ENHANCING THE EFFICIENCY OF ENVIRONMENTAL, REGULATION

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I. Introduction

Increasing attention to the efficiency of environmental regulation has been the direct result of several factors. First is the realization that the major regulatory programs put in place in the 1970s are expensive, with annual compliance costs now running on the order of $40-50 billion per year (see below). Thus, even a small percentage reduction in the cost of meeting environmental goals can mean large dollar savings. Second, a series of presidential executive orders, culminating with Executive Order 12291 issued by President Reagan in early 1981, has elevated economic efficiency to a position of importance in environmental rulemaking. Finally, actual experience with incentive-like mechanisms in regulation--namely, the EPA's offset and controlled trading policies--have begun to confirm what analysts had long alleged: substantial savings in control costs are possible in environmental regulation if regulatees are given the flexibility to reallocate the burden of control amongst themselves (see Tietenberg [1984]).

This brief report concerns itself with efficiency enhancement in environmental regulation. Its primary purpose is to identify respects in which, for statutory or administrative reasons, EPA's pursuit of economic efficiency in rulemaking has been inhibited historically. Where possible, the report also explains briefly why impediments to efficiency have arisen and, finally, what types of research would be helpful in illustrating the size of the efficiency losses. If an efficiency loss is small and the rationale for ignoring it is compelling, there might be no reason to push for a statutory or administrative change. If, on the other hand, it is substantial and the original rationale no longer persuasive, change might be entertained.

There are a number of ways that one might approach such a task. EPA is delegated major regulatory responsibilities under seven different statutes--the Clean Air and Clean Water Acts, the Federal Insecticide, Fungicide, and Rodenticide Act, the Safe Drinking Water Act, the Toxic Substances Control Act, the Resource Conservation, and Recovery Act, and the Comprehensive Emergency Response, Compensation and Liability Act. Each law has several important sections which implicitly or explicitly determine the extent to which economic factors can be considered in standard setting and economic efficiency pursued. One approach, then, would be to proceed section by section through each of these statutes identifying possible impediments to efficiency. This would not only be too time-consuming for the purposes of this report but would also overlook possible administrative approaches which, while not embodied in the statutes, have also inhibited the pursuit of efficiency in environmental regulation.

A more promising approach in such an exploratory report would concentrate on the most economically significant features of the EPA's regulatory programs. As suggested above, seemingly slight changes in parts of these programs could result in sometimes substantial efficiency gains. Moreover, since the regulatory programs with the most substantial current economic impact are also the oldest, identifying impediments to efficiency in them can provide valuable lessons for newer regulatory programs.

In the following section, the EPA's regulatory programs are rank-ordered by annual compliance costs, estimated from a variety of sources. Then, drawing where possible on work by EPA, RFF, ELI and other analysts or organizations, some important obstacles to economic efficiency in each of these programs are identified. In several cases, the justification for these impediments are also identified and research opportunities are suggested which would illuminate present inefficiencies and indicate what might happen if they were removed. A final section identifies common threads running throughout the major programs examined and makes several recommendations.

II. Compliance Costs of EPA Regulatory Programs

A. Air and Water Programs

Our reason for identifying programs which impose large compliance costs is that they may harbor the largest potential efficiency gains. However, since inefficiencies can involve under- as well as over-regulation, it is possible that areas which are under-regulated will be missed as a result of our taxonomy. We do not think such missions are likely to be important, but do note that large annual compliance costs are neither a necessary nor sufficient condition for resource misallocation.

DPRA Inc. has just completed the most recent report to Congress on the cost of complying with the Clean Air Act and the Clean Water Act. According to DPRA, annual compliance costs in 1981 for federal air and water quality regulation can be broken down and ranked as shown in the first five lines in Table 1.

TABLE 1

Category	Annual Compliance Costs (billions of $1981)
Public Water	$75.50
Utility Air	7.50
Industrial Water	6.60
Industrial Air	6.40
Mobile Air	6.00
Toxic Substances	0.35
Pesticides	0.30
Hazardous Wastes	2.00
Total	$44.65

In this break-down, "public water" refers to expenditures by federal, state and local governments for the collection and treatment of municipal wastes and the run-off collected by public sewer systems. "Mobile air" refers to the annual costs of controlling air pollution from cars, trucks, buses, motorcycles and other vehicles. The other three categories are self-explanatory once it is noted that "industrial" excludes electric utilities which are presented separately. Total annual compliance costs for air and water pollution control as estimated by DPRA in The Cost of Clean Air and Water Report amount to more than 1.4 percent of GNP in 1981.

Although they are the most recent, these are not the only estimates of the costs of complying with environmental regulations. Until 1981 the Council on Environmental Quality (CEQ) published annual estimates of environmental regulatory compliance costs. Generally speaking, the analysis underlying the CEQ estimates was less comprehensive than that supporting the Cost of Clean Air and Water Report because fewer resources were available for their preparation. However, because DPRA's estimates are quite primitive in certain respects, and because the CEQ estimates give a different ranking of relative program costs (a ranking supported in part by several recent independent studies), they are worth presenting here.

Taking the CEQ estimates of annual compliance costs for 1979 (the last year for which estimates exist) and converting them to $1981 using pollution control deflators published by the Bureau of Economic Analysis, gives the following:

TABLE 2

Category	Annual Compliance Costs (billions of $1981)
Public Water	$7.50
Utility Air	10.90
Industrial Water	7.80
Industrial Air	5.60
Mobile Air	12.20
Toxic Substances	0.40
Pesticides	0.10
Total	$44.50

(No RCRA estimate given, CERCLA not applicable in 1979.)

For two reasons the apparent similarity of the CEQ and Cost of Clean estimates is misleading. First, the CEQ estimates are for the year 1979 (expressed in $1981), and thus do not reflect substantial increases in mobile source pollution control costs as a -result of further tightening of carbon monoxide and nitrogen oxide emissions standards for 1980 and 1981 model -year automobiles. The CEQ estimates also omit other new compliance costs imposed during 1980-81, costs which are reflected in The Cost of Clean.

Second, although the estimates of <u>total</u> annual compliance costs are in close agreement, there are considerable differences in the composition of the total. For instance, the Cost of Clean estimate for "public water" is more than twice that the adjusted CEQ figure. On the other hand, annual compliance costs for mobile sources are twice as large in the CEQ estimates as in The Cost of Clean.

This is not the place to dissect each effort, but it is worth speculating briefly on which of the divergent estimates are more nearly correct. With respect to mobile sources, the adjusted CEQ estimate is probably too high but closer to the "true" number than that in The Cost of Clean ($6.0 billion). In his very thorough recent review of mobile source pollution control standards, White put the per-vehicle marginal lifetime cost, of complying with the 1981 emissions standards at $1400 (in undiscounted 1981 dollars) compared to the pre-EPA control vehicle (White [1982]). With 13,000,000 vehicles of all types sold annually, this implies an <u>eventual</u> steady-state annual cost of about $16 billion (assuming no technological advancement in emissions controls--probably unrealistic). But since the 1980 and 1981 model year emissions reductions account for $700 of White's $1400 estimate of total marginal cost, and since a small percentage of total vehicles on the road in 1981 were of 1980 or 1981 vintage, his steady-state total would have to be reduced. On the other hand, there are 160 million vehicles on the roads in the U.S.; if annual compliance costs per car are only $75, total annual compliance costs would be $12 billion. The $75 per vehicle figure does not seem unreasonable in view of the fuel economy penalties, inspection fees, added costs for unleaded gasoline, and annual capital costs associated with catalysts and other equipment on controlled vehicles.

With respect to the "public water" category, the estimate of $15.5 billion in The Cost of Clean is probably more realistic than the $7.5 billion adjusted CEQ estimate. According to the Congressional Budget Office, nearly $40 billion (in $1983) was spent in grants to states between 1972 and 1981 for the construction of sewage treatment plants (CBO [1984]). Adding the 25 percent state and local share would bring this total to $50 billion, although somewhat less in 1981 dollars. The annual capital costs (interest plus depreciation) on this stock alone could amount to nearly as much as the adjusted CEQ estimate. When expenditures for operation and maintenance are added ($4.5 billion in The Cost of Clean), the total annual cost probably exceeds $10 billion and may be closer to the $15.5 billion estimated in The Cost of Clean.

B. Toxics Programs

Isolating the annual compliance costs associated with the TSCA, FIFRA, RCRA and CERCLA programs--which we refer to generically as the "toxics programs"--is not quite as straightforward as the air and water case. Many of the specific activities under the Acts have not been subject to a cost analysis. Further, several of the regulations are only in the proposed stage (for example, Section 4 - Testing rules under TSCA) or are too new for a history of regulatory costs to have been developed. In addition, several of the available cost estimates are not particularly inclusive (for example, the testing costs associated with Section 5 actions under TSCA may leave out important cost components). A related problem, particularly with the information and registration requirements of TSCA and FIFRA, is that the specific cost elements that should be included are somewhat unclear. That is, most available estimates of the cost of premanufacturing notification under TSCA only include the cost of filing the required forms and not the costs of tests undertaken to provide information for the forms. On one hand, this makes sense since manufacturers are only required statutorily to provide the information that they have on-hand or is readily available. Alternatively, certain testing costs may be incurred indirectly by firms in anticipation of EPA review or to determine whether the firm's product has a reasonably good chance of successfully going through review. These costs are not directly attributed to the rulemaking, but may not have been incurred in the absence of Section 5 rules. Finally, since most of the actions under TSCA, FIFRA, RCRA, or CERCLA are on a case-by-case basis (chemical by chemical, active ingredient by active ingredient, or site by site), total cost estimates will depend heavily on the assumed or actual number of cases falling under the relevant action. Given the lack of history associated with these programs, any assumption in this regard is bound to be uncertain.

