Choosing Policy Tools: Seven Important Criteria

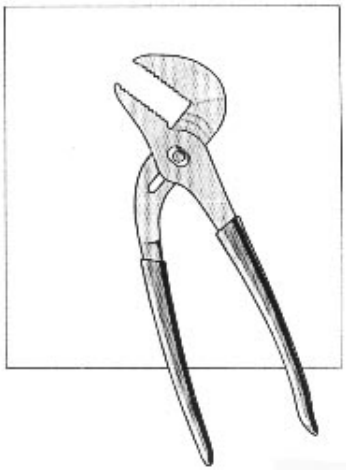
4

INTRODUCTION

Although the nation's near-term commitment to a cleaner environment is evident in the strong goals Congress has established, considerable controversy exists about how best to achieve these and future goals. For example, policymakers would ideally want to choose policy instruments that move the nation toward a cleaner environment at the lowest possible cost while accommodating, and further encouraging, the increasingly rapid changes in scientific and technological capabilities. Yet accomplishing all of this with the tools we have has seldom been possible in the past and may be even more difficult in the future.

One potential strategy for minimizing tradeoffs among these strongly held, yet at times competing, values and interests is to choose policy instruments according to their strengths and to use additional instruments to shore up overall performance. In the past, for example, the nation has relied heavily on harm-based standards and design standards because we would be able to tell on a source-by-source basis the progress being made in cleaning up the environment. However, by emphasizing assurance of meeting goals, in many instances we chose—implicitly or explicitly—to give up some of the potential for cost savings and technology innovation.

Rather than discard harm-based or design standards, policymakers can combine them with other approaches, such as trading programs or challenge regulations. These combinations offer firms more flexibility to choose the means or timing of compliance, allowing the implementation of more cost-effective solutions for individual firms with relatively little loss of the assurance the public wants. However, the use of trading programs



or challenge regulations may raise concerns that, even though overall environmental quality improves, the burden of remaining adverse environmental effects will be shifted from one group to another. Careful monitoring and required information reporting can address some of those concerns.

This chapter examines how knowledge about differences in instrument performance on a set of values and interests—called **criteria** in this report—might guide a policymaker's choices. The next section identifies each of the criteria used in this study. The following sections define the criteria in more detail and compare the relative effectiveness of the policy instruments described in chapter 3 for achieving each criterion.

IMPORTANT CRITERIA FOR ENVIRONMENTAL POLICY

OTA has identified three broad themes in the debate over environmental policy. The first theme, **environmental results**, addresses the public's demand not only that goals be met but also that goals be pursued in appropriate ways. The second theme, **costs and burdens**, addresses the public's concern that environmental goals be achieved at the lowest possible costs and with the fairest allocation of burdens among companies and between government and industry. And the last theme, **change,** reflects a growing consensus that adaptable programs are essential for encouraging new scientific and technological solutions.

Sharpening the focus to the details underlying these broad themes, OTA identified seven criteria policymakers typically consider when adopting specific programs to implement environmental initiatives (see table 4-1). We use each of these seven criteria as the basis for comparing the relative effectiveness of the policy instruments, based on literature reviews and actual experience with using the instruments.

Although lack of sufficient experience with many of the instruments made us less certain about how they might perform in some instances, we found that assessing instrument choice from the perspective of this set of criteria revealed distinctive and useful guidelines for policymakers.

Our rating system identifies those instruments that are particularly **effective** (represented by a filled-in circle), those for which **it depends** (represented by a partially filled-in circle), those that we suggest a decisionmaker might **use with caution** (represented by a caution sign), and those that are simply **average** (represented by a single dot). An effective instrument is considered reliable to use if the criterion is an important one. An instrument rated "it depends" is likely to be effective but could in some instances be simply average. And instruments that might be used with caution typically perform poorly on the criteria.

The remainder of this chapter is organized around the three themes and seven criteria presented in table 4-1. After a brief section introducing one of the three themes, we compare instrument effectiveness on each of the criteria associated with that theme. For each criterion, information is presented in the following order:

- discussion of the criterion;
- explanation of the factors used for comparing instruments;
- overview of instrument performance; and
- an instrument-by-instrument analysis, starting with the most effective ones, followed by those rated "it depends," then those requiring some caution, and concluding with those expected to be about average.

ENVIRONMENTAL RESULTS

Congress sometimes chooses voluntary approaches for accomplishing environmental goals and at other times requires specific actions to improve human health and the environment in some way. Yet even when Congress has required specific actions, the nation has often fallen short of achieving the goal (47). Thus, for many stakeholders in the environmental policy community, the most important priority continues to be working toward satisfactory **environmental results**.

When it comes to very serious environmental risks, the public is likely to want **assurance** that

TABLE 4-1: Criteria And Factors Used For Comparing Instruments

CRITERIA	FACTORS
ENVIRONMENTAL RESULTS	
Assurance of Meeting Goals — Do stakeholders have confidence that environmental goals will be or have been met?	▪Action forcing ▪Monitoring capability ▪Familiarity with use
Pollution Prevention — Can the approach promote use of strategies for preventing rather than controlling pollution?	▪Gives prevention an advantage ▪Focuses on learning
Environmental Equity and Justice — Does the approach seek equality of outcomes, full participation by affected communities in decision-making, and freedom from bias in policy implementation?	▪Distributional outcomes ▪Effective participation ▪Remediation
COSTS AND BURDENS	
Cost-Effectiveness and Fairness — Are we protecting human health and the environment at the lowest possible cost and with the fairest allocation of burdens for sources?	▪Cost-effectiveness for society ▪Cost-effectiveness for sources ▪Fairness to sources ▪Administrative burden for sources
Demands on Government — Are we protecting human health and the environment at the lowest possible cost and with the best use of resources for government?	▪costs ▪Ease of analysis
CHANGE	
Adaptability — How easily can the approach be adapted to new scientific information or abatement capability?	▪Ease of program modification ▪Ease of change for sources
Technology Innovation and Diffusion — Are we encouraging new ways to achieve our environmental goals that lead to improved performance in quality and costs?	▪Innovation in the regulated industries ▪Innovation in the EG&S industry ▪Diffusion of known technologies

SOURCE: Office of Technology Assessment, 1995.

goals will be met. In addition, the public has also become concerned about *how* goals are met. For example, support has increased for the idea that sources should be asked to try their best to use pollution prevention rather than control. And, community-based groups have been highly successful in raising awareness about environmental equity and justice concerns at all levels of policy-making.

The following three sections of this chapter—assurance of meeting goals, pollution prevention, and environmental equity and justice—present OTA'S assessment of which instruments might be most effective in achieving these criteria.

Assurance of Meeting Environmental Goals[1]

Assurance is stakeholder confidence that environmental goals have been or will be met.

Assurance of meeting the goal may be the bottom line criterion for many stakeholders, especially when the environmental problem poses serious risks to human health. In recent years, for example, community scrutiny of facilities using toxic or hazardous substances has increased, including efforts to block siting. In such a context, choosing policies that provide assurance of achieving the desired results may seem more important than satisfying criteria that might otherwise be favored.

At the national level, reports assessing progress toward protecting human health and the environment indicate that we are still far short of our goals (47). When it seems essential to meet public expectations that progress toward goals will occur in the future, requiring specific actions and establishing effective monitoring programs may be an important approach. Using instruments that have been implemented with some successful results in the past may also enhance public confidence in policy decisions.

Factors for Comparing Instruments

As defined in this OTA study, assurance means the confidence stakeholders have that environmental goals have been or will be met and sources held accountable for the results. Determining that environmental goals have been met requires the ability to monitor results and to force action should the results fall short of the goals. In addition, if an instrument has been extensively used or implemented in the past with successful results, the public may have confidence that the instrument will be effective in meeting future goals.

In order to compare how well each instrument assures meeting environmental goals, OTA uses the following three components:

- action forcing;
- monitoring capability; and
- familiarity with use.

Degree of action forcing

Central to the concept of assurance is the extent to which an instrument has "teeth" or the capacity to force sources to undertake actions needed to attain environmental goals. Action-forcing instruments specify pollution reduction results and provide a means for holding sources accountable. The relative importance of action forcing for a stakeholder may depend in large part on his or her assessment of what drives the behavior of sources or targeted industries. Some believe that if industry is provided a clear goal or target of pollution reduction and a reasonable timetable for action, a forcing action or level is not necessary for goal attainment. However, others believe that only those instruments that contain a lever for forcing action provide sufficient pressure and accountability to assure that individuals, facilities, or firms will have to change their behavior until the goal has been met.

Monitoring capability

Monitoring capability has two components: 1) having the capacity to determine whether or not the source is doing what is required, and 2) having the capacity to determine whether or not progress is being made toward the overall environmental goal. The strategy underlying this instrument may affect how easy or difficult it will be to monitor for results. For example, a technology-based strategy based on percent reductions in emissions or a best available technology is inherently easier to monitor than a risk-based strategy designating an ambi-

[1] Parts of this section are based on T.O. McGarity, "Assurance of Meeting Environmental Goals," unpublished contractor report prepared for the Office of Technology Assessment, U.S. Congress, Washington, DC, May 1994.

ent environmental quality goal across multiple sources. Instrument performance that is relatively easy to monitor increases the opportunities for eventual accountability, enforcement, and evaluation of instrument effectiveness.

The availability of adequate monitoring technologies and the type of monitoring regime used may also affect a stakeholder's sense of assurance. For example, continuous monitoring may be considered by some to be essential for individual sources even though systematic, yet less sophisticated and less frequent, monitoring may be satisfactory for others.

Familiarity through use

If an instrument has been used with any success in the past, policymakers may have more confidence in using it in the future. In fact, some instruments may be heavily used primarily because policymakers already know how to implement them and existing institutional arrangements make it easy to continue using them. Especially for problems that have very serious short-term consequences, the public may want policymakers to use instruments that are tried and true even though they may not achieve all or even any of the other major criteria.

Summary of Instrument Performance

- ● **Effective:** ***Product bans, technology specifications, design standards, harm-based standards, integrated permitting***
- ○ **It depends:** ***Tradeable emissions***
- ▽ **Use with caution:** ***Information reporting, subsidies, technical assistance***

Instruments with a strong action-forcing component are the most effective at assuring stakeholders that environmental goals will be met (see table 4-2). For example, all of the single-source, fixed-target instruments—**product bans, technology specifications, design standards, and harm-based standards**—and **integrated permitting** are very effective for assurance since the public can hold sources accountable.

