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Stationary Source Pollution Policy and Choices for Reform

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In response to the alleged adverse effects of regulation, the reconsideration of environmental policies now under way gives far more prominence to the economic implications of regulatory policies than has been the case in the past. Adverse economic effects associated with regulation, however, do not necessarily justify the abandonment of environmental policy objectives. Rather, these effects may be seen as emphasizing the importance of seeking alternative approaches.

The environmental policies with the greatest impact on the national economy are probably those that limit industrial air and water pollution. These policies are now under attack for imposing excessive compliance costs on households, firms, and government and for retarding innovation and investment. These costs have, in turn, been linked to excessive reliance on technology-based standards and to cumbersome and erratic procedures for obtaining permits for construction of new plant and equipment.

In this paper we briefly discuss the approach to stationary source air and water pollution that was formulated in the early 1970s and point out some of its limitations. We next examine some major modifications to this approach put in place in 1977 and discuss in detail the merits of a number of recent substantive and procedural reforms and their effects on the economy. Some of these reforms involve greater use of economic incentives in pollution abatement policy.

TECHNOLOGY-BASED STANDARDS

Congress enacted the Clean Air Act Amendments (CAA) in 1970 and the Federal Water Pollution Control Act Amendments (FWPCA) in 1972. Although earlier environmental pollution statutes were on the books, these two acts represented a fundamental change in the degree and kind of federal intervention to protect environmental quality.
The most important innovation in these two statutes was their extensive reliance on technology-based emission standards for waste dischargers. In the technology-based approach, the abatement regulations for an industrial category are determined solely by considering the abatement technologies available and are applied uniformly to all plants in the category.

The FWPCA required EPA to establish effluent limitations specifying, for each industrial category, the pollution abatement achievable by the best practicable technology currently available (BPT) and the best available technology economically achievable (BAT). Industrial dischargers were required to meet the BPT and BAT standards by 1977 and 1983, respectively, but were not required to adopt the technologies suggested by EPA as guidelines. The actual discharge limitation applicable to a particular plant was specified in an effluent discharge permit. In most states, the writing of permits has been delegated to the state water quality agency.

The Clean Air Act Amendments of 1970 required EPA to designate "criteria pollutants" and to establish national ambient air quality standards sufficient to protect the public health and welfare. Each state was then required to prepare and implement a state implementation plan which would achieve the ambient standards. This provision did not require the states to base their standards on particular technologies, but most states followed this course. In addition, EPA was directed by Congress to issue new source performance standards by industrial category for newly constructed plants. These standards were supposed to reflect the best performance in commercial operation at the time of promulgation, and were to be revised every few years. Unlike the Federal Water Pollution Control Act, the Clean Air Act did not require sources to have permits. However, every state implementation plan required new sources or modifications of existing sources to obtain construction permits, and in addition many required all sources to obtain periodically renewable operating permits.


4. One apparent exception to the technology-based standards occurred in so-called "water quality limited" streams. If it was estimated that application of BPT and BAT would not achieve the water quality objectives for a particular watershed, then permit writers were able to require dischargers to meet more stringent standards. 33 U.S.C. § 1312(a) (1976). Nonetheless, the emphasis remained on what technology could do, rather than on finding the cost-effective method of achieving the water quality objectives.


6. Id. § 111 (codified at 42 U.S.C. § 7411 (Supp. II 1978)).
THE 1977 ADJUSTMENT

Progress was made in improving air and water quality between 1972 and 1977, but the objectives of neither act were met.\(^7\) In water policy this was neither surprising nor especially disturbing, because the interim goal of making the water safe for contact recreation was not supposed to be achieved until 1983. (In addition, the “fishable, swimmable” goal of the water act did not have the same legal force as the ambient air quality standards.) Perhaps for this reason, the 1977 Clean Water Act involved relatively minor changes to the 1972 statute. The most important of these changes was a reorientation of best available technology toward toxic pollutants. Under the 1977 amendments, EPA is required to establish BAT standards for 65 designated toxic and “other nonconventional” pollutants for each industrial category.\(^8\) For biochemical oxygen demand (BOD), suspended solids, and pH—the so-called “conventional pollutants”—the old best available technology requirement was replaced by a requirement to meet best conventional technology (BCT) standards,\(^9\) which were intended to be somewhat more stringent than the original best practical technology standards, but less stringent than BAT. The deadline for meeting the new BCT standards was postponed one year to July 1, 1984, while BAT standards for toxic pollutants were to be met within three years after promulgation, but in no case later than July 1, 1987.\(^10\)

The primary ambient air quality standards were supposed to have been achieved by 1977, but that year came and went with many areas of the country—including most major metropolitan areas—having failed to achieve the standards for at least one criteria pollutant. In addition, in areas with air quality better than the standards, maintenance of air quality was not assured. Accordingly, the 1977 Clean Air Amendments made important changes to the Clean Air Act to address these problems of “nonattainment” and “prevention of significant deterioration” (PSD).\(^11\)

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7. “[D]ata from approximately 59 of the most polluted counties across the country show that violations of ambient air quality standards generally either stayed constant or decreased between 1974 and 1977.” COUNCIL ON ENVIRONMENTAL QUALITY, TENTH ANNUAL REPORT 17 (1979). “The available evidence . . . suggests that water quality in the United States, while not showing vast improvement since the early 1970s is at least not getting any worse.” Id. at 75.


10. Id. § 1311(b)(2)(F) (Supp. II 1978).

Additional changes included the creation of a noncompliance penalty, which was to be imposed on any source not yet in compliance with applicable federal or state (SIP) regulations.\textsuperscript{12} The economic incentive for firms to delay compliance was to be eliminated by setting the penalty equal to their cost savings from noncompliance.\textsuperscript{13} Another section of the amendments redefined NSPS to include a “percent reduction” requirement.\textsuperscript{14} The impetus for this change was the new source performance standards promulgated for coal-fired utility boilers which, under the 1970 Act, could be achieved by use of low-sulfur coal without installation of sulfur dioxide control equipment. By foreclosing such nontechnological responses to new source performance standards, the bias toward technology-based standards was strengthened.

ECONOMIC IMPLICATIONS OF CURRENT AIR AND WATER POLLUTION POLICY

As noted, 1977 brought changes intended to increase the effectiveness of the Clean Water and Clean Air acts, especially the latter. The realization is emerging, however, that these changes may be very costly. That possibility gives added impetus to the current discussion of environmental policy reform. Before discussing reform, we comment briefly on the economic disadvantages of the existing approach.