EPA has calculated total direct annual compliance and administrative costs of FIFRA to be in the $200 - $270 million range (in 1980 dollars) (Aspelin and Ballard, 1983). This estimate includes data requirement costs for registration and re-registration, EPA program costs for the data requirement program, data generation and rebuttal costs under the Special Review program, industry administrative/overhead costs for registration-related R & D, and costs imposed on the agricultural industry from cancellation and suspension proceedings. Not included in this estimate, among other things, are EPA administrative costs for cancellation and suspension actions or Special Reviews. In addition, it is not clear how or if the costs associated with pesticide residue tolerance setting are included in the totals. It is possible that these excluded costs elements could be substantial given the complexity of the cancellation and suspension process.

In 1979, CEQ estimated that total TSCA compliance costs were $400 million (in 1981 dollars). An alternative estimate comes from a survey of 36 firms representing 14.7% of total domestic chemical sales by the National Economic Research Associates (NERA, 1981). They estimated total direct costs of about $300 million over the period 1977-1979. Since this is a two year period, and if these costs are taken to be representative of future costs, this estimate would suggest direct costs in the range of $150 million annually. This would include the costs of section 5 rules, some Section 6 rules (pcb's), section 8(a) rules and imminent hazard reporting, and costs related to testing rules. NERA also estimates "TSCA-related expenditures" of $1.1 billion (which appears to be mainly research and development) over that same period of which approximately $200 million annually would not have occurred without TSCA. The $150 million figure seems reasonably accurate given, the current estimate of direct compliance with the PMN process of $6.8 - $17.3 million per year (assuming 1200 PMN's a year with an average cost of $5,700 to $14,400 per PMN) in 1981 dollars and proposed test rules costs (based on a sample of five 1983 proposed test rules) ranging from an average of $418,000 to $1.5 million each. In addition to direct compliance costs, EPA spends approximately $7,700 reviewing each PMN. Assuming 1200 PMN's a year, this would add $9.2 million to the total. A likely range for total direct compliance costs (exclusive of EPA administrative costs) might be $150-$400 million annually.

Turning to CERCLA, it is important to point out one difference between it and the other regulatory programs discussed here. Unlike the air and water programs, its major economic impact comes from a mix of government-financed clean-up actions (through the Superfund) and private clean-up actions undertaken in response to the CERCLA legal remedies. Thus, costs are not a direct result of mandated spending on the part of regulatees and are not directly analogous to the air and water statutes or even the other toxic programs.

Any estimate of CERCLA costs depends on assumptions concerning the number of sites that need remedy and the average cost per site. EPA estimates that ultimately there will be between 1,400 and 2,200 sites that will require federal action and that cleaning these sites will require $8.4 to $16 billion (in 1983 dollars) based on an average cost of $7.3 million per site (EPA, 1983). There are several reasons why the higher end of this range is more realistic. First, the data base used in the EPA estimates does not include municipal sites. Although there is evidence that many of the nation's municipal sites have taken in industrial hazardous substances and may be likely problems. Second, the EPA estimate assumes that active RCRA disposal sites will not become problem sites in the future. Finally, the estimate does not include compensation for damage to natural resources at these sites. Given the broad definition of natural resources under CERCLA, this item may be significant once federal and state trustees establish momentum for damages recovery.

While CERCLA cost estimates exist from both industry and environmental organizations, the EPA estimate remains the best. The General Accounting Office (GAO) has examined the EPA estimate and suggested an expansion of the range of costs to $5.3 billion - $26 billion based on alternative assumptions about the number of eventual sites, construction costs, percentage clean-up by private parties, and percentage of sites requiring groundwater treatment. Because these assumptions were expanded in both directions, the result was a wider range of total costs. GAO also predicted that states and private parties will incur costs of about $7.8 billion in matching EPA activities in the areas of construction and short-term operation and maintenance. Since EPA expects to take twelve years to finish addressing all the expected NPL sites, the total compliance cost would be in the range of $1 to $2 billion annually.

CERCLA compliance cost, by its nature, is surrounded by more uncertainty than the costs under other statutes. Three main factors contribute toward this uncertainty. First, it is unclear how many sites there are which will need some remedy. Second, there is considerable uncertainty surrounding the effectiveness of remedial technologies that can be used. Many of these technologies are so new that their effectiveness has not been tested over time. For example, there is no field evidence on the long-term effectiveness of slurry walls. However, the existing cost estimates are based on the assumption that these remedial technologies will be able to achieve and maintain the clean-up goals. To the extent that their expected long-term effectiveness does not materialize, additional remedial monies would have to be committed to the sites in the future. Third, there exists uncertainty about the extent to which sites have to be cleaned. While there are EPA guidelines relating to ambient concentration levels, they only apply to some of the chemicals found at hazardous waste sites. Even for the chemicals which are covered by the guidelines, site specific conditions require adjustments that are difficult to predict.

c. Combined Estimates

If the Cost of Clean and Water, the adjusted CEQ, and the other estimates discussed above are taken together, total estimated annual compliance costs in 1981 dollars are:

TABLE 3

Category	Annual Compliance Costs (billions of $1981)
Public Water	$7.50 - $15.50 billion
Utility Air	7.50 - 10.90
Industrial Water	6.60 - 7.80
Industrial Air	5.60 - 6.40
Mobile Air	6.00 - 12.20
Toxic Substances	0.35 - 0.40
Pesticides	0.11 - 0.30
Hazardous Wastes	1.00 - 2.00
Total	$34.1 - $55.5 billion

For reasons alluded to above, the "best" estimate is more likely to be toward the high than the low end of this range. (The upper bound is, incidentally, 1.9 percent of 1981 GNP.)

We reemphasize that not too much should be made of specific cost estimates here (mobile sources, industrial water, hazardous wastes, etc.). The point estimates themselves are not important except so as to indicate which are the EPA's major regulatory programs and how they compare with the smaller programs. The estimates themselves can, and should, be improved using more sophisticated techniques. This is an extremely important research opportunity. The substantial and highly productive EPA program to improve benefit estimation will result in more efficient regulation only if cost estimates are themselves accurate.

Either because they are newer than the air and water regulatory programs, or because they are simply more restricted in scope, regulations under RCRA, TSCA, FIFRA, and CERCLA are not of the same economic consequence (as measured by compliance costs) as the air and water programs. This will not necessarily always be the case however. In particular, the recent the RCRA amendments appear to impose significantly greater annual compliance costs which could become comparable to the smaller of the air and water programs. Even without modifications, RCRA and the other toxics program compliance costs are like to grow in importance over the next several years.

III. Impediments to Efficiency in Major Regulatory Programs

Drawing primarily on secondary sources, several broad causes of inefficiency can be identified (and sometimes quantified) in the major regulatory programs identified above. We turn now to these programs and causes.

A. Air and Water Programs

Mobile Source Pollution Control

Before discussing mobile source regulation, it should be noted that the vehicle emissions standards in the Clean Air Act are among few that Congress has written directly into the enabling legislation. This was due in large part to the intransigence of the automakers in complying with earlier efforts (see Kneese and Schultze [19751). In most cases in environmental regulation, the promulgation of detailed standards is left to the EPA Administrator. Thus, the Federal Motor Vehicle Control Program (FMVCP) can be viewed in part as a test of Congressional specificity. If so, there is evidence to suggest that administrative discretion may be preferred; of the major environmental regulatory programs, the FMVCP has drawn perhaps more criticism on efficiency grounds than any other.

According to many experts, the most important impediment to efficiency in the mobile source program is the overall stringency of the vehicle emissions standards. Beginning in 1972, a number of studies have examined the expected aggregate costs and benefits associated with the Congressionally-imposed standards for hydrocarbons, carbon monoxide, nitrogen dioxide and, more recently, particulate matter from diesel vehicles. The first two major studies--one called the Regulatory Effects on the Cost of Automotive Transportation (or RECAT) study, and one by the National Academy of Sciences in 1974--are summarized in Seskin [1978]. Both studies reach the conclusion that the costs associated with eventual attainment of the standards will exceed the benefits. In the 1974 NAS study, annualized costs were projected to be $8-11 billion while annualized benefits were projected to be $5 billion.

More recently Freeman reviewed these early studies as well as other analyses done in the intervening period (Freeman [1982]). His conclusion differed little from those of the earlier studies--he found annual "realized" benefits (those resulting from actual <u>improvements</u> in air quality since 1970) from mobile source controls of only $0.3 billion, which he compared with CEQ's estimate of annual control costs of $7.6 billion.

Finally, in White's excellent recent monograph on EPA's mobile source pollution control program, some qualitative benefit-cost judgments are expressed. They are qualitative because while White estimated emissions reductions attributable to the FMVCP, he did not attempt to translate them into improved ambient environmental conditions and consequent improvements in human health, visibility, agricultural output, etc. On the basis of estimated emissions reductions and cost projections, White tentatively concluded that mandated vehicle emissions reductions through 1979 were probably cost-effective when compared to other programs controlling the same pollutants. However, according to White, the 1980 and 1981 emissions reductions were not. Thus, while somewhat more favorably disposed toward the FMVCP, White's analysis is consistent with previous ones that have been, on the whole, quite critical of mobile source controls.

Two, important caveats color this conclusion, however, and point toward potentially quite important research. First, in Freeman's analysis, national benefit estimates were based upon realized improvements in air quality between 1970 and 1978. These have been negligible in many areas, at least for ozone and nitrogen dioxide, thus accounting in part for Freeman's low benefit estimate. Yet White contends that substantial emissions reductions have been accomplished over what would have prevailed absent the vehicle controls. Thus, benefits in the form of degradation prevented could be significant. Such potential benefits from the FMVCP must be investigated if a fair appraisal is to be made of that program.