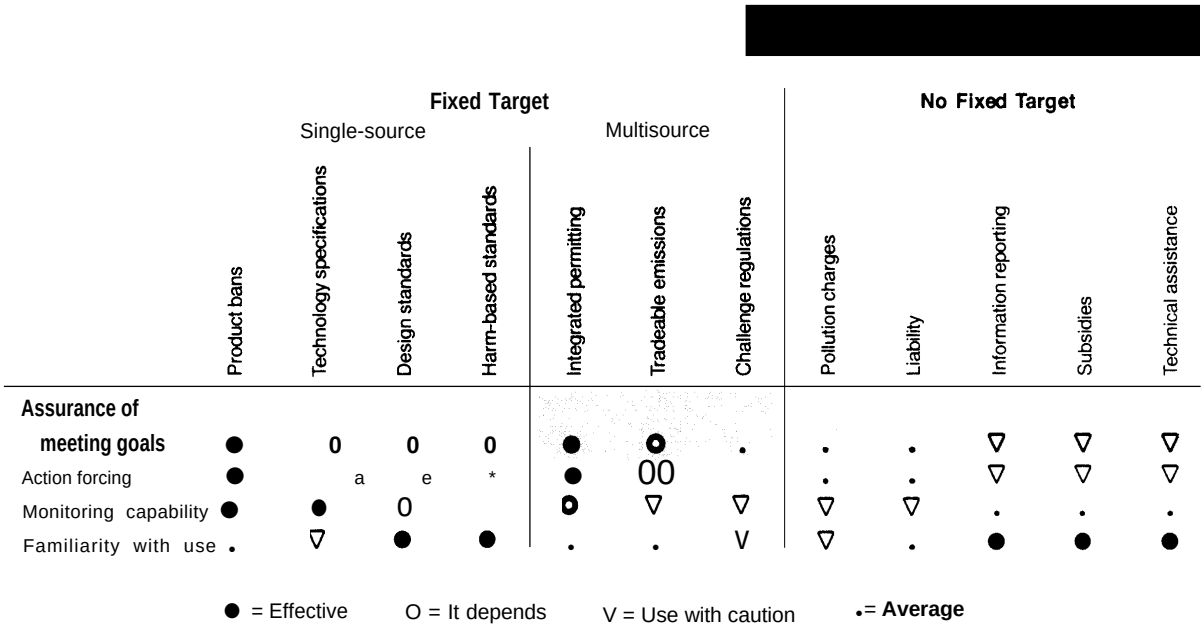
Since design standards are usually somewhat easier to monitor than harm-based standards, depending on how they are implemented in permits, **design standards** are a reliable choice either under a technology-based strategy or to shore up progress under a harm-based strategy when assurance is a major priority.

Although the relative ease of monitoring **technology specifications** and **product bans** makes them attractive instruments, they have seldom been used under the Clean Air Act (CAA), the Clean Water Act (CWA), or the Resource Conservation and Recovery Act (RCRA). Such prescriptive instruments may be most useful in a situation in which the cost of not acting in the short term might be very high.

Tradeable emissions and **integrated permitting**, two of the multisource instruments, also contain strong action-forcing components through provisions for emission caps and the writing of permits. However, we rated tradeable emissions somewhat less effective than integrated permitting and the single-source instruments because of the potential difficulty with monitoring.

At the other end of the spectrum are a set of instruments that might be used with caution if assurance is the major criterion. **Information reporting** can help with monitoring progress but does not require pollution reduction or prevention action by sources. Similarly, **subsidies** and **technical assistance** are almost always voluntary—that is, sources may be asked to reduce pollution but face no sanctions if the program is not successful—which may or may not result in attainment of goals. However, when used as supplements to other instruments, they may increase the overall confidence of the public that goals will be met.

Pollution charges and **challenge regulations** have the potential to move things in the right direction. However, with pollution charges, the action-forcing component is weakened since sources are given an option to pay rather than to reduce their discharges. And our lack of experience with challenge regulations makes them a less reliable instrument at the present time, especially if assurance is the primary concern. More experience in the future with instruments such as tradeable emissions, integrated permitting, challenge



NOTE: These ratings are OTA's judgments, based on theoretical literature and reports of instrument use. The evaluatlon of each instrument on a particular criterion is relative to all other instruments. Thus, by definition most instruments are "average."" Effective" means that the Instrument is typically a reliable choice for achieving the criterion. "It depends" means that it maybe effective or about average, depending on the particular situation, but it is not likely to be a poor choice. And "use with caution" means that the instrument should be used carefully if the criterion is of particular concern

SOURCE: Office of Technology Assessment, 1995.

regulations, and pollution charges may increase the confidence stakeholders have that they can ensure results.

Instrument-by-Instrument Comparison

● Product bans

Product bans and limitations provide a powerful and clear message to the sources about what is required to meet the goal, and the results are relatively easy to monitor. This approach seems best suited for a situation in which the risks of doing nothing might be very high in the short term or not easily reversed.

For example, if a product poses unacceptable risks to consumers, the agency can prohibit its sale, distribution, and use to eliminate those risks, or the agency can place limitations on the sale, distribution, or use of the product to reduce those risks to acceptable levels. Although they are seldom used by agencies to implement the CWA, CAA, or RCRA, Congress itself has in some instances enacted product bans or limitations, such as the phaseout of chlorofluorocarbons (CFCs).

In markets in which no substitutes are available, the product limitation or ban has the potential to induce technological innovation by stimulating intensive research and development aimed at producing products that are capable of filling the void left by the limited or banned product. The section on *technology innovation and diffusion* discusses this in more detail.

● Technology specifications

Technology specifications have the potential to be very effective at providing assurance, although they are also a very intrusive and prescriptive approach. Once a problem is identified, the targeted entity is told exactly how to act and faces both civil and criminal penalties for noncompliance.

Congress may want to use these standards in instances in which a serious environmental hazard

to human health exists and a known technology could provide at least an immediate result. For example, Congress enacted the requirement that new hazardous waste landfills and surface impoundment's install two or more liners and a leachate collection system above and between the liners (255). Although federal environmental statutes seldom direct EPA to enact such specifications, states often specify how sources must carry out their operations in state implementation plans promulgated pursuant to federal environmental standards.

Like design standards, technology-specification standards usually make it simpler for the inspector to ascertain whether a mandated technology has been installed and is working properly than to measure ambient air or water concentrations and relate them to particular sources.

Many observers have little confidence in the ability of legislative bodies or bureaucratic agencies to identify the technology or practice that does in fact meet the intended goal in each individual context. Prescribing a uniform technology for all facilities is not likely to be an efficient approach (7). And, more important, specification standards, standing alone, may discourage dischargers from developing innovative changes in manufacturing processes or recycling technologies to reduce the overall amounts of wasted residuals (3,86,175).

● Design standards

Design standards perform relatively well on assurance when used to meet a technology-based goal. In addition, they are used quite effectively in combination with harm-based standards to provide assurance of some interim progress toward a risk-based goal as well. In either case, the mandatory action and the relative ease of monitoring make design standards a slightly better choice than a stand-alone harm-based standard if assurance is the primary concern.

Design standards, while assuring some progress, can not ensure that risk goals will be fully met. Existing technologies, for example, may not be capable of reducing discharges from a single source enough to achieve the media quality specified by the risk goals. In addition, the cumulative effect of discharges from two or more facilities, each of which complies with the prescribed design standards, could be a concentration of pollutants in the receiving media that still violates the risk goal. Stringent application of the design approach to all new sources might actually slow progress toward risk goals by discouraging companies from replacing older, heavily polluting facilities (2).

In areas that currently meet risk goals, design standards could help ensure that media quality will not deteriorate as rapidly when new sources of the same pollutant are built. In fact, design standards could leave that area "too clean," at least for the present, if the medium can assimilate additional pollutants without violating the risk goal.[2]

The degree of difficulty for monitoring a design standard depends on how the permit is written and whether or not its medium is air, water, or land. If the design standard is translated by the states into an emissions limit, then monitoring might be as complicated and expensive as it is for harm-based standards. However, the compliance officer may also be able simply to check that the model technology is installed and working correctly. For example, if the model technology for volatile organic compounds (VOC) reductions is an incinerator, monitoring the temperature of the device rather than effluent gas concentrations might be sufficient.

Design standards have the advantage when it comes to experience with use. We have used them extensively because they provide a clear course of

[2] Regulated entities frequently criticize an agency for requiring "technology for technology's sake." If the only goal of the regulatory program is to achieve the level of acceptable risk for today, then this criticism is well founded. If the program also seeks to achieve a best-efforts goal, perhaps as a hedge against uncertainties about the future, the criticism is less cogent.

action that is easily enforced, even though they often pose some tradeoffs with criteria like efficiency and technology innovation.

● Harm-based standards

Harm-based standards can be very effective because they provide a clearly designated outcome for each source and some accountability for results. Nonetheless, the analytical complexity and scientific uncertainty of trying to establish a uniform harm-based standard that will actually result in achieving the media quality goals, the difficulties with continuous monitoring, and subsequent enforcement problems make the choice of a "pure" or "solo" harm-based standard a hard one for policymakers who insist on meeting goals.

These difficulties help explain why many harm-based programs end up with a reasonable-efforts floor or abatement strategy added on. Such clauses asking sources to do the best they can until the media quality goals are met provide assurance that some progress will be made.

To satisfy concerns about assurance, harm-based standards need either a technology to monitor emissions or some other widely applicable method for verifying that a source is complying with its limit. If no such technology or technique exists, or if it is too difficult or expensive, an instrument with a lower monitoring burden may be preferred. For example, design standards often include a model technology, whose emission characteristics are known and accepted by regulators, thus avoiding the need for direct emissions monitoring.

Despite all of these concerns, harm-based standards are often preferred over many other instruments because we have enough experience with them to know that they can be effective in assuring source-by-source compliance while nonetheless allowing the sources flexibility to choose the means.

● Integrated permitting

Integrated permitting may be among the more effective instruments at providing assurance, once agencies gain more experience with this instrument. At a minimum, having all of the information regarding a plant's effluent, emissions, and other environmental releases available in a single place, governmental and private citizen enforcers can more easily evaluate the plant's environmental compliance record and decide whether to initiate enforcement efforts.

