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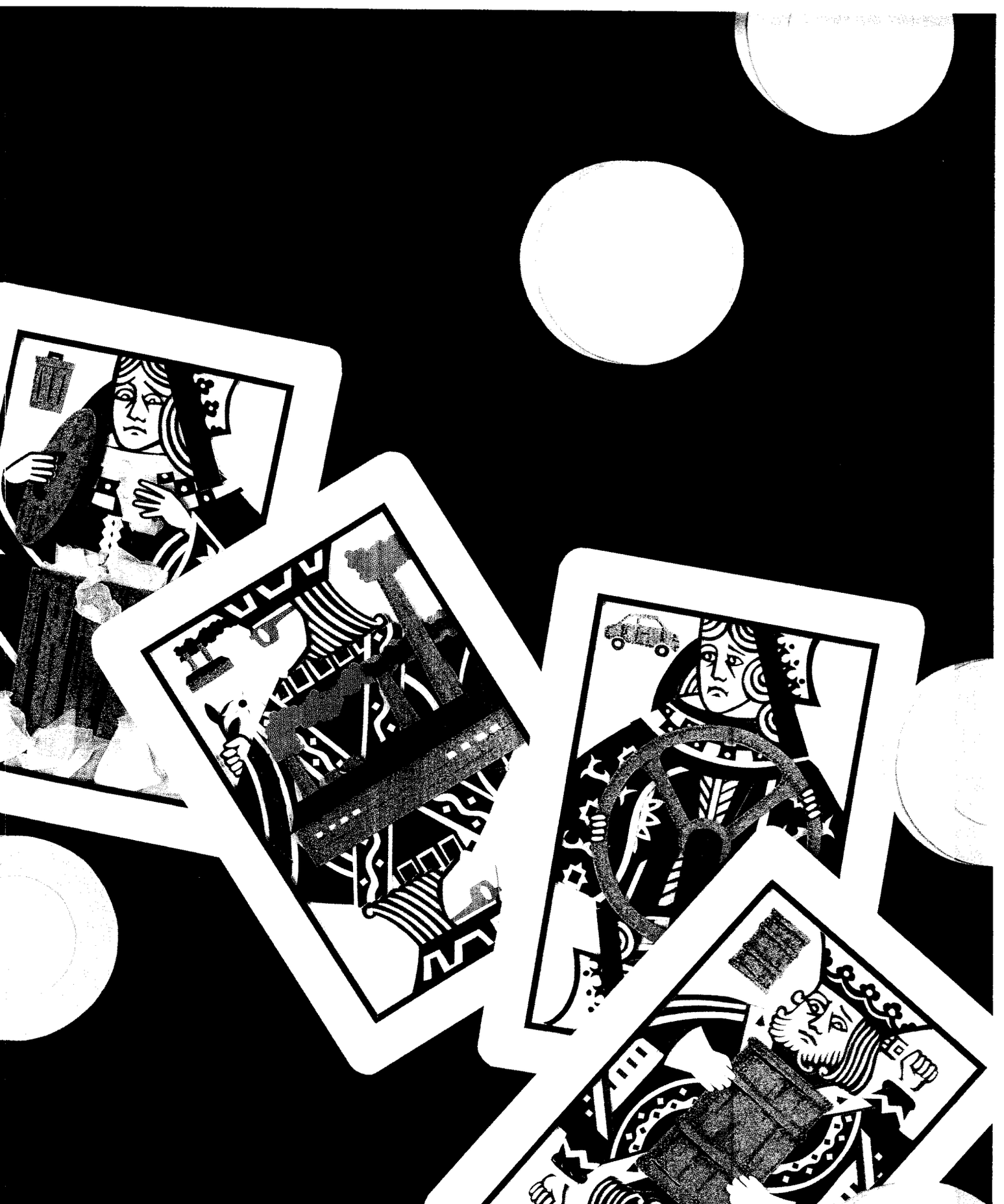

DEALING WITH POLLUTION

MARKET-BASED INCENTIVES FOR ENVIRONMENTAL PROTECTION

by Robert N. Stavins and Bradley W. Whitehead

As the United States prepares to address the environmental challenges of the 1990s, it faces an economic and political context fundamentally different from that of the 1970s, when the first environmental measures were enacted. More than a decade of large budget deficits, sluggish productivity growth, and intensified foreign competition has spurred interest in environmental approaches that lower compliance and administrative burdens for industry and government. Public restiveness over the size of government expenditures also has heightened interest in environmental approaches that require less bureaucracy and governmental intrusion into business and household decisions. These forces for change have led to a quest for innovative environmental policy instruments.

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New Challenges for Environmental Policy

Many environmentalists in the 1970s and early 1980s viewed the market as villainous because it drove businesses to pursue profits without regard for environmental consequences. According to this view, the government should make decisions concerning appropriate technologies and emissions levels in light of the "externalities"—social costs created by businesses but borne by others in society—that the business world ignores. Furthermore, the government should not merely specify policy goals but also intervene in decisions about the production process itself. The explicit goal of some legislation during this period was to maximize the benefits of environmental protection regardless of the costs. Indeed, some statutes and regulations explicitly forbade the consideration of costs in setting standards. For example, when the ambient standards for criteria air pollutants are set under the Clean Air Act, the costs of meeting the standards may not, according to law, be taken into consideration.

This philosophy has driven much of the environmental progress over the last two decades, and in many places, the environment is cleaner

now than it was before. But the United States and the world continue to face major environmental challenges, including such ongoing problems as urban smog, groundwater pollution, and acid rain and other, newly recognized problems, such as global climate change and indoor air pollution. Moreover, the economic and political contexts in which environmental policy is formulated have changed significantly. The challenge for policymakers today is to devise policies that harness rather than obstruct market forces.

The Need for Cost-Effectiveness

The days have ended when the United States could afford to consider environmental protection in isolation from costs. The U.S. Environmental Protection Agency (EPA) estimates that the nation now spends more than $100 billion annually to comply with federal environmental laws and regulations,[1] and there is heightened concern over the impact of these regulations on the strength of the economy and its ability to compete in international markets.[2] As a result, policymakers are increasingly cautious about the degree and type of regulatory burdens placed on businesses and individuals.

The existence of federal, state, and local budget deficits makes it difficult for the United States to increase environmental protection simply by spending more money on programs and policies already in place.[3] A new sensitivity to private costs exists, as well. U.S. citizens and policymakers have not lost sight of the benefits of environmental protection, but they are giving increased attention to cost-effective environmental policies. To some people, the concern over cost-effectiveness means getting more environmental protection for the same level of expenditures; to others, it means getting the same level of protection for less money. To both, however, it means making the most of scarce resources and maximizing returns on the resources invested—business costs, regulatory effort, political capital, and taxes—to improve the quality of the environment.

Harness Market Forces

An indicator of the presence of such concerns was the adoption of a market-based approach to the control of acid rain in the 1990 Clean Air Act Amendments—tradable "pollution reduction credits." The adoption of this approach suggests that some political leaders recognize that market forces are not only part of the problem but also a potential part of the solution. By dictating behavior and removing profit opportunities, past environmental regulation has placed unnecessary burdens on the economy and stifled the development of new, more effective environmental technologies. Furthermore, such policies have helped engender an adversarial relationship among regulators, environmentalists, and private industry. As a result, excessive economic resources often have been used for litigation and other forms of conflict among concerned parties.

Policies are needed to mobilize and harness the power of market forces for the environment and to make economic and environmental interests compatible and mutually supportive.[4] Policymakers must begin to link the twin forces of government and industry, without extravagant investment.

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Policies for Environmental Protection

There are two steps to formulating environmental policy: choosing the overall goal and selecting a means to achieve that goal.[5] Market-based environmental policies that focus on the means of achieving policy goals are largely neutral with respect to the selected goals and provide cost-effective methods for reaching those goals. Before investigating market incentives, in general, and pollution charges, in particular, it is useful to review the regulatory approach most frequently used—command-and-control.

Command-and-Control Regulatory Approaches

Command-and-control regulations tend to force all businesses to adopt the same measures and practices for pollution control and thus shoulder identical shares of the pollution control burden regardless of their relative impacts. Government regulations typically set uniform standards—mostly technology- or performance-based—for all businesses. As the name suggests, technology-based standards specify the method and, sometimes, the equipment that businesses must use to comply with a regulation. Usually, regulations do not specify the technology but establish standards on the basis of a particular technology. In situations where monitoring problems are particularly severe, however, technologies are specified. For instance, all businesses in an industry are sometimes required to use the "best available technology" to control water pollution, or, in a more extreme example, electric utilities may be required to utilize a specific technology, such as electrostatic precipitators, to remove particulates. Performance standards, on the other hand, set a uniform control target for each business but allow some latitude in how to meet it. Such a standard might set the maximum allowable

units of pollutant per time period but remain neutral with respect to the means by which each business reaches the goal.

Holding all businesses under the same target can be both expensive and counterproductive. Although uniform standards can sometimes be effective in limiting emissions of pollutants, they typically do so at relatively high costs to society. Specifically, uniform standards can force some businesses to use unduly expensive means of controlling pollution because the costs of controlling emissions can vary greatly between and even within businesses, and the right technology in one situation may be wrong in another. For example, in a survey of eight empirical studies of air-pollution control, the ratio of actual, aggregate costs of the conventional, command-and-control approach to the aggregate costs of least-cost benchmarks ranged from 1.07 for sulfate emissions in Los Angeles, California, to 22.0 for hydrocarbon emissions at all U.S. Du Pont plants.[6] Indeed, the cost of controlling a given pollutant may vary by a factor of 100 or more among sources, depending upon the age and location of plants and the available technologies.[7]

The command-and-control approach also tends to freeze the development of technologies that could provide greater levels of control. Little or no financial incentive exists for businesses to exceed their control targets, and both types of standards contain a bias against experimentation with new technologies. A business's reward for trying a new technology may be that it will subsequently be held to a higher standard of performance, without significant opportunity to benefit financially from its investment. As a result, money that could be invested in technology development is diverted to legal battles over defining acceptable technologies and standards of performance.

