departments (to mitigate wetland losses due to highway construction), eight involved port development (with commercial port authorities serving as sponsors), seven involved general land development, a total of three involved agricultural drainage, mining operations, and oil and gas activity. In addition, five active mitigation trusts were identified. In the latter cases, developers make cash contributions to a trust fund maintained by a local, State, or Federal entity in order to cover the wetland losses for which they are responsible. Accumulated monies are used to provide replacement wetland areas for after-the-fact mitigation purposes.

Owing to the relative newness of the concept, little information concerning the performance record of banks is available. Permittees and bank sponsors generally give them high marks because of the degree of efficiency and predictability they bring to the permit review process. Others, including some Federal and State resource agencies and conservation groups, contend that wetlands restoration and creation efforts have not been uniformly successful, thus calling into serious question the basis for providing credits from the bank. These and other implementation issues suggest that while mitigation banks appear to be a promising tool for cost-effective wetlands protection, successful implementation requires thorough understanding of the ecosystems in question and some degree of resource agency guidance on methods of determining credits and debits.

Information Requirements

Several examples illustrate the use of mandatory disclosure of information as a way to create possible incentives for nonregulatory reductions in hazardous substances.

SARA Section 313

One national example of the use of information intended to improve public knowledge and ultimately private management of harmful substances is Section 313 of Title III of the Superfund Amendments and Reauthorization Act. Title III requires manufacturers and users of toxic chemicals to provide a wide array of information to the public concerning the amounts of such chemicals stored on-site and released to the environment. Under Section 313, manufacturing establishments handling any of 329 listed substances must report annually the amount of the substances released to air, water, or land. The information is compiled by EPA into a toxic release inventory. The data are also available through an EPA computer system that allows users to identify emissions for specific companies as well as to aggregate releases by chemical and/or by geographical area. EPA recently proposed adding several more substances to this list.

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[87] Reppert, Richard. Institute for Water Resources, U.S. Army Corps of Engineers*Wetlands Mitigation Banking Concepts*. IWR Report 92-WMB-1, July 1992. 25 p.

Release of data from the first inventory, in April 1989, showed that over 20 billion pounds of the chemicals were released or disposed of in 1987 by the 17,500 facilities that reported. The availability of the data is widely expected to increase pressure on industries and individual facilities to reduce emissions. In fact, EPA announced in May 1993 that 1991 industrial releases of toxic chemicals had dropped by 30 percent since the "baseline" year of 1988.[88]

Proposition 65

The passage by direct voter initiative of the California Safe Drinking Water and Toxic Enforcement Act (Proposition 65) is a good example of using information along with regulation as a way to help reduce an individual's exposure to potentially harmful substances.

Proposition 65 provided for several mechanisms that reinforce market forces for reducing exposure.[89,90] First, for a list of chemicals known to cause cancer or reproductive toxicity, businesses must explicitly warn people if the business is knowingly not keeping exposure below a defined minimum-risk level. Businesses may exceed the level, but they must tell the public they are doing this and give the chemical dose. This provision provides two incentives. One to consumers to examine what it is they are buying compared to another product. The second to businesses to participate actively in the rapid definition of what the minimum-risk level for the chemical should be. This latter incentive is in direct contrast to current regulatory systems where those regulated have incentive to fight definition of safe levels as long as possible. In the California case, businesses want to be able to market their products against competitors. They therefore have every incentive to have the minimum-risk level determined quickly and to stay below it in order to avoid the warning label. This reversal of the burden of proof has powerful effects. Instead of regulators having to prove that a manufacturer is above the line of safety, now the manufacturer has to prove that it is below the safe level.

Second, for the same list of chemicals, businesses are prohibited from discharging any of them to drinking water. While this is a regulatory mandate, the law does not require proof that a drinking water source has been irretrievably damaged or that somebody has developed cancer as a result of discharges. The provision shifts regulation to prevention before contamination can occur.

Three, enforcement of the provisions is increased by allowing citizen and public defender suits with plaintiffs receiving a percentage share of any fines that are levied for violations. This provides strong incentives for producers to self-police their operations rather than waiting for regulatory enforcement under more traditional systems.

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[88]U.S. Environmental Protection Agency. *Environmental News.* Washington, D.C. May 25, 1993.

[89] Roe, David. *An Incentive-Conscious Approach to Toxic Chemical Controls.* Economic Development Quarterly. August 1989.

[90] Also see: Roe, David. *Barking up the Right Tree: Recent Progress in Focusing the Toxics Issue*. Columbia Journal of Environmental Law. Vol. 13, No. 2. 1988.

New Jersey's Environmental Cleanup Responsibility Act

Another example of the shifting of burden of proof through mandatory information disclosure is New Jersey's 1983 Environmental Cleanup Responsibility Act (ECRA). This law requires that industrial establishments dealing with hazardous wastes submit a "negative declaration" or a hazardous substances cleanup plan to the New Jersey Department of Environmental Protection as a precondition for the closure, transfer, or sale of the property. Failure of the seller to meet the requirements of the Act is grounds for voiding the sale, and the buyer can recover damages from the seller in such cases.

In the period since passage of ECRA, the law has had significant effects on the real estate and banking industries as well as the industrial operations that generate hazardous waste. Extensive literature on the problems include uncertainties over coverage, disagreement over what triggers ECRA, and the time the regulatory and approval process takes.[91]

Although this State act remains controversial, one of its main effects has been to shift the initial cost and burden of proof for environmental audits from the buyer to the seller. Thus an incentive has been created for industrial facilities to eliminate improper practices in the disposal of hazardous wastes in order to ease future sale or transfer of assets.

Liability Assignment

Toxics

Implementation of both Superfund and the Resource Conservation and Recovery Act relies in part upon a financial responsibility requirement under which disposers of hazardous chemicals have to demonstrate that they can handle the costs of corrective action. Treatment, storage, and disposal facilities must also show financial responsibility for proper closure and post-closure care regardless of contamination. Though both acts encourage insurance to cover the cost of pollution damage, large companies that can demonstrate financial capability may self-insure. Insuring these type of risks has proved difficult because of the uniqueness of such events and because of the unpredictability of court decisions on damage awards. Insurance companies also have not been in a position to raise rates sufficiently to cover the uncertainty since large companies have the option of self-insuring, thus raising further the costs of those still buying.

Groundwater

Liability assignment also has become an issue in groundwater contamination by pesticides. Connecticut's 1982 Potable Drinking Water law follows the principle of strict liability for groundwater contamination, and requires a responsible party to provide potable drinking water to replace contaminated water. This provision was invoked against five of the State's largest farms, following contamination of groundwater by a pesticide, Ethylene Dibromide (EDB). The farmers appealed orders to provide potable water and fines. The case was settled in August 1988. Most fines were dropped and the State legislature enacted a bill specifying that farmers using pesticides for agricultural purposes, strictly adhering to label requirements, having a plan to

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[91] See for example Schmidt, Joseph W. Jr. *New Jersey's Experience Implementing the Environmental Cleanup Responsibility Act*. Rutgers Law Review. Vol. 38. 1986.

minimize contamination, and keeping complete records could not be compelled to provide alternative water. However, the strict liability requirement was continued for damages.

The question of farmer liability for pesticide use has also become an issue in reauthorizing and amending the Federal Insecticide, Fungicide, and Rodenticide Act.

Deposit-Refund for Managing Solid and Hazardous Waste

Federal programs for solid and hazardous waste management were authorized in the Resource Conservation and Recovery Act of 1976 (RCRA) and in subsequent amendments. Under these laws, regulation and enforcement have focused on the 6,000 treatment, storage, and disposal facilities for hazardous waste. While substantial progress has been made as a result of this program, other aspects of solid waste disposal (e.g., industrial nonhazardous waste facilities) have been neglected. Even in the hazardous waste program, it has become clear that there are limits to what can be accomplished by focusing on the disposal end of the process. At some point, attention needs to be placed on the waste generators.

But here one immediately encounters a practical difficulty: the number of actors whose behavior one seeks to change is extremely large. Hazardous waste is generated by approximately 650,000 entities, including gas stations, dry cleaners, schools, photo developing labs, and others, and small amounts of hazardous waste in products such as paint, batteries, pesticides, and cleaning solvents are generated by nearly 100 million entities, including households, office buildings, commercial establishments, and institutions.

There is no conceivable enforcement mechanism that can address the large number of entities generating solid and hazardous waste. Thus, some attention continues to be focused on approaches that provide incentives to reduce waste generation or to manage wastes in more acceptable ways, such as deposit-refund systems.

In addition to beverage containers, deposits and refunds have been applied to auto batteries and to pesticide containers (in Maine).[92]

Beverage Containers

Most new proposals for deposit-refund systems are based on the experience of ten States with regard to beverage container deposits. States with refund systems for beverage containers (generally referred to as "bottle bills") report that 72-97% of deposit containers are returned for recycling, even though consumers are not required to return the containers. The economic incentive (a 5 or 10-cent refund per container) is sufficient to produce the desired behavior. Comparable data are not available for mandatory recycling programs (those not using deposits and refunds), but anecdotal evidence suggests that they are far less successful.[93]

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[92] *Project 88, Harnessing Market Forces to Protect Our Environment*. pp. 130-131.

[93] *"Where Recycling Is Spoken, Fines Add Some Clarity,"* New York Times, March 21, 1989, p. B1. The article reported on experience with mandatory recycling in Jersey City, New Jersey. About 20 percent of Jersey City residents actually comply with the mandatory program, according to the city's recycling director. See also McCarthy, James E. *Bottle Bills and*

(continued...)

Lead Acid Batteries

Deposits on lead acid motor vehicle batteries have already been implemented by at least ten States as a way to reduce problems with improper disposal.[94] In the State programs, retailers are required either to accept a used battery when selling a new one or to collect a deposit from the customer. Some have proposed a national system that would include deposits at both the manufacturing and retail stages with redemption centers for consumers to reclaim their deposits. Redemption centers would reclaim deposits from manufacturers to close the financial loop.[95]

One possible issue in a deposit-refund program is the unintended incentive the deposit may have for theft. Some speculate that too large a deposit may make it worth while to steal batteries for redemption. This could be countered by requiring proof of purchase, but such record keeping raises the inconvenience level thus reducing the incentive to return batteries. Along similar lines, inconvenience in the availability and proximity of return points for used batteries would limit program effectiveness, unless the deposit were sufficiently high. In the above proposal, unless the redemption centers were coordinated and linked to the existing auto-parts retail system, it would seem that consumer inconvenience could work against program effectiveness. Actual experience suggests, however, that these problems can largely be solved. A ten dollar return value is only for buying a replacement battery, so there is no incentive to steal. Retailers take the old batteries in trade solving the convenience problem.

Pesticide Containers

Since 1985, Maine has required deposits on limited and restricted use pesticide containers. Under this State system, any restricted use pesticide container sold in the State must have a sticker indicating that a deposit has been paid to the dealer. When a triple rinsed container is returned, the deposit is refunded. As of 1990, over 13,000 containers had been returned. Given deposits of up to $10.00 per container, this program appears to create a strong incentive effect.