One of the principal criteria for judging air and water pollution policy is cost-effectiveness: the ability to achieve given environmental quality goals for the lowest possible cost.\textsuperscript{15} For two reasons, technology-based standards do not perform well according to this criterion. First, because such standards are uniform within industrial categories, they cannot allow for the fact that the same pollutant discharged in different locations can have vastly different environmental effects. Second, such standards do not take adequate account of the large differences in abatement costs among dischargers even within the same industrial category.

Consideration of costs in establishing the various standards required by the Clean Air and Clean Water acts has almost always been

\textsuperscript{13} It was not until July 28, 1980 that final regulations were issued. See 45 Fed. Reg. 50,086 (1980) (to be codified in 40 C.F.R. §§ 66-67 (1981)).
\textsuperscript{15} Cost-effectiveness is related, but not identical, to economic efficiency. To judge the efficiency of a policy, we must estimate the benefits attributable to the policy and compare them to the costs. An efficient policy is cost-effective but not vice versa.
limited to an assessment of economic impact within an industry category, i.e., whether the standards would result in plant closings or unemployment. However, results based on such impacts are imperfectly related to cost-effectiveness: if standards must be uniform within industrial categories, the most cost-effective approach is probably to equate marginal abatement costs across industries.\footnote{16} It is apparent that EPA did not make cross-industry cost comparisons. Rough estimates of the marginal abatement costs of a sample of the best practicable technology standards promulgated under the Federal Water Pollution Control Act showed variation by a factor of 30.\footnote{17}

Although data do not exist to estimate the potential cost savings available nationally from increased cost-effectiveness, some studies suggest potential regional savings of over 80 percent.\footnote{18} Thus the cost savings may be significant given the fact that in the coming decade (1979–88) the average pollution abatement expenditures by manufacturing and utilities are expected to be $25 billion per year.\footnote{19}

Naturally, a policy which perfectly reflects the costs and benefits of abatement at thousands of sources is an unattainable ideal, but these estimates suggest that great improvements are possible, and help explain the intense current interest in alternative approaches.

**Indirect Effects**

Although the direct costs of environmental regulations are significant, some analysts think that the indirect effects on the overall economy are much more important. For one thing, the rigidities of the technology-based approach may inhibit technological innovation in this area, although this proposition is difficult to verify empirically.

\footnote{16} However, if industries with high marginal abatement costs just happen to be located where the marginal damages are high, it may be more cost-effective to set standards with different marginal abatement costs in different industries.

\footnote{17} The marginal abatement cost estimates varied from 10¢/kg of BOD removed for the large chicken-processing plant subcategory to $3.15/kg BOD for the small duck-processing plant subcategory. See A. Krupnick & W. Harrington, Equity and Efficiency in the Promulgation of Federal Regulation: The Case of EPA’s Effluent Discharge Standards (Sept. 6, 1980) (paper presented at Allied Social Sciences Association Annual Meeting).

\footnote{18} E.g., U.S. ENV'TL PROTECTION AGENCY, AN ANALYSIS OF MARKET INCENTIVES TO CONTROL STATIONARY SOURCE NO\textsubscript{x} EMISSIONS (Draft Oct. 1980).

\footnote{19} COUNCIL ON ENVIRONMENTAL QUALITY, ELEVENTH ANNUAL REPORT (1980). A study prepared at Resources for the Future estimates expenditures due to implementation of the 1970 Clean Air and the Federal Water Pollution Control acts to be about $34 billion per year in manufacturing and utilities. Total national expenditures are expected to be $77 billion per year (1978$). See H. Peskin, Environmental Gains and Economic Losses: A Connection? (April 1980) (report prepared for the Environmental Assessment Council of the Academy of Natural Sciences, Philadelphia, Pa.).
Technology-based standards by no means eliminate the incentives for innovation. Because such standards are usually based on the “best” technology available (variously defined), they may promote the diffusion of existing technology. In addition, with a technology-based effluent standard, there is an incentive to introduce innovations which reduce the cost of meeting the standard so long as there is some assurance the standard will not be tightened in response.

Nonetheless, it seems clear that technology-based standards provide little incentive for innovations that reduce emissions below state-of-the-art. In fact, these standards may discourage such innovations if EPA always responds to them by making the standard more stringent. This response leads to the so-called “ratchet effect,” which can affect incentives for abatement innovation at both new and existing plants. New plants are affected because EPA is supposed to revise new source performance standards to reflect “best available” technology. Existing plants are affected because their permits are of limited duration. If an existing plant adopts innovative technology that reduces pollutant discharges below the current discharge standard, it may find itself subject to a more stringent standard based on the new technology when the permit is renewed. When standards are ratcheted, only firms in the business of supplying abatement technology have incentives to develop pollution-reducing innovations. Because such firms typically supply end-of-pipe equipment only, opportunities for fundamental process innovations that reduce emissions may be lost.

Technology-based standards provide barriers to other types of innovation as well. Both the Clean Air and the Clean Water acts require new plants to meet more stringent emission limitations than existing plants through the use of new source performance standards. This discrepancy between old and new plant requirements tends to reduce investment in plant and equipment, and remaining investment is diverted away from new plant construction and toward rehabilitation of older equipment. Innovation is retarded because much of it would be embodied in new plant investment. The tendency to “grandfather”

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20. See, e.g., A. Freeman, *Air and Water Pollution Policy*, in CURRENT ISSUES IN U.S. ENVIRONMENTAL POLICY 12, 56-57 (1978). If the technology-based standard requires a particular technology, there is no incentive at all for innovation. As noted, the air and water discharge standards we are discussing required performance equivalent to a designated technology. Nonetheless, firms appear to behave as if the designated technologies are required, an approach that minimizes their exposure to risk. *Id.*


existing plants also works indirectly to inhibit innovation (and competition) by restricting entry.

Perhaps an even more serious consequence of the current approach is that it makes for a more uncertain business climate.\textsuperscript{2,3} Plant managers contemplating investment in new plants face uncertainty about what future regulations will require and when the requirements will take effect. Moreover, the extensive permitting requirements have greatly increased the lead time required for construction of new facilities.\textsuperscript{2,4} These uncertainties can substantially affect the profitability of new investment.