Market-Based Policies

Unlike command-and-control policies, which seek to regulate the individual polluter, market-based policies train their sights on the overall pollution in a given area. What is important to most people, after all, is not how many particulates the local widget factory emits but the quality of the air they breathe while walking downtown or sitting in their back yards. Thus, under a market-based approach, the government establishes financial incentives so that the costs imposed on businesses drive an entire industry or region to reduce its aggregate level of pollution to a desired level. Then, as in any regulatory system, the government monitors and enforces compliance.

In terms of policy, a market-based approach achieves the same aggregate level of control as might be set under a command-and-control approach, but it permits the burden of pollution control to be shared more efficiently among businesses. In economic terms, market-based policies equalize the level of marginal costs of control among businesses rather than the level of control. (The marginal costs of pollution control are the additional or incremental costs of achieving an additional unit of pollution reduction.) As a result, market-based policies provide a monetary incentive for the greatest reductions in pollution by the businesses that can do so most cheaply. The result is that fewer total economic resources are used to achieve the same level of pollution control, or more pollution control is obtained for the same level of resources.

Theoretically, the government could achieve such a cost-effective solution by setting different standards for each business and equating the marginal costs of control. However, such a task requires detailed information about the costs each company faces —information that the government clearly lacks and could obtain only at great cost, if at all. Market-based policies provide a way out of this impasse because they lead directly to the cost-effective allocation of the pollution control burden among businesses. By forcing businesses to factor environmental costs into their decision-making, market-based policies create powerful incentives for firms to find cleaner production technologies.

Market-based incentives also clarify the environmental debate for the general public because they focus on environmental goals rather than on the difficult technical problems of

reaching those goals.[8] One of the reasons market-based systems are not more widely used, however, is that many technical experts have sought to retain the complexity and exclude the public from such debates.

Market-based incentive systems do not represent a laissez-faire, free-market approach. Rather, the inability of a system of private markets to provide certain goods and services at the most desirable level is typically at the core of pollution problems in which the decisions of businesses and consumers do not take into account the consequences of their decisions for society. At the same time, an incentive-based policy rejects the notion that such market failures justify abandoning the market and allowing the government to dictate the behavior of businesses or consumers. Instead, market-based incentives provide freedom of choice for businesses and consumers to determine the best way to reduce pollution. By ensuring that environmental costs are factored into each company's or individual's decisionmaking process, incentive-based policies harness rather than impede market forces and channel them to achieve environmental goals at the lowest possible cost to society.

At the broadest level, market-based incentive systems fall into four categories:

- *Pollution charges*. Under this approach, polluters are charged a fee on the amount of pollution they generate.[9] In one category of pollution charges, called deposit-refund systems, all or part of some initial charge is rebated if the individual performs certain actions.
- *Tradable permit systems*. Under this mechanism, which was used in the 1990 Clean Air Act Amendments for acid rain control, the government establishes an overall level of allowable air pollution and then allocates permits to businesses in the relevant geographic area so that each is allowed to emit some fraction of the overall total.[10] Companies that keep their emissions below the allocated level may sell or lease their surplus permits to other firms or use them to offset excess emissions in other parts of their own facilities.

POLLUTION CHARGES AND TRADABLE PERMITS

Although the U.S. government has recently expressed great enthusiasm for tradable-permit systems, neither permits nor pollution charges—or any other incentive-based or command-and-control system—can be a panacea for all environmental problems. Therefore, it is important, to compare tradable permits with pollution charges to highlight the circumstances under which each is likely to be the most appropriate solution.

- *Permits set the level of control, but charges establish the marginal costs of control.* Through the issuance of permits, policymakers can determine total pollution levels, but they cannot set bounds on pollution control spending. Thus, permits could help solve environmental problems in which human health or other concerns are thought to rise precipitously once pollution exceeds a certain level and assist when marginal costs of control do not rise dramatically with increasing regulation. Pollution charges, on the other hand, control the maximum amount that a business may pay for its emissions but do not specify how much control will actually occur. Such an approach may be more appropriate when the margin of error on environmental damage is not high but the potential impacts on industry of too much control are especially great. For example, small increases in control costs could lead to large changes in production.
- *In the presence of technological change, permits freeze the level of control but charges increase it over time.* Under a tradable-permit system, technological improvements will normally cause control costs and permit prices to drop rather than cause a decline in emission levels. Under a pollution-charge system, however, new technology will lead to both lower total control costs and reductions in pollution. Thus, as technological change lowers the costs of controlling emissions, businesses will choose to control more emissions and pay less taxes. This trend can be offset to some degree by expanded production that results from lower total operating costs.
- *Under a permit system, payments are handled within the private sector, but such transactions involve the government with pollution charges.* Under permit trading, businesses that emit pollution beyond their permitted level must make payments to other businesses that agree to control more than their share. Under a system of pollution charges, however, payments for uncontrolled emissions are collected by the government. If the private sector can utilize the payments more effectively than government, a permit system would be advantageous over pollution charges. On the other hand, the government can earmark the revenue from pollution charges for environmental investments, deficit reduction, or reductions in distortionary taxes.
- *Both pollution charges and tradable permits impose costs on industry and consumers, but charges make the costs more explicit.* Both pollution charges and tradable permits force businesses to internalize the costs of polluting and, hence, spend more money on the environment, either by buying pollution control equipment or by making cash payments for permits or pollution charges. A pollution-charge system, however, publicizes these costs. Although doing so may be politically problematic in the short term, eventually, the public is educated about the costs and tradeoffs associated with various levels of environmental control.
- *Permits adjust automatically for inflation, but pollution charges do not.* Under a permit system, which deals in emission rights, levels of emission control are unaffected by price changes in the overall economy. Under a system of pollution charges, however, general price inflation will reduce taxes, which are expressed in dollars per ton, for example. Thus, in an inflationary economy, businesses will control pollution less. However, a remedy would be to link the charge rate to a price index.
- *Transaction costs can be important because they depend partly upon the number of businesses in the market.* Transaction costs, such as the costs associated with identifying will-

• *Removal of market barriers.* In some cases, substantial gains can be made in environmental protection by removing existing government-mandated barriers to market activity. For example, measures that facilitate the voluntary exchange of water rights can promote more efficient allocation and use of scarce water supplies while curbing the need for expensive and environmentally disruptive new water-supply projects.[11]

• *Eliminating government subsidies.* Many existing subsidies promote economically inefficient and environmentally unsound development. For example, the U.S. Forest Service subsidizes below-cost timber sales, which recover less money than is spent on making timber available.[12] These subsidies encourage excessive timber cutting, which leads to habitat loss and damage to watersheds.

Different mechanisms will be appropriate for different environmental problems, and no single approach is a panacea for all problems. Neither market-based policies nor conventional, command-and-control regulations hold all the answers. Furthermore, when market-based approaches are appropriate, specific circumstances will dictate which of the above categories is best. A discussion of the relative merits of permit policies and pollution charges is provided in the box beginning on page 10.

Market-Based Environmental Policies

The use of market forces to protect the environment is not a new idea. Economists have called for market-based environmental policies for the past 25 years.[13] Only recently, however, has the broader policy community begun to regard market instruments favorably. For instance, both U.S. President Lyndon Johnson's proposal for effluent fees and President Richard Nixon's recommendations for a tax on leaded gasoline and a fee on sulfur dioxide emissions were dismissed with little consideration.

It is important to understand what political forces have prevented broader acceptance of market-based environmental regulation over the years because these forces are likely to resist further use of such approaches beyond the new Clean Air Act Amendments. Four such forces have been most powerful.[14] The first of these forces is the adversarial attitude that characterized the beginning of the environmental movement. Throughout much of the 1960s and 1970s, environmentalists typically characterized pollution more as a moral failing of corporate and political leaders than as a by-product of modern civilization that can be regulated and reduced but not eliminated. Although that characterization may have been necessary and successful from a political standpoint, it resulted in widespread antagonism toward corporations and a suspicion that anything supported by the business world was probably bad for the environment. Thus, for many years, market-based incentives were characterized by environmentalists not only as impractical but also as "licenses to pollute."[15] Over time, environmental groups have frequently applied a different and more rigorous standard in measuring market-based systems against command-and-control policies, possibly because of the belief that market-based systems legitimize pollution by purporting to sell the right to pollute.[16] This suspicion probably continues among many rank-and-file environmentalists.

A second source of resistance to market-based approaches has been the environmental bureaucracy whose work, organizational power, or even existence might be threatened by a market-based approach. Within EPA, for example, market-based policies for controlling acid rain would not require the service of agency engineers whose task in the current policy regime is to evaluate technologies for disparate sources of emissions across the country.[17] Instead, decisions to select particular air-pollution control technologies would be left up to individual firms. In addition, there has been resistance from some staff in environmental agencies who are simply skeptical about new approaches that have not yet been applied on a large scale.

Third, resistance to market-based approaches has come from lobbyists who, having learned to influence a command-and-control regulatory system, are understandably reluctant to allow any major changes in the rules of the game. Thus, some lobbyists for both environmental organizations and the private sector, as well as some legislators, resist market-based approaches in part to protect the value of their expertise. The resistance by some industry lobbyists to putting these ideas into practice is especially

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ing buyers and sellers of permits or the costs of collecting taxes, drive up the total costs of compliance for incentive-based mechanisms and affect the amount of trading that will occur in a permit system and the amount of control a pollution-charge system will achieve.

• *Permit systems may be more susceptible to strategic behavior.* For a permit system to work effectively, relatively competitive conditions must exist in the permit and product market. The degree of market competition will help determine the amount of trading that occurs and cost savings achieved. A company that controls a significant share of the total number of permits may influence permit prices.[1] Businesses might attempt to manipulate permit prices to increase their profits in either the permit or final product market by withholding permits and thus force other firms to cut production or keep from entering the market.

1. It is unlikely that businesses could engage in price-setting behavior if they controlled less than 10 percent of the market. F. M. Scherer, *Industrial Market Structure and Economic Performance* (Chicago: Rand McNally College Publishing Company, 1980). However, if other businesses present credible threats to the market, it is less likely that anticompetitive behavior can thrive. W. J. Baumol, J. Panzer, and R. Willig, *Contestable Markets and the Theory of Industrial Structure* (New York: Harcourt Brace Jovanovich, 1982).