Using an integrated permit, such as a plant-wide bubble, to give flexibility to a plant or facility to trade off sources may provide adequate assurance to the public—assuming satisfactory monitoring can be installed. For example, 3M anted up improved continuous emissions monitoring for its Minnesota plant in order to gain some flexibility in making changes that affect individual source emissions across the facility.

The integrated approach might also enhance assurance if, during the course of issuing the permit, the agency and sources could identify instances in which requirements promulgated pursuant to one statute conflict with or hinder compliance with requirements promulgated pursuant to another statute. Congress has historically enacted separate statutes for different receiving media and our environmental goals and programs have likewise evolved separately.

Although we are learning, we really do not know how to do multimedia permits well at this point. A source *might* be allowed to reduce its compliance with part of a CWA requirement if it agreed to a more stringent requirement under the CAA, so long as the net environmental risk would be lower than that resulting from full compliance with both requirements. The environmental statutes, however, do not currently allow such arrangements, although EPA has proposed such a possibility for the Great Lakes. In any event, the art and science of risk assessment have not yet progressed to levels that can support such tradeoffs under most circumstances.

○ Tradeable emissions

Tradeable emissions can be an effective tool for providing assurance in many instances. However, since trying to monitor overall reductions made by

multiple sources is potentially difficult, we rate this instrument as "it depends."

For sources, this instrument is eventually translated into an emissions limit—usually as the sum of total allowable emissions over some longer time period such as three months or a year, but even over as short a period as a day—plus the amount of credits or allowances that are purchased from other sources. Thus, tradeable emissions share some of the same strengths and weaknesses for assurance as those discussed earlier for harm-based and design standards.

The degree of action forcing is quite similar to harm-based standards. The burdens of monitoring for an effective tradeable emissions program are quite high, but if they are met the program can be quite effective in holding sources accountable. To provide an effective level of assurance of meeting goals, a tradeable emissions program must also have frequent self-reporting and periodic audits by neutral outsiders (71,118,137). Since the ability of a regulator to determine compliance by any single source depends on the integrity of the entire system, monitoring for tradeable emissions may beheld to a higher level of accuracy than for harm-based or design standards.

A very important distinction between this instrument and harm-based standards is that, while the emissions limit for a harm-based standard is location specific, a tradeable emissions program usually provides no assurance that any one source will achieve a specific limit. Thus, the approach works well for certain types of pollutants where environmental quality can be safely based on total loadings over large geographic areas. If, however, emissions at individual facilities, rather than combined emissions from many, are the principle source of concern in a particular area, then moving from a source-by-source approach to a trading program may not satisfy the public's concern over maintaining environmental quality.

A distinct threat to assurance is the possibility of trading units of pollutants that do not represent equivalent risks (42). Under this regime, tradeable emissions could result in a decrease of easily controlled but innocuous substances and a corresponding increase in difficult to control but highly toxic substances.

Tradeable emissions permits are now being used in a variety of settings, including the national $S0_2$ (acid rain) trading program; the Regional Clean Air Incentives Market (RECLAIM) efforts in Los Angeles (see chapter 2); an open market trading system in Tulsa, Oklahoma; and several other small efforts in watersheds. As more experience with this instrument and thus more information on successes as well as difficulties is gained, the public may develop more confidence about the potential for meeting goals.

V Information reporting

Information reporting does not guarantee that any action will be taken by either the source or the public to prevent harm, even though the programs may be relatively easy to implement and may be effective in identifying risks associated with a product or facility. However, reporting require--merits can help an agency assess which activities pose the most serious environmental risks.

Under Section 5 of the Toxic Substances Control Act (TSCA), for example, manufacturers must make EPA aware of the production of new chemical substances or significant new uses of existing chemical substances (256) and must immediately inform EPA of any information that reasonably supports the conclusion that the substance presents a substantial risk of injury to health or the environment (258). EPA may use this information as the basis for regulatory action to protect the public.

In the direct consumer context, information may help consumers identify and reward manufacturers who develop less risky products or technologies. Information reporting may also provide the public the kind of specific information it needs to make a legal case against sources. For example, if a company's monthly discharge monitoring reports filed under the Clean Water Act show that the company is not complying with its permit requirements, an environmental group that becomes aware of those reports can use them in a

citizen enforcement action under section 505 of the CWA (246).

Although we have considerable experience with information reporting programs per se, we have little evidence of sustained behavioral changes in protecting the environment. Most of these programs have no mechanism for forcing less pollution from sources and thus cannot assure the public that goals will be met if they are implemented.

V Subsidies

Since they are strictly voluntary, government subsidies, including tax expenditures, are capable of achieving environmental goals only to the extent that the government is willing to pay to achieve those goals and sources are willing to participate. Tax breaks can reduce the pain of compliance with environmental requirements (165) and may be relatively easy to enforce (1 23). However, since participation is strictly voluntary, subsidies might be approached with some caution when assurance is an important consideration.

V Technical assistance

Similarly, although technical assistance can offer companies valuable information and encouragement, it cannot provide stakeholders assurance that environmental goals will be or have been met. Its goal is to persuade sources to adopt best practices or to diffuse innovation in order to move things generally in the right direction. The primary inducement behind such programs is the promise that taking environmentally beneficial action will ultimately save the company money in reduced production or energy costs.

The voluntary nature of such programs means that there is no leverage for forcing actions to achieve goals. Even if companies initially participate, the specific technical assistance can always be rejected, which may happen if the solutions identified are expensive or if the promised paybacks are not fairly immediate.

Challenge regulation

Challenge regulation, one of the less intrusive approaches for achieving environmental goals, gives sources the responsibility for designing and implementing a program to meet the targets established by government. The government would use milestones to measure progress toward the targets and retain the authority to implement a regulatory program should progress be unsatisfactory or the goals not met.

In the short run, since attainment of goals depends solely on industry choices, challenge regulation does not offer much a priori assurance to those who believe goals must be met. On the other hand, monitoring and information systems can be put in place to provide evaluations at annual intervals in order to measure progress toward the goals. If these evaluations are tracked and the targets backed by a mandatory abatement strategy should industry fail to meet them, then challenge might be effective in providing assurance.

The United States has not yet implemented a true challenge regulation, but the voluntary 33/50 program is very similar. Established by EPA in the late 1980s, the program challenged companies emitting 17 targeted toxic chemicals to reduce their emission of toxics by 33 percent by 1992 and 50 percent by 1995 (250). EPA left the impression that if releases were not reduced, it would take additional action under its existing authorities to bring about further reductions (167). Several challenge regulations have been implemented in Europe, including Germany's Green Dot program and several covenants in the Netherlands. However, uncertainty about the effectiveness of such negotiated plans in our very open, highly fragmented system suggests proceeding with some caution.

Pollution charges

To provide assurance to stakeholders of meeting goals, the emissions subject to pollution charges must be easily monitorable and enforceable and the charge must be set high enough to induce the

change necessary to reduce emissions. If available pollution reduction technologies will not achieve the goals, a high enough charge may nonetheless provide a continuing incentive to develop alternative technologies. Pollution charges could also make enforcement easier by replacing the bargaining that a company attempts with enforcement officials with the simple approach of "balance due, delinquent charges, plus penalties" (123).

However, not all emissions are easy to monitor. If emissions remain undetected, the source will have no incentive to install pollution reduction technologies, and estimates of progress toward goals will be flawed (7,177).

From the sources' point of view, pollution charges are among the least attractive instruments. Even though charges offer great flexibility in the choice of control method—including the choice of not controlling-they can be quite expensive unless emissions are almost completely eliminated. Sources end up both paying the costs of reducing emissions and paying a charge on any residual emissions, even after the desired levels are met. Thus, if the charge is set high enough to induce change (161 ,220), the owners of polluting sources may decide to resist the fees in available political and legal forums (86,95). Finally, pollution charges may not provide adequate assurance for emergencies and activities that pose risks of low probability but very large consequences (7,123,161,220).

Although Europe has implemented various forms of pollution charges, most are set to raise revenues; only a few have been set high enough to force substantial reductions. Most of the U.S. experience involves technology-based fees such as per-bag fees for residential solid waste. Success with these may make the public amenable to efforts to extend use of charges for other environmental problems.

Liability

A major barrier to liability providing adequate assurance is the very high burden of proof required to establish that the defendant is the source of harm and that the source acted in a manner that was unreasonably dangerous or otherwise socially unacceptable (77,93,1 13,188). If one party is demanding compensation from another party, the courts have been generally unwilling to tolerate uncertainties of the magnitude that are familiar in environmental regulatory regimes (276). The probability of being forced to compensate potential victims is often so low that polluters have little incentive to reduce pollutants to levels that meet the environmental goals.

Ideally, liability can be used both to encourage the prevention of future environmental problems and to fund remediation of existing sites that pose environmental threats when a defendant has been found responsible for harm in a court of law.

■ Pollution Prevention

Pollution prevention is reducing or eliminating pollution at the source of generation through changes in production, operation, and raw materials or resource use.

Pollution prevention is a strategic approach sources can use to meet or exceed environmental goals. Pollution prevention strategies seek the reduction of ***all*** nonproduct outputs, regardless of medium, restricted only by the limits of current process and product technology.

The Pollution Prevention Act of 1990 (PPA) does not mandate prevention but rather states that pollution should be prevented whenever feasible. It does, however, require certain firms to report through the Toxics Release Inventory (TRI) system on their "source reduction activities."[3] Thirty states have enacted pollution prevention statutes,

[3]The Pollution Prevention Act of 1990 (42 U.S.C. 13l0l) defines pollution prevention as". . . any practice which reduces the amount of any hazardous substance, pollutant, or contaminant entering any waste stream or otherwise released into the environment (including fugitive emissions) prior to recycling, treatment, or disposal; and reduces the hazards to public health and environment . . . ."

over half of which include provisions for pollution prevention facility planning. Some have also set statewide numerical pollution reduction goals.

Despite these initiatives, both policymakers and firms fail to adopt pollution prevention strategies as an alternative to pollution control in many instances, even when they may be less expensive in the long run. Explanations for continued reliance on control strategies include a lack of awareness or information about pollution prevention, regulatory disincentives (or lack of incentives), and economic and institutional issues (78,122).