The "prevention of significant deterioration" (PSD) and non-attainment policies exacerbate the uncertainty problem. A new plant (or an expansion of an existing plant) to be built in either a PSD or a nonattainment area is subject to significant new regulatory requirements that may be extremely difficult to overcome. Inasmuch as investment in new plants is a primary source of economic growth, the importance of these policies is obvious.

Under the PSD policy, the "clean air" areas of the country have been subdivided into three classes.\textsuperscript{2,5} In each class, a certain degradation of existing ambient air quality is permitted. These increments are approximately 2 percent of the primary national ambient standards in Class I areas, 25 percent in Class II, and 50 percent in Class III.\textsuperscript{2,6}

In order to ensure that the increments are not violated, PSD requires a preconstruction review of proposed new or expanded industrial facilities. In this review the following are required at a minimum:

(a) monitoring of preconstruction air quality, if not previously done;

(b) demonstration, using air quality models, that construction of the plant will not violate any allowable increment, either around the plant or in any other region (this could be very important for plants located in Class II or III areas but which are upwind of Class I areas);


24. Anecdotal evidence for the effect of environmental regulation on delay abounds. See, for example, the case studies found in CONGRESSIONAL RESEARCH SERVICE, LIBRARY OF CONGRESS, ENERGY DEVELOPMENT PROJECT DELAYS: SIX CASE STUDIES (Serial No. 96-7: 1979). However, we have been unable to find any systematic studies of the effects of regulation on construction delays.


26. Most national parks and wilderness areas were permanently designated Class I. All other areas were initially designated Class II. States are authorized to redesignate areas to Class I or III, but only after preparing an impact analysis and holding a public hearing. Class III designations also require legislative approval of local governmental units representing a majority of area residents. 42 U.S.C. § 7474(b) (Supp. II 1978).}
(c) agreement to install best available control technology (BACT); (d) commitment to conduct postconstruction monitoring; and (e) a public hearing.

If all requirements are satisfied, EPA will issue a permit and the source may commence construction.²⁷

With the possible exception of (d), each of these requirements is a potentially serious impediment to new plant construction. If previous air quality monitoring has not been adequate, it may take two years to establish a baseline. The need to demonstrate that increments will not be violated is potentially an even greater source of delay and uncertainty. Since air quality modeling is notoriously inexact, the stage is set for possibly lengthy litigation between opposing groups using competing models. The confusion will be exacerbated by the fact that the applicant will have to model not only his own plant but the proposed plants of others.

The requirement for best available control technology will be defined case-by-case for each applicant, though the adopted technology must be more effective than the applicable new source performance standards. This requirement may add considerably to the cost of abatement. Negotiation over the best available control technology could also be a significant source of delay and uncertainty.

The effect of the public hearing requirement on uncertainty and delay is unknown. It can be either an occasion for the establishment of communication between the company and the community in which it seeks to reside, or a tactical opportunity for interest groups opposed to construction for reasons that have little to do with air quality.

In “dirty air” areas, new or expanded plants are subject to the nonattainment policy,²⁸ the requirements of which are likely to be even more onerous than those of preventing significant deterioration. In the first place, the 1977 amendments to the Clean Air Act required the states to submit by July 1, 1979 revised state implementation plans to assure compliance with ambient air quality standards by the end of 1982 (with a possible extension of the deadline to 1987 for photochemical oxidants and carbon monoxide).²⁹ The new state implementation plans must put into effect a permit program for construction and operation of major new or modified sources (previously this was optional). Moreover, to obtain a permit, a firm wishing to install the new source must meet the following conditions:

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²⁷. To avoid confusion we use “source” to mean a discharge point. Thus, a plant can have several sources just as a firm can have several plants. In EPA usage “source” can refer to any of these entities.
²⁹. Id. § 7502(a) (Supp. II 1978).
(a) For those pollutants not meeting ambient standards, the plant must ensure that the total quantity of emissions does not increase. This will probably mean that pollution reductions, or “offsets,” greater than the source is expected to generate must be obtained from other sources of those pollutants. Alternatively, the states could force cleanup of existing sources in order to allow a sufficient margin for growth.

(b) The plant must install equipment that achieves a “lowest achievable emission rate” (LAER). Like best available control technology, it is set on a case-by-case basis and is supposed to be more stringent than new source performance standards.

(c) The firm must demonstrate that its other plants within the state are in compliance. In addition, the state must show that it is making reasonable progress toward achieving the 1982 (or 1987) objectives of the state implementation plan.

In principle, the offset approach can be an effective and efficient way to achieve air quality objectives, although practical difficulties may arise if few dischargers of the relevant pollutants can be found. However, this desirable feature may be overwhelmed by the other requirements of the nonattainment policy, which create special barriers for expansion of existing plants or construction of new ones. Probably the greatest source of uncertainty is the requirement that the state be making reasonable progress toward attainment. Because fulfillment of this requirement is vitally affected by the behavior of air quality agencies within the state and by other firms, it is something over which the applicant has little or no control.

The prevention of significant deterioration and nonattainment provisions together were intended to make the national air quality program comprehensive—to bring the heavily polluted areas of the country up to some minimum standard, while protecting the quality of the air where it is still clean. Instead, these changes created the potential for a regulatory quagmire. Because air quality in every location must either be better or worse than national standards, one of these two policies will presumably apply everywhere. Moreover, because air quality in an area can be better than the ambient standard for one pollutant and worse for another, it is possible, even probable, that an area will be subject to both the prevention of significant deterioration and nonattainment policies. This is not unlikely since

30. Id. § 7503(1)(B) (Supp. II 1978).
31. Id. § 7503(2) (Supp. II 1978).
32. Id. § 7503(3) (Supp. II 1978).
33. See discussion regarding offsets, infra.
much of the country violates the oxidant standard while complying with the sulfur oxide standard. Overlap can also occur if emissions from a source located in a nonattainment area can cross into a Class I area. In either case, the source will be subject not only to separate requirements but even to two different air quality bureaucracies: EPA (for prevention of significant deterioration) and the local or state agency (for nonattainment).