Market-Based Incentives
(continued from page 11)

notable given that the business community has long endorsed the theory of cost-effective, market-oriented approaches to environmental protection.

Finally, market-based approaches—pollution charges in particular—are problematic because they involve new taxes, which have been a controversial and often forbidden subject for much of the last decade. Although "compensating reductions" in other taxes—tax cuts that result in unchanged government revenues—can make pollution charges revenue-neutral and can improve the economic efficiency of the overall tax code, many elected officials are wary of embracing such approaches because voters and pundits might doubt that government would rebate revenues once they have been collected.

Of course, not all resistance to market-based environmental regulation stems from narrow self-interest. Some environmentalists may feel that market-based approaches will make the costs of environmental protection more salient to the public and therefore dampen popular demand for such controls. Similarly, some legislators may believe that the theories justifying pollution charges are too complex to attract broad popular support. Nevertheless, the United States has wasted many years and billions of dollars by moving so slowly to adopt market-based approaches for reasons that have more to do with narrow agendas than with the public interest.

Over the past several years, however, a number of factors have combined to overcome some of the older sources of resistance to market-based incentives for environmental protection,[18] including strong interest within the Executive Office of the President;[19] aggressive participation by some segments of the environmental community, notably the Environmental Defense Fund (EDF);[20] and the December 1988 release of the bipartisan Project 88 report and the follow-up effort two years later by Senator Timothy Wirth (D–Colo.) and the late Senator John Heinz (R–Penn.). (For more information on Project 88, see the January/February 1989 issue of *Environment*.)

Market-based systems are gaining an increasingly broad array of political supporters. In March 1991, EPA administrator William K. Reilly established the Economic Incentives Task Force to identify new areas in which to apply market-based approaches.[21] Congress also shows both increasing interest in and a willingness to debate economic incentives. In fact, the phrase "market-oriented environmental policy" may itself be assuming some political value.

Congressional opportunities for adopting market-based schemes have recently been enhanced by the evolving support of major environmental advocacy organizations. An increasing number of these environmental groups now support market-based reforms. First and foremost, EDF, an early supporter of market-based environmental policies, is an enthusiastic and effective proponent of such ideas. Furthermore, EDF was a major participant in the Project 88 effort, and EDF economist Daniel Dudek worked closely with the Bush administration to develop the Clean Air Act proposal. Other environmental groups, including the Wilderness Society, the National Wildlife Federation, the National Audubon Society, the Sierra Club, and the Natural Resources Defense Council, now support at least selective use of market-based instruments.

The ability of market-based policies to economize scarce resources, combined with a variety of other factors, has brought these policies to center stage in environmental policy debates within Congress. Debate at the federal level has focused mainly on the potential of tradable permits. The most important application to date has been the acid rain provisions of the 1990 amendments to the Clean Air Act.[22] Tradable-permit systems have also been part of other federal environmental policies, including EPA's emissions trading program for local air quality[23] and the nationwide phase out of lead in automotive fuel.[24] Although state impediments and uncertainty about the future course of the emissions trading program have sharply limited trading by firms, the trading that has occurred has saved more than $4 billion with no adverse effect on air quality.[25] According to EPA, the lead program, which has inspired much more trading among firms, reduced overall compliance costs by approximately 20 percent, or about $200 million annually.[26] Tradable-permit systems, including international trading in greenhouse gases, recycling targets combined with tradable permits, and point- and nonpoint-source water pollution control, are now being proposed for a host of environmental problems.[27]

A true pollution charge provides incentives to businesses or consumers to reduce emissions when that action is less expensive than is continuing to pollute.

Although permit systems command the attention of the federal government, state and local governments have expressed interest in other market-based environmental policies. "Bottle bills," a well-known type of deposit-refund system intended to reduce litter and promote recycling,

have been particularly popular. Also, the removal of market barriers to voluntary water transfers has been an increasingly important policy innovation in the western United States. Water transfers alleviate water supply problems and increase efficiency by creating incentives for water conservation. The most notable transfer plan to date is the $223-million agreement signed in 1988 between the Imperial Irrigation District (IID) of California and the Metropolitan Water District (MWD) of Los Angeles.[28] Under the agreement, MWD will finance the improvements of IID's water system in exchange for the use of IID's water stores.[29] Finally, Congress has reduced government subsidies that cause economic distortions and environmental damage, such as the federal subsidies given to the U.S. Army Corps of Engineers's flood-control projects, which provide incentives for individual landowners to convert forested wetlands to croplands.[30]

Not surprisingly, the business community continues to support cost-effective, market-oriented approaches to environmental protection. General Motors, for instance, has endorsed the adoption of a broad-based carbon fee to limit emissions of greenhouse gases.[31] Other major corporations have expressed support for incentives, at least in principle. The net result of this surge of interest in market-based incentives is increased awareness of the many options open to policymakers at both the federal and local levels. Furthermore, the political and bureaucratic sources of opposition to these approaches may be growing weaker.

Unfortunately, a wide range of market-based initiatives has been largely ignored. In particular, the potential of pollution charge systems has received scant attention compared to other market-based instruments, possibly as a result of the same forces that for years impeded adoption of tradable permits and similar approaches, or because the concepts involved are perceived as too complex. In either case, this lack of attention should now be remedied because pollution charges have several distinct advantages over other policy instruments, especially for certain categories of environmental problems.

The Mechanics of Pollution Charges

Pollution charge systems are designed to reduce polluting behavior by imposing a fee or tax on polluters. Ideally, the fee should be based on the amount of pollution generated rather than on the level of pollution-generating activities. For example, an electric utility might be charged a tax per unit of sulfur dioxide emitted rather than per unit of electricity generated. The choice of whether to tax pollution quantities, activities preceding discharge, inputs to those activities, or actual damages depends upon tradeoffs between costs of abatement, mitigation, damages, and program administration, including monitoring and enforcement. In some cases, a fee may be based on the expected or potential quantity of pollution. The Organization for Economic Cooperation and Development distinguishes five types of pollution charges: effluent charges based on the quantity of discharges; user charges, which are payments for public treatment facilities; production charges based on the potential pollution by a product; administrative charges, which are payments for such government services as registration of chemicals; and tax differentiation, which provides more favorable prices for "green" products.[32] A true pollution charge provides incentives to businesses or consumers to reduce emissions when that action is less expensive than is continuing to pollute. Pollution charges can be applied either to producers to affect their production decisions or to consumers to affect their consumption and disposal behavior.

Although pollution poses real costs to society—for example, health effects, property damage, and aesthetic impacts—businesses typically do not have to pay for these damages and, hence, face little or no incentive to take them into account in production decisions. A business that chooses unilaterally to consider such external costs in its production decisions would be penalized by the market, through reduced cost-competitiveness. Pollution charges force businesses to pay for the external costs of pollution and to incorporate those added costs into their daily decisions.

Although pollution charges are cost-effective, cost-effectiveness should not be the only criterion policymakers use to weigh policies.

Pollution charges also provide strong incentives for businesses to develop and adopt improved control technologies. Under a command-and-control system, businesses have no financial incentive to perform better than the regulatory standard demands. Pollution charges, however, do not specify a technology or a fixed standard. Instead, charges are incurred for each increment of pollution rather than only for pollution above a given standard. Thus, businesses are constantly motivated to improve their financial performance by developing technologies that allow them to reduce their output of pollutants.

By charging polluters a fee or tax on the amount of pollution they generate and not on their pollution-generating activities, the government gives businesses an incentive to re-

duce pollution up to the point at which their marginal control costs are equal to their pollution tax rates. As a result, businesses will control their pollution to different degrees, with polluters for whom control is very expensive controlling less and polluters for whom control is relatively cheap controlling more. The challenge for policymakers is to identify the desirable charge level. If the charge is too high, production may be curtailed excessively; if the charge is too low, insufficient environmental protection will result. An effective charge system thus minimizes the aggregate costs of pollution control and enables the public to pursue other environmental quality actions that might have seemed unaffordable under less efficient approaches, such as command-and-control regulations.

U.S. Experience with Pollution Charges

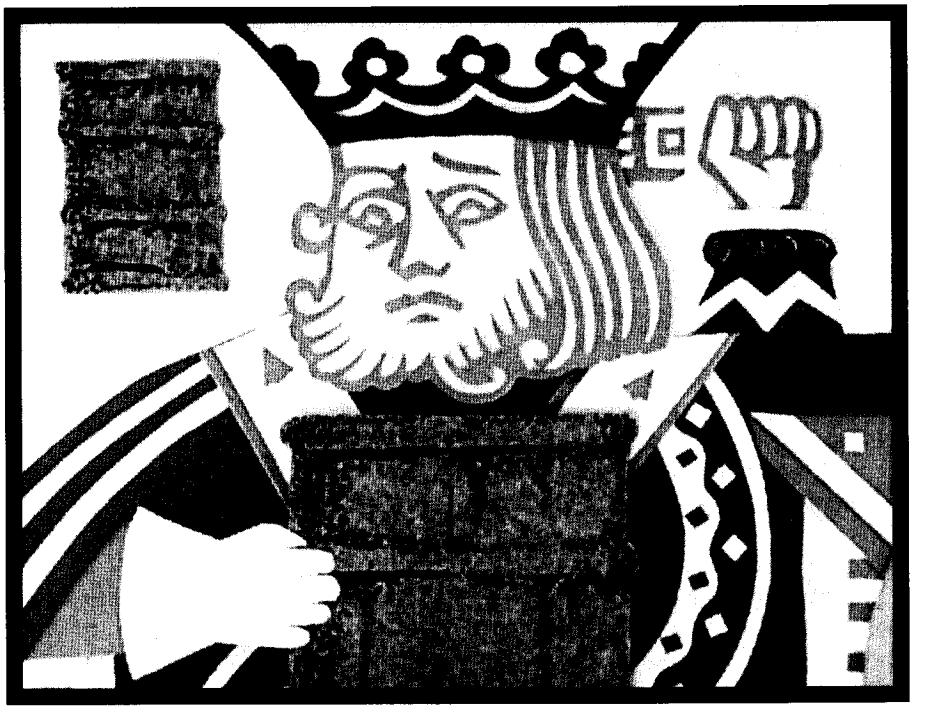
Although a few state and local governments have experimented with pollution charges, the United States does not have much experience with this approach. A few federal policies have embraced some pollution charge characteristics, but these were aimed primarily at generating revenue rather than at discouraging pollution. For example, in 1989, Congress enacted an excise tax on chlorofluorocarbons (CFCs), which deplete stratospheric ozone and are potent greenhouse gases,[33] and, as part of the 1987 Montreal protocol and the subsequent London revisions of 1990, the United States agreed to phase out all CFCs by the year 2000.[34] The primary mechanism for the United States to achieve this goal is a tradable-permit system. The excise tax, which is essentially a charge on the sale of permits, does not materially affect either the level or rate of the CFC phasedown. It simply ensures that the government rather than private industry receives any windfall profits associated with constrained supply of CFCs.[35]

The chemical and petroleum feedstock taxes that finance the cleanup of abandoned hazardous waste sites under the Superfund program of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) are not pollution charges, either. Superfund levies taxes on production, not emissions. As a result, there is no direct link between the environmental controls and the taxes paid and, therefore, no direct incentive for pollution control. Indeed, the Superfund tax was designed to raise revenues, not to act as a market incentive for environmental protection.