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[93](...continued)
Curbside Recycling: Are they Compatible? U.S. Library of Congress. Congressional Research Service. 93-114 ENR. January 1993.

[94] Carlin, Alan. Loc. Cit. p. 4-1

[95] Stavins, p. 63

PROPOSALS FOR NEW APPROACHES

Congress is currently considering a variety of market-type mechanisms in various reauthorizations such as the Clean Water and Solid Waste Acts. Proponents for U.S. action on mitigating possible global warming also are calling for taxes or tradeable overcontrol as means for slowing carbon dioxide buildup. Market-based mechanism are also under consideration in some State water resource management efforts as well as other Federal programs. While most of the proposed mechanisms are not new in concept, many would break new institutional ground, raising important questions about implementation.

ACHIEVING REGIONAL/LOCAL REGULATORY EFFICIENCY

Marketable Permit Programs In The Los Angeles Area

California's South Coast Air Quality Management District (SCAQMD) has been a leader in developing and implementing innovative regulatory strategies often including economic incentives. Since 1976, the District has been operating an emissions trading system for offsetting new, modified, or relocated sources of air pollution as part of the new source review program. SCAQMD recently adopted regulations to implement an emissions trading program as a means of achieving further emission reductions from stationary sources.

Background

In October 1990, SCAQMD began development of a new marketable permits program called the Regional Clean Air Incentives Market (RECLAIM). After three years of debate, public hearings, and rule revisions, the RECLAIM program was adopted in October 1993. The rules governing the RECLAIM program became effective January 1, 1994.

The program will require stationary air pollution sources to meet a specified reduction in current emissions levels. Any reductions beyond the required level will result in the generation of marketable credits. The marketable permits program is intended to help the South Coast air basin meet its air quality goals while allowing industry flexibility in accomplishing reductions, reducing compliance costs, and stimulating technological pollution control innovations. The RECLAIM program requires the same overall emissions reductions that the traditional command-and-control approach could achieve through the State Air Quality Management Plan (AQMP). Air pollution sources can meet required reductions through the method of their choice, including purchasing traded emissions, installing pollution control equipment, or changing production processes or products to prevent pollution.

The emissions trading program will apply to 390 facilities that are major sources of nitrogen oxides (NO_x) emissions. In addition, 41 of these facilities will make up a second market for sulfur oxides (SO_x) emissions. Although there are currently 24,000 permitted facilities in the District, the number of participants in RECLAIM is limited to 390 by excluding sources emitting less than 4 tons per year of NO_x or SO_x. The District's initial proposal also included a market for emissions of reactive organic compounds (ROC). The proposal to include ROC

in the RECLAIM program was opposed by business and industry leaders. After the program was approved in October 1993, SCAQMD staff began new efforts to expand the RECLAIM program to include ROC emissions.

The initial emissions allocation for all facilities is determined based on historical actual emissions data including peak years of facility use. After determining baseline emission rates, the program requires annual emission reductions. SCAQMD is expecting an 8.3 percent annual reduction in NO_x emissions and a 6.8 percent annual reduction in SO_x. emissions by 2010 when the RECLAIM program ends. Each facility will be issued a facility-wide permit detailing all emission sources at the facility, establishing emissions limits, and specifying annual reduction rates. Credits will be issued on an annual basis to facilities for each pound of NO_x or SO_x emissions below the level required for that year. Credit trading will be allowed without any prior approval from SCAQMD, as long as trades comply with certain geographical and seasonal constraints. Increased compliance monitoring will be required to ensure that emissions reductions are being achieved and that trades are being made properly.

The success of the RECLAIM program depends on meeting emissions reduction targets in the District. Backstop provisions are necessary to ensure that the program achieves the necessary reduction goals and that there is no backsliding. The RECLAIM program provides that facilities exceeding their annual emissions allocation will be required to make additional compensating reductions during the following year. Monetary penalties may also be applied to facilities exceeding their emissions cap.

Implementation Issues

Although emissions credit trading programs receive considerable attention in the literature regarding market-based environmental incentives, most of the discussion is theoretical. There has been limited experience in the United States actually implementing trading programs on the scale of the RECLAIM program. The acid rain allowance trading program under Title IV of the Clean Air Act Amendments of 1990 should provide implementation experience to draw on, however, few trades have been completed thus far. As the RECLAIM program becomes operational, there are several issues regarding its implementation that should be considered.

Compliance and Enforcement.. Increased compliance flexibility for the regulated community translates into an added enforcement burden for SCAQMD. To ensure the success of the RECLAIM program, SCAQMD must be able to verify that the regulated community is meeting its required emissions limits or purchasing the required number of credits. SCAQMD must also confirm that credits have been properly generated and traded.

SCAQMD initially proposed using sophisticated emissions monitoring equipment to assist in properly enforcing the program. For example, continuous emissions monitoring systems (CEMS) would have been used to calculate emissions of NO_x and SO_x. CEMs automatically record emissions data. The data would have been electronically transmitted directly to a central District computer system that would examine the data to determine facility compliance with emissions limits and reduction rates. Although daily monitoring might be appropriate and cost-effective for large facilities, alternative monitoring methods were developed for smaller facilities. The monitoring requirements are now correlated with the levels of emissions at a facility.

To ensure that individual facilities meet their emissions caps, SCAQMD is relying on backstop provisions in addition to stringent monitoring. Penalties for exceeding an emissions cap will be linked to the price of RECLAIM trading credits. This removes any incentive to violate the emissions cap rather than purchase credits.

To ensure that the basin as a whole is meeting its air quality goals, SCAQMD will institute an automated tracking system. Reports will show actual emissions on a quarterly basis and will allow the generation of geographical emission reports. The system will also track credit trades so that SCAQMD can determine whether facilities hold the necessary number of credits for compliance.

Compliance and enforcement issues will become more complex if ROC emissions are added to the RECLAIM program. ROC is emitted from a variety of sources and products including paints, coatings, adhesives, solvents, dyes, and inks. ROC sources also include combustion sources such as boilers, heaters, internal combustion engines, kilns, furnaces, ovens, and dryers. The ROC emissions from the use of a product cannot be calculated unless the product label clearly certifies the ROC content. If all products containing ROC were properly labeled, each source would still have to monitor the amount of each ROC-containing product used, and the effectiveness of any ROC control equipment used in conjunction with the product.

SCAQMD initially proposed that all products be labeled with bar codes that indicate the product's ROC content. Each time the product is used, the bar code would be scanned and ROC content information would be electronically recorded. Companies would keep daily logs of ROC usage. ROC emissions would be reported to the District on at least a monthly basis (more often for large sources). The District considered an automated tracking system similar to the type of accounting system credit card companies use. Each source would be issued a District 'credit card" to be used for information reporting. Total emissions would be tracked electronically in the same way credit card companies track total spending balances after each purchase is recorded.

The District must ensure that the method of reporting emissions is adequate and that accurate information is provided in a timely manner. If compliance determinations cannot be made quickly, the District risks being unable to identify improper "edits before they are traded and used by another company to demonstrate compliance.

Administrative Costs and Transaction Costs. Adequate enforcement will be one of the keys to RECLAIM's success, however, it must be balanced with administrative costs. Although the use of CEMs and automated ROG tracking would help ensure compliance, they would also impose significant costs on RECLAIM participants. It may be difficult for RECLAIM to meet both its program goals of reducing compliance costs below compliance costs of traditional regulation) and reducing emissions to a level below that achieved through command-and-control regulation. Administrative costs would need to be minimized so that they do not discourage eligible facilities from participating in the market.

One of the largest administrative costs for the District could be the added personnel necessary for additional compliance and enforcement activities. There is also an administrative cost associated with recording trades and verifying that proper transactions have occurred.

In addition to the District's cost of administering the program, participants will incur private transaction costs associated with trading. Transaction costs will result from the need to locate

trading partners. The District had developed a computer bulletin board that is available to the public for the-purpose of listing offers to buy or sell credits. In addition, two firms have announced their intention to hold a private auction of RECLAIM credits which they hope will jump-start the credit trading market. The auction sponsors will use a computer system to match buyers and sellers, and to identify market clearing prices. These measures should help limit transaction costs.

Impacts

The consequences of the RECLAIM program may be evaluated not only in terms of air quality improvements, but on the socioeconomic impacts as well. Some are concerned that facility shutdowns will increase under RECLAIM adding to job loss in California and damaging the State's economy. Some businesses may have additional incentive to move away from the Los Angeles area because of potential profits from the sale of emission credits earned by shutting down plants. To ensure retention of businesses in the area, the District is allowing shutdown credits to be generated only by the 390 facilities in the RECLAIM market. Non-RECLAIM facilities will not receive credits for shutdowns.

MEETING POLLUTION REDUCTION OR PHASE-OUT REQUIREMENTS THROUGH TRADING

Tradeable Permits For Carbon Dioxide Control

Approaches to implementing a CO_2 control program include: (1) regulatory schemes involving efficiency standards and other mandated requirements, along with financial incentives or subsidies; (2) consumption taxes (carbon, Btu or gasoline) on the various sources of CO_2; and, (3) emission reduction programs based on market incentives such as trading and banking of CO_2 credits.[96] These approaches are not mutually exclusive, but can be used in tandem to complement each other. The following discusses trading and banking.

Background

The Clean Air Act Amendments of 1990 establish allowance-trading programs to control SO_2 emissions and to phase out chlorofluorocarbons (CFCs),[97] which deplete stratospheric ozone (and also are greenhouse gases). The two programs differ in that the SO_2 program provides for trading of emission allowances while the CFC program provides for the trading of production allowances of the ozone-depleting chemicals. Thus, the CFC program creates a market for the right to produce certain quantities of the controlled substances rather than for the right to emit

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[96] Much current debate concerns the potential extent and timing of climate change; many argue that controls are premature pending further scientific research and development. As noted, this paper does not evaluate the extent or magnitude of the problem, but rather focuses on options for addressing it. Research and development, and public education campaigns, while not directly controlling emissions, will inevitably be essential components of developing and implementing any policies directed at controlling climate change.

[97] Sec. 607, Title IV, P.L. 101-549.

specified quantities of the substance. Paralleling the SO_2 control program, most proposals for CO_2 control focus on the actual pollutant as the basis of trading, not the production rights.

In the emission trading approach,[98] potential emitters of a pollutant are provided permits or allowances for a specified activity--the production of a hazardous product, or an emission of a pollutant--with each permit "worth" a unit of production or pollution (e.g., a ton of CO_2). Each affected facilities would be granted annual pollution permits corresponding to its allowed level of emissions as set by legislation or regulation. No emissions above the level for which a facility held permits would be permitted. However, facilities could choose to reduce their emissions below permitted levels and sell the resulting excess permits received from those pollution reductions to others. Facilities would be encouraged to trade these permits among themselves or with others in order to find less costly ways of meeting the overall reduction in emissions.