In sum, the existing structure of air and water pollution regulation, particularly the prevention of significant deterioration and nonattainment provisions of the Clean Air Act, is a potentially serious obstacle to economic growth in the United States. The direct resource costs of these policies may not be the main problem. Indeed, while the econometric studies discussed elsewhere in this volume do not ascribe much of our current poor economic performance to environmental regulation, these models are driven only by reported or estimated direct expenditures on environmental protection. Regulatory delay and uncertainty may be causing economic distress that these models attribute to other causes or to the "unexplained residual." Any discussion of reform, therefore, must consider both the expenditures necessitated by regulation and their effects on uncertainty.

PROCEDURAL REFORMS

One general approach to regulatory reform is to alter the procedures used to develop and implement environmental regulations. Such changes can reduce both direct expenditures and the losses associated with regulatory delay and uncertainty. Several of these proposed procedural reforms—in particular, in rulemaking and permit procedures, delayed compliance for innovations, cost-effectiveness standards, and improved federal-state coordination—may have clear macroeconomic impacts.

Rulemaking Reforms

Of the myriad proposals advanced to reform the process of setting technology-based standards, we discuss reforms of the information-gathering phase of writing effluent limitations, the use of subcategorization, and the timeliness of promulgating regulations.

Improving Information Flow

Writing any technology-based standard requires gathering and organizing information on waste treatment practices, costs, and efflu-
ents from industry sources, control equipment vendors, and industry experts. Typically, outside consultants, acting more or less in close consultation with an EPA project officer, are hired to produce a "development document" or "background information" report containing this information. This process came under attack during the BPT rulemaking because contractors, rather than EPA, initially recommended effluent limitations. Contracts were often let to the lowest bidder regardless of credentials, and qualified contractors were accused of underbidding on initial work in order to obtain future, sole source contracts. Finally, the range of technological alternatives considered by the contractors was too narrow.

The practice of having contractors recommend limitations has been modified for establishment of the BAT standards in response to questions about EPA's lack of oversight over the information flow. But, pressures of time, funding, and custom will still limit the range of technological alternatives considered by the contractor for best available technology. Because many firms may be unwilling to incur the higher risk of enforcement action associated with a compliance strategy that departs from the suggested technology, restrictions on the options considered may impose compliance costs that are higher than necessary. Moreover, this problem is exacerbated for BAT because the range of pollutants, and therefore abatement options, is so much greater than for best practicable technology.

One approach might be for EPA to fund simultaneously a number of competitive development documents, with EPA acting as arbiter and synthesizer. Doing so would ensure that information from many points of view would be brought into the process at a sufficiently early stage to affect the outcome. Doubtless this approach would substantially increase the cost of preparing a development document because not one but two or three draft documents would be prepared. It would also mean more work for EPA: the agency would no longer be able to issue the contractor's draft report as the development document without substantial changes, as it often did in earlier rulemaking procedures. In the long run, however, the use of competitive development documents might significantly reduce the administrative cost and thereby the total social cost of a regulation. The use of information from wider points of view may make the industry

37. While information from a wide range of sources does make it into the process, most of it enters after the regulation has been proposed. By this time the broad outlines of the regulation usually have been set, and the regulation can be changed only slightly.
more receptive to the regulation, reducing the chance of a court challenge, and thereby reducing administrative cost.

Greater Attention to Subcategorization

The Environmental Protection Agency issues separate regulations for groups of firms in an industry with similar air or water problems. This "subcategorization" of industry is required to tailor suggested technologies and effluent limitations to specific processes, products, or other industry characteristics. It is also used for equity reasons, to cushion the impacts on industry segments, which otherwise would be especially hard hit by the regulation. This practice plays a central role in water pollution rulemaking and a more indirect role in the state implementation planning process for air pollution control. Subcategorization can affect not only control costs for firms placed in one category or another but also the competitiveness of the industry. Where subcategorization is used primarily to give smaller or older plants more lenient treatment, competition is enhanced since exit from the industry may be prevented. Competitive industries may be less resistant to downward pressures on prices and wages, which in turn may make anti-inflation policy more effective. Also, more subcategories for smaller, older plants may promote efficiency if the marginal compliance costs for these plants are higher than for larger, newer plants at a given treatment level. However, greater subcategorization has its drawbacks. Reducing the likelihood of exit by favoring smaller or older plants interferes with the turnover of capital stock in the industry and thereby reduces productivity. These effects are especially pronounced when existing plants are favored over new plants, as is currently the case.

Because of the mixed effects of subcategorization, no simple policy option emerges. Nonetheless, explicit attention should be given to the incentives offered to firms in the industry instead of concentrating solely on questions of equity or technology.

It should not be too surprising that greater subcategorization could emerge as a reform. Effluent fees, marketable permits, and other traditional economic incentive policies allow environmental targets to be reached at minimum resource cost. At the limit, if government established subcategories so as to equalize marginal treatment costs (a subcategory for nearly every firm might be needed), this optimal resource allocation could be approximated. Yet, it is difficult to imagine how such a system would work in practice. For instance, small plants do not necessarily have higher marginal costs of compliance, while an old plant may not necessarily have all old equipment. And, informational demands would probably be prohibitive.
Permit Reform

Permits are used extensively in both air and water pollution policy to promote compliance with regulations. Some options which could reduce uncertainty and delay follow.

Extend Permit Life

Increasing the life of a permit will reduce the effects of uncertainty about future requirements because it tends to allow a more complete amortization of existing or newly installed equipment. With a short permit life, an operator must worry about how the requirements will change when the permit expires, particularly in view of the ratchet effect.

Federal water pollution permits for existing sources have a term of five years, while for new sources the term is ten years. There is evidence that some plants are attempting to have their sources classified as new sources, even though that designation subjects them to more stringent effluent standards (new source standards rather than best practicable technology) because they are willing to trade increased certainty for the increased costs of more stringent requirements.38

Improve Coordination with Other Federal and State Policies

At present, new industrial projects are subject to a wide array of environmental statutes besides the Clean Air and Clean Water acts.39 The individual impact of any one of these statutes on business, much less the cumulative effects of all of them, could be substantial. It would be useful if the agencies administering these statutes could coordinate their efforts to ensure that this burden is no worse than necessary. Quarles suggests that one of the most difficult tasks for a businessman—especially a small businessman—is to find out precisely what kinds of regulations can affect him. This task becomes more difficult as new statutes are enacted or regulations issued. As Quarles points out,

[A]lthough substantial considerations of public policy support the position that some system of government review should precede industrial decisions having major impacts on public values affecting

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38. J. Quarles, supra note 11, at 25.
the environmental and natural resources, the current system of numerous single-purpose reviews, each conducted separately and according to its own timetable, is not the best solution. Appropriate environmental tradeoffs are difficult to make under the current framework; unnecessary paperwork and administrative burdens are virtually inevitable; and unduly long delays in reaching a final government decision are highly likely.\(^4\)

Several measures could be taken to help streamline the permitting process. A regulatory clearinghouse, where a developer can find out the permits required for particular projects, might be useful. Another possibility would be to create an agency which would help secure the permits. Most important, a "one-stop" permitting process could be initiated, although this is not as simple as it might appear. The requirements of the various environmental statutes constrain the extent of possible consolidation. A one-stop process would also require much more cooperation and communication among disparate government agencies whose goals may conflict.