Factors for Comparing Instruments

Policy instruments can provide an advantage for pollution prevention efforts either by giving firms a reason to choose pollution prevention instead of control strategies or by demonstrating the value of prevention strategies so that organizations incorporate them in routine decisionmaking. We compare instruments on their potential for encouraging pollution prevention by assessing the extent to which each instrument:

- gives an advantage to prevention, and
- focuses on organizational learning.

Gives an advantage to prevention

For both regulators and regulated entities, staying with known control technologies is often the least-risky choice even when regulations provide some flexibility of choice because costs, operational conditions, and monitoring capabilities are predictable. Making it easier to use, or even requiring pollution prevention rather than control, is one way that instruments can be effective.

Focuses on organizational learning

Both private and public sector experts typically specialize in air, water, or waste management, with a unique set of language, technologies, and institutional concerns. Moving away from this pattern toward prevention strategies may require considerable learning within organizations. Important issues to be considered include how a firm is organized to make decisions about environmental issues; who makes the key decisions; whether or not top management demonstrates a commitment to prevention, makes resources available, and rewards workers for their efforts; and capacity for flexibility in production processes (146).

In most industrial firms except the smallest, linkages between the production and environmental units have been weak (31). Since pollution prevention seeks to integrate the idea of prevention into production design, organizational leadership or even a change agent at the facility level maybe essential for accomplishing this objective.

Summary of Instrument Performance

● ***Effective: Product bans, technical assistance***
0 ***It*** depends: ***Technology specifications, design standards, liability***
∇ Use with caution: —

Most instruments can be used in a way that is compatible with pollution prevention (see table 4-3). While experiences with product bans and technical assistance suggest their effectiveness, neither is extensively used under the CAA, CWA, or RCRA. Product bans eliminate a source of environmental risk and may force the development and use of alternatives. The level of resources devoted to technical assistance is currently too low to reach all firms that could benefit and, in general, is not targeted at larger firms. Implementing combinations of these and other instruments may be essential to improve the use of pollution prevention strategies (141).

Liability may also be effective at prevention because many firms would rather prevent pollution, and thus reduce their liability exposure, than rely on control of large quantities of potentially damaging emissions or wastes.

Although widely criticized as perpetuating preferences for end-of-pipe technologies, both technology specifications and design standards can be used effectively to *promote* pollution prevention approaches. The criticisms are most often summarized as: "standards *require* specific end-of-pipe technology" even though, except in the most restrictive cases, regulated entities are actu-

TABLE 4-3: Pollution Prevention

	Fixed Target							No Fixed Target				
	Single-source				Multisource							
	Product bans	Technology specifications	Design standards	Harm-based standards	Integrated permitting	Tradeable emissions	Challenge regulations	Pollution charges	Liability	Information reporting	Subsidies	Technical assistance
Pollution prevention	*	0	0	.	.	.	.	.	O	.	.	●
Gives prevention an advantage	●	O	O	.	O	.	.	.	O	.	O	O
Focuses on learning	.	∇	∇	∇	.	.	O	.	O	O	.	●

● = Effective O = It depends V = Use with caution .= Average

NOTE: These ratings are OTA's judgments, based on theoretical literature and reports of instrument use The evaluation of each Instrument on a particular criterion is relative to all other instruments. Thus, by definition most instruments are "average." "Effective" means that the instrument is typically a reliable choice for achieving the criterion. "It depends" means that it maybe effective or about average, depending on the particular situation, but it is not likely to be a poor choice, And "use with caution" means that the Instrument should be used carefully if the criterion is of particular concern

SOURCE: Office of Technology Assessment, 1995.

ally allowed to chose "equivalent" methods to meet standards. The de facto requirements come from the practice of setting and applying standards rather than the standard itself.

However, since most design standards were written before pollution prevention became a policy priority, they typically have not been based on pollution prevention concepts or written in ways that accommodate prevention options. Thus, they tend to perpetuate the choice of control technologies. Since pollution prevention often involves process modifications rather than off-the-shelf technologies, continuing to use source-by-source emission standards of any kind restricts the opportunities for using pollution prevention approaches.

Instrument-by-Instrument Comparison

● Product bans

Banning or phasing out a product deals directly with the source of a problem but may require the development of substitutions. Examples include the domestic phaseout of lead in gasoline and paints, the banning of polychlorinated biphenyls under TSCA, and the international treaty on phasing out ozone-depleting substances, commonly referred to as CFCs. A potential problem with **product bans,** as discussed in chapter 3, is that not all substitutions end up being as environmentally friendly as they might first appear or may result in shifts in the location or types of risk. Product limitations, such as labeling and use restrictions, are not necessarily as effective at encouraging pollution prevention options unless compliance costs or public pressure are high.

● Technical assistance

Since these programs are usually voluntary in nature, the decision about whether or not to use **technical assistance is** made by firms. For those that do use the services, technical assistance has been

successful in getting firms to use prevention to address specific environmental problems.

The primary argument for using technical assistance has been that firms are much more likely to adopt pollution prevention once they learn about its advantages for specific problems and have access to reliable technical and economic information (204). Whether this kind of assistance alone is sufficient to persuade sources to pursue pollution prevention rather than control strategies on a continuous, long-term basis is not yet clear (55). While the government has learned a great deal about the value of technical assistance, and especially the importance of change agents or key individuals in the agricultural and energy policy systems, application of this approach is relatively new for achieving pollution prevention.

The voluntary, cooperative nature of technical assistance is part of its appeal. However, the success of technical assistance programs lies in demonstrating to regulated entities that altering their behavior and the way they think about solutions to environmental problems can have tangible payoffs. This may require a long period of shared learning and building trust between technical staff in the government or vendor firms and the volunteering firm before the firm is willing to make major changes.

More than 60 programs are operating at the state and local level today, but most are very small. While some of the mature programs may have up to 30 staff people, the average size is four to five people. Thus, even the largest programs "reach only a small fraction of facilities that might benefit" (204).

Design standards

While there is no reason in theory for end-of-pipe technologies to be selected as the model for **design standards**, they generally have been. The model often becomes the de facto standard, despite the fact that design standards may be expressed as emission limits in the agency's final rule. For instance, even though CWA effluent guidelines based on best available technology (BAT) are expressed as effluent limitations, they may be written into a permit as a technology, making prevention a difficult choice (6).

Even when a design standard remains as an effluent limitation, regulated entities face a dilemma. They can choose to minimize the regulatory burden by using the technology they know is the basis for the standard or they can attempt to lower their abatement costs by finding an alternative but pay the cost of proving equivalence to regulators or the facility inspector.

EPA's proposed joint rule for the pulp and paper industry used prevention as the reference control technology for best available technology and made prevention the only way to comply by setting the measurement point for limitations after the process but before the outlet pipe to the wastewater treatment plant. Environmentalists wanted EPA to go further and select total chlorine free (TCF) technology as the reference. EPA instead offered regulated entities a break from monitoring if they used the TCF technology once it was operating and meeting the effluent limitation.

Technology specifications

Technology specifications are straightforward: they either are or are not based on a preventive strategy. There are only a few cases where prevention has been chosen as a technology specification. One example is oxygenated fuel provisions added to the CAA in 1990 to control carbon monoxide. Congress instructed EPA to give preference to oxygenates made from nonfossil sources.

Under RCRA, landfill operators are required to install specific technology, such as special liners and monitoring systems, for hazardous waste facilities. However, this is at a point at which pollution already exists. If the standards raise the costs of landfilling high enough and if those costs are passed back to the waste generator, they create an incentive for pollution prevention.

Liability

Anecdotal evidence suggests that **liability** provisions prompt regulated entities to adopt pollution prevention. The Superfund statute, with its retroactive joint and several liability provisions, has

been one of the most effective strategies if judged by this criterion because prevention is perceived as the only sure way of avoiding possible future liabilities. However, Superfund uses a strict liability approach; not all forms of liability create as strong a set of pressures. In addition, impacts from Superfund liability on industries other than the petrochemical industry may be less profound or absent (43).

When firms take into account future liabilities, such as the estimated costs of future litigation and cleanup, in addition to waste management or treatment costs, the comparative viability of prevention projects may increase. While future costs and benefits can be difficult to quantify, newly developed cost-accounting systems include methodologies for quantifying future liabilities.

Harm-based standards

Because a regulated entity is free to choose the technical means it determines is most cost effective for meeting the standard, a **harm-based-standard** is neutral to the choice of prevention or control. However, the fact that they tie the desired outcome to the single-source level of emissions can inhibit initiatives for process-based prevention solutions.

The way harm-based standards are expressed at the facility level can affect prevention. Expressing the standards as a mass-based limit, for example, may increase prevention options, while using concentration limits for water emissions may restrict options to conserve water use. Eliminating part of a waste stream through water conservation might cause a facility to increase pollutant concentrations even though total mass might decrease (209). Mass-based emissions could become technology forcing if an overall cap on emissions is included.

Integrated permitting

The goals of **integrated permitting** may determine whether or not pollution prevention is chosen. These permits can be written in a way that requires or favors pollution prevention strategies, but that is not a necessary feature of integrated permits.

Permitting has traditionally been done separately for sources according to air, water, and waste problems. One goal for integrated permitting is to help resolve these conflicts by allowing multi- or cross-media tradeoffs. Another goal is to change the way an organization approaches choices about environmental solutions in order to increase the adoption of pollution prevention strategies.

For example, New Jersey's integrated permitting program utilizes the information and experience gained from a required facility-wide pollution prevention planning process. Before the permitting process begins, a facility has already examined all its process units (as sources of nonproduct outputs to all media), identified prevention opportunities, and planned an implementation schedule. Despite these types of efforts in several states, it is too early to draw conclusions about the impact of integrated permitting on the adoption of pollution prevention strategies.

Tradeable emissions

Tradeable emissions allow regulated entities to choose whatever method of compliance they determine is most cost effective, including paying for releases, and thus are essentially neutral to the choice of prevention versus control. No empirical evidence to date suggests that these programs can be counted on to stimulate prevention more than control strategies, independent of the cost implications for the firms.

When pollution prevention is the least-cost option for industry, it may be chosen; but other influential factors may include the nature of the environmental problem, the availability of prevention approaches that can produce results in a timely manner, the extent to which the regulated entities use methodologies, such as total cost accounting, and the presence of individuals who strongly support pollution prevention.