The Clean Air Act Amendments of 1990 also charge emissions-based fees to raise revenue, and the level of the charge ($25 per ton of pollutant) is not likely to be sufficient to change producer behavior significantly.[36] In addition, although the act uses charges and other economic incentives to urge polluters into compliance, the rules have yet to be developed or applied.[37] Furthermore, state environmental agencies, faced with general revenue cutbacks, are increasing their reliance on charge systems as a source of dedicated funding.[38] Typically, however, such systems take the form of permit fees that are either uncoupled from levels of emissions or are too small to affect producer behavior. Several European nations, including the United Kingdom, France, the Netherlands, Sweden, Norway, Denmark, Finland, Italy, and West Germany, also have adopted air- and water-pollution charge mechanisms to generate revenues rather than to discourage pollution.[39] One partial exception is the effluent charge law adopted by West Germany in 1976.[40] Under the law, polluters pay a set fee for each increment of emissions of five pollutants. In practice, however, even this charge is not a fully functioning market incentive because it is linked to uniform performance standards, and, as a result, marginal costs of control are not equalized and full cost savings potentials are not realized.[41]

Using Pollution Charge Revenues

The transfer of money from polluters to the government could be substantial. For instance, the Congressional Budget Office estimates that a $100-per-ton charge on carbon dioxide emissions could result in more than $120 billion in annual revenues for the government.[42] This situation



raises the obvious question of how such revenue should be used. There are at least three possible courses of action. First, the funds could be used to reduce the federal budget deficit. This alternative has obvious appeal in times of unprecedented government borrowing.[43]

Second, the tax revenue could finance other programs related to environmental protection, such as programs that clean up or mitigate pollution. Indeed, revenue-raising charge systems have grown from 28 percent of New Jersey's environmental protection expenditures in 1989 to 37 percent in 1991, and the level is expected to reach 55 percent by 1993.[44] Such revenues might also be directed to assist people who are hurt economically by the change to a system of pollution charges. For instance, although pollution charges are cost-effective, cost-effectiveness should not be the only criterion policymakers use to weigh policies. Questions of fairness and equity are also important and often dominate political debate. Most environmental policies, whether command-and-control or market-based, require some tradeoff between efficiency and equity. Even when the aggregate benefits of a policy exceed its aggregate costs, usually some individuals or businesses do not benefit, such as consumers who have to pay higher prices for goods and services, employees who are laid off, or shareholders whose profits erode.

Whether and how to compensate such groups are political questions whose answers depend on the availability of resources. One of the attractions of pollution charges is that they can provide the resources necessary to buffer their own impact on specific groups. For instance, if a pollution charge was used to raise energy prices, it could impose a particular burden on low-income households. However, the revenue from the charge could be used to fund a system of "life-line rates," or free or discounted rates for the first units of energy consumed by a household. Similarly, revenues from a pollution charge that eliminated certain jobs could be used to fund job-search and job-training programs. In addition, revenues from pollution charges might be used to compensate groups deemed to have been unfairly harmed by past environmental policies, such as residents of a neighborhood who were effectively disenfranchised by toxic wastes that were dumped nearby.

Finally, the use of pollution-charge revenues to offset reductions in other taxes may be the most attractive option.[45] Pollution charges are "corrective" taxes that reduce market inefficiencies by discouraging undesirable activities that generate externalities. This effect contrasts sharply with that of "distortionary" taxes, which distort economic behavior by generating market inefficiencies, as in the case of corporate profit taxes, social security and other payroll taxes, and personal income taxes.[46] The corrective nature of pollution charges provides a "double dividend": In addition to providing incentives to reduce pollution, pollution-charge revenues can finance reductions in distortionary taxes.[47] This tradeoff is particularly important in today's political climate, in which policymakers are reluctant to consider any new taxes. A revenue-neutral tax policy change, which combines the introduction of pollution charges with the reduction or elimination of other taxes, would protect the environment by reducing harmful emissions and would reduce distortions associated with other taxes. Studies indicate that, on average, U.S. personal and corporate income taxes generate distortions or pure losses of 20 to 50 cents for every new dollar of tax revenue collected.[48] Such a shift in tax policy would discourage socially undesirable activities such as pollution, rather than socially beneficial activities, such as labor and capital formation.

By encouraging the greatest reductions in CO_2 emissions by businesses that can make those reductions most cheaply, a CO_2 charge system could reduce total industry compliance costs.

Greenhouse-Gas Reductions

Pollution charges can address a variety of environmental problems through various levels of government and work best when the central question is not whether but how much emission is acceptable, when margins of error are not particularly high, and when emissions can be monitored at reasonable cost. Although the list of potential applications includes many forms of air and water pollution, as well as many solid and hazardous waste problems, there are four particularly promising areas that need immediate action: greenhouse-gas reduction; motor vehicle fuel efficiency; solid waste reduction; and hazardous waste management.

Few of the environmental problems that have arisen since the beginning of the industrial revolution have posed greater risks or greater uncertainties than has the threat of global climate change as a result of the greenhouse effect. If emissions of carbon dioxide (CO_2) and other greenhouse gases (such as methane, nitrous oxides, and CFCs) continue to grow at current rates, many scientists believe, global mean temperatures may rise by 2° to 5° F over the next century. Such an increase could cause widespread changes in precipitation patterns,

storm frequency and intensity, and the ocean level.[49]

Recent international negotiations have focused on how to limit emissions and how to allocate the control burden among nations.[50] Given the importance of CO_2 to the global-warming phenomenon and the central role that CO_2-producing fossil fuel combustion plays in the U.S. economy, the nation will need to adopt cost-effective approaches that minimize economic dislocations if enforceable international agreements are signed. A properly designed CO_2 charge system, such as one that would impose charges to increase the costs of CO_2 emissions, could enable the United States to achieve a national CO_2 target cost-effectively.[51] The charge would vary by type of fuel, such as coal, oil, and natural gas, and depend on the CO_2 emissions associated with that fuel. Higher fuel prices would internalize the anticipated costs of climate change and would thus reduce direct demand for fossil fuels, encourage conservation, lead to a more appropriate mix of various energy sources used, and stimulate the development of new, less carbon-intensive technologies.[52] Thus, both fossil fuel use and CO_2 emissions would decrease.

Because the goal is to reduce CO_2 emissions, the ideal charge system would, theoretically, be based on the quantity of CO_2 emitted. However, the vast number of individual sources of CO_2 emissions makes such a system impractical. An alternative is to charge a fee on coal, crude oil, and natural gas, based on the fuel's carbon content, which is roughly proportional to the amount of CO_2 emitted upon combustion. This charge could be imposed at the point of entry for imported fuels and at the point of primary production for domestic fuels. There would be no need for additional charges on refined petroleum products or on other goods derived from fossil fuels. A viable alternative to the carbon charge is a BTU (British thermal units) charge, which would be based on the energy yielded by burning the fuel rather than on the

fuel's carbon content. If the principal goal is to reduce CO_2 emissions, the carbon charge is theoretically superior because it targets more effectively the source of emissions. But if the BTU charge is applied only to fossil fuels, the difference in cost-effectiveness between the two is not dramatic.[53]

The CO_2 charge offers several advantages over conventional regulatory approaches. By encouraging the greatest reductions in CO_2 emissions by businesses that can make those reductions most cheaply, a CO_2 charge system could reduce total industry compliance costs. Also, administrative costs for the system would be much lower than those of conventional regulatory standards, which limit fossil fuel burning by setting different standards for the thousands of industrial, commercial, and residential uses of each fuel. Determining, monitoring, and enforcing these standards would be very costly, to say the least. By contrast, a CO_2 charge would require essentially one tax rate for each fuel type and would create incentives for technological innovation because businesses could reduce their CO_2 fees by reducing their fossil fuel consumption.

The charge should be set at a level that will encourage reductions in CO_2 emissions equal to national targets. This is easier said than done. Although it is clear that a carbon charge could significantly reduce fossil fuel use, the relative impacts of different charge levels are very uncertain. The Congressional Budget Office projects that a $100-per-ton carbon charge, phased in over 10 years, would lead to reductions in CO_2 emissions of between 8 and 36 percent by 2000, relative to the emissions that would occur without a charge. Such a charge could begin with a $10-per-ton charge in 1991 and rise smoothly to a $100-per-ton charge in 2000 (all figures in 1988 dollars). In contrast, EPA estimates that a $5-per-ton fee would, by 2000, reduce annual domestic CO_2 emissions by from 1 to 4 percent and raise from $7 to $10 billion annually; a $15-per-ton fee would reduce emissions by 3 to 12 percent and raise some $20 to $30 billion per year; and a $25-per-ton fee would reduce emissions by 8 to 17 percent and raise $38 billion to $50 billion annually.[54] However, to drop CO_2 emissions to 20 percent below 1990 levels would require a $200- to $400-per-ton charge by

2040. To maintain emissions at this level for the longer term (2050 and beyond) would require a $250-per-ton charge.[55]

The impacts of a carbon charge on U.S. economic activity cannot be overlooked. A $100-per-ton charge unilaterally adopted by the United States could lead to a 2-percent annual loss in gross national product, according to baseline projections, by the time the charge was fully implemented. However, the impact would be substantially less if other nations acted in concert. Recently, the European Commission broadly endorsed the notion of carbon-based charges to combat global warming and is developing mechanisms for applying them.[56] In any event, a revenue-neutral tax that rebates the revenues from a CO_2 charge by reducing other taxes would greatly reduce the 2-percent loss in gross national product and might offset it altogether.