The Environmental Protection Agency began the complex and difficult task of consolidating permits in 1978. Over a year ago, two task forces were established: the New Source Review Task Force and the EPA Permit Consolidation Task Force. Among other things, the former recommended the designation of a new source facilitator/expeditor in each region, so that a prospective applicant could go to one place in the agency to determine the requirements it would have to meet.\(^4\)

The Permit Consolidation Task Force recently issued regulations which offer a single permit form to be used for simultaneous application and review of several EPA permits.\(^4\) Definitions and program requirements have been made more uniform and a series of booklets on the regulations addressing the concerns of particular users will be issued.

The Environmental Protection Agency is also involved with expediting energy projects through its Energy Mobilization Task Force and developing a more efficient format for handling the environmental impact requirements of the National Environmental Protection Act. Thus the problem of duplicate, conflicting, and above all, cumulative permit requirements is well recognized within EPA, but numerous opportunities still exist for further consolidation of interagency permits.

\(^4\) J. Quarles, supra note 11, at 4.

\(^4\) EPA Consolidated Permit Regulations, 44 Fed. Reg. 34, 244 (1978).

\(^4\) In response to concern that environmental groups will find it more difficult to challenge a consolidated permit, procedures for public hearings, evidentiary hearings, and non-adversary hearings are built into the process.
Reforms that streamline permit procedures will necessarily reduce opportunities for environmental and other citizens' groups to delay or alter projects. That is why the reforms will be so difficult to implement. Nevertheless, there may be some scope for shortening the time spent negotiating without compromising substance.

**Cost-effectiveness Standards**

As noted earlier, technology-based standards can impose very different marginal abatement costs for different industrial categories, resulting in losses in economic efficiency unless damages vary in the same way. One way of dealing with this problem in a regulatory framework is to set standards which equalize marginal abatement costs and thereby minimize the costs of obtaining the resulting reduction in aggregate emissions. There are three problems with this approach, however. The first is the designation of the marginal cost target, or "benchmark." There is no obvious connection between any benchmark and the resulting levels of environmental quality. The second problem is dividing the industry so that firms with similar abatement cost functions are in the same category. The third problem is that finding the standard corresponding to the benchmark entails construction of detailed marginal abatement cost functions in each industrial category. The more finely an industry is divided to obtain homogeneity, the more work is required to construct cost functions.

A version of this policy tool surfaced in the Clean Water Act of 1977. To reduce the differences in marginal compliance costs of meeting best conventional technology, Congress designated the marginal cost per unit biological oxygen demand (BOD) removed by municipal waste treatment as a cost ceiling. Marginal costs above the ceiling for a subcategory presumably would provide grounds for EPA to lessen the subcategory's BCT standards. Marginal costs less than the ceiling would mean that the compliance costs were "reasonable." Thus Congress settled by legislative fiat the problem of setting the benchmark—at least in theory. It is still too early to tell how this process will work out in practice.

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44. The initial EPA estimate of municipal marginal treatment costs of conventional pollutants was $1.15/lb. of BOD removed. The Council on Wage and Price Stability (COWPS) challenged EPA's estimates and methodology while issuing a benchmark range of its own. COWPS found marginal costs from $0.31 to $0.82 per pound of BOD removed depending on assumptions about the proper form of the abatement cost function and correcting for differences in plant performance variables. EPA responded that the wide variability of costs made any benchmark open to criticism. See A. Fraas & V. Munley, Municipal Wastewater Treatment Costs (Sept. 1980) (report to Council on Wage and Price Stability, Washington, D.C.).
Perhaps the greatest benefit from the implementation of cost-effectiveness standards for best conventional technology will be in setting precedents. In establishing limits for best available technology, a convenient benchmark marginal cost is unlikely to be available for the myriad nonconventional and toxic pollutants. But the principle of cutting down the variance of marginal abatement costs for a given pollutant over all affected sectors is worth serious consideration in future rulemaking.

Innovation Waivers

In amendments to both the Clean Air and Clean Water acts, the debilitating effects of technology-based standards on abatement innovation were recognized and legislative adjustments were introduced. In the Clean Air Act Amendments, firms experimenting with innovative abatement methods were given additional time to comply with the standards. However, with “innovation” never defined and poor agency support, the program has been limping along. At present, a regulation is being drawn up to grant compliance delays for innovations under the Clean Water Act Amendments. The statutory limit of a three-year extension is too short a period to stimulate anything but off-the-shelf technology. The inclusion, however, of process innovations in the “innovation” definition and support for the regulation within EPA should make it more successful than its counterpart in the air program. Still, if the program fails to provide additional compliance time for firms with innovative technologies that fail, the risks of innovating may still outweigh expected gains.

SUBSTANTIVE REFORMS

The procedural reforms discussed in the previous section center on changes in rulemaking or implementation that do not challenge the central place of technology-based standards in water and air pollution control policies. Certain substantive reforms, however, have begun to supplant the technology-based approach in state implementation plans and are on the drawing board in the water program at EPA.

There are powerful economic reasons for supporting economic incentive-based reforms over technology-based standards. Nevertheless,


the interest in these reforms owes more to the practical problems created by certain features of the Clean Air Act than to increased awareness of economic principles on the part of public officials and industry.47 For areas in nonattainment, industrial growth has been effectively halted unless newcomers or expanding firms can secure emission reductions from an existing source or unless the state forces existing firms to roll back emissions to create a "margin for growth." In PSD areas, growth has also been limited because of requirements on emissions from new or expanding firms. Incentive-based policies can reduce both the roadblocks to growth and the compliance burden on existing firms. Also, some offices in EPA view these policies as a better means of fostering abatement innovations than through continuously redefining best available technology.