In addition, the health benefit estimates in the RECAT, NAS, and Freeman studies were based largely on epidemiological studies attempting to link both stationary and mobile source air pollutants to premature mortality (and, in some cases, chronic illness). Relatively little use was made of clinical or epidemiological studies attempting to link the mobile source pollutants to acute illness. This may be a key omission since at least some of these studies find adverse health effects at or near the level of the NAAQSs. An overall benefit-cost assessment that took acute effects into account, and made use of recent findings linking ozone to potential agricultural, forest and visibility damage, might reach a very different conclusion about the FMVCP.

Even if the FMVCP were efficient on a take-it-or-leave-it basis, substantial efficiency improvements would be possible were it not for the national uniformity of the program. This is most apparent in the case of the high-altitude standards which are part of the program. They require all 10 million or so new cars sold each year in the U.S. after 1983 to meet the same emissions standards at high altitudes as at sea level, even though only 3 percent of vehicles are used at high altitudes. The uniformity imposes a $60 additional cost on approximately 9,700,000 cars used at lower altitudes for an annual cost of $582 million. This cost could be avoided if cars sold or registered in Denver and other high-altitude locations were required to meet more stringent standards than those elsewhere, in much the same way California has stricter vehicle standards than the FMVCP requires for the rest of the country.

In the same way Denver's high altitude causes special air pollution problems, so too do the special topographic and meterological conditions in the Los Angeles basin. Indeed, that area is a kind of natural ozone production laboratory. Similar problems arise in New York City, where extraordinarily dense traffic patterns in downtown urban "canyons" can often result in very high carbon monoxide and nitrogen dioxide levels at hot-spot locations. Different kinds of air pollution problems arise periodically in other cities as well.

But many parts of the country do not have such serious problems and would be unlikely to, even if the vehicles operated in them met pollution standards less stringent than the uniform ones in the FMVCP. This suggests that more geographic flexibility in those standards might result in cost savings that would outstrip any adverse environmental consequences attending less strict standards. For instance, if White is correct in estimating that the 1980 and 1981 ratcheting down of the standards added $700 to the lifetime cost of a new vehicle, $3.5 billion could be saved annually in a steady state if the 1979 rather than the 1981 standards were sufficient for half of the 10 million new cars sold each year. Moreover, since mobile source-related air pollution problems are partially dependent on unique local conditions, it is possible to envision these savings coming at little environmental cost. Determining whether this is <u>likely</u> to be so is an empirical question that should receive careful attention.

What we have suggested here is a variant of the "two-car" strategy, first proposed by Harrison in 1974, in which cars registered in different areas are required to meet different standards. One very legitimate objection to such an approach concerns the cheating that might take place if cars designed to be used in "less strict" regions are sneaked into "more strict" regions. Since cars registered in California must currently meet stricter emissions control standards than those registered elsewhere in the U.S., we already have a _de facto_ two-car strategy. Thus, it would be worthwhile to study the California experience to see how pervasive such cheating has been. While the situation there differs from other areas where such an approach might be attempted (California is a large, somewhat isolated state), at least some lessons concerning the feasibility of a two-car strategy could be learned.

A final source of inefficiency in the FMVCP--potentially quite large--concerns the overwhelming emphasis the program puts on the manufacturers of automobiles and other vehicles, at the expense of those who operate and maintain them. This inefficiency arises because an optimal allocation of responsibility would recognize the important role that proper tuning and other maintenance can play in reducing vehicle emissions. On account of improper O&M, on-the-road emissions are substantially greater than those of test vehicles used to determine compliance. According to White (pp. 29-34), EPA tests indicate that cars only four years old exceed the new-car hydrocarbon standard by 33 percent and the carbon monoxide standard by nearly 50 percent. Thus, to the extent that poor operation and maintenance, tampering with the catalyst or exhaust gas recirculation system, misfueling or other problems could be readily corrected, some substantial savings might be recognized in control equipment at the front end. It is unclear the extent to which inspection and maintenance programs will address this problem.

It is extremely important to search for ways to reduce front end costs in view of Gruenspecht's findings that "new source bias" in the FMVCP slows down the retirement of older vehicles (Gruenspecht [1983]). This is important since a 1967 model year car, for instance, emits about 16 times as many grams per mile (gpm) of hydrocarbons and carbon monoxide and twice as many gpm of nitrogen oxides as a 1980 model car. In other words, the environmental consequences of new source bias in the FMVCP may be as serious as any perceived adverse economic effects, although they are less serious than in the case of stationary sources which can be left operating twenty years or more than was originally intended so as to avoid costly new source controls. Some type of controlled trading program might be envisioned, aimed at removing older vehicles from the road while permitting slightly higher emissions from new cars. Because of the relatively short life of a vehicle, however, the administrative costs of establishing such a program may fall short of the potential cost savings.

A more ambitious program would permit trades between motor vehicle manufacturers and stationary sources of hydrocarbons, nitrogen oxides, and carbon monoxide. Cost-effectiveness analysis suggests that a number of excellent opportunities may exist here. Finally, requiring new cars (but not <u>all</u> cars) to use unleaded gasoline creates another inefficiency. Specifically, owners of new cars have taken to using leaded gasoline because of its lower price even though this "poisons" the catalyst and renders it ineffective. A more uniform treatment of vehicles could remedy this problem as well.

Relating the emissions standards written into the Clean Air Act will not be easy. Because the Administrator of EPA can grant waivers and/or delay the effective dates of the standards, a convenient "escape hatch" already exists. Thus, when upcoming cost increases appear to be economically unachievable, it is easier to defer them than deal with the fact that they may always outweigh the benefits that will accompany them. Moreover, as Kneese and Schultze point out, the auto companies were less than forthcoming about their ability to reduce pollution, both prior to and during the period while the original standards were being debated (Kneese and Schultze [1975]). Thus, there is likely to be little sympathy for adjustments in the FMVCP in spite of evidence suggesting that substantial improvements could be made.

Municipal Water Pollution Control

As data presented above suggest, the control of water pollution from municipalities may currently be the most expensive of EPA's regulatory programs. From its onset, the program has also come under heavy criticism for its inefficiency.

Perhaps the most serious criticism of the program is the charge that it has had little effect on the actual amount of construction. This is in spite of the $52 billion spent on such grants since 1972 (Congressional Budget Office [1984], p. 77). As early as 1973, reports by the Council on Environmental Quality and the EPA itself were suggesting that the availability of federal funding for sewage treatment plant construction was prompting state and local governments to defer their own spending for these plants (see Kneese and Schultze [1974], p. 38). Thus, the net effect of the program on wastewater treatment may have been considerably less than suggested by the magnitude of federal spending for the construction grants program.

How much less is the subject of a recent analysis using data for the period 1949-81 (Jondrow and Levy [1984]). After analyzing the determinants of state and local spending on sewer systems, the authors found that for every dollar of federal spending on sewer systems, state and local governments permanently reduce their spending by $0.66. Thus, each federal dollar adds but thirty-three cents to the net stock of pollution control capital. In addition, they found temporary displacement of state and local spending equal to $0.28 per $1.00 of federal spending because of delays in processing grant applications and waiting to see which projects get funded. This evidence does not bear directly on economic efficiency (which depends on a comparison of benefits and costs alone--regardless of who pays the cost) but it does suggest that the program has been much less effective than was hoped.

Even if all $52 billion represented a net addition, another aspect of the program appears to have bred inefficiency. Anecdotal evidence had long supported the contention that the large federal subsidy (as much as 85 percent, in some cases, often accompanied by a state subsidy of 10 percent) led to the construction of plants which were overly complex and capital-intensive. A preliminary report under preparation at the Congressional Budget Office appears to lend analytical support to this hypothesis. The study uses data on 70 municipal sewage treatment plants, some of which were built with the maximum federal subsidy while others received little or no subsidy (they were ineligible or the locality decided to proceed without waiting for federal funds). Controlling for the design flow of the plant and other characteristics, CBO found that the unit cost of waste treatment was positively and significantly related to the size of the federal subsidy. In other words, the subsidy blunted local incentives to design efficient plants--even though the locality would be responsible for subsequent operation and maintenance.

Perhaps on account of these operation and maintenance costs, another problem has impaired the effectiveness (and hence the efficiency) of the municipal waste treatment program--a relatively poor operating record. First, initial compliance (the installation of clean up equipment) has been less good among municipalities than among industrial water polluters (Council on Environmental Quality, 1980). Second, as Harrison and Leone [1984] point out, EPA's own inspections in 1976 and 1977 revealed a non-compliance rate of nearly 50 percent (p.5-2). As recently as 1983, the General Accounting Office (GAO) audited a sample of 531 large municipal treatment plants in six states (GAO [1983]). The GAO found that 82 percent of the plants audited were in violation of the terms of their permits and that 31 percent had been in violation by at least 50 percent for four consecutive months (p. ii).

To this point we have reviewed evidence that suggests that: (i) the federal funds did not result in nearly as much new capital investment as expected; (ii) the plants that were built did not utilize efficient designs; and (iii) that, for many actual plants, the effluent removal was less than federally required, in some cases much less. Unfortunately, even if all these problems had not arisen, the nationally uniform nature of the standards would be another obstacle to efficient regulation. (This same problem pertains to the industrial dischargers regulated under a different part of the Clean Water Act.)

Harrison and Leone [1984], drawing on previous studies by Luken and Pechan [1977] and Gianessi and Peskin [1981], offer several alternatives to the present system, each designed to improve the efficiency of controls on municipal (and industrial) polluters. Several are based on the recognition that a given quantity of effluent will have very different effects if discharged into different watercourses, or even into the same water body at different times. Thus, allowing municipal treatment standards to be relaxed if effluent is discharged into very clean bodies of water (where degradation would be so minimal that, say, fishing and swimming could still take place), or into very dirty ones (where, on account of heavy non-point source pollution, say, no recreation could take place even if municipal discharges were zero), could result in substantial cost savings but little or no attendant environmental or economic loss. Temporal variability in standards could result in similar efficiency gains. Permitting higher discharges during periods of high streamflow when the assimilative capacity is higher, but maintaining strict discharge standards during periods of low streamflow, could reduce costs without affecting total benefits very much.