By over controlling and selling excess permits, facilities with economies of scale or generally low control costs can reduce their total costs of compliance. Those facilities that have incremental control costs that are less than the price at which they could sell permits have an incentive to overcontrol. Proceeds from selling the excess permits mean that the facility's total cost of overcontrol could be less than if it just controlled to the mandated level. Ideally, the excess allowances will be sold to utilities with incremental control costs above the allowances price. By purchasing allowances for their emissions in excess of the standard, these facilities can meet any requirement more cheaply than if they controlled to the required level. The desired outcome is a lower total national cost for meeting the limitation than if all sources just met the standards regardless of their differences in incremental costs.

If the market works efficiently, pollution reductions will be achieved cost-effectively. Current experience with the SO_2-allowance market is as yet insufficient to give much guidance on how well a CO_2 permit market might work.

Implementation Issues

The major economic advantage for a tradeable permit program is the flexibility that the system would provide to emitters in complying with reduction goals. In controlling greenhouse gases, this flexibility could include options beyond reducing emissions, such as increasing CO_2 sinks (by planting forests for example), or permitting tradeoffs with controls on other greenhouse gases, like methane. For example, a utility could choose to capture and burn coal-bed or landfill methane, which would have the effect of offsetting its emissions of CO_2. Hence, the program could provide a broad range of alternatives to emitters in complying with the goals of the program. Like a tax system, the trading system would encourage development of cost-effective control measures as trading would provide flexibility to emitters in determining what specific control to use in meeting mandated targets.

A further characteristic of this approach is that by focusing on the quantity side of the price-quantity equation, it effectively limits total emissions--a characteristic that made it useful in addressing acid deposition, and that makes it attractive for greenhouse gases. The option of simply paying the price of pollution (as in a tax) is subject to prohibitively stiff penalties. Thus,

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[98] For example, see Daniel J. Dudek, "*A Short Discussion of Greenhouse Gas Trading*." Prepared for the Keystone Global Warming Dialogue Policy Evaluation Working Group, August 1990.

the quantity of reductions achieved is much more certain than under a tax scheme. This would provide some assurance to interested parties that a specific amount of CO_2 would be reduced or a specific trend in emissions obtained. For those confident that achieving a specific level of CO_2 reductions will yield very significant benefits--enough so that even the potentially very high end of the marginal cost curve does not bother them--then a regulatory system or tradeable permit program may appear most appropriate.[99] CO_2 emissions would be reduced to a specific level, and, in the case of a tradeable permit program, the costs involved would be handled efficiently, but not controlled at a specific cost level.

Also, the program could be phased-in over time, beginning with a new source offset program and later expanding to existing sources if necessary.[100] Thus, the program could begin with a offset provision requiring new sources to get permits from existing sources in order to operate, and expanded over time to increase reduction targets on existing sources. However, there is also the possibility that a ceiling on emissions could become a floor as no direct economic incentive would exist to reduce emissions below the mandated ceiling.

Impacts

Implementing even the most elementary of this type of program raises several practical issues. First, the more sources involved, the more complex and burdensome a trading scheme becomes. A trading system would need the most sophisticated monitoring system of the approaches outlined here. Besides determining a basis for the initial allocation of credits, monitoring systems would be needed for determining compliance and for overseeing trades. For small, diffuse sources, this could be a challenge. For example, 12% of all CO_2 emissions comes from the residential/commercial sector (space heating/cooling, water heating and appliances) and 33% from the transportation sources (trucks, automobiles, airplanes, etc.). Designing a tradeable permit program to cover these sources (45% of total) would be a challenge. If an international scope is desired, the monitoring question is multiplied again.

Second, when utilities are the sources affected, the trading scheme may pose unresolved issues concerning the jurisdiction of State public utility commissions. Questions arise about how investments in pollution equipment verses investments in permits might be treated. Such questions are currently being asked with respect to the SO_2 program with no consistent answer yet.

Third, the initial allocation of permits/allowances/credits poses critical equity issues. One option is to simply auction off initial allocations, which could adversely affect economically disadvantaged participants. Another option is to distribute them free, which requires the development of some allocation formula, for example according to existing emissions or production. Yet another option is to allocate them according to a complementary regulatory scheme. This initial allocation could be very complicated, depending in part on the numbers of emitters and gases included in the program. Indeed, it may be more critical than under a tax

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[99] For a general discussion of emission permits versus carbon taxes in the face of uncertainty, see Oates, Wallace E., and Paul R. Portney, *Economic Incentives for Controlling Greenhouse Gases*. Resources for the Future. Resources, Spring 1991. pp. 13-16.

[100] Daniel J. Dudek and LeBlanc, Alice, "*Offsetting New CO_2 Emissions: A Rational First Greenhouse Policy Step*," Contemporary Policy Issues, vol. 8, no. 29 (July 1990).

scheme as the permit program will generate no revenue to government for potential redistribution to heavily affected areas or industries.

Liquidity of the trading system could require Government intervention in terms of auctions or as a source of last resort. The necessity and degree of such intervention could affect the efficiency of the system.

In summary, the development of a system where current and/or future CO_2 emissions allowances or permits (or credits) could be traded would introduce some of the advantages of an economic incentive program while retaining some of the certainty of a regulatory system. Likewise, implementation of a tradeable permit program would be easier than many regulatory programs, but more difficult than a tax scheme, as is discussed later.

Recycling Credits in the Solid Waste Area

Solid and hazardous waste programs offer a clear example of the three factors stimulating a reconsideration of market-based approaches. First, the United States is in the midst of a new round of regulatory efforts that could increase dramatically the cost of traditional approaches to waste management. As costs increase, the need to consider more efficient waste management mechanisms grows.

Second, existing regulatory programs appear ill-conceived to manage many of the new regulatory targets, such as gas stations, dry cleaners, households, and other small quantity waste generators, whose numbers make traditional enforcement approaches impracticable.

Third, because of the Federal budget deficit, it appears unlikely that there will be increased funding for existing or new control programs. Spending for solid and hazardous waste programs grew more rapidly than other components of EPA's budget in the 1980s, but there are still substantial backlogs of permitting and enforcement cases, and little attention is being given to some potentially major problems. Thus, market-based approaches have drawn interest for their ability to serve as revenue sources.

Background

During the 102nd Congress, more than 100 bills were introduced to revise and reauthorize the primary Federal solid and hazardous waste law, the Solid Waste Disposal Act (SWDA).[101] Many similar bills have been reintroduced in the 103rd Congress. These bills contain numerous examples of economic incentives for solid waste management. They mostly create incentives for reducing the amount of waste placed in landfills, collecting recyclable materials, reusing recovered materials in manufacturing new products, or purchasing products that contain recycled materials. Many of the sponsors of these bills believe that recycling is better for the environment than landfilling waste because recycling may preserve natural resources and conserve limited landfill space. Some believe that landfills are unsafe because they have the potential to leak and contaminate nearby ground water. Although communities and private waste disposal companies

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[101] The Solid Waste Disposal Act (SWDA) is frequently referred to as the Resource Conservation and Recovery Act (RCRA), the law which substantially amended the SWDA in 1976.

can continue to construct new landfill capacity, it is costly to meet Federal and State requirements for new landfills and politically difficult to site new landfills.

There are more than 5,000 curbside recycling programs currently in place nationwide, up from about 1,000 in 1988. The dramatic increase in collection has lead to an over-supply of recyclable materials. Without a corresponding increase in the demand for collected recyclables, municipalities and other recyclers have had difficulty identifying markets for the reuse of the recyclable materials collected. Many of the proposed incentive approaches aim to jump start the markets for collected recyclable materials by equalizing supply and demand. Bills introduced in Congress attempt to stimulate demand where broad-based recycling markets have not thrived (e.g., scrap tires, used oil, newspapers, etc.).

A series of bills aimed at improving markets for used lead-acid batteries, scrap tires, and old newspapers was introduced in the 103rd Congress. The bills impose requirements on producers and importers of these products requiring them to recycle an amount of their product proportional to the amount of that product they produce or import. The recycling percentage would be determined by EPA. EPA would also create a recycling credit system under which recyclers could receive credits for recycling and producers or importers could purchase recycling credits to comply with the recycling percentage requirement. The number of credits received depends on the method by which recovered materials are managed. One method of reuse or recycling could receive more credit than another to create a greater incentive for using one recycling method over another. For example, a tire producer or importer could comply with the recycling requirement by incorporating used tire rubber in the new tire manufacturing process, retreading old tires, or purchasing recycling credits. Incorporating old tires into asphalt pavement or retreading old tire casings generates twice as many credits as burning a whole tire, and four times as many credits as shredding a tire for disposal.

The bills covering lead-acid batteries and old newspaper contain a slight variation on the credit system for scrap tires. Rather than setting an overall recycling rate as proposed for scrap tires, the bills set a minimum recycled content for new lead-acid batteries and newsprint. For example, a producer or importer of lead-acid batteries could comply with the recycling requirement only by recycling old lead in the production of new batteries, or by producing new batteries with reclaimed lead purchased from a secondary lead smelter. The third compliance option would be to purchase recycling credits from another lead-acid battery producer who exceeded the minimum content requirement.

The main difference is that the minimum content approach encourages recycling of old newspaper back into newsprint with recycled content and the use of lead from old lead-acid batteries for producing new lead-acid batteries. This approach does not encourage the use of recovered materials for anything other than the original product. It would discourage alternative uses such as exporting recovered newspapers for recycling abroad.

Implementation Issues

The main assumption fundamental to the various bills is that existing markets for batteries, newspaper, and tires are either non-existent or imperfect. Therefore, requiring those responsible for producing or importing these goods to also recycle them enhances and stabilizes existing markets, or creates markets that do not currently exist. One drawback is that in areas where these markets do indeed exist and are working, these bills could interfere with the existing market by imposing an artificial market. Recycling activity would center around the federally specified

recycling percentage or minimum recycled content and natural market forces that could otherwise increase recycling above that level could be suppressed.

In some of these industries, where consumer behavior is an important part of the recycling system, the effectiveness of these bills may be limited. For example, in the used battery recycling industry, many manufacturers are already using 100 percent recycled lead in producing new batteries. However, even if all manufacturers used 100 percent recycled lead, many used batteries would not enter the used battery collection system. Various proposals encourage increased collection by mandating that retailers accept used batteries. However, because the behavior of individual consumers is so important to the collection of batteries, such proposals may not be highly effective unless collectors provide incentives to consumers for returning used batteries.

Whether a credit trading market will work, depends on the ease of identifying potential market participants. For items covered by these bills, the number of recyclers is fairly limited, therefore the number of credit generators would also be small. Nonetheless, brokers may be needed to facilitate trades. Administrative costs could be very high if a credit trading market did not develop on its own and EPA had to promote trading.

Transaction costs also need to be low. High transaction costs would limit trading because it might raise the cost of purchasing credits close to the cost of compliance with the recycling requirement or minimum recycled content requirement. The more information EPA makes available on who has credits and who may need to purchase credits, the lower transaction costs will be. Producers and importers must also be fairly certain that credits will be available and that they will be available at a lower price than it would cost to meet recycling requirements on their own. Long-term contracts would help reduce uncertainty of credit price and availability.