Challenge regulations

Because the content and purpose of **challenge regulations** could be so variable, pollution prevention is not necessarily an outcome. The Green Dot program in Germany has had mixed results. Although the evidence indicates that a reduction occurred in some types of packaging materials for large shippers, most other types of packaging were recycled.

Although EPA labeled 33/50 a pollution prevention initiative,[4] the agency used changes in the TRI to measure success. Thus, either a prevention or a control option that reduced releases from a facility would count. EPA did not ask firms to identify what percent of their reductions came from prevention and to explain why pollution prevention was or was not chosen. A number of groups are studying the 33/50 data to determine whether the program's flexibility did, in fact, result in greater pollution prevention.

Pollution charges

Pollution charges, such as waste end fees, emission fees, tipping fees, and permit fees, are rarely set high enough to change behavior, but instead are used to raise revenue for environmental programs. However, even when they are set high enough, they are absolutely neutral toward whether firms adopt a prevention, control, or payment strategy. Pollution charges might encourage pollution prevention if they are made avoidable only through prevention (141).

Information reporting

Requiring **information reporting** may have two potentially beneficial outcomes. First, the information collected may help policymakers make better choices in the future to promote pollution prevention. Second, the way a firm is required to collect and organize information for submission may help it learn more about its own processes and identify opportunities for pollution prevention. Attributing successful outcomes to information reporting, however, may be difficult to justify given the many other influences on sources.

The RCRA Amendments of 1984 required certain hazardous waste generators to include their waste minimization efforts in their RCRA biennial reports. In addition, generators who ship wastes offsite have to certify on RCRA manifests and in permit applications that they have a waste minimization program in place. Despite claims the wastes from the largest generators are being minimized, there is no clear indication that the reporting requirements are the cause (206).

The Toxics Release Inventory, although enacted as a right-to-know measure, has also been characterized as creating incentives for pollution prevention. However, as an information reporting tool for promoting pollution prevention, TRI initially had at least two drawbacks. First, it has counted chemical *releases* from facilities but not chemicals *generated*. Both prevention or control options implemented on the site of a facility can result in reduced levels of reported releases. Second, releases are not necessarily related in any way to production levels.

Facilities subject to TRI are now required to submit annual prevention and recycling reports showing changes over the previous year, using a production ratio. And facilities that claim reductions through pollution prevention must submit qualitative information that help officials understand why and how pollution prevention happens.

State mandates for filing facility planning reports are still another example of trying to use information reporting to promote pollution prevention. As of early 1994, 16 state governments had enacted such laws (226). A major assumption is that the planning process will spur organizational awareness and change as firms discover for themselves the benefits of adopting pollution prevention.

It is too early to evaluate the impact of these programs on pollution prevention efforts in the private sector. Successful outcomes may depend

[4] Under its original title of "Industrial Toxics Project," it was part of the EPA Pollution Prevention Strategy published in February 1991.

highly on a firm's existing culture and staff expertise. If a firm simply hires a consultant to create a report that will comply with the requirements, little learning may occur within the firm. On the other hand, these laws may enable environmental managers inside firms to push for pollution prevention (66).

States have also enacted information reporting programs, such as California's Proposition 65, which allows regulated entities to choose between prevention, such as reformulation to remove a listed chemical, and warning labels for consumer products. These programs have not been fully evaluated for their pollution prevention impact.

Subsidies

Although the federal government does not offer **subsidies** to regulated entities specifically for prevention, some states do in the form of financial assistance, such as grants, loans, or tax deductions or credits, for prevention technology development, demonstration, or application (201).

Since a comparison of subsidies has not been done, their impacts on the investment behavior of regulated entities toward pollution prevention is unknown. For example, it is unclear whether motivated firms find applicable subsidies or the availability of the subsidy motivates the firms.

The effectiveness of subsidies for prevention can be more difficult to verify than for pollution control equipment. The latter is a discrete set of easily recognized technologies, whereas prevention is synonymous with manufacturing processes and products. Other countries have attempted to solve this problem. The Netherlands, for example, allows tax rebates only for a list of cleaner technologies that are preselected on a periodic basis through a special review process.

Environmental Equity and Justice

Environmental equity and justice seeks equality of outcomes, full participation by affected communities in decisionmaking, and freedom from bias in policy implementation.

Traditionally, concern about the distributional effects of environmental protection policies focused primarily on the relative costs and burdens placed on particular industries or on the differential impacts on small versus large or old versus new control sources (see the following section on *costs and burdens)*. Less attention was given to understanding how these policies might redistribute environmental risks and benefits among individuals (99). In fact, the thrust of much of the theoretical literature has been that environmental protection might hurt low-income individuals by eliminating jobs or forcing facilities to relocate (189a).

Over the past decade, however, even these traditional concerns of environmental equity have been recast toward determining the extent to which specific groups of Americans may bear a disproportionate burden of environmental risks. This new focus is now widely referred to as "environmental justice".[5]

The body of empirical research investigating this focus is relatively new. However, initial studies indicate that some minority and low-income communities have experienced adverse impacts from discriminatory siting of facilities and from the implementation of environmental laws (36, 124,194,199,221,225).

These studies generally conclude that minorities and those in low-income communities are more likely to be exposed to higher levels and multiple sources of environmental risks than are whites and higher income neighborhoods. A num-

[5] The literature remains unsettled about which words best identify this new focus. See, for example, D. Ferris, "A Challenge to EPA," *EPA Journal* 18:28, 1992; N. Walker and M. Traynor, "The Environmental Justice Movement: Two Cases in Point," *Environmental Law* 12:3, 1992; R.D. Bullard, "The Threat of Environmental Racism," *National Resources and the Environment*, winter 1993, pp. 23-26, 55-56.

ber of other interpretations of these data have been offered, and attempts to verify the data and, where possible, to clarify the reasons for and the extent of the disparities are continuing (18,20).

Advocates of environmental justice seek to institute the following set of principles for decisionmaking on environmental issues: "right to protection, prevention of harm, shifting the burden of proof, obviating proof of intent to discriminate, and targeting resources to redress inequities. . ." (23). These principles restate environmental priorities to address the concerns of minorities and other vulnerable populations that environmental issues are issues of equity, social justice, and public health, not conflicts requiring tradeoffs between health and economic well-being (24,25).

Environmental equity and justice is now one of the standards against which environmental protection policies are measured. For example, federal agencies are now required to address the "disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations" (268). The EPA, which has characterized environmental justice as concerned with identifying and addressing disproportionately high and adverse human health or environmental effects in minority populations and in low-income populations, incorporates it as one of its six "guiding principles" for strategic planning (213). More recently, the Clinton Administration's "10 Principles for Reinventing Environmental Protection" incorporated ideas of environmental equity and justice as well (32).

Factors for Comparing Instruments

The concept of environmental equity and justice encompasses multiple concerns, ranging from funding more research to identify the disparate impacts of environmental policies to developing more effective strategies for achieving the goals. At the heart of the environmental justice concept is the theme that environmental policies have discriminated against racial minorities and low-income communities in both direct and indirect ways (63). A major concern is that, through their neighborhoods, jobs, and diet, these groups are exposed to more pollution than are other members of the public.

Many of the strategies for pursuing environmental equity and justice, while important, involve initiatives that fall outside the scope of this assessment. For example, efforts to reshape the siting procedures for hazardous waste facilities in the states can be important for achieving equity and justice goals. However, procedural improvements for decisionmaking are not instrument specific in effect.

In this section, OTA has restricted its comparison of the policy instruments to three major components of environmental equity and justice:

- distributional outcomes of policies;
- effective participation in policymaking; and
- remediation of existing problems.

Distributional outcomes of policies

The redistribution of risks and benefits through implementation of environmental laws occurs at varying geographic scales. For example, some areas of the country, notably urban areas such as Los Angeles, have much higher concentrations of air pollutants such as ozone than do rural areas. Within a local community there may be large differences among neighborhoods in the relative exposure to hazardous or toxic substances. These types of inequities, especially in the absence of compensating benefits, are a primary concern for achieving environmental equity and justice.[6]

This report looks at two specific types of distributional outcomes that are central for trying to protect all members of the public. First, environ-

[6] Economists have used the assumption that winners will pay losers to "wash out" the distributional inequities that ultimately develop in any real-world implementation of policies. This has generally not happened, although the idea of direct compensation for siting has been adopted by some states; see V. Been, "Compensated Siting Proposals: Is It Time To Pay Attention?" *Fordham Urban Law Journal* 21(3):787-826, 1994.

mental equity and justice seek to address the issue of protection for the most vulnerable populations, especially since evidence exists that environmental regulatory agencies have failed to protect these populations adequately in the past (189,208).

For example, in establishing water quality standards, proponents point out that fish consumption data are usually averaged across populations and may miss special sensitivity within smaller subgroups such as Native Americans (222). It is this more sensitive group. according to advocates, on which the regulations should be established since they not only eat more fish but also more of each fish, often including the head and tail, which are parts with higher bioaccumulation (92).

Second, proponents of environmental equity and justice are concerned that, once that level of protection is set, the actual levels of exposure to pollutants should not differ across individuals or groups. For example, proponents argue that, if national standards are set for air pollution emissions, no individual should be more exposed than another individual. Thus, differential exposure across areas of the country or within local communities—so-called "hot spots''—would not be acceptable. This proposition is based on the claim for a "civil right to equal protection" from environmental harm (34,65,191).

Effective participation in policymaking

Another major component of environmental equity and justice is to establish informed and meaningful participation in all decisionmaking arenas where specific environmental policies are developed (52). By forcing policymakers to consult with communities and local grass-roots leaders, proponents expect to achieve higher visibility for their ideas and to change the regulatory culture for environmental policymaking at the federal level (35,61,191).

A major difficulty is often the discrepancy between the capacity of industry and government and that of minority and low-income communities to participate as equals. Language barriers, convenience of the forums, and lack of technical preparation are examples of problems that may have to be overcome for individuals to get involved in neighborhood and community problem solving (26).

Remediation of existing problems

Some minority and poor communities also have experienced discrimination when decisions have been made about siting hazardous facilities and about choosing priority sites for cleanup (98). Yet efforts to establish remediation through equal protection suits have been generally unsuccessful (65). While remediation will continue to be a concern in the short run, because communities cannot simply move away from their problems, the ideal is to eliminate the need for remediation efforts in the future by emphasizing pollution prevention strategies.