Electric Utility Air Pollution

Fossil-fuel fired electricity generating plants are among the nation's largest air polluters. In 1980, they accounted for 65 percent of estimated sulfur dioxide. emissions and 30 percent of total. emissions of nitrogen oxides. As data presented above suggest, these utilities are estimated to spend $8-10 billion annually on air pollution control. This total should increase with time as older power plants now regulated under SIP controls come to be replaced by newer plants meeting the generally much more stringent new source performance standards.

In contrast to the mobile source and municipal waste treatment programs discussed above, the regulation of air pollution from electric utilities has come under somewhat less comprehensive review. To the extent that inferences have been drawn about those regulations, however, they appear consistent with the view that the program (or substantial parts of it) produce benefits in excess of their associated costs. For instance, in his broad review of the benefits of air and water pollution control programs, Freeman estimates that the control of all stationary source air pollution has resulted in "realized" benefits of $21.4 billion annually by 1978 (this is a "best estimate"--the range was $4.8-49.4 billion). According to Freeman, this is to be compared with annual costs on the order of $9 billion per year in 1978. While electric utilities were not separated out from other industrial dischargers in this estimate, they are far and away the major stationary sources of air pollution. Thus, one inference that might be drawn from Freeman's analysis is that existing controls upon them have paid for themselves.

Others reviewing the efficiency of sir pollution controls on electric utilities have reached somewhat similar conclusions. For instance, Perl and Dunbar [1982] concluded that the SIP controls on existing power plants do result in benefits in excess of costs (p. 209). However, they contend that the additional costs imposed by the 1977 amendments to the Clean Air Act could not be justified by the benefits they estimated would result. Since Perl and Dunbar's benefit estimates are restricted to health benefits, though, they must be viewed as quite conservative.

On the other hand, two recent studies--neither restricted solely to electric utilities--can be interpreted as calling into question this assessment of the efficacy of utility air pollution controls. Broder [1984] has analyzed changes in ambient concentrations of particulate matter in a sample of SMSAs as related to expenditures on pollution control equipment by utilities and other industries in those SMSAs. After controlling for other possible determinants, she finds only weak evidence of an effect for pollution control spending on ambient air quality. Clearly, if such a link does not exist, then the benefits of controlling utilities or other stationary sources would be hard to demonstrate. Similarly, MacAvoy [1984] has attempted to explain estimated changes in industry-specific annual pollutant emissions using pollution control investments in those industries and other explanatory variables. After correcting for these other influences, MacAvoy concludes that environmental controls have had no effect on emissions. If supported by additional, more careful analysis, this work would call into question favorable benefit-cost assessments of utility (or other) air pollution controls.

Broder and MacAvoy have taken an important step by trying to analyze <u>ex post</u> the effect of air pollution controls on air quality and emissions respectively. But both studies have serious data and methodological shortcomings that limit the usefulness of their conclusions. Thus, one obvious area for future research is <u>ex post</u> evaluation of existing regulatory programs using better data and more sophisticated statistical techniques.

Even if existing utility air pollution controls were desirable on an all-or-nothing basis, several obvious inefficiencies still exist. The first has to do with the generally considerably more stringent regulation of new than existing power plants, a characteristic generic to almost all industries. According to an EPA report, for example, for electric utilities burning eastern coal with a sulfur content of 3.5 percent, a plant regulated under the "old" (1971) NSPS faces a marginal cost of $31 per ton of sulfur dioxide removed, a plant regulated under SIP controls $252 per ton removed, while one meeting the current (1978) NSPS incurs marginal costs of $2566 per ton (EPA [1981], Appendix C, p. 1). This suggests that a reallocation of control dollars away from the plant meeting the "new" NSPS and toward plants meeting SIP or "old" NSPS regulations would increase the SO_2 removal possible for the same amount of money. Thus, it also undercuts major rationale for the entire new source approach to air pollution control--that it is less expensive to control at new sources than existing ones because of the difficulty of retrofitting at the latter. We will say little more here about the potential inefficiencies associated with a "new source bias" because EPA has several efforts underway relevant to it. Nevertheless, it is important to recognize that this bias is one of the major sources of inefficiency in EPA rulemaking. This is no less true of the emerging new regulatory programs than it is for the older air and water pollution control programs.

The same EPA report points out another possible inefficiency associated with the regulation of electric utilities--the high cost per ton Of SO_2 and particulate removal when contrasted with requirements in other industrial categories. For instance, the chemical, cement and non-ferrous metals industries are all required to spend less on average per ton of particulate removal than electric utilities by factors of 2 or 3 to 20 (EPA [1981], Figure 3.1). In the case of SO_2, non-ferrous metals manufacturers spend seven times less on average for SO_2 removal than electric utilities (Ibid., Figure 3.2). This suggests cost savings or environmental improvements would be possible through a reallocation of control effort. Such reallocations may be especially appropriate when--as in the case of acid rain--total regional emissions are what matter rather than location-specific emissions. Where location of emissions is important, a trading system may have to incorporate a weighting system to reflect this.

One aspect of the NSPS for coal-fired electric utilities cannot escape mention, however. We refer to the so-called "percentage reduction" feature added in 1977-1978 by Congress and the EPA itself. This is the requirement that new power plants not only limit emissions to no more than 1.2 pounds of SO_2 per million BTU of energy generated, but that this be done specifically through the use of scrubbers or other mechanical means. By apparently ruling out the use of low-sulfur coal to meet the emissions limit, Congress and the EPA denied the utilities access to the most economical means of SO_2 removal for all but a few plants. According to the Congressional Budget Office, by the year 2000 this constraint will be costing the nation $3.3 billion per year more than if no specific means of sulfur removal had been specified--at no additional environmental gain (CBO [1981]). This single restriction on pollution removal in one industry adds more to compliance costs than are expended each year to comply with FIFRA, TSCA or (currently, at least) RCRA or the Superfund. It is the single most obvious inefficiency in the entire regulatory apparatus of the EPA.

As Ackerman and Hassler point out, the justification for percentage reduction was a concern about the jobs of high sulfur coal miners who might be dislocated if fuel switching were permitted. As one of us has pointed out, (Portney [1980]), however, this protection comes at a very high cost--perhaps as much as $700,000 per job protected *per year.* It is very important that the implied cost-per-job-protected be analyzed in a more careful and systematic way than in this preliminary analysis. If the true cost of job protection is much lower than estimated, perhaps the percentage reduction requirement is not so burdensome as it now seems. If, on the other hand, the preliminary estimates are supported by more painstaking research, such analysis might constitute a strong case for elimination or modification of the requirement.

Finally, the cost-effectiveness of a new source/old source trading program depends in an important way on the fate of acid rain control measures. If one such measure were to be enacted, a number of older, low-cost emitters would come under additional control. This would reduce the attractiveness of a trading program considerably. It is important to determine just how much less attractive before a trading program is fully developed.

Industrial Air and Water Pollution Control

We have elected to discuss inefficiencies in industrial air and water pollution controls together here. Although there are many important differences in the form of regulation under the Clean Air and Clean Water acts, the types of inefficiencies are similar. They include several identified above. At the same time, data on the benefits and costs of these programs considered by themselves are harder to come by than in the areas discussed above.

Harrison and Leone [1984] have recently completed a comprehensive review of federal water pollution control efforts since 1972. They conclude that one major shortcoming of the program is its overall stringency. Based on their review of previous analyses (including Luken and Pechan [1977], Feenburg and Mills [1980], Freeman [1980], Russell and Vaughan [1982], Ridker and Watson [1980], and Gianessi and Peskin [1980]), Harrison and Leone conclude that the costs associated with the industrial. and municipal controls appear to exceed the benefits, perhaps by more than $10 billion per year (pp. 7-20). While they do not attempt a separate analysis for industrial and municipal polluters, Harrison and Leone do suggest one important reason why benefits are projected to be small for both components. This is the virtual complete lack of control to date on non-point sources--stormwater runoff in urban areas and sediment and chemical runoff from herbicides and pesticides in rural areas. So long as non-point source water pollution continues virtually unabated, they point out, it may do little good to control point sources to present levels.

Harrison and Leone point out that there are certain areas where industrial water pollution controls have led to improvements in water quality and, subsequently, to economic benefits. And they also are careful to point out uncertainties in benefit estimation that might result in underestimates. Nevertheless, the overly stringent nature of the Clean Water Act controls on industrial sources is a clear conclusion in their study.

Less evidence exists concerning the overall efficiency of industrial air pollution controls. Freeman's review lumped utilities and industrial sources together and, to our knowledge, no effort has been made to examine the costs and benefits of controls on non-utility stationary sources alone. We can speculate that such an assessment would be more optimistic than that concerning industrial water pollution control. This is because stationary sources are often large dischargers of particulates and sulfur dioxide (a precursor of sulfates), two of the pollutants most likely to adversely affect health, visibility, and other important values. If it is thought important to have more precise information, a prospective research project might involve a comprehensive look at the benefits of industrial air pollution control.

Closely related to overall stringency is the problem of national uniformity of industrial air and water pollution controls. Clearly, even if a regulatory program were inefficient on a take-it-or-leave-it national basis, there might still be particular metropolitan areas or even larger regions where controls would be justified. In the case of water pollution control, our discussion above has suggested what kinds of areas these might be: regions where water quality is neither so pristine nor so befouled by non-point source pollution that control efforts would have little effect on the instream or withdrawal uses to which the receiving waters could be put. In areas where industrial water pollution control can significantly alter water quality and hence recreation or other uses, benefits could be great. Redirecting pollution control efforts toward these areas and away from others where the marginal benefits of control are small would permit possibly substantial cost savings at little loss of benefits.