A credit trading system would be difficult to enforce because EPA would need to be able to verify the number of credits a recycling firm generates, as well as whether the producer or importer has purchased the proper number of credits. EPA could accomplish this through inspections and audits of company records.

Impacts

All domestic producers and importers of any of the products covered by these mechanisms would be affected by the legislation. Major consumers such as automobile manufacturers and newspaper publishers would also be affected by the legislation. The cost of producing or importing the covered products would rise because of the additional costs of purchasing recycling credits or meeting the required recycling percentages. This could cause some consumer price increases, depending on how large a component of total product cost the recycled material was. Collectors of recyclable materials would see increased demand for these commodities and possibly increased prices paid for them, depending on supply and demand balances. Recyclers would also benefit by selling recycling credits to producers and importers.

These proposals could provide benefits to some industries while damaging others. Which industries would be affected would depend on manufacturers' choices for recycling methods. For example, if manufacturers find that it is cheaper and easier to recycle all used tires by making them available to the rubberized asphalt industry, the tire retreading industry might suffer because its access to retreadable tires would be diminished. Alternatively, if manufacturers provided most of their scrap tires to tire burning plants, both the retreading industry and the

asphalt rubber industry would be harmed. This problem could be diminished by properly weighing credits given for each use.

By providing an incentive for the use of batteries with recycled content, secondary lead smelters could gain from the implementation of this bill, while virgin lead manufacturers would suffer. The virgin newsprint industry would also lose market share to recycled newsprint manufacturers, although the trend for newsprint as well as most other manufacturers is to incorporate recycled materials into their operations.

These types of proposals could have an impact on existing State and local programs. Many States already require the management of used batteries, tires, and newspapers. For example, almost three quarters of the States have scrap tire laws or regulations or are considering such legislation. Some State and local governments may have already entered into contracts with private recycling operations that require the community to supply a specified amount of recovered materials. For example, some local governments have contracts with rubberized asphalt firms for the building of highways using scrap tires that require the local government to provide a specified amount of used tires. If manufacturers must recycle tires on their own, the number of tires available at municipal solid waste facilities may decline and become insufficient to support rubberized asphalt road construction projects.

INTERNALIZING SOCIAL COSTS THROUGH NONREGULATORY MEANS

Carbon Taxes[102]

Background

In the view of many economists, a carbon tax would be the most efficient approach to controlling CO_2 emissions. A pollution tax attempts to maximize net social welfare from polluting activities. Economists observe that pollution imposes costs on society that are not incorporated in the price of the goods or services responsible for the pollution; these are called "external" costs. An ideal pollution tax "internalizes" these external costs by making the beneficiary of the polluting activity pay a price that accounts for the socially borne costs. When the tax is set at the level at which the marginal costs of more controls would just equal the marginal benefits society gains by further reductions, society's net welfare is maximized. Polluters, finding it cost-effective to reduce their emissions to avoid paying the tax, would add pollution controls, or take other actions, to the point where further controls would cost more than the tax or than the benefits society would gain. In the case of global warming, the pollutants being taxed and the level of the tax would be based on their respective contributions to global climate change and on an assessment of the future damages from climate change.

Implementation Issues

In practice, attaining a "socially optimal" level of control from an carbon tax may not be achievable. Setting the tax at the level that maximizes net social welfare would require

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[102] Although this section focuses on carbon taxes, much of the discussion is relevant to other tax proposals.

calculating external costs (such as of global warming). This is extremely difficult if not intractable, because of uncertainties about effects, the problem of monetizing impacts, and other scientific and methodological problems.[103] For example, Cline has estimated the annual damage from a doubling of CO_2 equivalent from $61 billion (1990 dollars) to as high as $117 billion or possibly more.[104] Others suggest the damage could be lower than this range.[105]

Because of this uncertainty, a second approach to setting the carbon tax has been suggested where a policy decision is made to achieve a stabilization or reduction in CO_2 by a certain year (for example, stabilization of emissions at their 1990 levels by the year 2000), and then to estimate the tax level necessary to achieve that objective. Economic theory indicates that a pollution tax is an efficient vehicle to minimize control costs for a given level of reductions (regardless of whether the level achieves the ideal net social welfare). In this sense, a pollution tax is efficient because it decreases the compliance costs of individual firms by allowing them the flexibility to make the best use of information and technology relevant to their circumstances. Individual firms can determine whether it is in their interest to pay the tax or to invest in emission-abating alternatives. Since the tax must be paid on remaining emissions, firms have a continuing incentive to innovate and find cheaper ways of reducing emissions.

However the tax is set, it creates an incentive to reduce emissions by raising the cost of polluting. Hence, the purpose of the tax would not be to raise revenue per se (although it would) but to induce reductions at the lowest costs achievable. Presumably, the policy goal would be to set a carbon tax at a level to achieve a specific level of CO_2 emissions by a specific date--given the assumptions and uncertainties of predicting how a particular tax level would affect activities emitting CO_2.

Impacts

Besides being economically efficient, a carbon tax provides some protection against the uncertainty of carbon reduction costs at the cost of some uncertainty about the quantity of pollution reduced. Proposed CO_2 reduction mechanisms present large uncertainties in terms of the perceived reductions needed and the potential costs of achieving those reductions. In a sense, preference for a carbon tax or another system depends to some degree on how one views the risks and uncertainty regarding the necessity of achieving specific reduction levels versus the risks and uncertainty regarding costs. If one is more uncertain about the benefits of a specific level of reduction--particularly with the potential downside risk of substantial control costs to the economy--then a carbon tax may appear most appropriate. In this approach, the level of the tax effectively caps the marginal control costs that affected activities would have to pay under the reduction scheme, but the precise level of CO_2 reduction achieved is less certain--subject to the boundaries and uncertainties of model projections. Basically a carbon tax resolves the "price

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[103] See Blodgett, John. *Health Benefits of Air Pollution Control: A Discussion*, CRS Report 89-161 ENR, February 1989.

[104] Cline, William R. *Global Warming: The Economic Stakes*. Washington D.C.: Institute for International Economics, May 1992.

[105] For example, see Nordhaus, William D. *To Slow or Not to Slow: The Economics of the Greenhouse Effect*. The Economic Journal 101, no. 6, 1991. pp. 920-37.

versus quantity" debate in favor of having more cost control over having absolute certainty of reductions.[106]

An additional strength of tax mechanisms is that they are self-executing in many ways, solving some of the implementation problems raised by regulatory systems. For example, if the tax were imposed on fuel inputs (e.g., coal, oil, and natural gas), little additional data collection would be necessary to impose the tax; no cumbersome or expensive monitoring systems, such as stack monitoring, would be necessary to determine emission levels and potential tax liability.[107] Other transaction costs, such as tracking credits under a tradeable permit program, would be unnecessary. Once set up, legal challenges and the delays resulting from legal proceedings might lessen. This would be particularly true if farther down the line it were decided that increased reductions in CO_2 were necessary. With a carbon tax system, focus would be on changing the tax rate, compared with a tradeable credit program where concern about legal rights and "takings" or disruption of any credit market or corporate compliance planning could be involved. Like a tradeable permit system, a carbon tax system could also stimulate development of a wide range of cost-effective control measures as specific reductions would be determined by the balance between control costs and the tax, rather than limited by specific reductions mandated under a regulatory system.

However, in some ways, a tax system merely changes the forum, rather than the substance of implementation issues. Because paying a carbon tax becomes an alternative to controlling emissions, the debate over the amount of reductions necessarily becomes a debate over the tax level imposed. Those wanting large reductions quickly would want a high tax imposed over a short period of time. Those more concerned with the potential economic burden of a carbon tax would want a low tax imposed at a later time with possible exceptions for various events. Carbon taxes would remain basically an implementation strategy; policy determinations such as tax levels would require political/regulatory decisions.

Climate change is also a global problem, making at least some international cooperation on strategies desirable. Current European efforts to begin addressing CO_2 emissions focus on a carbon tax or a hybrid carbon tax/energy tax. The European Community (EC) had proposed a $3 per barrel of oil equivalent tax beginning in 1993, rising to $10 per barrel by 2000. Fifty percent of the tax would be imposed on energy production (including nuclear power) except renewables; fifty percent of the tax would be based on carbon emissions. This choice of a hybrid tax reflects concern within the EC that energy efficiency be promoted as an explicit goal, and concern within the environmental community about promoting nuclear power. Although any U.S. carbon tax would not necessarily be identical to an EC levy--even if the reduction goals were comparable--using the same general approach would make discussions of comparability or reciprocity easier.

A final consideration is that a carbon levy would raise money. For example, the proposed EC tax is estimated to raise about $63 billion annually by the year 2000. What governments choose to do with that money would have some influence on the macroeconomic effects of a CO_2

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[106] Of course, this is no guarantee that once a carbon tax level were set that it would not be adjusted in the future as desired reduction levels are achieved or not achieved.

[107] However, substantial data needs would be required if one endeavors to measure net social costs and benefits, for example to validate the achievement of maximized net social welfare.

reduction program. In any case, the revenue could provide the governments involved with flexibility in addressing economic concerns within their countries and between the industrialized countries and the developing countries. On the latter point, funds might be allocated from the revenue received to encourage programs to control global warming gases (or to promote sustainable development and species preservation, for example) in Third World countries. In addition, the carbon tax approach would not involve massive government intervention in terms of direct regulation. Of course, it is a tax whose effects would be particularly felt by energy-intensive industries.

In dealing with the complex and global nature of climate change, carbon taxes have some important strengths in terms of economic efficiency, implementation, cost control, and potential international harmonization. As a tax, a carbon levy would result in revenues being created for the government--the disposition of which would have a substantial impact on the economic effects of the tax.

Effluent Fees

From topics discussed at public conferences[108] to initiatives endorsed by the Administration,[109] market-based alternatives to conventional environmental regulation have moved out of the economics journals and into the policy debates. In the policy area, market-based strategies for water pollution control are a topic of somewhat more recent interest than related areas such as air pollution control. Two basic options are the focus of much of the attention: effluent charges, which put a price on each unit of discharge, and tradable permits of the sort already endorsed in diverse regions such as the Tar-Pamlico river basin of North Carolina and the Dillon Reservoir in Colorado (see discussions in previous section of this report). Effluent fees or charges are a newer instrument in the water pollution control field, even for demonstration purposes.

In 1990 direct and indirect releases of toxic pollutants to water by manufacturing facilities amounted to 645 million pounds, according to reports of facilities subject to the Toxics Release Inventory (TRI) established by section 313 of the Superfund Amendments and Reauthorization Act of 1986.[110] Releases of conventional pollutants, though not reported pursuant to TRI, are estimated at an additional 3.4 million pounds. That volume of discharges, of both toxic and conventional pollutants, although regulated by traditional permit and control measures, is responsible for widespread impairment of the Nation's waters. Water pollution injures animal

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[108] See, for example: U.S. Environmental Protection Agency, Office of Water. *Clean Water and the American Economy, Proceedings of a Conference, Oct. 19-21, 1992*. EPA 800-R-001a. March 1993. 2 vol.