Summary of Instrument Performance

- ***Effective: Information reporting, subsidies, technical assistance***

O It depends: —

V Use with caution: ***Tradeable emissions, challenge regulation, pollution charges***

The concerns of environmental equity and justice are not easily addressed by the choice of policy instruments. In fact, many of the proposed strategies for achieving equity and justice—including redesigning administrative processes to secure more meaningful participation, establishing an active enforcement and compliance program, requiring more financial and analytical support of environmental justice issues, and strengthening environmental goals—for the most part require actions that are far beyond the scope of this assessment.

Instrument choice is not a particularly effective way to achieve those goals, although few of the instruments actually impede the goals. In fact, most of these instruments can be used in a manner that is either consistent or inconsistent with seeking one or more of the factors that are part of environmental equity and justice.

The most effective instruments for achieving environmental equity and justice are those that can provide either financial or technical assistance

TABLE 4-4: Environmental Equity and Justice

	Fixed Target							No Fixed Target				
	Single-source				Multisource							
	Product bans	Technology specifications	Design standards	Harm-based standards	Integrated permitting	Tradeable emissions	Challenge regulations	Pollution charges	Liability	Information reporting	Subsidies	Technical assistance
Environmental equity and justice	.	.	.	.	.	▽	▽	▽	.	●	●	●
Distributional outcomes	.	.	.	●	.	▽	▽	▽	.	.	.	.
Effective participation	.	.	.	.	.	▽	▽	▽	.	●	●	●
Remediation	.	.	.	.	.	.	.	.	●	.	●	●

● = Effective O = It depends V= Use with caution . = Average

NOTE These ratings are OTA's judgments, based on theoretical literature and reports of Instrument use. The evaluation of each Instrument on a particular criterion is relative to all other Instruments Thus, by definition most instruments are "average." "Effective" means that the Instrument is typically a reliable choice for achieving the criterion "It depends" means that it maybe effective or about average, depending on the particular situation, but it is not likely to be a poor choice, And "use with caution" means that the Instrument should be used carefully if the criterion is of particular concern

SOURCE Off Ice of Technology Assessment, 1995

to community groups and other organizations to enhance and improve their capacity to become involved in decisionmaking and to affect progress toward local environmental quality (see table 4-4). Although boosting the participation of such groups may help with *assurance of meeting goals,* the purpose goes beyond that criterion to seek the views and ideas of those individuals likely to be affected by choices about priorities and programs.

Several instruments have the potential to provide funding to help local communities. For example, although **liability** has been quite controversial, it nonetheless could provide a vehicle for obtaining remediation funds for cleaning up environmental hazards. **Subsidies** can also be used in similar ways. **Technical assistance** can increase the capacity of communities to understand the environmental risks in their communities and prepare them for participation in technical proceedings. And **information reporting** by facilities and government agencies alike can be critical for communities trying to evaluate the environmental risks they face.

In the case of distributional outcomes, instrument choice may bean important issue. For example, requiring all sources to adopt the same pollution abatement capacity regardless of the ambient environmental quality in an area, as a de**sign standard** does, cannot address the fact that some areas may have multiple facilities and thus face relatively higher exposure levels. In contrast, **harm-based standards,** which are typically based on the media quality in an area, could be tightened for sources that are discharging pollutants into areas with relatively poorer air or water quality.

Three instruments---tradeable emissions, challenge regulation, and pollution charges—may create serious problems if equity is a major concern. The first two give firms or industries the choice regarding which facilities will make improvements in performance and in which order

these improvements will be made. Thus individuals in one area of a region could be comparatively worse off even though others are much better off—even though the overall environmental performance for the industries or firms involved is improved. In the case of pollution charges, firms have the choice of paying the charge per unit of pollution emitted or discharged rather than controlling or reducing the pollution.

None of the instruments per se are very effective at ensuring that groups are experiencing the same exposure levels of pollutants. The real gains for improving distributional impacts are likely to come through improving the quality and level of participation in environmental policymaking and increasing efforts to secure remediation of existing problems. However, these changes are more likely to be successfully pursued through changing social and political values rather than through instrument choice.

Instrument-by-Instrument Comparison

● Information reporting

Information reporting can aid the goals of environmental justice in several important ways. Information can be used by researchers to identify ongoing environmental problems and to improve our understanding of effects of exposure on individuals and communities, by citizens to improve grass-roots participation in decisionmaking, and by government officials to identify and respond to inequities in the implementation of environmental policies.

For the public to participate fully in decisionmaking, communities need adequate notice, accurate information, and an understanding of the community and individual risks involved. One of the factors that led to the environmental justice movement was the increase in public knowledge about the nature of transfer and storage facilities for toxic and hazardous waste provided by changes in right-to-know laws and "cradle-to-grave" manifests (35).

Publicly available information from facilities can also be used by technical experts to help educate and empower local groups (35). Changes in right-to-know laws have empowered minorities and local communities. The Environmental Justice Committee of the California Comparative Risk Project recently recommended that the state expand community right-to-know opportunities because of their demonstrated effectiveness in several disputes (26).

● Subsidies

The Environmental Justice Act proposed a number of **subsidies** to promote its goals (269). It contained provisions for grants, for example, to support inspections of facilities and research on environmental issues. It also directed EPA to establish user fees on toxic chemical facilities to be used in funding the grants.

Grants are particularly useful instruments for funding such projects as remediation work at existing facilities or abandoned property, technical education and training of members of minority or low-income communities to prepare them for careers in environmental science and engineering, and research on health impacts in communities with a history of high exposure to pollutants. EPA, for example, is providing subsidies to several health clinics, including one in Torrance, California, to help communities assess the health impacts of high exposure levels to toxics (46).

Financial compensation to communities for accepting hazardous facilities has been a widespread practice in states. The Massachusetts Hazardous Waste Facility Siting Act, for example, has been sited as a model for other states and Wisconsin has experienced moderate success using compensated siting. However, many grass-roots organizations and communities have opposed the concept of compensating communities for the inequitable burden they bear by accepting a hazardous waste facility (19).

● Technical assistance

Technical assistance can be a powerful tool for improving the capacity of communities to evaluate for themselves the status of environmental problems in their communities and to work more

effectively with government and industry in developing solutions (191). For example, programs can be developed to provide information about environmental problems and issues in the community's primary language, to train local workers in the kinds of practical skills needed to participate in decisionmaking or in monitoring environmental problems.

Technical assistance programs are currently available under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) to help communities hire technical advisors. However, administrative requirements for obtaining the grants have impeded efforts to take full advantage of them (52). Such technical assistance is especially important for helping communities understand and evaluate the cleanup status of remediation projects.

EPA has awarded a number of grants to local organizations representing low-income and minority communities to implement programs to advance the goals of environmental justice. Six Massachusetts community groups, for example, received small grants for activities to reduce lead contamination, complete research on air quality, and survey public housing communities to identify environmental concerns of residents (44).

▽ Tradeable emissions

Tradeable emissions, one of several multisource instruments that treat emissions from a group of sources or facilities as a single source, might be used with caution if distributional issues are a concern. In a tradeable emissions program it is possible that, even though the emissions cap is stringent enough to protect the overall population, the patterns of the trading may lead to very different levels of exposure for individuals. For example, one possible outcome is the further aggravation of pollution hot spots in minority or low-income communities and neighborhoods (4,155).

This is not necessarily the case, however. As discussed in the case study of the RECLAIM program in Southern California in chapter 2, little difference is expected for the Los Angeles area in the exposure outcomes for minorities between RECLAIM and a more traditional regulatory alternative. Moreover, since the emissions cap is increasingly stringent over the life of the program, everyone should be better off.

▽ Challenge regulations

Challenge regulations focusing on industry sectors or large individual firms represent a potential threat to the idea of emphasizing the distributional effects of environmental policies. A major strength of challenge regulations is that they set standards at a larger geographic scale than the facility level in order to improve opportunities for efficiency and innovation in meeting goals. They also emphasize less formal administrative proceedings in favor of more consensus-based decisionmaking.

But when standards or targets to be met are established by industrial sector rather than for a facility or source, the distribution of environmental impacts is uncertain. Particularly when standards cover a relatively large geographic scale, the exposure patterns for the area will depend on the choices of specific companies or facilities. However, since overall emissions would be reduced, everyone should be less exposed than when the program was initiated.

The implications of challenge regulations for participation are uncertain. If decisionmaking moves more toward negotiation between regulators and industry, the capacity of minorities and low-income individuals to participate may be even more constrained.

▽ Pollution charges

Pollution charges are unresponsive to concerns about the unequal distributional impacts of environmental policies. Their strength lies in the simplicity of administration and uniform application to all discharging sources. The disadvantages in terms of equity and justice are twofold. First, such uniformity in the implementation of charges prevents taking actions to improve hot spots by ratcheting down the allowable discharges from specific facilities. And second, a facility has the right un-

der such a program to pay the fee and continue discharging regardless of the impacts on environmental quality.

One possible advantage of pollution charges might be the use of fees to fund remediation efforts in particular communities. The charges might be placed in a fund for use in the future or used to clean up existing sites.

Product bans

Actions to alter product status may enhance the goals of equity and justice by benefiting all of us. However, they may also increase protection for minorities and the poor, who are often more exposed than others. For example, pesticides are more likely to be handled by farm workers, increasing their exposure through multiple pathways (144). Since toxic and hazardous products are more likely to be handled by minority and poor employees (60), efforts to reduce risks through **product bans** or limitations might provide more direct benefits to these workers.

Technology specifications

The uniformity of **technology specifications** goes to the spirit of ensuring that any facility that is built uses equally performing technology. However, since these standards are uniform for sources, they will not be effective at addressing pollution problems in areas with multiple sources or with unique conditions.

Formulating these standards requires considerable expertise and knowledge of the equipment and industrial setting. The process for rulemaking can also be lengthy and focus on highly technical issues. These circumstances may work against some grass-roots organizations participating effectively in formulating policies.

Design standards

Design standards are often established based on a determination of what it is possible for an industry to do, rather than according to public health concerns. By requiring that every facility do the same thing, design standards cannot accommodate all of the concerns of communities that already have a large number of facilities in the area.

While new sources usually have to adopt state-of-the-art technologies, older facilities may not have to do so, at least until their permits are renewed. Especially in communities which have a large number of older facilities, this instrument will be generally unresponsive to concerns about distributional impacts. Yet, as discussed in the section on *assurance of meeting goals*, design standards may be a safer bet for getting actual reductions in pollution levels than more complex approaches, simply because they are relatively easy to administer (95).