The same principle can be applied to industrial air pollution control. For instance, targetting strict new source standards only for plants built in heavily populated areas or regions with unique natural resources (like exceptionally good visibility) can ensure that most of the benefits that would obtain under a uniform national program are captured at a fraction of the cost. Apart from Nichols [1983], and Harrison and Nichols [1983], however, little research has gone into analyzing how benefits-based strategies can be incorporated into standard setting in the same way that variations in marginal costs of control are partially addressed by marketable permit or effluent charge schemes. The area of industrial air pollution control is an appealing one in which to estimate the percentage of total national benefits that could be captured at a fraction of current projected costs through selective targetting of air pollution standards.

Regardless of the overall efficiency of industrial air and water pollution controls, substantial static inefficiences exist because of variations in marginal costs of control. Crandall [1984] has recently reviewed a large number of studies of the control of industrial air pollution. His conclusion is that from 10 to as much as 90 percent of annual industrial air pollution control costs could be saved through a reallocation of control effort toward lower cost sources. For one "model" steelmaking plant, for example, Crandall used EPA data to estimate potential cost saving of 30 percent (pp. 44-45). If cost savings averaging only 20 percent could be achieved across all industrial sources (and this is well within the realm of possibility according to existing studies), annual savings would amount to $1.0 - 1.5 billion. Once again, however, locational considerations would be important since extreme concentrations of emissions could prove harmful.

The data on potential efficiency improvements in industrial water pollution control are less favorable than those for air pollution control. Nevertheless, those that do exist suggest that equally large efficiency improvements may be possible through mechanisms that reallocate control toward low-cost sources. In their study of EPA rulemaking in the effluent guidelines program, Harrington and Krupnick [1980] uncovered substantial variation in the marginal costs of BOD removal under BPT regulations. For the 20 types of sources they examined, 30 times more was spent per kilogram of BOD removed at the most expensive source than at the least expensive. Using Harrington's and Krupnick's data, and assuming both constant marginal costs and equal BOD discharges from all 20 categories (both of which are somewhat unrealistic), savings of 80 percent would be possible for a given amount of BOB removal under the BPT standards by reallocation of controls to low-cost sources. This estimate is merely illustrative; actual savings from reallocation of control burdens would depend on the pollutants and sources controlled as well as the level of control. Nevertheless, it suggests that savings in industrial water pollution control may be comparable to those possible in air pollution control. Once again, if savings of only 20 percent could be recognized, this would amount to $1.1 - 1.5 billion dollars annually.

A more thorough analysis reaching the same conclusion might provide a strong impetus for the expansion of the controlled trading program (including EPA's bubble and offset policies) to water pollution control. The currently successful state demonstration project involving marketable discharge permits for specific water pollutants on Wisconsin's Fox River provides real-world evidence that such a program can work if savings in control costs make it economically appealing. The current absence of a well-developed incentive-based program in EPA's water office contrasts markedly with the situation in the agency's air program. A final source of inefficiency in the industrial air and water pollution control programs results from the sometimes poor compliance record of some major sources. This lack of compliance means of course that ambient concentrations of air or water pollutants are higher than they would be otherwise; and this in turn implies that benefits are forgone that might otherwise be obtained. This is particularly frustrating when non-compliance results from a failure to operate and maintain pollution control equipment that has already been installed and perhaps paid for. In such cases, capital costs have been incurred--sometimes substantial as in the case of scrubbers, say--but no benefits are realized because continuous compliance has not followed initial compliance (equipment purchase). Where the operation and maintenance of control equipment is a relatively small fraction of total compliance costs, an entire benefit stream may be foregone for a small cost. In such cases, targetting enforcement efforts on those sources would be a very efficient strategy. While perhaps obvious, adhering to this point--that enforcement efforts should be targetted at those sources where the cost-per-unit-of- benefit-obtained is the lowest--could do much to improve the efficiency with which EPA expends its compliance dollars across all regulatory programs.

B. Toxics Programs

As compared to the preceeding discussion, our analysis of inefficiencies in the toxics programs is much less empirically based. There are several reasons for this. First, all of the regulatory programs discussed in this section are relatively new. There is no very strong historical context (and associated data base) within which to judge their relative performance. While federal programs to control pesticide risks to health and the environment have been on the books for decades, many of the current federal activities have been put into place only since 1978. Some of them (for example, the registration review program for existing pesticides) are even more recent. The Premanufacturing Notice provisions, in many ways the heart of TSCA, were developed in 1979 and were finalized only last year. CERCLA was enacted in 7980, but there have been only six fully completed remedial responses to date. The resulting dearth of time series data on these programs and their implementation is directly reflected in the small volume of published, peer-reviewed economic analyses on their efficiencies.

An additional, and we think important, reason for the informality of the toxic discussion is that the cost and risk or benefit data generated by the toxics programs are often not in a form that invites ready analysis of economic efficiency. Economic data on the FIFRA programs is the most obvious example, but other programs share a similar problem. In the case of FIFRA, costs and risk data is presented in pre-regulatory terms; that is, the economic benefits of using a particular chemical and its risks in that use. This data perspective makes it difficult to estimate the post-regulatory costs and benefits of pesticide control. Without such information it is difficult to say anything very conclusive concerning the net benefits of an action or its cost-effectiveness.

Given these caveats, the following section highlights several potential sources of inefficiency in the toxics programs. We have tried in several areas to construct some empirical measure of the nature and extent of these inefficiencies, but the calculations should be regarded as illustrative, not necessarily conclusive.

Information Provision Programs

All of the toxics-related statues share a common theme. In addition to their various direct regulatory mechanisms, they contain explicit provisions for the collection of information necessary for regulation. Few would question that a major impediment to efficient regulation under TSCA, FIFRA, RCRA, and CERCLA is the lack of information on the products or activities that are regulated. While this problem is not unique it is more pronounced under the toxics programs for at least two reasons. First, the sheer size and scope of the regulatory directive is overwhelming. There are at least 60,000 existing chemicals potentially subject to TSCA review with at least 1000 - 1500 new chemicals or new uses being reviewed each year. In addition, there are at least 600 existing active ingredients or groupings of active ingredients requiring review under FIFRA. The total number of hazardous waste sites falling under the CERCLA program is the subject of current debate, but is almost certainly is the range of several thousands. And the number of active disposal sites to be controlled under the new RCRA amendments is unknown, but likely to be in the tens of thousands if one includes underground storage tanks. Second, the balancing nature of some of the statutes places a premium on complete and accurate information concerning the potential environmental and health effects associated with the chemicals and their economic benefits.

Informational uncertainties increase the risk of either over- or underregulating and therefore of economic inefficiency. Efforts to reduce informational uncertainty should be taken as long as the marginal costs of those efforts are less than their marginal benefits (i.e., the gain in efficiency in the resulting decision, be that priority-setting or regulatory in nature). The value or benefits of increased information is thus defined in terms of its contribution to improved decision making. Although this description hides a number of complicated links, it demonstrates the two important and interrelated dimensions of the value of information. First, inaccurate or incomplete information widens the uncertainty surrounding the efficiency of any given decision. Second, information provision programs must themselves be subject to a balancing test where one side of the equation is the program's ability to reduce uncertainty. It is not possible at this point to empirically state whether or not the current toxic program information provisions meet the efficiency requirements outlined above. Analytical examinations of the economics of regulatory information programs are almost non-existent. What we can say is that there exists no clear discussion of how the reams of information collected under these programs is being or will be used. An examination of EPA's information collection programs seems long overdue--it would shed valuable light on the benefits of these activities.

In order to make reasoned judgments concerning the cost-effectiveness of the current information programs, it would be useful to have cost estimates of alternative approaches to providing the same information as well as cost estimates of alternative informational requirements. For example, the EPA Regulatory Impact Analysis on the FIFRA information regulations provides total direct and indirect cost estimates for 5 alternative approaches to collecting information on pesticides: Reference guidelines ($83.6 - $134 million); Regulatory Requirements ($83.6 - $134.3 million); Self Certification ($63.6 -

$134.3 million); Comprehensive Data ($104.3 - $177.3 million); and Provisional Registration ($78.8 - $127.2 million) (EPA [1983]). In addition, it is important to establish what levels or types of information would be available in the absence of regulation. For example, insurance requirements, potential liability and good business practices presumably provide an incentive for firms to conduct at least some testing and to generate some data that may be comparable to the EPA requirements.

The benefit side of the equation is decidedly more complex. Essentially, it is necessary to trace out the probable effects on regulatory decisions of alternative quantities and types of information. For example, for a given chemical it is necessary to establish a baseline for analysis; that is, given current information on the risks and benefits of the chemical, what regulatory decision would likely be made? Second, the effects of additional data on the decision must be predicted. Finally, the costs and benefits of the range of predicted regulatory responses must be estimated and compared to establish the point at which additional information (or different information) yields zero net benefits. The value of information is this context would be measured by the gains in efficiency or the increase in net benefits resulting from the additional information. An implicit assumption underlying these steps is that all information collected is actually used. This is an extremely important assumption, the validity of which may be open to question. As suggested above, the range of data collected under TSCA, FIFRA and RCRA is tremendous and unless it is used, and used well, there will be little or no benefit from its availability.

Some studies do exist on the theoretical underpinnings of the value of information, but there appears to be little direct application to regulatory decision making in general and to the toxics programs in particular. Most prior efforts seem to focus on the value of using information provision programs as an alternative to direct regulation. Benefits are generally ascribed to the TSCA/FIFRA information programs, but are stated in very general terms such as better priority setting. Consider the subtle and not so subtle interractions between the costs of the programs and their effects on regulatory outcomes. For example, the analysis of FIFRA information requirements does try to associate benefits with five alternative approaches, but the resulting estimates are only rankings, the basis for which is somewhat vague. Although there does appear to be an effort under TSCA and FIFPA to tailor the information requirements to specific chemicals or classes of chemicals, suggesting a sensitivity to variation in the marginal costs and benefits of the information collected, the process appears ad hoc at best. That the current procedures lead to consistent and efficient requirements would be coincidental.