Because of the magnitude of the reduction targets frequently discussed by policymakers and the dependence on fossil-fuel energy in the U.S. economy, achieving greenhouse reduction goals, such as a 20-percent reduction in CO_2 emissions, could entail very substantial costs, regardless of the policy instrument selected. Indeed, an advantage of pollution charges beyond their cost-effectiveness is the fact that they explicitly clarify for the public the costs of environmental protection and, hence, what the public must be willing to pay to reduce the risks of global climate change. An important question, however, is whether this burden will be evenly distributed across income classes. By some measures, low-income households spend a larger proportion of their incomes on fossil-fuel-related products than do more affluent households. As a result, a carbon charge might hit low-income households harder. A revenue-neutral approach could mitigate some of the charge's impact on low-income households by providing "life-line rates" for initial increments of energy use. A further challenge concerns the regional distribution of the charge's impacts; some regions of the country would likely bear larger burdens than would others. For instance, some studies indicate that the distribution of the burden of a carbon charge would vary regionally by as much as 50 percent.[57] In particular, the high carbon content of coal, relative to other fuels, would translate into relatively greater costs for coal-producing regions. A $100-per-ton carbon charge could reduce coal use by 13 percent annually by the year 2000.[58] It should be noted, however, that regional impacts would be essentially the same if a conventional emission-standard approach were adopted.

There may be arguments in favor of both a carbon and a gasoline tax, but the public may not tolerate more than one new federal pollution charge initiative.

Motor Vehicle Fuel Efficiency

Increasing gasoline taxes is one way to address a broad set of environmental and other problems.[59] Because of the wide coverage already given to such a proposal in the media, however, it is not necessary to pay much attention to specific benefits here, except to note that the appeal of this approach will depend on the specific objectives being considered. For instance, a gasoline tax would be a legitimate instrument for dealing with some environmental problems closely related to the burning of gasoline, such as the emissions of air pollutants. However, a number of existing policy proposals are related to, although distinct from, a gasoline tax. For example, Project 88-Round I recommended increased use of "gas-guzzler" taxes and "gas-sipper" rebates to help automobile manufacturers achieve corporate average fuel economy (CAFE) standards. Similarly, recent legislation seeks to impose taxes on the production of less fuel-efficient automobiles. EPA has considered the use of gas-guzzler fees instead of gasoline taxes because the former can overcome the observed tendency of consumers to favor products with low initial and high long-run costs. Such mechanisms, however, provide no incentives for people to modify their driving habits once they have purchased their cars and trucks. Although gasoline taxes reduce miles driven and, in the long run, lead to the purchase of more fuel-efficient cars, they would be more cost-effective as a pollution control mechanism if there were also a change from EPA's current system of regulating "grams of pollutants per mile traveled" to a system of regulating "grams of pollutant per gallon of fuel burned."[60] Likewise, increased gasoline taxes could provide significant energy-security benefits by reducing the nation's overall demand for petroleum products and would tend to reduce highway congestion.[61] A 50-cent-per-gallon gas tax increase could eventually reduce gasoline consumption by between 10 and 15 percent, reduce oil imports by 500,000 barrels per day, and generate about $40 billion per year in revenue.

Because a gasoline tax is simply a charge added to the price of gasoline, consumers, when faced with higher prices, will change their driving behavior in the short run and their vehicle-purchasing behavior in the long run to achieve greater fuel efficiency. This approach could be far more effective than proposals to increase CAFE standards for new cars.[62] How

changes in gasoline taxes would be administered depends on policy objectives and political considerations. If the primary purpose is to address local pollution problems or traffic congestion, the charge is probably best levied by local or state authorities. If, on the other hand, the purpose is to address national or global environmental issues or national security issues, federal authorities should implement the charge.

If the concern is reducing CO_2 emissions, a gasoline tax is likely to be less attractive than a carbon tax because it is linked less directly with carbon emissions and would require one user group—gasoline consumers—to shoulder the burden. In principle, there may be arguments in favor of both a carbon and a gasoline tax, but the public may not tolerate more than one new federal pollution charge initiative. Moreover, apart from the issues of dependence on foreign oil and global climate change, most of the problems associated with gasoline consumption are regional or local. Therefore, a pragmatic approach may be to focus on a carbon charge at the federal level and leave consideration of gasoline taxes to the states.

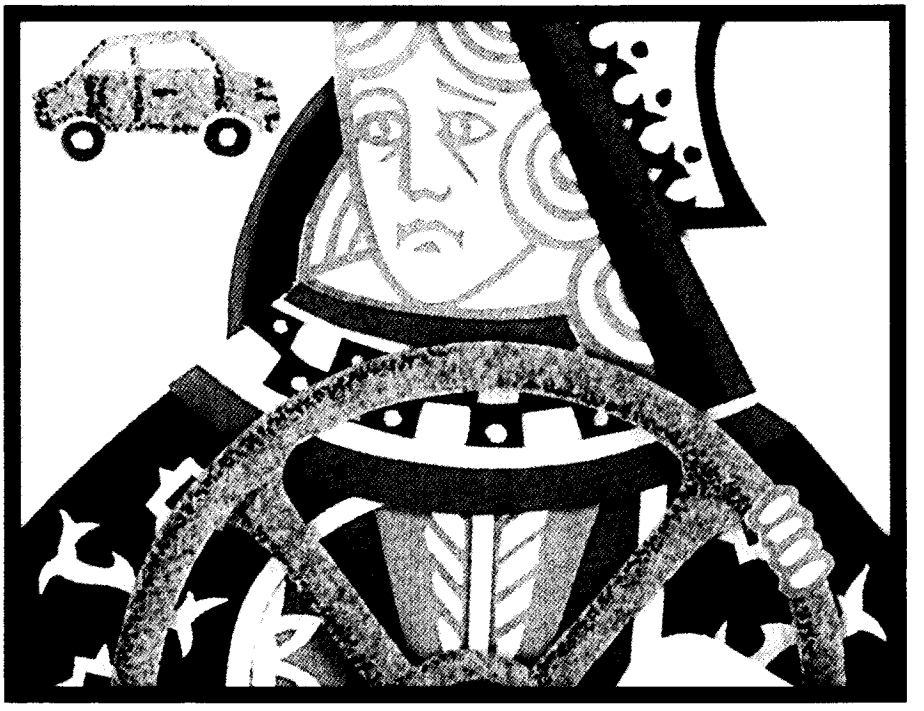
The potential revenue-neutrality of any change in gasoline taxes is important. If the tax were levied by the federal government, transferring the revenue from the gas tax to the Social Security Trust Fund and crediting it to current workers might address the greatest concern about higher gas taxes—that they can hit hardest on working families and particularly on workers who drive to their jobs. If a $40-billion-per-year revenue from a 50-cents-per-gallon gas tax were paid into social security, the payroll tax—the employee's contribution to social security—could be cut by almost one-third. Thus, a worker earning annual wages of $30,000 would take home an additional $700 per year. The extra income would more than offset the cost of the gas tax, unless the worker drove more than 30,000 miles per year in a car that gets 25 miles or fewer per gallon. A tax of this magnitude also could be phased in gradually, perhaps at no more than 10 cents per year over 5 years, which would allow individuals and businesses to adjust their consuming and producing behavior. Although such a scheme is not a panacea for all energy and environmental problems, it could make a significant contribution.

Solid Waste Management

The increasing volume of solid waste that U.S. society generates has emerged as a pressing problem over the past decade. Many areas are running out of landfill space, and many communities have effectively blocked the construction of new facilities.[63] This "space squeeze," in conjunction with stricter landfill regulations, has significantly increased the cost of waste disposal in many parts of the country. In the Northeast, disposal charges, or tipping fees, are now as high as $125 per ton. Nationwide, tipping fees rose more than 26 percent annually between 1984 and 1988.[64] Although some communities have begun to incinerate their waste, scientists warn that garbage burning contributes to air pollution and that the ash it generates poses its own disposal problems. Pollution charges offer a natural and cost-effective way to use the market to address the waste problem.

The difficulties of providing safe and adequate waste disposal have led many scientists to call for reductions in the amount of solid waste generated. Reducing waste cost-effectively can be a complex task because the appropriate strategies vary by both type of disposal material and geography. Although increasing recycling may be the best alternative in some cases, the high costs of collection and separation, the distance to processing facilities, and a lack of adequate technologies make recycling prohibitively costly in others. Also, practical collection strategies must match consumer needs. For instance, separating recyclable materials can be time-consuming, particularly when materials must be brought to a transfer station. Some consumers may be willing and able to undertake this activity, but it will represent a significant burden for others.

Most waste reduction efforts to date have used conventional command-and-control regulations. In some cases, state governments and lo-



cal municipalities have enacted draconian measures, such as product bans or across-the-board, recycled-content standards for packaging, with little regard for costs or consumer preferences. Often, these policies have raised costs and had little effect on the amount of solid waste generated. Indeed, a lack of markets for used newsprint has caused many communities with mandatory separation requirements to store or even bury their collected newspapers in landfills.[65]

Flawed pricing systems for waste disposal are at the core of most solid waste problems. Disposal fees that do not reflect the total cost of waste disposal lead to excessive generation of waste and inefficient disposal and recovery methods. If price distortions are eliminated, the market can provide incentives for waste reduction and recycling without resorting to cumbersome and distortionary measures such as product bans and mandatory separation.

The pricing problem has several dimensions. First, most individuals never directly encounter the costs of waste disposal. In many communities, these costs are simply imbedded in local property taxes. However, some cities have made the costs of waste disposal more apparent to consumers by charging a separate fee for waste collection. Unfortunately, even these charges do not provide incentives for decreasing the amount of waste because they are typically fixed monthly payments that do not vary with the quantity of waste generated.