Harm-based standards

Since **harm-based standards** are typically expressed as a mean or maximum permissible discharge from a particular source, they can be adjusted to respond to differences in exposure levels at the community level.

For problem areas such as those with unique meteorological conditions, harm-based standards could be particularly useful for bringing the ambient quality in line with surrounding areas. However, efforts to base harm-based standards on the most vulnerable populations rather than on average populations may run into difficulties because of the statutory language describing the basis for the standard.

Harm-based standards are not very effective in promoting participation by a wide range of individuals. The technical quality of most proceedings makes it difficult for most members of the public to take advantage of the public participation opportunities offered under administrative law, such as public notice of rulemaking, notice and comment periods, and representatives allowed to participate in siting, regulatory negotiation, etc.

Integrated permitting

Integrated permitting, in contrast to the other multisource instruments, is used to increase flexibility in controlling emissions across sources in a single facility. Thus, it is unlikely that substituting an integrated permit for a single media or single-

source permit would create a large difference in the distributional impacts around a facility. Overall, permits implemented as facility bubbles, allowing facility-wide trading of source emissions, should be neutral for equity and justice concerns.

There is no evidence to date that integrated permitting has explicitly incorporated concerns about greater participation by minorities or other member of the local public. In fact, these permitting initiatives have been developed by state and industry officials, rather than by the environmental advocacy groups (149). However, it seems likely that a more systematic, comprehensive inventory of a facility and the subsequent filing of a permit with that information in one place could improve the quality of information available to the public.

Liability

Liability could provide a mechanism for seeking funds to be used in remediation work, thus aiding environmental justice goals. The CAA and RCRA do not provide a mechanism for those alleging injury from pollution to seek compensation; the CWA, as amended by the Oil Pollution Act (OPA) following the Exxon Valdez incident does allow compensatory damages. CERCLA, or Superfund, which imposes strict and joint and several liability on anyone whose disposal of hazardous substances causes a property owner to incur remediation or cleanup costs, has been widely criticized (248). Nonetheless, it has given members of the public a mechanism for getting support for cleanup efforts (52).

COSTS AND BURDENS

Although meeting environmental goals remains a priority, the public is also concerned that these goals be achieved at the lowest possible cost and with the fairest allocation of burden among companies and between government and industry. Congress has seldom set goals without including a concession to the costs and burdens imposed. In some instances, however, the desire to provide sufficient protection of human health or the environment has resulted in the use of strict source controls and additional requirements, such as continuous monitoring, which has added significant **costs and burdens**.

One of the most pervasive concerns about environmental protection programs in the United States has been that they are costly to implement, thus reducing productivity and placing firms at a competitive disadvantage. Certainly, identifying and implementing policies that are effective at improving both **cost-effectiveness and fairness** has not been an easy task.

Concerns about the administrative **demands on government** has also intensified. Especially pertinent to this study have been claims that some alternatives for protecting human health and the environment offer the advantage of placing a significantly lighter burden on government, either by shifting the burdens to ward other groups—industry or consumers—or by loosening the level of control altogether.

The following two sections—cost-effectiveness and fairness and demand on government—present OTA's assessments of which instruments might be most effective in lessening burdens and lowering costs.

Cost-Effectiveness and Fairness to Sources[7]

Cost-effectiveness and fairness to sources considers protection of human health and the environment at the lowest possible cost and with the minimum burdens on industry.

Concern about the impact of environmental regulations on U.S. productivity as well as the impact of compliance costs on sources has been a recurring theme in the environmental policy community since the 1970s. However, current ef-

[7] Parts of this section are based on C.S. Russell and P.T. Powell, "Efficiency and Fairness of Candidate Approaches to Environmental Pollution Management," umpublished contractor report prepared for the Office of Technology Assessment, U.S. Congress, Washington, DC, May 1994.

forts to improve the performance of the U.S. economy in comparison to other countries have heightened the scrutiny given to the relative effect of environmental policy choices on cost-effectiveness and fairness (73,88,197).

One of the most consistent criticisms of environmental regulations in the United States has been that they force very inefficient activities on sources while also placing heavy administrative demands on regulatory agencies (88). Such criticisms often assert that using different policy instruments, particularly economic incentives, would result in accomplishing the goals at lower costs for both sources and the government (4,22, 145,200).

Evaluating which instruments use resources in the most efficient and fair way, given an environmental goal, has sparked considerable academic and political debate over the past 2 1/2 decades (37). However, a major barrier to comparing the efficiency of policy instruments has been the paucity and poor quality of information on the social benefits of pollution abatement, in comparison to the availability of reasonable, if imperfect, estimates of compliance costs (9,192). Moreover, there is little systematic empirical evidence that economic incentives are effective in changing the behavior of sources in the desired direction (81). In fact, experiences with real-world implementation of these instruments suggest that the conclusions about relative performance on efficiency that are derived from theoretical studies should be interpreted cautiously (197). Yet, even when political compromises and negotiation among stakeholders in a particular context make pure efficiency unreasonable to seek, it may be possible to identify second-best strategies that allow at least some potential for cost savings.

Factors for Comparing Instruments

Instruments that are cost effective—for sources and for society as a whole—have a relatively low administrative burden for industry and for government and are viewed by sources as evenhanded. Despite continuing efforts to implement strategies which are both cost effective and fair across the board, most situations seem to require tradeoffs among some the following four components:

- cost-effectiveness for society;
- cost-effectiveness for individual sources;
- fairness to sources; and
- administrative burden for sources.

Cost-effectiveness for society

This study does not attempt to assess the benefits or value of a legislatively determined goal, but rather assumes that Congress has chosen a statutory goal that captures the desirable level of social benefits (97,142,170). Thus cost-effectiveness for society considers the total industry and government expenditures per unit of pollution abatement required to meet the environmental goal. The maximum net benefits to society for accomplishing a particular goal would be achieved by use of the instrument with the lowest total of expenditures by industry, government costs, and transfers of money to and from government—for example, through taxes or subsidies.

Cost-effectiveness for individual sources

Another measure of cost-effectiveness is at the firm level—that is, does the instrument allow a firm to minimize its costs for compliance. In most studies, the goal is assumed to be an unchanging one and the regulator and the firm are interested in finding the least-cost solution in that particular context (21). However, the potential of long-run cost-effectiveness, where an instrument allows the firm the flexibility to continue seeking least-cost adjustments over a period of time, is also important. The following sections on *adaptability* to change and *technology innovation and diffusion* discuss the importance of allowing sources and regulators more flexibility to respond to dynamic conditions.

Some instruments can be cost effective for society but not for a firm, and vice versa. This is particularly true for those instruments that transfer

money from firms to government (taxes) or from government to firms (subsidies).

Administrative burden for sources

Another concern for regulated industries is the extent to which various instruments add burdens, especially those that do not seem necessary to accomplish the environmental goal. The most typical responsibilities firms have are problem solving (e.g., information, technologies, prices, expertise, etc.) and monitoring (auditing and reporting emissions of pollutants). Unless they expect changes to a regulatory program to be particularly efficient compared to other options, sources may resist taking on such additional costs as new analytical studies, extensive reporting requirements, fees for service, or certification costs. This may be the case particularly when sources view the requirements as unrelated to achieving environmental goals or as adding legal costs or delaying production schedules. On the other hand, they may be supportive of an alternative that, although adding initial costs, gives the firm greater responsibility for and control over the development and implementation of solutions.

Fairness to sources

Fairness is usually in the eye of the beholder. Accordingly, this report assesses the perspective of sources on how the instruments might affect either their choices or their competitive position vis-à-vis other similar firms. (For a consideration of fairness from the perspective of how instrument choice affects individuals and communities, see the preceding section on *environmental equity and justice*.) When choosing among environmental policy instruments, an agency typically confronts an inherent tension between treating all sources as if they were the same (uniformity of treatment) and trying to assure that all sources experience the same outcomes (uniformity of outcomes) because few policies, if any, can achieve both.

Within an industrial sector and even within some firms, there are always important differences in size, age of facilities, location, financial arrangements, profitability, etc. These differences ultimately create tensions for government in making specific policy choices. For example, under what circumstances might it be best to treat small and large firms alike, even though the small firms might be placed at a competitive disadvantage? Are there other circumstances in which it might be better to choose a different policy that regulates small and large firms very differently in order to promote a more equal outcome among all the sources? Uniform national standards could be judged "fair" in the sense that everyone is treated the same. But differences in firm characteristics, such as type of industry, type and volume of production, location and age of facilities, and technology performance, may have more bearing on how a firm is affected by a policy and thus how it assesses fairness.

Another dimension of fairness to sources is the extent to which a policy instrument allows a firm some autonomy in choosing environmental strategies for itself. Although firms argue that this autonomy gives them the requisite flexibility to achieve least-cost solutions, the principle of private sector control over internal decisions regarding process- and product-related changes is also an ideological issue in American culture.

Government policies can sometimes be crafted to satisfy all of the sources, but not very often. Most approaches involve tradeoffs between degrees of equality of treatment and equality of outcome (106).

Summary of Instrument Performance

- ● **Effective:** ***Tradeable emissions***
- ○ **It depends:** ***Integrated permitting, challenge regulations, information reporting, technical assistance***
- ▽ **Use with caution:** ***Product bans, technology specifications***

The most effective instruments for promoting cost-effective and fair use of resources are those that expand the range of options for sources at the facility level or higher to respond to environmental regulations. This will be particularly true where high variability in marginal abatement costs among stationary sources provides the po-

TABLE 4-5: Cost Effectiveness and Fairness

	Fixed Target							No Fixed Target				
	Single-source				Multisource							
	Product bans	Technology specifications	Design standards	Harm-based standards	Integrated permitting	Tradeable emissions	Challenge regulations	Pollution charges	Liability	Information reporting	Subsidies	Technical assistance
Cost-effectiveness and fairness	▽	▽	·	·	O	●	O	·	·	O	·	O
Cost-effectiveness for society	▽	▽	·	·	·	●	O	●	·	O	▽	·
Cost-effectiveness for sources	▽	▽	·	·	O	●	O	·	·	O	●	●
Fairness to sources	▽	▽	·	·	·	●	●	▽	▽	·	·	·
Administrative burden to sources	·	·	·	·	▽	▽	▽	·	▽	·	·	·

● = Effective O = It depends V = Use with caution · = Average

NOTE: These ratings are OTA's judgments, based on theoretical literature and reports of instrument use. The evaluation of each instrument on a particular criterion is relative to all other instruments. Thus, by definition most instruments are "average. " Effective" means that the instrument is typically a reliable choice for achieving the criterion. "It depends" means that it maybe effective or about average, depending on the particular situation, but it is not likely to be a poor choice. And "use with caution" means that the instrument should be used carefully if the criterion is of particular concern

SOURCE: Office of Technology Assessment, 1995.

tential to achieve significant cost savings by relaxing uniform control requirements for all sources. Conversely, those instruments for which we recommend using caution—product bans and technology specifications-require uniform control of all sources, regardless of the cost.