[109] See, Gore, Al. *Creating a Government that Works Better & Costs Less, Report of the National Performance Review*. September 1993. p. 63. This report notes that market mechanisms -- fees on pollution, trading systems, and deposit-rebate systems -- can be effective alternatives to environmental regulation, and it recommends that EPA and Congress use administrative and legislative measures, for example, the Clean Water Act, to promote market mechanisms to abate pollution.

[110] U.S. Environmental Protection Agency, Office of Pollution Prevent and Toxics. *1990 Toxics Release Inventory*. EPA 700-S-92-002. May 1992. 229 p.

and plant life and exposes humans to health risks. As a supplement to command-and-control systems, water pollution discharge fees can give polluters a strong incentive to change their behavior and reduce the volume and toxicity of wastewater.

Background

Economists argue for effluent fees as a way to internalize external social costs, and a well-designed fee or charge system should incorporate evaluation of potential benefits (avoided damages) in a structure that accurately accounts for all sources of those damages. In the 103rd Congress legislation has been introduced that would impose effluent fees on industrial wastewater discharges in order to generate revenue for water quality programs, H.R. 2199 and H.R. 2255.[111] The legislation proposes to raise $2 billion annually by assessing a charge on a specified group of chemicals (300 toxic and three conventional pollutants) released to surface water by industrial direct dischargers and indirect dischargers (companies that discharge wastes to municipal sewers for treatment by the local sewerage utility) throughout the United States. The legislation has dual objectives -- a specified revenue goal for water quality programs raised through a "polluter pays" fee system.

Under the proposal, the pollutants are grouped in five categories consisting of a base group and four other groups that reflect increasing toxicity to aquatic life and human health. A fee rate is established for each of the five categories that would be applied to actual loadings, or discharges, of the individual chemicals. Toxicity characteristics, developed by EPA in connection with standard setting under the Clean Water Act, yield a toxic weighting factor for each pollutant and, hence, a means of ranking and grouping the chemicals according to their relative toxicities.

Implementation Issues

Two key issues associated with the proposals are identifying which chemicals would be subject to effluent fees and determining the rate or rates applicable to discharges of those chemicals. A discharge fee can be applied most easily to discharges from point sources, since the discharges can be accurately measured or calculated. Measurement or calculation based on actual or estimated discharges is essential. Also important is basing the proposal on as comprehensive a list of chemicals as possible, so that all pollutants with potential for causing environmental harm are made subject to the same manner of incentives to reduce damages.

The chemical list in the legislation includes three conventional pollutants (total suspended solids, biological oxygen demand, and oil and grease) because discharges of these substances can impair water quality and because they provide a reference point for relative toxicity of the other chemicals. They include metals and metal compounds, organic chemicals, non-metallic inorganics, pesticides, and acids, bases and salts. The toxic pollutants include chemicals from several lists: pollutants included in TRI reporting requirements and known to be discharged to surface waters; chemicals regulated as priority pollutants under the Clean Water Act; and

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[111] H.R. 2199 was introduced Rep. Gerry Studds and was referred to the Committees on Merchant Marine and Fisheries and Public Works and Transportation. H.R. 2255, introduced by Rep. Norman Mineta and referred to the Public Works and Transportation Committee, is substantially the same (including the tax proposals discussed here) except for provisions affecting jurisdiction of the Merchant Marine and Fisheries Committee.

chemicals of more recent concern because of their potential to accumulate in living organisms and become more concentrated as they move up the food chain (through bioaccumulation or biomagnification) which are not currently covered by either TRI or Clean Water Act regulations. This substantially addresses the issue of a data set that is both comprehensive and current.

Fundamental to the proposal is the concept that the rate of fee or charge should be tied to the environmental harm or threat of harm caused by the discharge of the pollutants. Thus, the toxicity of the substance is important as a basis for determining the fee. Under the legislation, toxic weighting factors are used to rank each chemical and place it in a group, for purposes of determining the applicable effluent fee. EPA uses toxic weighting factors in the process of evaluating technological options under the industrial point source regulatory program. The analysis reflects the fact that some pollutants are more toxic than others and removal of pollutants by one technology may be more or less effective than another technology based on its ability to remove the more toxic chemicals. A weighting factor for a pollutant parameter is calculated in relation to a selected standard pollutant (e.g., copper).

EPA has developed toxic weighting factors for 126 priority pollutants and approximately 250 pesticides, but no toxic weighting factors have been developed for a number of chemicals listed in the legislation. Thus, in the proposal, those chemicals were assigned a proxy factor. For those chemicals, this results in a somewhat arbitrary assignment or ranking; actual toxic weighting factors, if available, could easily be lower or higher.

Use of EPA's toxic weighting factors is an imperfect strategy for ranking the toxicity of chemicals, since it does not cover all chemicals of potential interest or concern. Other ranking systems might take into account a range of parameters such as toxic effects (acute and chronic toxicity, wildlife and human health toxicity), environmental fate (persistence), and exposure data (detection in water and sediments). Inclusion of multiple parameters has the potential to strengthen the results of chemical ranking, but sufficient data in this broad array of categories and for all pollutants of concern do not currently exist.

Effluent fee rates under the legislation are based on the categories of chemicals, their relative toxicity to one another, and the amount of total revenue to be collected. A rate of 0.6 cents per pound of pollutant discharge is set for chemicals in the base category (Group 1), which consists primarily of conventional pollutants and others with very low toxicity. Each of the other categories' fee rates is then established in relation to the base rate in order to reflect relative toxicity. The rate of fee for chemicals discharged in Group 5 (consisting of chemicals with the highest toxicity) would be a fee of $63.39 per pound discharged.

Impacts

The objective of the proposed industrial wastewater effluent fee is revenue generation, but if a quantity- and toxicity-based discharge fee program were implemented, polluters' residuals management practices would be expected to change because the fees would increase the cost to polluters of using surface waters as a waste disposal medium. The changes in polluters' behavior would depend on the magnitude of the fee and discharge abatement costs. Thus far, little or no empirical study has been done on what level(s) of fee(s) would result in reduced discharges.

Faced with a discharge fee, the polluter has five possible adaptations.[112] First, the polluter can treat its wastewater to reduce the quantity and toxicity of discharges. Many would probably choose this response, in particular by installing additional control equipment. Second, the polluter can alter production processes (substitution of less toxic chemical inputs or processes involving reduced wastewater discharges), which in turn can reduce the quantity and toxicity of discharges. This response amounts to greater use of pollution prevention as a waste minimization technique. Third, the polluter can follow some combination of these actions.

Fourth, the polluter can simply pay the fee or charge, postponing a change in residuals management until the fee increases or abatement costs decrease sufficiently. The revenue goals estimated for the proposal ($2 billion per year) assume, in fact, that this will be the response of most industrial sources, since the proposed fee rate for most chemicals is low enough that paying the fee would generally have minor impact on individual firms or most industry categories. With the exception of the chemicals and allied products industries (which accounted for 63 percent of TRI discharges in 1990 and would pay about two-thirds of fees paid by all industries under the proposal), impacts on most industries would not be significant.[113]

Finally, the polluter could reduce production or close down.

To the extent that revenue-raising is a key objective of an effluent fee (rather than purely as an economic incentive to dischargers), it is necessary to build into the fee system a means for making adjustments over time. For example, to maintain a predictable revenue stream -- where that is the goal -- the design of the system should provide for periodic changes in the fee rates to account for effects of inflation. Similarly, the fee system needs to recognize and adjust for uncertainties in its initial design. One major uncertainty could result if the fees in fact have the effect of altering polluters' actions, that is, if imposition of fees led to reduction in use of the chemicals and revenues were to decline. While it is difficult to estimate the extent to which chemical use would be altered, the potential for reduced revenue should be considered.

Input Fees - Fertilizer, Pesticide and Animal Feed Tax

Background

Policy interest in taxing inputs to agricultural runoff also is reflected in the same legislative proposals, H.R. 2199/H.R. 2255. The legislation recognizes that surface and ground waters are potentially vulnerable to contamination by various types of runoff from agricultural lands and activities. When pesticides and fertilizers are applied to crops, rangeland, forests, urban landscapes, and other lands, they may be transported by wind, rainfall, runoff, and infiltration. Chemicals dissolved in runoff water are carried to nearby surface water or may enter

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[112] Morton, Brian J., Ian Burns, Jenny Dempsey, Kristy Mathews, Tayler Bingham. *Effluent Charges and Water Quality: A Preliminary Assessment.* Draft report prepared by the Center For Economics Research, Research Triangle Institute for the US EPA Office of Water. May 1992. pp. 6-20 - 6-23.

[113] Congressional Research Service, U.S. Library of Congress. *Funding Water Quality Programs: Revenues for a National Clean Water Investment Corporation*Report prepared for the House Committee on Merchant Marine and Fisheries, Subcommittee on Fisheries and Wildlife Conservation and the Environment. July 1992. pp. 14-15.

groundwater through direct infiltration, as well as through sinkholes or abandoned wells. Another significant source of surface and groundwater pollution is animal waste runoff, estimated to account for over one-third of all agricultural nonpoint source pollution and causing impairments of water bodies in 32 States.

Implementation Issues

This legislation would impose taxes on three sources of this nonpoint source pollution runoff, pesticide active ingredients, the nutrient content of fertilizer chemicals, and processed animal feed in order to generate revenues to support water quality programs. The concept underlying the legislation is to generate revenues that would be dedicated to supporting water pollution control programs authorized by the Clean Water Act, including projects to control nonpoint sources of pollution. It embodies the "polluter pays" principle of charging the polluter in some proportion to his contribution to the problem of environmental contamination or degradation. Those who use the most fertilizers, pesticides, or animal feed would pay the bulk of the cost.

There are about 750 actual active ingredients used in pesticides which would be covered by the legislative proposal and would be taxed at a rate of 24.27 cents per pound of active ingredient in the pesticide. These active ingredients are formulated into more than 20,000 individual products. Two plant chemicals that constitute the nutrient content of fertilizers (nitrogen and phosphorus) are of concern environmentally and would be subject to the tax proposal. Fertilizer chemicals would be taxed at a rate of 0.845 cents per pound of nitrogen or phosphorus. Finally, processed animal feed would be taxed at a rate of $2.68 per ton.

Impacts

As true economic incentives, the pesticide, fertilizer, and animal feed taxes proposed in the legislation are rather blunt instruments. The principal purpose of the taxes is revenue generation, and the individual tax rates were set at levels necessary to generate specified revenue goals ($500 million from the tax on pesticide active ingredients, and $250 million each from the fertilizer and animal feed taxes), based on production volume data used in the analysis. With the defined revenue goal of the legislation, plus the relative inelasticity of demand for the three types of products, it is quite likely that these tax rates are set at levels that are too low to affect use significantly. Consequently, any chemical use reductions due to the taxes would be an indirect result of the legislation.