With such pricing systems, it is not surprising that the throw-away ethic has thrived. The cost of throwing away an item of trash is relatively small because U.S. residents merely place empty bottles, cans, lawn clippings, and other wastes in a trash chute or at the curbside, and the municipality or contractor picks them up. Imagine what kind of car the average citizen would buy and how much he or she would drive if the total annual cost for gasoline were independent of the quantity of gasoline used. This scenario is equivalent to that of municipal solid waste management in almost all communities in the United States.

Effective waste management strategies must communicate to consumers the true total social cost of throwing things away. Waste management must create incentives for consumers to generate less waste, either through increased recycling and reuse of materials or by demanding less wasteful packaging and products from manufacturers. Decisions by individuals and businesses should reflect the incremental costs of waste disposal, which can be initiated at any point in a product's life cycle. At least three incentive-based approaches exist: curbside waste collection charges at the point of disposal; retail disposal charges at the point of sale; and virgin material taxes in the production process itself.

Municipal Waste Disposal Charges

The first option for addressing solid waste problems links household charges to the real costs of collection and disposal. In other words, citizens are charged a fee for the specific quantity of waste they generate. The rate structure of such a system should reflect not only the costs of pick-up but also the associated tipping or incineration fees. These fees motivate residents to reduce the quantity of waste they generate, whether by changing their purchasing patterns, reusing products and containers, or composting yard wastes. Furthermore, placing a higher unit charge on unseparated refuse than on specified, separated recyclables can induce residents to separate the recyclable components of their trash. Such household unit pricing for collection and disposal can provide incentives at the community level for a cost-effective combination of waste disposal alternatives: landfills, incinerators, and recycling facilities. Unit pricing can lead to efficient, cost-effective levels of reliance on alternative waste disposal methods only if prices accurately reflect the real, incremental costs of these alternatives. Many municipalities, however, have underpriced waste disposal services by performing incomplete cost accounting and using average rather than marginal cost prices. Also, problems have arisen with the cost calculations associated with specific disposal alternatives. For example, landfill costs have historically been underpriced because of weak environmental regulations.[66]

The per-household charge can be based on either volume or weight. Most initial forays into unit pricing charge residents by the number and size of trash receptacles they use. In Seattle, Washington, for example, consumers choose from four sizes of receptacles, ranging in price from about $11 per month for a 19-gallon container to almost $32 per month for a 90-gallon container. The program appears to be having a positive effect. In 1979, the average family set out approximately four 30-gallon containers per week; by 1989, 87 percent of the households filled one 32-gallon container or less.[67]

Many municipalities have underpriced waste disposal services by performing incomplete cost accounting and using average rather than marginal cost prices.

A potential problem with per-receptacle pricing is that customers are charged for a full can even if it is not used or only partially filled in a particular week. A number of systems

avoid this problem. Under a "bag-and-tag" system, for instance, residents dispose of unseparated refuse only in specially designated trash bags sold by the municipality. Another approach involves placing stickers on cans or bags of specified dimensions. A third approach involves charging customers by the weight of their refuse. Under such a system, the unseparated waste is weighed on site by the collectors, and a bill is either left with the customer or mailed later. This approach eliminates the need to register cans or administer a bag-sales program and eliminates the advantage of possessing a trash compactor. However, such a system may require an investment in new or remodeled garbage trucks.

A number of communities have combined unit charges for unseparated refuse with curbside collection of recyclable materials. This combination lowers the direct cost of recycling for consumers and gives them additional control over their waste charges. Some communities provide free curbside recycling services, but this approach is not always desirable. The rate for collecting recyclable materials should, theoretically, equal the cost of transportation and program administration minus the value of the recyclable materials, whether positive or negative. However, charging less for some recyclables or providing refunds at the curbside raises administrative costs dramatically above those for a system that charges for mixed refuse and provides free pick-up for some recyclables. The latter combination can provide strong incentives for separation without significantly increasing administrative costs.

Although unit pricing to date has been shown to reduce waste generation, there is concern over the policy's fairness to residents of low-income households, who would pay greater shares of their income for pick-up services than would residents of high-income households. However, unit pricing tends to be less regressive than conventional payment systems, though there is substantial variation among communities.[68] Seattle uses a system similar to the low life-line rates provided by electrical utilities. Customers pay only the fixed cost of curbside pick-up for their first 32-gallon container.

Although unit charges may lead to increased illegal dumping, properly designed systems can prevent this problem.[69] New programs can be introduced incrementally to raise charges gradually until they equal the true marginal costs of disposal. Municipalities can remove much of the incentive for illegal dumping by providing free or very low-cost disposal at transfer stations. Housing developments whose residents dispose of their waste anonymously could pose a more serious obstacle to unit pricing. Charges per building (rather than per housing unit) will, however, provide an incentive to landlords or condominium managers to encourage residents to reduce wastes and will ensure that the building as a whole will bear the costs of its waste disposal. Although the design and implementation of curbside charges must be undertaken at the local level, EPA could serve as a clearinghouse of information on different systems.

Retail Disposal Charges

An alternative approach to unit charges is retail disposal charges, which administer disposal costs at the point of product purchase. For example, communities may place a surcharge on the sale of items that reflects the costs of disposal.[70] Retail charges can act as a substitute for unit curbside charges when the latter are impractical, for example, in a community with many large, multi-unit residences. Retail charges also can supplement curbside charges for specific products whose disposal costs are well in excess of the costs associated with their volume, such as household products whose ingredients could have significant environmental consequences in landfills or incinerators. Examples include electrical-appliance batteries, inks, paints and paint solvents, and household pesticides.

There are limitations on the practicality of a broad-based retail charge system. First, retail charges will probably involve higher attendant administrative costs than do curbside charges. In addition, charges deemed politically feasible may be too small to in-

fluence sufficiently consumers' buying behavior.

Responsibility for setting the charge level should rest with municipalities. Because disposal costs vary greatly by geographic area, disposal charges applied to retail products should likewise vary. However, gathering the necessary information on product composition would be a daunting task for any single community. Given the national scope of most product markets and the economies of scale involved in collecting and aggregating data, the federal government is probably best suited to perform this task.

Virgin Materials Taxes

Incorporating disposal costs at the point of production is a third alternative for improving solid waste management. By placing charges on virgin materials that reflect ultimate costs of disposal, the government can encourage manufacturers to switch to materials and products that have lower disposal costs. This approach would favor recycled materials because the costs of virgin materials would be higher than those of secondary ones. Virgin materials charges also are likely to be a much more cost-effective approach to encouraging recycling by consumers than are the recycled-content standards that have recently been established in several states. For example, California, Connecticut, Maryland, Missouri, and Wisconsin have all enacted legislation requiring publishers to increase their use of recycled newsprint.[71] It should be noted that virgin materials taxation ought to be viewed as a potential substitute for unit curbside charges or retail disposal charges. A clear disadvantage of virgin materials charges is their insensitivity to local conditions. Because the charges would need to be standardized nationally, they should only be applied to those materials that are particularly large contributors to solid waste problems, such as newly mined lead.[72] If charges reflected national averages, consumers in areas where disposal costs are low would pay too much for certain products, while those in areas of high disposal costs would not pay enough. Therefore, although virgin materials charges might create more demand for recyclable materials than do most conventional approaches, they are not likely to be as effective as are unit curbside charges in encouraging the right mix of recycling and disposal technologies for each community.

A deposit-refund system encourages businesses to prevent net losses of targeted materials in the production process.

Hazardous Waste Management

Improved consumer notification of prices can reduce the volume of waste reaching landfills and incinerators. However, as more stringent regulation increases the costs of legal disposal, incentives for improper disposal increase. For instance, a waste-end fee (a tax placed on waste at its time and place of generation) that is designed to cover the costs of disposal can lead to illegal dumping. This is not a problem with unit curbside charges for solid waste because neither the quantity of dumping nor its consequences is severe. For some wastes, however, cleanup is much less attractive because of significant health risks or ecological consequences. Such wastes include not only industrial by-products but also consumer goods, such as batteries that contain lead and acid and petroleum-based oils.

Virgin materials taxes and retail disposal charges, which are imposed up front, provide incentives for businesses and individuals to find safer substitutes for and to recover and recycle taxed material. But such charges, if levied on hazardous materials, may encourage businesses to circumvent the process through illegal emissions. Furthermore, such systems do not provide incentives to change disposal methods. Deposit-refund systems, on the other hand, represent a potentially cost-effective way to manage toxic wastes and encourage businesses and individuals to dispose of wastes properly and to search for more benign substitutes.

By combining a special front-end charge, or deposit, with a refund payable when quantities of the substance in question are turned in for recycling or proper disposal, deposit-refund systems provide an incentive to both follow the rules for proper disposal and minimize substance loss during production.[73] Deposit-refund systems are particularly useful when the improper disposal of waste, rather than its generation per se, is of concern. The initial charge can be levied either as a material enters the production system or at any point in the manufacturing, distribution, or sales process.

Deposit-refund systems offer several potential advantages. First, they ease the government's often impossible task of tracking and controlling waste generation and disposal as it exists under the 1976 Resource Conservation and Recovery Act (RCRA). Thus, the government would only ensure that deposits are collected and that the materials returned for refund are legitimate. A deposit-refund system also encourages businesses to prevent net losses of targeted materials in the production process and, thus, motivates them to search for less environmentally damaging substitutes.[74]

Although deposit-refund systems have been applied primarily at the state level, federal assistance is appro-

priate for some substances and problems, such as when businesses face national markets with easily transportable products or when the consequences of improper disposal do not vary significantly from one location to another. Geographic homogeneity of charges also reduces the cost and complexity of control both to businesses and to administering agencies.

Although deposit-refund programs have been proposed for a variety of materials, including vehicle tires and car bodies, the strongest case for regulation can be made for products whose costs of separation and redemption are usually outweighed by the benefits of proper disposal. The best regulatory approach may involve experimenting with deposit-refund systems for toxic but not officially hazardous wastes. As such systems are perfected, they may alter or replace parts of the "cradle-to-grave" tracking system of RCRA. Deposit-refund systems would eventually focus on a variety of products, including used batteries, certain industrial chemicals, and used lubricating oils.