The actual extent to which the toxics information provisions programs constitute an area of economic inefficiency is difficult to evaluate. One study by the Office of Management and Budget (OMB) on TSCA's PMN program is suggestive of the need for concern. OMB estimated that EPA will spend approximately $200 million per-life-saved if it initiates actions on 5 percent of all PMN's (this is the actual performance through January, 1984) with an average level of risk reduction of 10^{-4} and an average annualized filing cost of $1,000. Of course, this estimate is highly unreliable and changing any of the assumptions underlying the calculation would significantly alter the estimate. For example, this estimate assumes that no catastrophic risks are avoided and does not take into account risky chemicals that are withdrawn in anticipation of a negative PMN review. It does, however, support the argument that the value of the individual information programs is open to question.

Chemical Review Programs

TSCA and FIFRA share several common characteristics. They both contain explicit requirements to balance the risks and benefits of their regulatory programs and have been a pre-commercialization focus. That is, they direct EPA to evaluate and, if appropriate, control chemical risks before a substance has had a chance to result in significant environmental or human exposure. They both are also directed towards the regulation of substances with an economic value or use, not the generally unwanted outputs or residuals (wastes) or a production activity--the main focus of conventional pollution control programs.

Efficient regulation of chemical risks requires that the marginal benefits of individual chemicals or classes of chemicals be balanced with their potential risk to health and the environment. The efficient regulator would have no inherent reason to distinguish between existing and new chemicals unless the risks or benefits justified such a view. EPA's TSCA and FIFRA programs, however, are bifurcated along existing and new chemical lines and have different review procedures for new versus existing chemicals. Of course, the mere existence of an administrative distinction does not mean conclusively that efficiency losses are being experienced and that too few social resources are being devoted to a particular class of chemicals. It does suggest, though, reason for concern.

Under TSCA, any manufacturer wishing to market or commercialize a chemical not currently listed on the TSCA inventory (chemicals in use before 1976 and chemicals that have already been reviewed) must submit a PMN containing certain production and, if available, test data. EPA has up to 180 days after receipt of a PMN to review the submission and approve the chemical with or without use restrictions or request additional information (the options are actually more varied). Existing or "inventory" chemicals are not subject to such a review process. Although EPA can regulate unreasonable risk from existing chemicals through Section 6 (based on information gained through Section 8 reporting rules and the promulgation of Section 4 testing rules), the process is relatively cumbersome and resource-intensive. This has resulted in few existing chemicals actually being subjected to EPA review (GAO [1984b]). The total volume of chemicals going through the EPA review procedures is illustrative. The TSCA inventory contains approximately 60,000 chemicals; this is a rough first estimate of the universe of existing chemicals. Only four have been subject to a Section 6 action and there are no final Section 4 test rules (although approximately eleven have been proposed and a number have been established through negotiation). Presently, approximately 1,200 new chemicals a year go through the PMN review at an average cost of $7,500 per chemical, exclusive of testing costs.

EPA's pesticide program involves a similar existing-versus-new pesticide review procedure. Any new active ingredient must be reviewed and classified by EPA. The agency has promulgated information requirements for the review procedure under Section 3 which impose an average cost of $2 - 3 million per new active ingredient. Fewer than fifteen such active ingredients go through the registration process each year. All pesticides must be registered before being sold, but many existing pesticides registrations are based on information that is much less detailed than that required for new pesticides. Further, the registration standards program, established to review the 600 or so existing active ingredients or classes of active ingredients, impose different standards and far fewer costs on the registrants, approximately $100,000 per registration (for example, chronic effects testing may not be required for existing pesticides). Existing pesticides can be subject to EPA's Special Review Program resulting in a possible change in registration classification, cancellation or suspension, but this expensive procedure is used relatively infrequently. Only 75 special reviews (or RPAR's) have been conducted through the years and no new RPAR's were issued from 1981 to mid 1983.

Congress and EPA have explicitly chosen to emphasize the review and regulation of new chemicals over old or existing chemicals and chemical risks. By doing so, they have adopted an implied presumption of relatively large ratio of costs to benefits of existing chemicals regulation and a relatively low ratio for regulating new. The evidence to support this presumption is inadequate. The presumption supposes that older chemicals have lower risks and/or higher costs of control than new chemicals. Given the paucity of data on chemical risks there would appear to be no firm basis for reaching this conclusion (NAS [1984]). In fact, one might construct an intuitive argument that one effect of the PMN review process and the FIFRA registration requirements (as well as non-regulatory developments such as toxic tort litigation) is that fewer chemicals with significant environmental or health risks ever reach the stage of applying for EPA approval. To the extent that incentives exist for manufacturers to weed out the really tad "actors" very early in the research and development phase, the average risk associated with new chemicals may be smaller than that for existing chemicals.

Assuming that the relative risks and benefits do not justify the current distinction between new and old chemicals, two broad types of potential efficiency losses are most easily identified. First, EPA may be imposing larger social costs for a given level of benefit (risks reduced) than necessary. To turn this around, EPA may be achieving a lower level of benefits for a given cost outlay than possible under a more neutral review process. Each of these possibilities are discussed in turn.

Cost-effectiveness is a useful indicator of the relative efficiency of new versus old chemical reviews. An indication of the cost-effectiveness of the FIFRA existing chemical review program is given in a recent study of several risk reduction programs by EPA's Integrated Environmental Management Program (EPA [1983]). There, it was estimated that the cost-per-life-saved by an RPAR action against the pesticide Amitraz ranged between - $50,000 to $10,000 depending on the specific use. This observation would suggest that the existing pesticide review process is relatively cost-effective since a number of other regulations have implied costs-per-life-saved that are as much as two orders of magnitude greater than those costs. Unfortunately, there are no comparable estimates for the new pesticide review.

Several recent studies and analyses have argued that the most significant cost element associated with EPA's new chemical review programs involves the potential negative impact on innovation and concentration in the chemical industry. In general terms, the argument holds that additional costs of regulatory review, when added to the costs of new product development, marketing and commercialization, result in greater uncertainty and lower expected returns to new product innovation. The net effect is to discourage the introduction of new chemicals. The impacts are often held to fall particularly hard on small producers, who are less able to spread the increased cost of regulation over a pool of new chemicals, and on chemicals used on a small scale where expected profits are not large enough to offset the increased costs of EPA approval. Thus, it is argued, rates of technological innovation and productivity in the industry are below what they would have been in the absence of the review process. In addition, it is argued that the chemical manufacturing sector will become more concentrated as small firms disappear and that some relatively minor chemicals will also disappear from the market.

The intuitive appeal of this logic is quite strong. In fact, one would expect such effects of any pre-commercialization regulatory program. The new-versus-existing emphasis simply serves to exacerbate the expected effects of any regulatory review that was intended to isolate chemicals- with an unreasonable risk before they can cause a problem. The real efficiency question, though, is whether the lost surplus from the potential innovation is offset by the expected benefits of pre-commercialization review.

The empirical answer to this question is much less clear. Most of the analyses on innovation effects under TSCA and FIFRA have focused on the cost side of the equation. Even then, the data tend to be descriptive rather than empirical. A 1978 analysis by Arthur D. Little estimated that as a result of then-proposed PMN requirements, new chemical introduction each year would decline by between 0 percent and 90 percent as the costs of the PMN program rose from $0 to $40,000 per chemical (ADL [1978]). A later study by ICF, Inc. arrived at estimates of 0 percent to 50 percent reductions in new chemical introduction for the same cost figures (ICF [1980]). In its Regulatory Impact Analysis of the PMN program, EPA estimated that of a sample of ten chemicals going through a PMN review costing $5,600 each, only 1 would be dropped for lack of a positive expected return; if the cost of the PMN were $13,000, two chemicals would not be introduced (ICF [1983]). Further, based on the ADL study and on a report prepared by the Chemical Specialties Manufacturers Association, EPA estimated that less than 5 percent of the value of innovation in terms of expected profit prior to TSCA would be lost as a result of the PMN review.

The total dollar value of this effect is difficult to estimate and can only be approximated with great uncertainty. OMB estimated a future stream of costs of $336 million annually by assuming that the PMN process would reduce productivity growth in the chemical industry by one percentage point annually (COWPS [1981]). Productivity growth in the chemical industry is about 8 percent of total value added in the industry ($44,565 million in 1977); it was assumed that innovation accounts for four percentage points (or half), and that the PMN process would cut that by 1 percent point. Thus, 1 percent of $33,565 million is $336 million annually.

An alternative, but highly uncertain,estimate can be derived by merging the EPA and OMB analyses. By taking OMB's estimate of the value (pre-TSCA) of innovation as half of the growth in productivity, then for a sample year, say 1977, the value of productivity would be 50 percent of 8 percent of the value added during that year of $33,565 million or $1,342 million. Using EPA's top estimate of a 5 percent loss in the value of innovation, the cost impact of PMN review on innovation would be approximately $67 million annually (Varying of course with the value added in any given year.) This is probably an overestimate since the 5 percent figure is based on foregone expected profits and not value added).

There seems to be a reasonably strong case for the existence of some producer or consumer surplus losses from foregone innovation under TSCA. In aggregate, however, they appear relatively small, with indirect costs ranging perhaps from $68 million per year to $336 million or between approximately 0.2 percent and 1.0 percent of total value added of the affected industries. However, the available evidence also suggests that the impact is almost certainly not distributed equally across the industry, but falls more heavily upon smaller manufacturers. It has been estimated that at an average PMN cost of $4,000 to $18,000, small firms (less than $10 million in sales) would reject from 17 percent to 51 percent of the "ingredient innovations that would otherwise have been undertaken"; the rejection rates of large firms (over $200 million), however, would be relatively unaffected (Regulatory Research Service [1982]).