To be more precise economic incentive tools, the tax rates might incorporate factors to reflect the degree of human health or environmental harm from the pesticide, fertilizer, or animal waste runoff, such as calculating something like a toxicity weighting factor. In the case of fertilizers, such a calculation would need to reflect a range of potential environmental damages, including both toxicity (for example, public health concerns of nitrates in groundwater) and over enrichment of surface waters. Likewise, in the case of animal feed, a tax rate set reflect the environmental and health effects of livestock wastes should account for both the pathogens and nutrients in the waste.

For pesticides, analytic approaches to ranking the active ingredients in order to reflect environmental harm or toxicity might be explored. One option might be to rank pesticide active ingredients according to their LD_{50} ratings. (LD_{50} is a commonly used technique that measures the concentration of a chemical that will produce a lethal dose to 50 percent of a test species; the

results of LD_{50} tests are one of the required data sets used in EPA's pesticides registration process.) Further, toxicity rankings such as this might be combined with rankings of the chemicals' potential for leaching to groundwater or for surface water runoff, to yield a somewhat broader ranking system for pesticides.

The outcome of these environmental tax proposals is uncertain. There is, of course, strong opposition to imposing new taxes, even for specified, dedicated purposes such as pollution control programs. In addition, a particular concern of those who would pay the bulk of these taxes, the agricultural community, is that under the legislation as much as 85 percent of the revenues would go to controlling non-agricultural sources of water pollution (capital improvements to publicly owned sewage treatment works).

User Taxes - Water Use Tax

Background

The same legislation, H.R. 2199/H.R. 2255, also proposes a water use tax as a form of wastewater discharger fee. Under the legislative proposal, commercial and industrial water use would be taxed at a rate of 1.95 cents per thousand gallons of water used. The objective of the tax is revenue generation (estimated by bill sponsors to be $1 billion per year, based on 1990 water usage by those sectors), with revenues to be dedicated to water pollution control programs, particularly capital investments in wastewater treatment construction.

Implementation Issues

The concept underlying this tax is that users of wastewater services contribute to water pollution, and users benefit from the services of wastewater treatment -- either directly if they are connected to public sewerage facilities, or indirectly if they discharge to waterways or septage systems. (The tax charges the user for the privilege of discharging to waterways or groundwater.)[114] Water use is the basis of this tax, since the quantity of water released or discharged is a function of water consumed. In general, water use is measured (even where water is self-supplied), while the quantity of water discharged may or may not be measured -- particularly for discharges through public sewerage systems.

Impacts

The long run price elasticity of demand (the measure of sensitivity to price changes) for water has been estimated at between 0.5 and 0.8 for industrial users.[115] That is, a 10 percent increase in price would lead to a drop in industrial demand of 8 percent or less. Over the long

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[114] Apogee Research, Inc. *An Inventory of Financing Options for the Albemarle-Pamlico Sound.* December 1991. p. 51.

[115] Boland, John J., Benedykt Dziegielewski, Duane D. Baumann, and Eva M. Optiz. "Influence of Price and Rate Structures on Municipal and Industrial Water Use," a report submitted to the U.S. Army Corps of Engineers Institute for Water Resources, June 1984, p. 6, in Apogee Research, Inc. *America's Environmental Infrastructure: A Water and Wastewater Investment Study*, prepared for the Clean Water Council. 1990. p. 36.

term, less water use would represent resource savings, but it also would erode the anticipated revenue goal in this portion of the legislative proposal.

Excluding some user sectors from the tax weakens the incentive basis of the proposal. In particular, irrigation use by agriculture represented 40 percent of all freshwater withdrawals in 1990 and was the largest sector use.[116] Both the infrastructure associated with the systems that deliver water to irrigated agriculture and the discharges or return flow from irrigation represent economic and environmental costs to society which could be better internalized through more accurate price signals to those users. In contrast, industrial and commercial use which are included in the water use tax proposal represented just 6.4 percent of 1990 water use but a larger share (28 percent) of public-supply deliveries in 1990.[117]

Wetlands Mitigation Banking

Interest has grown recently in creating wetlands mitigation banks, in which wetlands are created, restored, or enhanced expressly for the purpose of compensating for unavoidable wetland losses associated with development actions. Units of restored or created wetlands are expressed as "credits" and accumulated credits are subsequently withdrawn to offset "debits" incurred at the development site. While more than 100 such banks are either actively operating or are being developed, so far there has been little Federal guidance on mitigation bank objectives, methods of determining credits and debits, and other implementation issues.

Background

In August 1993 the Clinton Administration announced a series of initiatives that constitute a comprehensive reform of wetlands policies and embody a number of regulatory, administrative, and legislative details. The proposal includes support for the use of mitigation banking in appropriate circumstances as a means of compensating for wetlands impacts authorized by wetlands regulatory programs. The Administration proposed several actions to ensure that mitigation of environmental impacts within Federal regulatory programs is effective and predictable.

First, the Army Corps of Engineers, which issues permits for activities in wetlands under the Clean Water Act Section 404 program, is to issue guidance to field staff to clarify the requirements for developing compensatory mitigation conditions in Section 404 permits.

Second, the Administration endorsed in the policy the use of mitigation banking under the Section 404 program. The Administration noted that while a number of technical and procedural questions remain regarding the establishment and long-term management of mitigation banks, the concept offers numerous advantages, if carried out with appropriate environmental

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[116] Solley, Wayne B., Robert R. Pierce, Howard A. Perlman. U.S. Geological Survey, U.S. Department of the Interior. *Estimated Use of Water in the United States in 1990*. U.S. Geological Survey Circular 1081. 1993. 76 p.

[117] Ibid., p. 22. Public supply refers to water withdrawn by public and private water suppliers and delivered to multiple users for domestic, commercial, industrial, and thermoelectric power uses. Public supply withdrawals represented 11 percent of freshwater withdrawals for all off stream categories in 1990.

safeguards. Banks are often ecologically advantageous because they consolidate fragmented wetland mitigation projects into one large contiguous parcel that can more effectively replace the lost wetland functions within a watershed. Mitigation banks also provide a framework for financial resources, planning, and technical expertise to be brought together in a fashion often not possible with smaller mitigation projects.[118]

Third, the Corps and EPA (which shares responsibility for administering Section 404) issued guidance to field staff to clarify the manner in which wetlands mitigation banking is appropriately used within the Section 404 program. This guidance is intended to provide interim direction pending the results of additional studies to encourage the use of mitigation banks for compensatory mitigation under Section 404.

Finally, the Administration requested that Congress endorse the appropriate use of banking as a compensatory mitigation option under Section 404. Two bills introduced in the 103rd Congress to amend Section 404 of the Clean Water Act address mitigation banking.

H.R. 1330 includes a provision directing that mitigation banking programs be established in each State. Under the bill, these programs would provide for crediting contributions to the mitigation bank in land, cash, or in-kind contributions so that persons unable to sponsor specific mitigation projects can contribute to the bank. The programs also would be required to ensure completion and maintenance of mitigation projects for at least a 25-year period and would limit activities on wetlands that are part of a mitigation bank to uses that are consistent with maintaining or gaining significant wetlands values and functions.

S. 1304 authorizes the use of mitigation banks within the context of appropriate safeguards. In part, this proposal is intended to set certain boundaries on ongoing mitigation banking practices to improve their operation while protecting wetlands values. Under this legislation, the Corps and EPA would issue rules governing establishment, use, maintenance, and oversight of mitigation banks. Among the requirements, mitigation banks would need to ensure that consistent and scientifically-sound methods are used to determine credits and debits at the site of proposed permits and sites of mitigation banks. In addition, fees charged for participation in the bank would be based on the full costs of replacing lost wetlands functions and acreage, including the costs of land acquisition, management measures, long-term maintenance, potential remediation of project failure, and other relevant factors.

Implementation Issues

The proponents of mitigation banks have been enthusiastic about the potential for their use in allowing development projects to proceed without costly regulatory delays and to minimize planning and design costs by pooling what would otherwise be several smaller mitigation undertakings. In both respects, mitigation banks may serve the purpose of allowing economic development to proceed while minimizing the loss of (and possibly maximizing the increase of) environmental benefits to society.

Still, a number of implementation issues are apparent that lead to uncertainties about the success of the concept. Prominent among the issues is that determining the success of a

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[118] "Protecting America's Wetlands: A Fair, Flexible, and Effective Approach," in Bureau of National Affairs, Inc., *Daily Environment Report*, No. 163, Aug. 25, 1993, p. E-9.

mitigation bank is a very complex task, and considerable uncertainty exists surrounding the measurement of functional values. None of the traditional wetlands management techniques are totally proven, and all possess limitations which sometimes detract from their utility in wetlands mitigation banking. Wetlands creation is regarded in scientific circles as a still somewhat experimental technique. While wetlands restoration and enhancement exist as the surest techniques for the purposes of mitigation banking, the slow rate at which many wetlands actually return to the natural state or to an enhanced condition and begin to amass bankable credits has also been a problem in several cases.[119]

The use of *preservation* as a means to compensate wetlands losses is a particularly contentious point among those who argue the pros and cons of wetlands mitigation. Preservation of existing wetlands areas for compensation purposes becomes a valid consideration only when it can be shown that the wetlands in the preservation area would be lost in the absence of preservation. Otherwise, wetlands would not be replaced, and in fact, a net reduction in wetlands would result. Further, wetlands restoration or creation costs vary significantly. They range from as low as several hundred dollars per acre for restoring wetlands in the Prairie Pothole region of the central United States to tens or hundreds of thousands of dollars per acre for some coastal wetlands. At the high end in particular, sponsorship of mitigation banks will hinge on the perceived certainty of credit accrual.

Impacts

The Administration's August 1993 policy endorsement and legislative clarification could give guidance on the establishment and operation of banks that some observers believe is lacking. If appropriately bounded, wetlands mitigation banking can benefit developers by allowing economic activity to proceed more efficiently, while providing a realistic mechanism for permanently preserving areas that might otherwise not be protected. Banking also increases the likelihood that mitigation can be incorporated into local or regional comprehensive planning objectives.

On the other hand, the use of mitigation banking introduces risk into the public's environmental benefits portfolio -- for example, financial bankruptcy of a sponsor could result in breaking of a wetlands management contract and curtailment of associated benefits. Further, establishment of a mitigation bank can be time-consuming and costly and may even introduce administrative risks into the Section 404 permit review process if a permit application were denied even after resources were invested in the mitigation banking. In the long run, good project planning may be neglected, and banked credits may be resorted to instead of avoidance and minimization of impacts.

Assurance Bonding To Reduce Agricultural Nonpoint Source Pollution

Background

One method of incorporating the social cost of water pollution into dischargers' decision making is to require dischargers to purchase dated assurance bonds that reflect the full value of potential worst-case costs to remediate environmental damage resulting from their actions.