Lead in Batteries

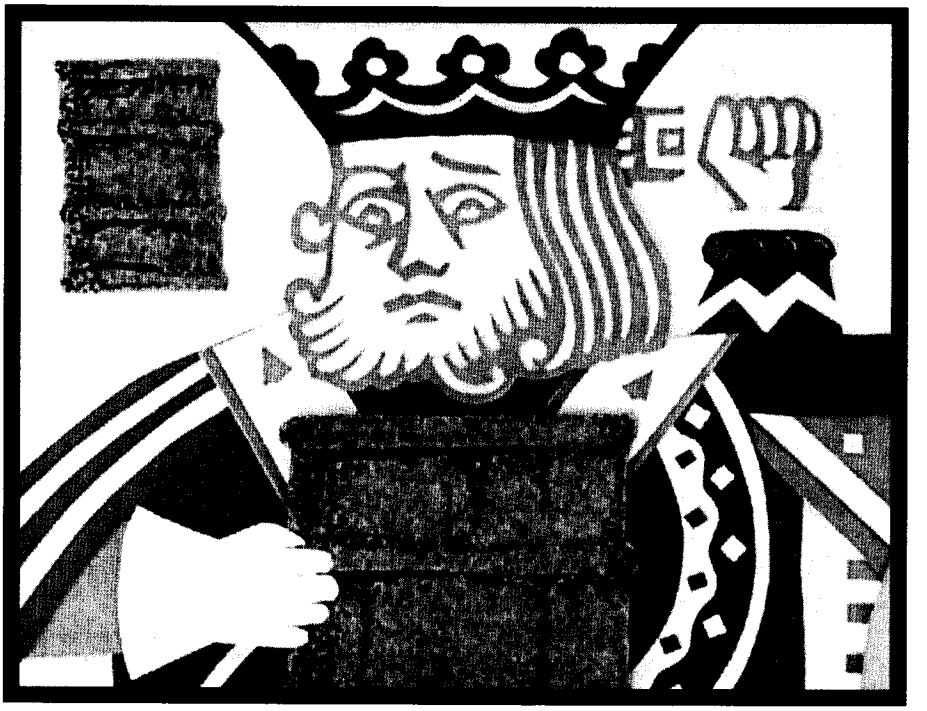
Most of the lead that enters landfills and incinerators comes from storage batteries. Although a substantial amount of lead from motor vehicle batteries is recycled each year, the percentage of batteries recycled has been decreasing over the last 30 years.[75] At present, more than 20 million unrecycled batteries enter the waste stream annually; this number may increase by more than 30 percent by 2000.[76] Under a deposit-refund system, when manufacturers sell batteries to distributors, retailers, or original equipment manufacturers, a deposit would be collected as a tax. Retailers would collect their deposits by returning used batteries to redemption centers, which in turn would redeem deposits from the administering agency. A national program could be designed to accommodate existing deposit systems for batteries. The deposit must be large enough to encourage a substantial level of return but small enough to avoid an incentive for theft. Another option for deterring theft would be to require that sales receipts be used to claim deposits. Requiring a sales receipt for a refund, however, will remove the incentive for the return of batteries that have already been purchased. Furthermore, because of the extended life of most batteries, it may be unrealistic to expect consumers to maintain a receipt for many years.

Industrial Chemicals

Deposit-refund systems may also be a cost-effective instrument for ensuring safe management and disposal of certain hazardous liquid chemicals stored in metal drums. About 30 percent of industrial wastes are generated in small enough quantities to be containerized. Of those wastes, almost half are solvents and oils that are potentially recyclable after reclamation or re-refinement. Because it is difficult to keep track of containerized wastes, they are particularly hard to manage. If an industrial plant uses a metal degreasing solvent in its production process, for example, monitoring emissions to the environment of spent solvent requires checking all shipments out of the plant gates. Even a single plant can have thousands of very small but collectively significant sources. Furthermore, highly contaminated used solvents are often not economical to recycle and may be illegally dumped to avoid disposal costs.

Under a deposit-refund system, businesses could recover a deposit paid on each unit of solvent by returning spent solvent to designated recycling facilities, which would repay the deposit plus the amount normally offered for spent solvent. Improper disposal of solvents would be discouraged because companies would be motivated to recoup their deposits and minimize on-site losses by installing equipment to control emissions or by substituting new materials and processes. For solvents incorporated into products, such as methylene chloride used in aerosols, the deposit would serve as a front-end tax that would reflect the social costs of the solvent's use and thus encourage businesses to seek alternatives.

The administrative complications associated with such a program should not be underestimated. Verification of content is an important issue be-



cause a deposit-refund system could encourage users to dilute solvents. Furthermore, because waste products vary in terms of their solvent content—from sludges to chemicals with the consistency of water—testing of solvent shipments would be needed to determine the appropriate refund.

Used Oil

The improper disposal of used motor oil has both health and ecological consequences. It is often dumped into storm sewers or placed in unsecured landfills, and it contaminates ground and surface water supplies. Used oil is frequently burned as heating fuel and so produces air pollution. At present, about 30 percent of used oil is recycled and only 5 percent of the used oil generated by individuals is typically recycled, which accounts for the highest incidence of improper disposal.[77]

Enforcing proper disposal of used oil through conventional regulations would be exceedingly costly and require monitoring hundreds of thousands of businesses and millions of consumers. A deposit-refund system, on the other hand, would be much more cost-effective.[78] Consumers would pay a deposit on each quart of oil purchased and receive a refund by returning the used oil to redemption centers. The program could be expanded to include service stations and commercial fleets by imposing the deposit at the point of manufacture. However, the deposit-refund approach for used oil could be hindered by the costs associated with detecting counterfeit substances.

Other Potential Applications

Pollution charges and user fees can be used for combatting many contemporary environmental problems. For example, a charge placed on the sale of pesticides and other agricultural chemicals could encourage farmers to use chemicals more efficiently and manufacturers to find less environmentally harmful substitutes. Such a charge also could help address the difficult problem of non-point source water pollution.

Similarly, the United States could follow the example of Germany and impose effluent charges on water pollution. Such charges could encourage businesses to reduce emissions below levels currently allowed by discharge permits. Emissions charges also could be used to control air pollution, even where standards are already in place. For example, the EPA Economic Incentives Task Force proposed fees on major stationary sources of volatile organic compounds, which are precursors of urban smog.[79]

A set of related policies could help address environmental problems associated with automobile use in major cities. In particular, "congestion pricing" could be used to charge drivers a fee for rush-hour trips. Other approaches that could reduce the total miles traveled in automobiles and, therefore, air pollution include employee parking charges, increased charges for public parking, and smog taxes.[80]

Establishing user fees for U.S. national parks and forests could improve resource management. Such schemes may be critical in weaning forest managers away from their dependence on timber revenues.[81] Although 41 percent of gross U.S. Forest Service forest value is related to recreational uses, recreation generates only 3 percent of Forest Service revenues. Clearly, users of publicly owned natural resources should pay for a portion of the benefits they receive.

Pollution Charges in the Political Arena

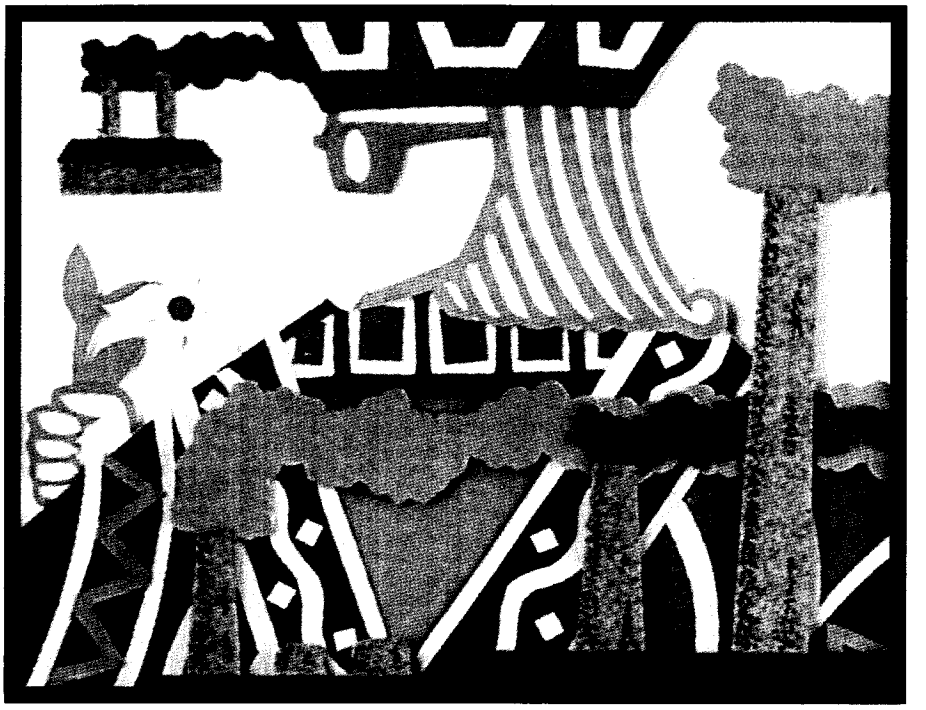
No single policy mechanism—neither incentive-based policies in general nor pollution charges in particular—can be an environmental panacea. Pollution charges, however, promise to provide cost-effective solutions for some pressing environmental problems while spurring technological advances.

Good ideas are not self-adopting, however. Even if the new Clean Air Act provisions have signaled the beginning of a new era of environmental policy, resistance to market-based approaches has not disappeared. In addition to opposition from those who simply oppose environmental protection, pollution charges will have to overcome the same combination of self-interest and suspicion from those within the environmental protection process who have obstructed market-based approaches for decades.

Initially, it may be practical to apply pollution charges to new problems for which policy mechanisms are not already in place. Such an approach could minimize disruptions to industry and consumers, reduce the chance that regulations will work at cross purposes, and challenge the authority of fewer vested interests. If pollution charges turn out to be effective, they could serve as alternatives to environmental regulations in place today that are deemed to be ineffective or that achieve their objectives only at extremely high costs to society. Furthermore, a growing array of state and local initiatives may help pollution charges overcome public dislike for taxes, reduce the costs of environmental protection, and stimulate technological development.