**Bubbles, Banking, and Offsets**

The details of these policies have been changing so rapidly that only their general characteristics are described below. Basically, they all involve shifting the clean-up burden toward sources with lower abatement costs and away from those with higher abatement costs. Thus, the aggregate compliance costs of meeting a standard can be reduced while maintaining or improving ambient quality. Firms have incentives to find the cheapest source to control even if the control involves a reallocation of abatement activity within the firm, an innovation, or the purchase of emission reductions from another firm.

Historically, offsets are EPA's first attempt to reduce compliance costs through reallocating the clean-up burden. New or expanding firms in a nonattainment area are required to install advanced treatment technology and secure emission reductions from other polluters in the area in excess of their own emissions.48 The net effect of this policy is to allow for growth in nonattainment areas, while reducing air pollution and compliance costs. It also gives existing firms an incentive to find cheaper means of controlling their pollution. A more recent policy innovation allows firms that reduce emissions below their permit level to "bank" these emissions for use in their future expansion or to sell them to a new or expanding firm as an offset.

The bubble policy that was announced in December 1979 permits all of the stacks in a plant to be considered as one stack.49 This pol-

47. In addition, Congress created the opportunity for these reforms in both the CAA and its amendments.
49. EPA’s bubble policy was affirmed in *Alabama Power Co. v. Costle*, 636 F.2d 323 (D.C. Cir. 1979). The policy is codified in 40 C.F.R. §§ 51.24(b)(2) and 52.21(b)(2) (1978).
icy allows controls to be relaxed at those stacks where abatement costs are high and tightened at those stacks where control is cheaper. It is thus much like an offset transaction taking place within a firm. Recently, the policy has been broadened so that even plants with different owners and at different locations can use the bubble policy so long as air quality is not degraded.

Innovations that reduce emissions or costs may be stimulated under any of these programs because emission reductions resulting from these innovations can be sold, held for later use, or used to offset an increase in emissions elsewhere in a plant. In addition, should these reforms reduce uncertainty and other regulatory burdens, long-term investments and associated innovation prospects may be enhanced.

**Experience**

The Environmental Protection Agency claims that 650 documented offsets have taken place since January 1977. Most of these were internal offsets—where an expansion of emissions at one source was more than compensated by a decrease in emissions from another source owned by the same firm (e.g., closing one plant and rebuilding another at the same site).

External offset transactions between two or more firms are not yet common. Those external offsets that have occurred may not be typical of future offsets because they involve once-and-for-all emission reductions, such as the substitution of water-based for oil-based asphalt by a state highway authority.

Experience with bubbles and banking is very limited. The first bubble application was approved in November 1980, when an electric utility proposed to substitute high for low sulfur coal at one plant while burning natural gas instead of low sulfur coal at another plant. Sulfur dioxide emissions should fall overall, with savings of $27 mil-

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51. One much publicized case involved a new General Motors plant and offsets obtained from local oil companies in Shreveport, Louisiana, and Oklahoma City. As a result of these transactions engineered by local Chambers of Commerce in both areas, GM built a $400 million plant employing several thousand people. However, not only were the offsets given at no cost, so the incentive for locating the cheapest sources didn't exist, but most of the offsets were only on paper. The oil companies were voluntarily abating pollution they would have been required to abate two years later (under a ruling being discussed at that time). Also, they were going to make some of the adjustments on their own for economic reasons. See R. LIROFF, AIR POLLUTION OFFSETS: TRADING, SELLING, AND BANKING (1980).
lion per year. Over 40 companies are developing bubble applications, showing savings of several million dollars each in either capital or operating costs.\textsuperscript{52} Banking programs have recently begun in San Francisco, Puget Sound, and Louisville, but few transactions have taken place. Thirty states are formally considering the banking approach.\textsuperscript{53}

**Problems**

Although it is certainly too early to make solid judgments on the viability of these programs and their macroeconomic impacts, it is not surprising that the initial experience has been mixed. A major problem lies in the conservatism of firm managers who may fear that these policies will be followed in short order by others. New policies may have contradictory requirements that leave them stuck with valueless banked emissions and converted boilers that would need to be reconverted. Another problem is the administrative obstacles and high cost of obtaining bubbles and banking emissions. Only firms in compliance may apply, and a SIP revision is required for every bubble—a lengthy and nonroutine process.\textsuperscript{54}

The Environmental Protection Agency is working to reduce regulatory uncertainties and simplify some administrative procedures, but the policies still have basic problems. First, the scope for trading offsets is limited by the technology requirements on new and existing sources. New or expanding firms must still install expensive abatement technologies. Thus, offset trading and the cost savings that go with it involve only the relatively small amount of emissions not treated by this technology. Existing sellers of offsets also have technology-based standards to meet.\textsuperscript{55} Further, firms that are likely to be facing the largest abatement costs are those excluded from these plans—namely, those firms not in compliance. While an equity case can certainly be made for treating recalcitrant firms differently from


\textsuperscript{53} The performance of the bank in Puget Sound cannot yet be evaluated because it is too new, but over 90 requests for credits have been received. In San Francisco there exists an informal bank for emission credits deposited by a firm for its future use, and a formal bank where credits are available for sale to other firms. Participation in the informal bank has been high because many firms which had installed more strict controls than necessary prior to the bank's operation were "grandfathered" in. No deposits to the formal bank have been made as yet. In Louisville, the 20 deposits resulted mainly from shut-downs. Personal communication with Charles Bausell, economist, General Accounting Office, Washington, D.C. (Dec. 12, 1980).

\textsuperscript{54} New rules put into effect recently by EPA, the so-called "generic" bubble policy, waive the SIP revision rule if certain conditions are met. *See Inside EPA: Weekly Report* (Dec. 5, 1980).

\textsuperscript{55} These standards are termed Reasonably Available Control Technologies (RACT).
those cooperating with clean-up efforts, there would likely be efficiency gains if such firms were included.\textsuperscript{5,6}

Another problem plaguing these policy initiatives is the high transaction costs involved in finding offset or bubble partners. Few seekers of offsets have actually paid another firm to reduce its emissions so that the firm could move in or expand. The SOHIO case in California is an example of an attempted offset reportedly beset by delay and strategic behavior on the part of suppliers of potential offsets.\textsuperscript{5,7} Moreover, the volume of offsets, formal emission deposits, and multi-firm bubble opportunities has not been sufficient to facilitate the development of a market. The problem is classically circular: thin markets generate little profit for middlemen, so they don’t participate. Without middlemen the market stays thin.