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[119] Reppert, Richard. Institute for Water Resources, U.S. Army Corps of Engineers. *Wetlands Mitigation Banking Concepts*. IWR Report 92-WMB-1, July 1992. p. 13

Where water quality degradation could be linked directly to one or a small number of agribusinesses, they could be required to post assurance bonds. The bond would be repaid in full (possibly with interest) at the time of maturity if the bondholder demonstrates that the potential damage has not occurred. It would be repaid in part if some level of damage less than the potential baseline has occurred and would be forfeited if worst-case damages are incurred.

This market-based approach is designed to resolve a specific problem in environmental quality: reducing potential damages under conditions of uncertainty. In the context of agricultural nonpoint source pollution, assurance bonds can facilitate internalization of costs in several ways. First, the farmer is responsible for choosing and implementing agricultural practices that reduce water quality damages, providing flexibility to encourage innovation by the farmer. Second, the farmer is responsible for demonstrating the water quality damages did not occur. Thus, public monitoring and enforcement costs could be less than under traditional approaches. Third, interest from the bond pool could also generate additional monies for water quality protection. The most striking feature of the approach is the incentive it offers both public and private entities to improve the data on the environmental costs of economic activity.[120]

Implementation Issues

An assurance bonding requirement would be administered by an appropriate public agency. State water quality regulatory agencies could act as the bonding agency. Several conditions could give rise to the utility of an assurance bonding approach: uncertainty over availability of control technologies and methods; uncertainty over water quality benefits derived from control efforts; and uncertainty over relative contributions from different sources. Several types of activities fulfill one or more of these criteria, including nonpoint source discharges of conventional and unconventional pollutants from agricultural, silvicultural, mining, and development activities.

To determine the value of the assurance bonds, the bonding agency would base its decision on existing scientific information reflecting the monetary value of either repairing and rehabilitating the worst-case environmental damage or providing an alternative to normal services, such as drinking water. The bonds would be required to be purchased annually for a continuous discharge, and the value of the bond could change to reflect changes in potential damages, repair costs, or inflation. The bonds would be held for a specified period that reflected the anticipated lag time in the expression of potential damage.

Impacts

Potential benefits of an assurance bonding approach include giving dischargers an incentive to minimize discharges and flexibility to determine the most efficient means and levels of control, while giving environmental agencies sufficient funds to clean up damage resulting from any discharges.

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[120] Costanza, Robert, and Charles Perrings. "A Flexible Assurance Bonding System for Improved Environmental Management." *Ecological Economics*. v. 2, 1990. p. 69.

A number of potential drawbacks also exist.[121] First, setting the value of the bond, even with the benefit of scientific information, would essentially be a subjective decision dependent on numerous assumptions. The bonding agency could be subjected to political pressures or legal challenge to its actions, thus requiring extensive administrative expense and documentation.

Scientific uncertainty that could be expected in many cases creates an additional problem because there must be legal justification for withholding all or part of the bond.

Second, because it is based on the cost of remediation or replacement, the value of the assurance bond would not necessarily capture the social cost of *permanent* environmental damage. Basing the value of the bond on some measure of the value of environmental damages poses numerous methodological problems.

Third, an additional cost of the assurance bond is the opportunity cost of the capital tied up in the bond. This might be unaffordable for all but the largest farmers.

Investment Tax Credits for Recycling

Historically, tax credits have been used in a variety of areas to encourage certain types of investment. Federal, State, or local governments could offer investment tax credits for the purchase of recycling equipment. Such credits would encourage increased private capital investment in recycling. Firms would be more likely to make capital investments in recycling because the tax credit would effectively reduce the cost of purchasing new recycling equipment.

Background

A bill that would provide a 25 percent investment tax credit for the purchase of recycling equipment was introduced in the First Session of the 103rd Congress. The tax credit would allow businesses that purchase recycling equipment to deduct 25 percent of the cost from their total tax liability. Recycling equipment is defined in the Internal Revenue Code of 1986 as any equipment used exclusively to sort and prepare solid waste for recycling or in the recycling of solid waste.[122] The tax credit would also be available for equipment used in processing some virgin material, as long as the virgin material is less than 10 percent of the total material processed by the equipment. Finally, the credit would be allowed for equipment used in the conversion of solid waste into fuel or energy.

Implementation Issues

If firms took advantage of the tax credit and purchased more recycling equipment, recycling capacity would increase, causing an increase in the demand for recyclable materials (e.g., old newspaper, glass bottles, aluminum and steel cans, and plastic milk and soda bottles). The impact of increased demand on prices would depend on whether current demand for recyclable materials exceeds supply. For example, currently more old newspaper is collected

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[121] U.S. Environmental Protection Agency. "Assurance Bonding for Nonpoint Source Control." *Potential Market Force Mechanisms to Help Achieve Clean Water*. Mar. 6, 1991. pp. 3-5.

[122] 26 CFR 48(l)(2)(A)(iv)

than paper mills can process because mills do not have enough newspaper deinking machinery. Paper mills could use the tax credit to purchase enough deinking equipment to match the current old newspaper supply, causing prices for old newspaper to rise. Alternatively, the market for high quality glass cullet[123] is very strong. High quality cullet can be substituted for other raw materials in the glass manufacturing process, and recycled glass is produced in the same furnaces in which virgin glass is made. Recyclers could invest in sorting equipment to produce high quality cullet and increase the supply of cullet, causing prices to fall.

Any increase in the price of recyclable materials could be offset by increased collection to keep pace with increased demand. The tax credit could be repealed when enough investment has taken place to equalize the demand and supply of recyclable materials and when relative prices of virgin and recycled materials have stabilized.

Allowing the tax credit for equipment used in converting solid waste to fuel or energy would likely cause increased capital investment for incineration plants. Although incineration reduces the quantity of waste landfilled it also reduces the amount of recycling. If the investment tax credit is used primarily for incineration equipment, the legislation could reduce the amount of waste landfilled and recycled. The types of equipment eligible for the tax credit would need to be carefully defined to meet the goals of the legislation.

A tax credit is easy to administer because it is virtually self-implementing. However, one drawback is that it could be costly in terms of lost tax revenue. In addition, the total cost of the program cannot be determined in advance, but depends on how many businesses purchase new recycling equipment. As with any tax incentive, enforcement would rely on periodic audits by Internal Revenue Service personnel to ensure that the credit is only applied to equipment that meets the eligibility requirements.

Impacts

If prices for recyclable materials increased as a result of a recycling equipment tax credit, municipalities would benefit because waste disposal and recycling services are typically provided by local governments. Municipalities often run recycling collection programs at a financial loss because in some areas the cost of collecting used materials is higher than the revenues that municipalities receive from the sale of the recyclables. Municipalities that currently offer only waste disposal services to their residents might begin to provide recycling services if the proceeds from the sale of recyclable materials could be used to offset the costs of collection or to make the collection of recyclables profitable.

Businesses likely to benefit from an investment tax credit are those that are already in the recycling industry and are able to expand by purchasing new equipment or virgin producers who can change their method of production (e.g., by adding deinking equipment). The tax credit may not provide enough of an incentive for many new businesses to enter the recycling industry, especially because startup businesses often show income losses in early years and would not benefit from the tax credit because they would not have any tax liability. The tax credit also would not provide any benefit to businesses for investments in recycling equipment prior to the

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[123] The small pieces of broken glass used to make new glass is called glass cullet. The most valuable cullet is sorted by color and contains few contaminants such as glass of another color, or ceramics.

effective date of the credit. This puts existing firms that have made recycling investments at a disadvantage relative to new firms or existing firms that could use the tax credit to expand. If few new business take advantage of the tax credit, its impact would be to subsidize investments that would have been made even in the absence of the credit.

Other Tax Credits for Recycling

In addition to investment tax credits which are meant to spur long term investment, there are other types of tax credits that have different goals. Tax credits can be developed to favor the purchase of certain raw materials over others. Governments that want to encourage the use of recycled products could provide a tax credit applied to the value of recycled products purchased.

Background

A tax credit bill introduced in the 102nd Congress would have amended the Internal Revenue Code of 1986 to allow newspapers a credit against income tax for using recycled newsprint. Newspapers would have been allowed a 15 percent tax credit on the amount paid for recycled newsprint during 1991 and 1992. The credit would have dropped to 10 percent in 1993 and 1994, and 5 percent in 1995 and 1996. The credit would have been phased-out completely in 1997.

Implementation Issues

The rationale for this policy is that publishers are reluctant to use recycled newsprint because of perceived differences in price, availability, or quality compared to virgin newsprint. A tax credit for the purchase of recycled newsprint makes recycled newsprint less expensive relative to virgin newsprint, encouraging newspaper publishers to purchase more recycled newsprint. When large newspaper purchasers begin to purchase recycled newsprint, they enhance the market for recycled newsprint by generating greater demand. As long as mills continue to increase capacity for deinking old newspaper, the increased demand for old newspapers would lead to increased newspaper collection and recycling. If the supply expansion were sufficient, it would further drive down prices for recycled newsprint relative to virgin newsprint. Eventually, the price differential would reach an optimal level, and the tax credit would no longer be necessary.

Some paper mills have lower costs for producing recycled newsprint because they are located closer to the supply of old newspaper and do not incur high shipping costs to receive recyclable materials. These mills are able to sell recycled newsprint at lower prices than mills located farther from sources of old newspaper. For example, some Canadian mills incur higher costs because they purchase old newspaper from the United States then produce recycled newsprint and ship it back to the United States for use by newspaper publishers. A tax credit that is fixed nationally does not account for geographical differences in prices. Therefore, the effectiveness of the tax credit may depend on underlying regional price differences that are unrelated to the change in tax policy.

Administration of this type of tax credit requires strict recordkeeping by newspaper publishers and newsprint producers and manufacturers. Because there is no other way to track sales of recycled newsprint, publishers would need to save newsprint order receipts and newsprint producers and manufacturers would have to record sales transactions to newspapers.

Another aspect of implementing this tax credit is ensuring that the paper purchased meets the eligibility requirements. The proposal requires that newsprint contain at least 40 percent recovered fiber in order to qualify for the tax credit. Because it is impossible to determine the recovered fiber content of paper by inspecting the finished product, enforcement would depend on mill certification as to the recycled content of its products, and inspection of the mill's records. Similar requirements already exist for certifying the recycled content of paper purchased by the Federal government. In addition, the number of paper mills in North America is relatively small, making such inspections feasible.

Impacts

This type of proposal would be beneficial in the short run to some participants in the recycling loop. Collectors could receive higher prices for old newspaper. In addition, mills that produce recycled paper could experience increased sales. Alternatively, producers of virgin newsprint could experience a decline in sales.

Whether newspaper publishers would be better off depends on the current price difference between virgin and recycled newsprint and how prices change in the next five years. The price of recycled newsprint is currently comparable to the price of virgin newsprint, therefore, newspaper publishers would gain from the tax credit. Because the percentage of the tax credit decreases before being phased-out completely, the incentive will become less effective in later years. Currently, 28 States require newspaper publishers to use recycled newsprint. In these States, publishers benefit from the tax credit regardless of the relative prices of virgin and recycled newsprint. However, the tax credit has little incentive effect in these States, it merely rewards publishers for complying with State law.