In fact, pollution charges could make the process of environmental policy formulation more explicit to the U.S. population, which has always been shielded from the very real trade-offs involved in establishing environmental goals and standards. As a result, policy discussions could move away from a narrow focus on technical specifications to a broader consideration of goals and strategies. The public could become involved in constructive debates regarding the desirable level of environmental protection and could recapture the critical decisions of environmental goal-setting from bureaucrats, technicians, and special-interest groups. As new environmental policies arise and old ones persist, the limited resources of government agencies and society at large will be stretched further and further. Pollution charges and other incentive-based instruments may eventual-

ly be the only feasible courses of action to sustain or improve environmental quality while maintaining economic well-being. With the necessary political leadership, it may be possible to begin moving in the right direction now.



NOTES

1. See U.S. Environmental Protection Agency, *Environmental Investments: The Cost of a Clean Environment*, report of the administrator to Congress (Washington, D.C.: U.S. EPA, December 1990). This estimate excludes environmental activities not directly associated with pollution control or cleanup, such as wildlife conservation and land management. The $100-billion estimate covers spending by private businesses, local governments, the federal government, and state governments.

2. For an analysis of the impact of environmental regulation on productivity, see D. Jorgenson and P. Wilcoxen, "Environmental Regulation and Economic Growth," *Rand Journal of Economics* 21 (1990): 314–40.

3. See W. K. Reilly, "Our Market Environment" (Paper presented at "Market-Based Strategies for Environmental Protection: A Tribute to Senator John Heinz," John F. Kennedy School of Government, Harvard University, Cambridge, Mass., 16 May 1991).

4. "Project 88: Harnessing Market Forces to Protect Our Environment—Initiatives for the New President" and "Project 88—Round II: Incentives for Action: Designing Market-Based Environmental Strategies" are available from the office of Senator Timothy Wirth in Washington, D.C. 20510.

5. See R. W. Hahn and R. N. Stavins, "Market-Based Environmental Regulation: A New Era From an Old Idea?" *Ecology Law Quarterly* 18 (1991): 1–42.

6. See T. H. Tietenberg, *Emissions Trading: An Exercise in Reforming Pollution Policy* (Washington, D.C.: Resources for the Future, 1985); and C. W. Howe, "An Evaluation of U.S. Air and Water Policies," *Environment* (September 1991), 10.

7. For numerical examples of the variance of incremental costs of air-pollution control, see R. W. Crandall, "The Political Economy of Clean Air: Practical Constraints on White House Review," in V. K. Smith, ed., *Environmental Policy Under Reagan's Executive Order: The Role of Benefit-Cost Analysis* (Chapel Hill, N.C.: The University of North Carolina Press, 1984), 205–25.

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10. For more information about transferable property rights as applied to environmental protection, see J. Dales, *Pollution, Property, and Prices* (Toronto: University of Toronto Press, 1968); and R. Hahn and R. Noll, "Designing a Market for Tradeable Permits," in W. Magat, ed., *Reform of Environmental Regulation* (Cambridge, Mass.: Ballinger, 1982), 119–46.

11. See Z. Willey and T. Graff, "Federal Water Policy in the United States: An Agenda for Economic and Environmental Reform," *Columbia Journal of Environmental Law* 13 (1988):325–51; and Project 88—Round II, pages 69–77, note 4 above.

12. See M. D. Bowes and J. V. Krutilla, *Multiple-Use Management: The Economics of Public Forestlands* (Washington, D.C.: Resources for the Future, 1989); and Project 88—Round II, pages 77–86, note 4 above. For other examples of economically inefficient and environmentally disruptive subsidies, such as those associated with U.S. Army Corps of Engineers flood control projects, U.S. Bureau of Reclamation projects, and Bureau of Land Management and Forest Service public lands grazing programs, see Hahn and Stavins, note 5 above.

13. See, for example, Dales, note 10 above.

14. For further discussion of these points, see Hahn and Stavins, note 5 above.

15. See A. L. Alm, "The Postregulatory Environmental Protection Regime," *Environmental Science and Technology* 23 (1989):1338–39.

16. See, for example, R. W. Hahn and G. L. Hester, "Marketable Permits: Lessons from Theory and Practice," *Ecology Law Quarterly* 16 (1989):361–406.

17. See J. Baden and R. Stroup, eds., *Bureaucracy vs. Environment: The Environmental Costs of Bureaucratic Governance* (Ann Arbor, Mich.: University of Michigan Press, 1981).

18. For a discussion of the factors leading to the increased attention given to economic instruments, see Hahn and Stavins, note 5 above.

19. See R. W. Hahn, "The Politics and Religion of Clean Air," *Regulation* (Winter 1990), 21–30.

20. See F. Krupp, "New Environmentalism Factors in Economic Needs," *Wall Street Journal*, 20 November 1986, 34.

21. See U.S. Environmental Protection Agency, *Economic Incentives: Options for Environmental Protection*, report number 21P-2001 (Washington, D.C.: U.S. EPA, Office of Policy, Planning, and Evaluation, 1991).

22. Clean Air Act Amendments of 1990, Pub. L. No. 101-549, 104 Stat. 2399 (1990).

23. See U.S. Environmental Protection Agency, "Emissions Trading Policy Statement: General Principles for Creation, Banking, and Use of Emission Reduction Credits," 51 Fed. Reg. 43,814, 43,829 (1986) (final policy statement).

24. 40 C.F.R. §80.20(d) (1988); and U.S. Environmental Protection Agency, "Control of Lead Additives in Gasoline," 38 Fed. Reg. 33,734 (1973) (final rule).

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26. See U.S. Environmental Protection Agency, "Costs and Benefits of Reducing Lead in Gasoline" (Final regulatory impact analysis VIII-31, Washington, D.C., 1985).

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30. See R. N. Stavins, and A. B. Jaffe, "Unintended Impacts of Public Investments on Private Decisions: The Depletion of Forested Wetlands," *American Economic Review* 80 (1990):337–52; and R. N. Stavins, "Alternative Renewable Resource Strategies: A Simulation of Optimal Use," *Journal of Environmental Economics and Management* 19 (1990):143–59.

31. See G. C. Eads, "Response to Comments of

Robert N. Stavins" (Speech prepared for the workshop "Economics of Sustainable Development" sponsored by the United Nations Economic Commission for Europe and the U.S. Environmental Protection Agency, Washington, D.C., 25 January 1990).

32. See Organization for Economic Cooperation and Development, *Economic Instruments for Environmental Protection* (Paris: OECD, 1989).

33. U.S. Congress, *The Omnibus Budget Reconciliation Act of 1989 Section 7506: Excise Tax on the Sale of Chemicals Which Deplete the Ozone Layer and of Products Containing Such Chemicals* (Washington, D.C.: U.S. Congress, 1989).

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35. See D. Harrison, Jr., and A. L. Nichols, "Tradeable Permits and Other Economic Incentives for Environmental Protection: Final Report" (Paper prepared for the Canadian Electrical Association Workshop on Tradeable Permits, Cambridge, Mass., 28 June 1990).

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37. Ibid.; U.S. Environmental Protection Agency, "Economic Incentive Program Rules," 56 Fed. Reg., 46,756 (1991); and B. Elman, Office of Policy, Planning and Evaluation, U.S. Environmental Protection Agency, personal communication with the author, 20 March 1992.

38. K. P. Doyle, ed., "States Turn to Dedicated Funding for Environmental Budgets," *Environment Reporter*, 20 March 1992, 2580–90.

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40. For a description of the charge, see G. M. Brown, Jr., and R. W. Johnson, "Pollution Control by Effluent Charges: It Works in the Federal Republic of Germany, Why Not the U.S.?" *Natural Resources Journal* 24 (1984):929–66.

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51. See L. H. Goulder, "Using Carbon Charges to Combat Global Climate Change," Stanford University Center for Economic Policy Research publication no. 226 (Stanford, Calif.: Stanford University, December 1990).

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53. See D. W. Jorgenson and P. J. Wilcoxen, "The Cost of Controlling U.S. Carbon Dioxide Emissions," John F. Kennedy School of Government discussion paper (Cambridge, Mass.: Harvard University, September 1990).

54. See U.S. Congressional Budget Office, *Carbon Charges as a Response to Global Warming: The Effects of Taxing Fossil Fuels* (Washington, D.C.: U.S. CBO, August 1990); and D. Lashof and D. Tirpak, eds., *Policy Options for Stabilizing Global Climate* (Washington, D.C.: U.S. Environmental Protection Agency, February 1989). The models used for short-term projections to the year 2000 are the PCAEO simulation model developed by the Energy Information Administration of the U.S. Department of Energy, the Data Resources Incorporated quarterly econometric model of the U.S. economy, and the Dynamic General Equilibrium model developed at Harvard University.

55. See A. Manne and R. Richels, "CO_2 Emission Limits: An Economic Cost Analysis for the USA," *The Energy Journal* 11, no. 2 (1990):51–74. The Manne-Richels model has been criticized because of its conservative assumptions and failure to provide for endogenous technological change. R. H. Williams, "Low-Cost Strategies for Coping with CO_2 Emission Limit, *The Energy Journal* 11, no. 4 (1990):35–59.

56. See J. Rogaly, "Carbon Tax on Its Way," *Financial Times*, 17 December 1991, 21; and "Heseltine Supports 'Green' Energy Tax," *The Independent*, 14 December 1991, 9.

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59. See, for example, C. H. Percy, "The Broad Benefits of a Gasoline Tax Hike," *New York Times*, 8 July 1990.

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64. See C. I. Petit, "Tip Fees Up More Than 30% in Annual NSWMA Survey," *Waste Age*, March 1989, 101–06.

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72. See H. Sigman, "A Comparison of Public Policies for Lead Recycling" (Cambridge, Mass.: Massachusetts Institute of Technology, Department of Economics, December 1991).

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80. Cameron, note 61 above.

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COMING NEXT MONTH

The Columbian Encounter and Global Change