Among other problems, monitoring is particularly vexing. The approval of bubbles and offsets requires air diffusion modeling to prove nondegradation of air quality under certain conditions. Much disagreement exists on the capabilities of air quality models, their consistency with one another, their appropriateness in various situations, and so on. Until agreement is reached, the required use of such models will add to the uncertainty surrounding these policies and restrict participation.

Turning to macroeconomic effects, well-functioning offset, bubble, and banking systems could improve the allocation of resources, increase productivity and innovation, and reduce inflation. But a poorly functioning offset program will tend to restrict entry of new sources into nonattainment areas and discourage the expansion of existing plants. Also, because most nonattainment areas contain large cities with high unemployment, an unworkable offset program could seriously undermine attempts to reduce the rate of unemployment. Finally, problems in implementing these programs and in relaxing the vast array of conditions burdening banking and bubble programs may sour industry and regulatory authorities on other incentive approaches to pollution control.

\textit{Marketable Pollution Permits}

The marketable pollution permit (MPP) approach to controlling pollution is an idea first advanced by Dales in 1968 as an alternative to effluent taxes. Until recently, this idea generated little but aca-

\textsuperscript{56. Recalcitrant firms selling offsets would then be given credit for emission reductions they should have made.}

\textsuperscript{57. See CONGRESSIONAL RESEARCH SERVICE, supra note 24, at 105-32.}
demic interest. It wasn't until the application and elaboration of the offset policy that EPA began to consider buying and selling pollution permits. Now, marketable permits are seen as the final step in a progression that includes the bubble and banking policies discussed earlier.

Moving to a full marketable permit system in nonattainment areas would first involve the elimination of all technology-based emission standards. In addition, the banking, bubble and offset policies, together with associated administrative procedures (e.g., revisions of state implementation plans), would be combined and simplified. In PSD areas, the lack of an offset policy means that greater institutional changes would be required. Nonetheless, with ambient standards tighter than the national ambient standards, a marketable permit system is perfectly compatible with prevention of significant deterioration.

Two general types of marketable permit systems can be envisioned, one based on emission permits and another on ambient permits. Where ambient conditions are relatively insensitive to polluter location—chlorofluoromethane emissions may be an example—a system where permits are defined in terms of allowable emissions may work well. Thus, a firm in California could sell its right to emit 100 pounds of Freon to a firm in New York without a change in the effect of the Freon on stratospheric ozone.

Where the location of the source matters, as is the case with NO\textsubscript{X} or particulates, the authority could issue permits allowing the source to have some specified effect on ambient pollutant concentrations at particular receptor points. These permits would also contain information to convert concentrations to allowable emissions. When concentration permits are traded between firms, allowable emissions would need to be adjusted because the emissions value of a right to degrade air at a receptor by one unit depends on the location of the buyer and seller relative to the receptor.

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58. See J. Daies, Pollution, Property, and Prices (1968); D. Montgomery, Markets in Licenses and Efficient Pollution Control Programs, 5 J. Econ. Theory 395 (1972); T. Tietenberg, The Design of Property Rights for Air Pollution Control, 22 Pub. Pol'y 275 (1974).


60. This information is embodied in a ratio of transfer coefficients (termed exchange rates), $\frac{T_{ij}}{T_{kj}}$, where $T_{ij}$ is the contribution of a source at location $i$ per unit of emissions to the concentration of a pollutant at receptor $j$. See D. Montgomery, supra note 58, for more on this point.
If ambient standards are to be met at all points, the ambient permit system must be complex, requiring a firm to hold a portfolio of permits covering each receptor point. In contrast, the emission system requires holding only one type of permit. Yet, the simplicity of the latter system comes at the cost of uncertainty over meeting ambient standards and in a loss of efficiency. A study of the abatement cost of meeting a hypothetical short-term NO$_x$ standard in the Chicago area indicates that the compliance costs may be up to ten times higher with a uniform rather than a fully spatially differentiated market permit (or effluent fee) system. For longer term standards, different pollutants, or other locations, the cost savings may be less. In any case, balancing the costs and benefits of greater spatial differentiation can provide guidance about the type of system to adopt.

The theoretical advantages of marketable pollution permit systems may be compromised by uncertainty created by two implementation problems. First, firms must have confidence regarding the future behavior of the government. Unless discharge permits are treated as property rights, entitled to the same constitutional guarantees as other property, firms would face the uncertainty of having their permits revoked or redefined in the future. At the same time, when the government wishes to change the quantity of rights outstanding, it must do so in a way that minimizes market disruption. Second, firms may face market uncertainty if the number of participants is too few. A potential buyer’s fear that it will be unable to find a seller will itself tend to prevent trading, causing firms to hold their permits for future use rather than make them available to others. Strategic concerns may also hinder market development, i.e., a firm may have monopoly power and refuse to sell its permits to prevent entry or expansion by other firms.

In view of these shortcomings, it is clear that marketable permits will not be a panacea; the proper regulatory environment that would make these permit markets viable will not be easily or quickly

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61. Since national ambient standards must be met at all points, in theory the portfolio would be infinitely large. In practice, receptor points in a given area could be sifted for hot spots. Then the overall airshed would be divided into markets, each with its own hot spot. Exchange rates would be computed from these receptor points.


63. Other implementation issues concern the distribution of permits, their terms, participation by citizen groups and other third parties, verification, and enforcement. See S. Rose-Ackerman, Market Models for Water Pollution Control: Their Strengths and Weaknesses, 25 PUB. POL'Y 383 (1977), for a discussion of implementation issues.

64. The analogy to government behavior with strategic metal or petroleum reserves is instructive here.
achieved. The macroeconomic effects associated with reduced compliance costs and increased innovation may therefore be slow in coming. Present regulatory uncertainty caused by changes in technology-based standards may only be replaced by a different kind of uncertainty—that associated with the operation of the permit markets.