Virgin Materials Tax

Virgin materials taxes are used to raise the cost of producing or importing virgin materials. These taxes aim to make recycled materials more competitive with virgin materials or even less costly than virgin materials, thus reducing the use of the taxed virgin material.

Background

One bill introduced in the 102nd Congress would have imposed a 4 percent tax on the price of any paper product sold by a manufacturer, producer, or importer that did not meet minimum recycled content standards. The minimum recycled content standards would have become more stringent over time, requiring manufacturers to increase their use of recycled fibers each year to avoid the tax.

Implementation Issues

The tax would be paid by wholesalers and retailers when they purchase paper products that do not contain the specified amount of recovered material. The increased cost of these materials would be passed on to consumers, thus reducing demand for non-recycled paper products. Producers, manufacturers, and importers would experience reduced sales of paper products with high virgin content, and would be pressured to switch to production processes that incorporate higher percentages of recovered materials.

The virgin material tax on paper products is likely to cause some substitution away from paper products to glass or plastic alternatives. While it would be difficult to substitute another product for printing and writing paper, it is possible to substitute alternatives for paper packaging such as plastic milk containers instead of paper, and plastic shrink wrap instead of cardboard boxes. Because plastics are typically lighter and less bulky than the paper products they replace, the tax could decrease the amount of waste disposed. For products where substitution is unlikely, consumers may seek to reduce the amount of the product used. For example, organizations might try to use electronic mail or use more double-sided copying to reduce their use of printing and writing paper.

Because the tax is based on paper sales prices, some consumers will shift to less costly paper products where the total amount of the tax imposed is lower. This does not, however, change the amount of waste generated. A tax based on total paper weight or volume would provide a more effective incentive to reduce waste.

The tax could be difficult to administer because of the large number of domestic producers and manufacturers of paper products. Each producer and manufacturer would need to be able to verify the recycled content of their products as well as the post-mill, deinked, and post-consumer waste contents. In addition, each producer and manufacturer would have to track the amount of taxable products sold in the United States. Producers and manufacturers would probably be responsible for reporting such amounts and paying the proper tax. Enforcement would rely on audits performed by Internal Revenue Service personnel to determine if the proper amount of products sold was reported. In addition, it is difficult to verify recycled content of paper products based on an inspection of a paper manufacturing site.

Applying the virgin material tax to imported products increases administrative complexity. Foreign manufacturers would have to know the recycled content of their paper products and the amounts exported to the United States. Inspections of foreign plants to verify recycled content claims could not be easily conducted. Applying the tax would be especially difficult for foreign non-paper products that are shipped in paper packaging such as corrugated cardboard boxes. Although the importer would be importing the product contained in the box, it would have to know the recycled content of the box itself or pay the tax on the price of the box.

Impacts

In general, manufacturers of products using virgin materials are made worse off by this legislation and manufacturers of products that substitute for virgin materials are made better off. Where recycled paper products are competitive with virgin counterparts, the tax would increase the demand for recovered paper, driving up the prices paid to collectors for used paper. Because municipalities often provide community collection services for recovered material, they would benefit from higher prices paid. Municipalities are likely to expand recycling programs in response to higher prices.

Unit Pricing

Many local governments have instituted policies that provide individual households with incentives for reducing waste generated and increasing recycling. These policies ensure that waste disposal charges reflect the actual cost of disposal. Typically, households are charged a fixed fee for solid waste collection, or an unknown portion of general revenues are used to pay for waste disposal. Neither of these methods of paying for solid waste management allows waste

generators to understand the impact of their behavior on waste management costs. Unit pricing is a method of pricing waste disposal services based on the amount of waste discarded.

Background

Some municipalities sell specially-marked garbage bags in local stores at a price that includes the cost of waste disposal. Only garbage placed in these bags is picked up by the municipality. Other communities sell stickers that must be placed on existing garbage cans or bags before waste is picked up. Seattle has a unit pricing system that has been operating since the late 1970s where residents purchase subscriptions for a certain level of service (e.g., one, two, or three cans per week) and pay higher fees for higher levels of service. As a result of recent increases in these rates, the utility reports that citizens became aware of the cost of solid waste disposal for the first time. As rates increased, the utility reported that it was overwhelmed by calls from customers wanting to reduce their subscription level.[124] Thus, higher prices and rates that vary with the amount of waste generated appear to have reduced waste generation and increased recycling. Seattle officials view these incentives as an integral part of reaching the city's ambitious goal of 60% recycling.

Implementation Issues

Unit pricing can provide a strong incentive for households to recycle. Some communities report that participation in recycling programs doubled after a unit pricing system was implemented.[125] This effect may be stronger in communities where recyclable materials are picked up at no charge or at a price substantially lower than the per bag fee. Unit pricing may also encourage households to reduce the amount of waste they generate by composting yard and food waste; by purchasing products with less packaging; by purchasing non-disposable items; or by using items more times before disposal.

A unit pricing system could have some additional unexpected effects. First, it could lead to increased illegal disposal. Those trying to avoid paying disposal fees could illegally burn their trash, dump it on others' property, or transport it to other communities where stickers are not required. It is very difficult to identify and prosecute perpetrators of illegal disposal. In addition, volume-based unit pricing may not reduce the total weight of garbage disposed if households merely compact their usual amount of trash and place it in fewer bags.

Administrative complexity of a unit pricing plan is highly variable depending on how the program is designed. Designing a billing system that accounts for the number of bags disposed could be complex. Municipalities can avoid billing if they use local stores to sell bags or stickers. Municipalities would still need an accounting system for tracking the number of stickers or bags sold and the amount of money received. The inclusion of apartments in the unit pricing system would also add to administrative complexity because there is no way to monitor how much trash each individual apartment places in a common dumpster.

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[124] Gale, Diana H. *Seattle: A Case Study in System Planning.* Resource Recovery. December 1988. p. 31.

[125] Robert Bracken, *North Carolina County Institutes Sticker System,* BioCycle, February 1992, p. 37.

Impacts

Individuals who recycle and minimize waste generation benefit from a unit-pricing scheme. Large families and households that generate large quantities of waste are likely to pay higher waste disposal fees with a unit pricing system than they would with a fixed waste disposal fee.

Deposit/Refund for Batteries and Other Hazardous Substances

Requiring refundable deposits on the purchase of certain products would encourage consumers to return the products for refund of the deposit, and proper disposal. Deposit/refund systems are most appropriate for small consumer items that are often illegally discarded such as batteries, but variants of the system have also been suggested for small quantity hazardous wastes, such as solvents. In the latter case, the purpose of the system would be to reverse the incentives for midnight dumping that are a side effect of the increasing cost of legal disposal, ease the task of monitoring and enforcement, return valuable materials to manufacturers for recycling, provide incentives to recapture losses from production processes, and encourage the substitution of less hazardous materials.

Background

The RCRA reauthorization bill reported by the Senate Committee on Environment and Public Works in the 102nd Congress included a provision that would require retail sellers of lead acid batteries to collect a deposit of at least $10 on the sale of any new lead acid battery not accompanied by the return of a used lead acid battery. A similar provision is contained in S.729, the Lead Exposure Reduction Act, reported by the same committee in the 103rd Congress. Consumers who have paid a deposit may receive a refund equal to the amount of the deposit paid when they return a used lead acid battery of the same type as the battery purchased within 21 days of sale. The proposal would require that any retailer that sells lead acid batteries also accept them in return. Any unclaimed deposits become the property of the retailers.

Implementation Issues

The most difficult aspect of implementing a deposit/refund system is ensuring that refunds are only given to those that have paid deposits. Regulations implementing such a system could require that retailers provide a receipt for any deposit paid and that the receipt be presented when a battery is returned and a refund is requested.

Several problems would arise if the law did not require a receipt proving that a deposit was paid in order to receive a refund. First, anyone possessing old lead acid batteries on the effective date of the law could bring them to any retailer and demand a refund. More refunds would be requested than deposits paid, causing a financial loss for retailers. There would also be an incentive to import used lead acid batteries from other countries if the $10 refund would cover transportation costs and allow the importer to receive a profit. Lack of a receipt requirement would also encourage battery theft. Because lead acid batteries are easily removed from automobiles, thieves could steal the batteries and return them for a $10 refund.

Individual battery retailers could experience cashflow problems if there were no requirement that refunds be collected from the same retailer to which the deposit was paid. At establishments where the retailer installs a new battery and recovers the old battery, no deposit would be required. However, when a do-it-yourselfer purchases a lead acid battery from one

retailer and returns it to another, some retailers could end up paying out more in refunds than they accepted in deposits.

A battery deposit/refund system is self-implementing. Retailers have an incentive to take deposits when batteries are purchased because they are entitled to keep any unclaimed deposits. Once the deposit has been paid, the consumer has an incentive to return a used lead acid battery to receive a refund. Retailers are likely to recycle the batteries received because the lead contained in used lead acid batteries is typically sold at a price that is high enough to compensate battery handlers for the cost of shipping used lead acid batteries to recyclers.

Strict recordkeeping by retailers, manufacturers and recyclers would be required for enforcement. Each party would have to document the amount of deposits received, refunds disbursed, and lead acid batteries recycled.

Impacts

A deposit/refund system for lead acid batteries would result in a greater number of batteries being collected, and an increase in the supply of old lead. Secondary lead smelters would be able to purchase old lead at lower prices. The price of recycled lead would drop relative to virgin lead. A deposit/refund system would, therefore, have a positive impact on the secondary lead smelting industry and a negative impact on the primary lead smelting industry.

Other Deposit Refund Systems

Lubricating Oil. Improper disposal of used motor oil is considered an important nonpoint source of pollution by EPA, with a large share coming from do-it-yourselfers. Deposits on each quart of oil sold and refunds for return of used oil have been examined as a way to reduce improper disposal.[126] Most of the proposals include a deposit at the time of sale or return of equal amounts of used oil. Proof of purchase would be required for any refunds for returning used oil without buying new oil.

Analysts point out two difficulties in using deposit-refund in this context. First, counterfeit product (stolen or otherwise) could be introduced. The second problem is the effect of fluctuating oil prices on the incentive for used oil recycling. Below a certain oil price, recyclers charge for pickup from service stations, so that there is little incentive to collect oil from do-it-yourselfers.[127] Thus, regulatory actions would still be needed to assure proper final disposal of used oil under conditions of fluctuating oil prices.

Industrial Solvents. Some have suggested that industry generates sufficient amounts of hazardous waste in small enough quantities to warrant consideration for a deposit-refund system.[128] As proposed, this system would deal with the approximately 15% of industrial hazardous wastes that are potentially containerizable and recyclable. Deposits paid to distributors would be recovered when the spent chemical was returned to designated recycling

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[126] Anderson, p. 45

[127] Anderson, p.5

[128] Stavins, p. 64

facilities. If the material has recovery value, an additional payment to users would be made by recyclers.

In addition to the problem of counterfeit product, qualitative differences in the solvent content would require extensive testing of returned-product in order for a deposit-refund system to work.