The evidence of a potential impact on innovation as a result of FIFRA's new chemical registration procedures appears to be even more anecdotal and inconclusive. ICF has estimated that the cost of bringing a new pesticide to market has risen from $5.5 - 6 million in the early 1970s to approximately $15 to 20 million (these figures have not been adjusted for inflation) and the average time from discovery to marketing has increased from 60 months in 1967 to 110 months in 1977. While this might suggest a declining incentive to invest in innovation, ICF also notes that the average share of R&D expenditures going to new ingredient development has remained reasonably constant at 65 percent over the last five years (1975-1980) and total R&D has steadily increased. The regulatory cost portion of total expenditures, however, has also increased, possibly displacing resources that would have been invested in new chemicals development. ICF acknowledges this possibility, but the lack of pre-FIFRA data limited their ability to draw any firm conclusions. Finally, ICF, as well as other studies, have documented a decrease over time in the number of new pesticides, although new registrants appear to be on the rise in the 1980s. It does not appear that any study has been able to isolate the effect of FIFRA on this decline from other relevant factors (such as a maturing of the pesticide industry).

It has been argued that the pesticide industry has become more concentrated as smaller firms find it increasingly difficult to justify FIFRA regulatory costs in terms of their expected net profits. Large firms, it is held, can more easily spread the regulatory burden across a larger number of new pesticides. Here the evidence is slightly more conclusive, although efforts to control far all other influences on industry structure appear inadequate. A U.S.D.A. study of the pesticide industry estimated that 33 percent of pesticide sales were controlled by the top four firms in 1966 and that by 1976, these same firms controlled 59 percent of sales. Additionally, the number of major pesticide producers has declined from roughly 80 in the early 1970s to 20 in the early 1980s. Whether this effect is caused by increased FIFRA costs and has resulted in efficiency losses is unclear. In addition, one could argue that if smaller firms are unable to bear the costs of ensuring safe pesticides, they should not be in the market. On the other hand, it may also be the case that only small producers would find it profitable to develop and market pesticides with limited application potential (so called "minor use" pesticides) and that the surplus losses from a possible decline in the production of such chemicals would be greater than the benefits of the full scale registration process. Neither perspective can be reasonably addressed on the basis of existing data.

The efficiency consequences of increased concentration are the subject of a continuing economic debate that will not be reviewed here. At least one recent study (Fustgarte [1984]) has found that, for a sample of manufacturing industries, increased concentration led, on average, to lower product prices (related to productivity gains) and higher profits. The more conventional wisdom argues that prices would rise with increased industrial concentration. It is beyond the scope of this paper to reconcile these views in terms of the chemical industry. It is sufficient to note that the efficiency losses and gains are an empirical matter requiring further analysis.

up to this point, the potential mitigating effects of variances and exemptions under the TSCA and FIFRA regulatory programs have been ignored. This is an important omission. The preceding discussion suggests that if the emphasis in regulation on new chemicals results in efficiency losses, due to decreased rates of innovation, such effects are more likely associated with smaller chemicals and smaller chemical manufacturers. One approach to solving the problem is to segregate minor use or small volume chemicals and small manufacturers through variances or exemptions. In fact, both TSCA and FIFRA have or will shortly adopt such exemptions. For example, under the PMN program

EPA employs consultants to assist small manufacturers in preparing the notices, at no cost to the submitters and EPA has drafted rules that would exempt site--limited and low-volume chemicals from certain PMN requirements. The 1978 amendments to FIFRA contained the authority to establish a policy regarding preferential treatment of minor use pesticides. The act also provides for exemptions granted for emergency uses and special local uses. There are not necessarily directed towards small or minor use pesticides; they do, however, offer mechanisms for producers of new pesticide to defer or avoid the full-scale registration procedure.

In theory, a possible justification for a new-versus-old emphasis might exist if the expected risks associated with new chemicals was known to be higher than the expected risks of existing chemicals. Assuming everything else being equal, higher expected regulatory costs of putting a new chemical on the market would be offset by the higher expected benefits of the review. One common justification of the new chemical review, in fact, is that it Will minimize the probability of future catastrophic risks.

Public and Private Cleanup Emphasis

CERCLA was originally designed for "abandoned" hazardous waste disposal sites, or sites for which there is no known responsible parties. Responsible parties have been identified, however, for the majority of the sites on the National Priority List. In fact, many are the generators of the hazardous wastes, and therefore are liable for the problems at the sites through strict, joint and severable liability. EPA's current approach is to press the responsible parties into paying for the relevant cleanup operations. This leads to the pivotal question of what level of private participation is economically optimal. In other words, how far should the government go to identify responsible parties and their participation in clean-up operations. If the direct and indirect costs of ensuring private participation in the cleanup program are not accompanied by corresponding benefits, social resources may be more efficiently allocated. Although the data are far from complete, there are several indications that the current emphasis is a impediment to efficiency.

Ensuring private participation in Superfund actions most often involves lengthy negotiation and settlement proceedings. First, the establishment of liability can be difficult even with the new legal provisions in CERCLA. For instance, generators are often the most financially capable to fund responses, but it has been only recently that the courts have interpreted CERCLA to hold them under strict, joint and several liability. Second, problem sites typically have more than one responsible party. Determining the appropriate contribution of each of the responsible parties has been a major obstacle to quick settlement. Often some of the parties want to settle while others do not. EPA has to decide at what point it will accept less than full compensation for a remedial action (the cut-off point is 80 percent in the existing settlement policy). Third, private parties often do not agree with EPA on what constitutes an "adequate protection" of public health and environment. This is particularly problematic because EPA has no explicit interpretation that can be applied across the sites either. And finally, even if the above points are settled, disagreement may center on what clean-up technology to use. Private sector experience in cleanup operation can differ from the public one. Given the credibility gap between the two parties, agreement often takes some time.

The negotiation process imposes three major cost elements. First, there are tremendous legal and administrative costs to private parties and federal or state agencies to resolve their difference. For example, it is common to find that legal fees constitute 10 percent to 40 percent of the cost to remedy a site (EPA, [1984b]). These costs would suggest an incentive for firms and EPA to reach agreement as quickly as possible. However, this incentive may be countered by the expected costs, particularly to private parties, of reaching agreement. It may be in their best economic interest to delay decisions as long as possible. The second cost results from the health risks that go unaddressed during the negotiation period. In fact, these risks may increase if contamination spreads to larger populations.

The third major cost element is somewhat more hypothetical. It results from incentives embodied in the current system for private firms to make information on hazardous waste sites known to EPA. While the data base on existing hazardous waste sites has improved in recent years, much is still unknown concerning the total number of potential sites and their probable risks. It is likely that the current system provides little incentive for parties, often generators, with access to data and information on potential future Superfund sites to come forward and make it available to EPA. Cost recovery actions and potential liability actions may inhibit the flow of information and, in the end, require EPA to duplicate existing, but unavailable, data. This potential inhibiting effect is offset, to some extent, by provisions in the statute (such as treble damages), but these may not be great enough to balance the expected costs to a private party of making information public.

The benefits of private cleanup are less concrete than the costs. Some argue that private parties can clean up sites more effectively than the government. Second, given the resource constraints EPA faces, private industries have claimed that private cleanups can alleviate some of the government burdens. Another alleged benefit is that going after responsible parties is efficient if it serves as an incentive for better management of hazardous wastes.

These benefits have not been documented and may be analytically questionable. There is no empirical evidence to support the contention that private cleanups can be done cheaper than the public ones. Case studies have shown that while private firms appear to have better management of clean-up actions, they may ignore the cost of in-house resources committed to the project. As to the concern of an overly burdened EPA, there is no barrier to responsible parties helping the government clean-up sites. Given the fact that the government will attempt to recover the remedial costs from the responsible parties, any cost saving from private assistance would benefit the responsible parties. Such assistance takes the form of information provision (where, what and when), technical expertise, or even direct participation. Finally, it is questionable that firm-specific costs add substantially to the incentives for proper waste management or even that CERCLA is the correct vehicle to prevent future actions. The Resource Conservation and Recovery Act (RCRA) is the vehicle designated by the Congress to provide such incentives on the firm level. The RCRA regulations are largely in place now. There has been no study on the additional incentive provided by CERCLA.

If the costs of Superfund are significantly greater than the potential benefits, the goal of Superfund to minimize the total social cost of cleanup may be most efficiently produced by a program that is entirely publicly financed and managed. While there may be compelling reasons for requiring private responsibility wherever possible, there may be no inherent economic justification. In fact, it has been argued that since consumers (the general public) of the products resulting in hazardous waste generation benefited through lower prices by past disposal practices, they should pay the cost of those practices. Taken to the logical, if not necessarily feasible, extreme, the case presented here might suggest a Superfund program financed out of general tax revenues (leaving the current and future disposal incentives up to RCRA), reduced (or no) cost recovery actions or liability actions against parties who make information on sites available to the government,and complete government funding of cleanup actions (these might be undertaken by private parties, but using public funds). A better understanding of the role played by private insurance markets and legal transactions in inducing efficient clean-up actions represents an important research opportunity.

Risk-based Site Selection

The selection of sites requiring long-term remedial responses is made through EPA's Hazard Ranking System (HRS). The cut-off point mostly reflects the size of the Fund, state concerns and the ability of government to handle the responses. The system is driven from the demand side since it incorporates only the potential risk reduction from cleaning up a site. Cleanup cost is not considered at this point and there is no way of knowing whether the selected sites will result in the greatest reduction in risk for a given total expenditure. Of course, the HRS is not designed to make decisions on what remedial action is to be taken; it merely points to a set of sites that require attention on the basis of risk. If some balancing of cost and benefit occurs further down the line, remedial responses might be still efficient. Since "no action" is an alternative during the feasibility study of the remedial action, excessively expensive sites responses can still be precluded. Nevertheless, some inefficiency may occur at the site selection level when cost-ineffective sites are included at the exclusion of cost-effective sites.