Effluent Charges

No discussion of environmental policy options would be complete without mention of effluent fees, but because this approach is already the subject of a vast literature, we will be brief. Under an effluent fee policy, each discharger must pay a fee or tax for each unit of pollution discharged. By forcing firms to internalize heretofore external costs, this fee provides an incentive for pollution abatement.

In theory, effluent fees share with marketable permits two important advantages over technology-based standards. First, with either system, an aggregate pollution discharge target can be met at least cost. Under a uniform effluent fee, each plant would reduce its pollution discharge until the marginal cost of further abatement equaled the fee. Most of the abating would be done by those for whom it was least expensive. In addition, fees offer an important long-term advantage over standards; every discharger has an incentive to search for both pollution-reducing and cost-reducing abatement innovations. As noted earlier, effluent standards encourage only innovations that reduce cost.

Effluent fees also enjoy important advantages over marketable permits. Because the fee approach does not require the operation of a market, the problems of establishing a market, of market thinness, and of monopoly power discussed earlier are avoided. In addition, an effluent fee avoids the rigid constraints on growth imposed by a too-restrictive permit system because the level of the fee places a ceiling on marginal abatement costs.

Unfortunately, however, effluent fees have their own unique disadvantages. One is the obverse of the problem mentioned in the preceding paragraph. In an expanding economy, while marketable permits risk imposing heavier than optimal abatement costs, constant effluent fees risk deteriorating environmental quality. Second, effluent fees are emasculated through inflation.

66. However, environmental quality depends not only on the sum of pollution discharges, but on their spatial and temporal patterns. For this reason a nonuniform fee—one depending on the location of the discharger—may be less costly.
67. For further discussion see Rose-Ackerman, Effluent Charges: A Critique, 6 CAN. J. ECON. 512 (1973).
A third problem of effluent fees is the disposition of the collected revenues. The cost of an effluent charge policy to a firm includes not only the cost of abatement but also the taxes it pays on its remaining discharges. Unless these transfer payments are returned to industry, the total cost of an effluent charge system to the producing sector may be greater than under an effluent standards policy, even though the abatement cost is less.  

Finally, it is difficult to determine what the effects of a given fee structure on ambient environmental quality will be. Achieving an ambient quality objective with effluent fees requires fairly detailed knowledge of the abatement cost functions of all dischargers and the "transfer coefficients" between each discharger and the different areas of the receiving medium. Only the latter is required for either marketable permits or effluent standards. To remedy this problem, some writers have suggested a trial-and-error approach or a "self-adjusting" charge. In either case, the fee would initially be set at a low level and would increase annually until the desired ambient conditions were met. This approach might work with a uniform charge, but if the fee is spatially differentiated and some areas exceed the ambient objective and other areas fail to meet it, it would be virtually impossible to know how to adjust the fee structure. This problem would be especially difficult in an area undergoing rapid economic growth.

CONCLUSION

The high costs and limited success of the air and water pollution policies formulated in the early 1970s have given impetus to a search for reform. Most of the suggested reforms discussed above have been promoted either to remove procedural obstacles to plant expansion or to replace the current command-and-control approach to regulation with economic incentives. Their proponents see these reforms as the means to a considerable reduction in the cost of environmental policy, with little, if any, sacrifice in environmental quality. At the same time, many of these ideas will be strenuously opposed by environmentalists, who generally fear that any change in the status quo will represent a retreat in the nation's commitment to environmental quality.

The effects of these reforms may not be nearly as disastrous as op-

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68. E. Brill, C. Revelle & J. Liebman, An Effluent Charge Schedule: Cost, Financial Burden and Punitive Effects, 15 WATER RES. RESEARCH 993 (1979). Transfer payments would need to be returned to industry in such a way that incentives to abate are left undisturbed.
ponents fear. There is little in them that is inherently hostile to environmental quality. Indeed, if these policy instruments can achieve given levels of environmental quality at lower economic cost, the tension that certainly now exists between the goals of environmental quality and economic growth will be reduced. In other words, cost-effective policy instruments are also environmentally benign.

However, the expectations of the benefit to be derived from any of the alternatives need to be tempered. Some of the difficulties of the current approach are not corrected by any of the reforms discussed here, and may well be inevitable regardless of policy. One of these is the need for source surveillance. Accurate information about what sources are actually discharging is necessary to determine whether effluent standards or permit conditions are being complied with, and to calculate each plant's effluent charge payment. However, surveillance is expensive and for this reason has hitherto been infrequent. Therefore, we do not really know the extent to which existing permits or standards are being violated, although some empirical work suggests that it is substantial.69

Another difficulty with current policy that is not easily handled by the reforms we have discussed is the spatial problem. Every imaginable pollution control policy works immeasurably better for those pollution problems which are not location-specific. Unfortunately, few problems fall into this category.

A third element common to all policies is the importance of politics. Attempts to remove political considerations from environmental policy-making have been prominent ever since environmental concerns first arose. For example, the desire to put environmental concerns above politics probably contributed to Congress' initial embrace of the technology-based approach; it was hoped that these standards could be based purely on technical decisions made by disinterested experts at EPA. We know now that enough ambiguity was written into the Clean Air Act and the Federal Water Pollution Control Act to allow extensive room for negotiation between EPA and affected industries, as well as plenty of opportunities to apply political pressure. These opportunities will almost surely be just as important for any other policy instrument.70 Environmental decisions are political, of course, because alternative policies or programs have different dis-

70. C. Russell, What Can We Get From Effluent Charges, 5 POL'Y ANALYSIS 155 (1979), argues that an effluent charge system will be subject to the same political influences as the current regulatory approach.
tributional consequences. What we rather disparagingly call "politics" is really the process by which various parties exercise their rights to be heard and to petition for a redress of grievances. Choice of policy instrument will not affect this fact, inconvenient though it may be.

Finally, much of the uncertainty that is said to dampen the entrepreneurial spirit may be an inevitable consequence of environmental policy. One reason environmental regulation imposes so much uncertainty on the economy is that so little is known about the health and ecological effects of pollution, especially trace amounts of toxic materials. Removing regulatory barriers to economic growth does not eliminate this uncertainty; rather it shifts the burden of risk to the environment.

We insert these notes of caution, not because we think that environmental policy reform is hopeless. On the contrary, the alternatives discussed here, especially those involving economic incentives, offer much promise. However, nothing would destroy that promise with greater sureness than a backlash caused by unfulfilled expectations.