Including cost considerations at the HRS level may affect the timing of cleanups; it needs to be balanced against the benefit of the additional information. This benefit consists of better decision making on various aspects of the cleanup, such as problem identification, analysis of technical effectiveness and determination of appropriate cleanup level. The benefit of avoiding such errors is typically high at the initial stages of collecting information and decreases as more sophisticated methods are used to further refine the initial bulk of information. For example, waiting for the remedial investigation report is essential to correct response designs.

The cost of gathering additional information is the deterioration of the site condition and resulting increase in risk on top of other expenditures. For example, a rapidly moving chemical plume in an aquifer can make waiting costly because of the enlargement of the population at risk. The optimal speed of clean-up of course depends on the EPA capacity to manage of what? Not the plume, presumably.

Risk and Technology-based Cleanup Strategies

The appropriate type and extent of cleanup has been a controversial point from the very beginning of the Superfund program. From an economic perspective, efficient use of the Fund and other resources calls for balancing the benefit and cost of responses at all sites. Alternatively, one would expect that, for any class or level of risk, the incremental cost of reducing it should be the same across the sites. When such equality does not exist, resources can be allocated from a high cost site to a low cost site with a net gain in risk reduction, notwithstanding the potential distributional effects and transactions costs that may result.

The present EPA decision process on clean-up options and levels depends heavily on existing criteria and consensus among involved parties. It is not clear, from an economic perspective, whether optimal clean-up levels are achieved. The use of existing regulations and guidelines interjects the technology or risk-based bias of these goals. Further, even if these standards were determined by balancing benefits and costs, the latter are almost certainty different at different Superfund sites. A straight application of the standards may result in either too high or too low a cleanup level. This potential impediment to efficiency is compounded by the technology-based consideration of alternatives. The least-cost clean-up approach, and the establishment of technological feasibilty, inhibit consideration of incremental cost information together with incremental benefits. Incremental analysis is a powerful tool to determine in which region (too clean or not clean enough) the response strategies fall. [The extent of efficiency gain from moving toward a more careful consideration of benefits and costs is unclear.] The risk of the current approach is that it tends towards nationally or regionally uniform standards insensitive to variation in costs and benefits.

C. National Hazardous Waste Standards

Although data on benefits and costs are scanty, it is possible to identify some potential sources of those inefficiencies in hazardous waste regulation. In the RCRA program, the major inefficiency is likely to result from uniform national standards as applied to hazardous waste storage and disposal facilities and to incinerators. Although RCRA specifically calls for the establishment of "performance standards" for such facilities, ERA is taking an approach under which uniform design standards are being promulgated. Efficiency requires that these design standards--which mandate double clay liners of certain thicknesses in landfills, for instance--be tailored to the special circumstances at each site. These would include geological and hydrological considerations at the site involving the porosity of the soil, propinquity to underground aquifers, etc. They would also include demographic considerations, as well, including the size of nearby population centers and the reliance on groundwater for drinking water or agricultural irrigation. Since these can be expected to vary from site to site, so too should the stringency of control in an efficient regulatory program. That this is not being done looms as a potentially substantial inefficiency in RCRA, even though it is not possible at this time to estimate its magnitude. It appears as if the recent RCRA amendments will exacerbate this inefficiency by moving towards a no-landfill disposal system. While such an approach maybe justified for certain parts of the country, others may offer a safer geophysical environment for landfills.

The economics of the emerging RCRA program provide an important research opportunity. Fortunately, the theory behind the estimation of hazardous waste control benefits has been well developed by Smith and Desvousges [1982]. What remains now is to apply this theory to the RCRA program as it begins to take shape. While this will take time, it will also provide much-needed information if this rapidly growing regulatory program is eventually to be understood in the same way as are the air and water programs. We should also point out that while cost estimation may appear straightforward for the RCRA programs, this may be deceiving. Cost estimates should include not only regulatees' out of pocket compliance costs but also producers' or consumers' surpluses foregone because of other more subtle effects of regulation. These may be particularly hard to pin down under RCRA.

IV. Conclusions

In this review of efficiency enhancement in EPA regulation, we have examined the agency's major programs quite broadly, concentrating on those sections in each of the major laws giving rise to the most significant compliance costs. Our logic in so doing is that the best opportunities for efficiency improvements will exist where compliance costs are currently greatest. The program areas examined include those applying to air and water pollution control as well those directed at threats posed by toxic substances.

Using compliance cost estimates from a recent EPA report, and updated estimates from an earlier CEQ report, it appears that air and water pollution controls currently entail annual compliance costs on the order of $40-50 billion. Thus, and this is an extremely important point, relatively small percentage improvements in the efficiency with which these programs are designed and operated can result in substantial savings to society. Since studies of air and water pollution control regulation routinely report efficiency gains of 20-50% through incentive-based or otherwise targetted programs, savings from careful redesign of existing programs may be measured in the tens of billions annually. Thus, potential savings in these areas far exceed the current total impact of all regulation under EPA's other regulatory programs including RCRA, FIFRA, SDWA, TSCA and CERCLA.

Moving to generic types of inefficiencies across all regulatory programs, several possible causes turn up regularly. Of all such possible causes, perhaps the most significant is the differentially more stringent treatment of any new source of air or water pollution, or new chemical or pesticide, when compared to comparable existing ones. We pay relatively little attention to this "new source bias" as a source of inefficiency in this report because EPA is giving it separate attention. It should be noted, however, that very substantial efficiency improvement is likely to result from the equivalent treatment of equivalent environmental hazards.

In the case of the Federal Motor Vehicle Control Program, the municipal waste treatment program and the industrial water pollution control program, substantial evidence suggests that the current standards appear to be too strict to be justified on a cost-benefit basis. That is, even when fully implemented and enforced, the programs as a whole are inefficient.

One reason for this likely overall inefficiency is that costs are not as low as they might be given the goals of the program. These could be reduced if more use was made of controlled trading or other mechanisms to reallocate control costs toward low cost sources. The opportunities we identify here include the mobile source program where more emphasis could be placed on improved operation and maintenance of the vehicle fleet and less on initial technological "solutions" to emissions. Also, total costs could apparently be reduced in the construction grants program by reducing the capital subsidy and forcing communities to look more carefully at lifetime (primarily operating and maintenance) costs. Finally, static inefficiency could be reduced in industrial water pollution control by promoting more widespread use of controlled trading or other similar approaches.

Even if costs were minimized everywhere, some regions might still face uniform national standards for which potential benefits fall short of costs. In such areas economic efficiency would be enhanced by the flexibility to adopt at least some standards less strict than current national minimums. These would make sense in regions where, for example, the cost of meeting current standards are prohibitively high because of special geographic or meteorological conditions, or where benefits would not be large because of local preferences or, more likely, other influences besides the regulation on the enviornmental medium in question. Potential savings are great if control efforts could be relaxed in potentially low-benefit areas but maintained or even expanded in high-benefit areas.

One obvious political problem arises when different standards are to be applied to different areas because of benefit or cost differences. Particularly -in the case of health-based regulations, individuals living in areas where controls were to be relaxed could claim unequal protection under federal statutes. Why, they might argue, should they get less health protection just because they have fewer neighbors than someone in a densely populated region? This argument is a compelling one. The strength of its refutation depends upon the particulars of the matter. Of great value in deciding the desirability of pursuing geographically varying standards is some idea of the cost savings and benefit sacrifices that would be entailed. One such study might select several air quality regions and calculate the welfare costs associated with the imposition of identical standards in them. This is both do-able and valuable because it would suggest how much might be saved in control costs if regulatory programs were more carefully targeted. Only such an empirical and theoretical effort can provide the basis for a serious challenge to national uniformity in standard setting.

A similar though not identical set of problems appear to inhibit the efficiency of the toxics programs. One potential inefficiency in the toxics programs concerns provisions requiring information collection. While potentially quite useful, these requirements will only produce benefits if the resulting information is used appropriately. If it is not, costs will have been incurred to no demonstrably beneficial end. This suggests the importance of research on the management and use of data on chemical and waste manufacturing, transportation and/or disposal or use. Similarly, research might identify less expensive ways of eliciting the same the same information.

Another potentially serious inefficiency in toxics regulation is the distinction drawn between new and existing chemicals, pesticides or other substances. Here the same argument applies as was made above in the discussion of electric utility regulation: by regulating identical risks identically, society can maximize the total amount of risk reduced for a given expenditure of resources. Research is clearly called for on the inefficiencies that inhere in the present approach.

Still another potential inefficiency concerns the selection of clean-up sites under CERCLA based on risk alone. If unit clean-up costs are constant across sites, this poses no problem since net benefits would be maximized by cleaning up the most dangerous sites first. But because unit costs of clean-up are likely to depend upon the special characteristics of a site, the "riskiest-first" approach might not maximize societal protection. The extent of this potential efficiency loss is an important, and researchable, question.

We believe this report has one very important implication for current EPA regulatory strategy apparent from the research opportunities we identify. For purposes of focusing scarce agency, public and congressional attention, there exists a strong temptation to put the air and water quality programs behind us and turn to hazards associated with pesticides and toxic chemicals, hazardous air, water and solid waste pollutants, and drinking water contaminants. Indeed, the regulatory programs pertaining to the latter are not as well developed as the former, and there is an opportunity to "get them right" the first time.

In our view, there is a great risk in doing so since even in their maturity at least some of the newer regulatory programs will never approach the economic significance of the traditional air and water programs. We realize the empirical evidence cited in this report about the economics of both the new and old programs should be viewed with great skepticism. It should also be updated and improved. But it does point to one very important conclusion: even though the air and water programs are older, more complete, and more "comfortable" to all affected parties, they also harbor the greatest inefficiencies in environmental regulation. Improvements of the sort associated with now-familiar incentive-based programs have potential savings in the tens of billions of dollars. Thus, while it is well worth avoiding old mistakes in newer, emerging regulatory programs, we cannot afford to turn our backs on the old.

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