Tradeable emissions offer the best opportunities for efficient and fair use of resources in comparison with other approaches (see table 4-5). Tradeable emissions give firms holding facility permits the options of trading, pollution abatement, or a mix of the two, depending on which strategy meets their needs, as long as the overall choices of multiple firms are within the program rules and will meet the ambient environmental standards established for an airshed or water quality limited stream (16).

Integrated permitting and challenge regulations can open opportunities for such interfirm strategies as trading, information sharing, and technology innovation or diffusion within an industrial sector. For both instruments the initial costs and hassle of establishing a program and maintaining adequate monitoring might be substantially increased for both industry and government, although over the long run this may become less burdensome.

Information reporting and technical assistance also have the potential to be quite cost effective and fair, depending on their design and associated requirements. Although information reporting usually requires additional work by firms, they usually prefer this approach since it leaves choices about reduction strategies to the

firm. Similarly, technical assistance is usually free to firms and so is obviously cost effective for them. However, neither instrument requires that firms produce results toward the environmental goal, so we have rated them as "it depends."

Pollution charges, while cost-effective for society, ultimately fall short on the fairness issues. Charges allow firms the flexibility to identify the point at which it is more cost effective for them to pay the charge than to reduce pollution. Also, a charge system, once in place, is relatively easy for government to administer in comparison to many of the other instruments. However, firms are not likely to consider paying both the cost of pollution reduction investments to meet the goal and charges on the remaining pollution as fair.

The instruments that we have rated "use with caution"—**technology specifications** and **product bans**—are usually implemented for other reasons, such as assurance of meeting goals. Because they require all firms, facilities, or products to meet the goal in exactly the same way and within the same timetables, they restrict opportunities for identifying facility- or industry-specific, least-cost solutions in the short run. In addition, locking the technology standard or product restriction into a firm's production routines is likely to create a disincentive to seek a more efficient solution. The uniform treatment of sources could be considered fair only in the restricted sense that each source must meet the same requirement. The widely disparate impacts on the expenditures required by firms within the same industry or across industries may be perceived as unfair by the majority affected.

The remaining instruments fall somewhere in the middle. That is, they could be efficient or fair depending on the particular context in which they are used, but the inherent characteristics of the instruments themselves do not seem as promising for success on this criterion as do tradeable emissions, integrated permitting, challenge regulations, and technical assistance. Other tools, like subsidies, may be very cost effective for firms, for example, because they are free or relatively low in cost to the firm. However, other factors such as the costs to government or the perception of lack of uniform availability because of resource constraints restrict their overall performance on this criterion.

Instrument-by-Instrument Comparison

● Tradeable emissions

Tradeable emissions have the potential to perform very cost effectively and fairly. They offer an opportunity to lower per-unit expenditures for pollution abatement. Firms are given flexibility to seek least-cost solutions and a clear set of rules, allowing the government to get out of the way once the targets have been established. In addition, most firms are already familiar with permits and thus may be comfortable with the idea of a permit-based system.

However, early efforts to establish RECLAIM suggest that, at least in the short run, the analytical and administrative burdens on both industry and government will be considerable (15). These additional transaction costs lessen the cost-effectiveness of abatement under a tradeable emissions regime, although they may lessen over time as agencies gain more experience.

The initial allocations of permits can be every bit as time consuming and analytically difficult as harm-based and design standards. In addition, in the end they may not be evaluated as fair by all since the process and outcomes are likely to reflect political compromise rather than optimization of efficiency concerns. Any efforts to change the permit allowances or schedules once they are in place may be viewed as unfair because it would be changing the rules. However, once the initial allocations are set, no firm can be made to trade or to be worse off with a tradeable emissions program than it would be with a straight harm-based standard written into a permit.

○ Integrated permitting

One of the key arguments for using **integrated permitting** is that it is more cost effective for both sources and the government agency than permitting a facility separately for air, water, and solid waste. Cost savings could be realized if the firm is able to find more cost-effective ways to meet ex-

isting requirements or if the firm and agency incur fewer administrative costs because of the coordinated permitting process.

However, at least initially, the learning curve for this instrument may require more investment of time and resources for writing new permits for which there is no model or example (149). Firms may be able to identify ways to prevent pollution at a lower cost than reducing pollutants in some facilities. However, early experiences in New Jersey and in Minnesota suggest that states and the sources have underestimated the personnel, research, documentation, and time required to complete the permits.

Nonetheless, if a facility is large enough and has multiple sources of the same pollutant, such as many of the refineries in the mid-Atlantic and Gulf Coast area, a facility-wide harm-based standard (or bubble) may be a very cost-effective approach for pollution control and would be judged more fair by sources than source-specific emission limits. The 3M plant in Minnesota, for example, has used the integrated permitting tool to establish a facility bubble in which they have a VOC facility cap rather than specific source limits. To satisfy concerns about violations, 3M developed a continuous emissions monitoring system (149).

Challenge regulations

Challenge regulations redirect the government's effort from facility level standards to the next level up (e.g., industry or regional level standards), allowing firms to determine for themselves how they intend to comply, thus providing an opportunity for an increase in cost-effectiveness for firms and a decrease in overall abatement costs in comparison to the costs of using uniform source controls. The opportunities for cost savings at the national and firm level also improve because sources participating in determining the means for meeting the targets can identify potential market and technology constraints. In addition, because of their ability to participate, sources may see this approach as generally fair for meeting goals (152).

The Dutch have used a type of challenge regulation that combines statutorily-based, long-range environmental targets for industry sectors and a system of permits specifying the level of control should the targets not be met. Once the government sets the targets, it works with specific industries or even individual large firms to establish agreements outlining how the targets will be met.

Although data are not yet available to assess whether or not the firms involved believe they have been able to achieve more cost-effective solutions than they would have under another approach, some potential benefits from participation in such an approach include overall savings at the industry level through, for example, emissions trading, cooperative activities to spur technology innovation or diffusion, and reduced financial liability (39,134).

Germany's Green Dot program, which encourages reduction of packaging waste, is also an example of challenge regulation. The mixed results achieved to date suggest using caution if adopting this approach in order to achieve the best possible results.

The United States has had no experience with challenge regulation, although the 33/50 program is somewhat similar. The major component 33/50 lacks is the backstop of mandatory requirements should industry fail to meet the targets established.

The primary concern over fairness to sources focuses on companies that may refuse to participate in pollution abatement efforts (free riders), forcing other firms to overcomply or risk failure (53). Thus industries may want the agency to enforce challenge regulations once choices have been made. Concerns may also exist over the potential for corruption in reporting and compliance activities given the difficulty of monitoring. However, the potential for industry acceptance of environmental targets established through challenge regulation is high given industry's participation in determining the feasible means for meeting the targets (39).

Information reporting

Information reporting by firms regarding the types and quantities of pollutants emitted provides the agency and the public information about some of the environmental impacts of facilities. Political choices about priorities for environmental protection, either locally or nationally, can thus be made more carefully (11,12). Accessible information about facilities in an area could be used by the public in making such choices as where to live, when to seek actions requiring a facility to improve its performance, etc.

Possibly of greater importance, information reporting may induce firms to identify the magnitude of problems and develop solutions voluntarily (12). Each firm can weigh the costs of control against the benefits from improved public perception. While this allows each firm to choose the most cost-effective means to lower emissions, this may not be a particularly fair way to lower emissions.

Costs to government come in the form of administrative responsibility for database development, management, and, if desired, distribution to the public. However, information reporting programs such as the TRI may be less burdensome for government to administer than an alternative regulatory scheme.

Technical assistance

Technical assistance is essentially a cost-reducing program for sources because the government provides the infrastructure costs for maintaining state-of-the-art expertise and outreach capacity. Firms that choose to participate are not obligated to use the assistance they are offered. If they do not benefit from the assistance, the high costs to government would obviously outweigh the cost savings to industry.

Nonetheless, most programs are directed at small firms that may operate with limited information concerning the nature and impact of their emissions or what the best practices might be for minimizing emissions. Programs that disseminate information or turnkey programs utilizing new abatement capability, for example, could provide cost savings. (See the following section on *technology innovation and diffusion* for a discussion of diffusion of new technologies.) Under these circumstances, technical assistance programs have the potential to help firms make more cost-effective decisions about meeting environmental regulations. The ultimate test for the cost-effectiveness of technical assistance programs is the extent to which they are successful in motivating the kind of behavioral changes regulators want.

▽ Product bans

Product bans and limitations are not used because of concern over efficiency; in fact, almost no literature exists that examines their performance on efficient and fair use of resources. In addition, firms faced with restrictions on production, marketing, or sales are unlikely to believe that they are fair, although a case can be made that they produce a uniform result and thus are fair to consumers. Sources are not likely to consider such bans as fair without very compelling evidence of risk, since they will have considerable "sunk costs" invested in the products. However, a case can be made that they produce a uniform result for consumers in that no one has access to them.

Product bans are typically reserved for cases when the potentially negative impacts of a particular single-purpose product are known to be large, such as with spraying a particular pesticide, using lead paints, or allowing use of a product that becomes hazardous upon disposal. In these instances, simply banning the product is a quick way for the government to provide protection with a reasonable degree of *assurance of meeting goals.*

▽ Technology specifications

Technology specifications are not implemented to achieve cost-effectiveness across firms. Requiring all sources to use identical equipment or placing uniform restrictions on techniques obviously constrains opportunities for firms to seek least-cost solutions. In addition, requiring all firms to solve problems in an identical manner, despite such meaningful differences as location,

technological capacity, and marginal abatement costs, is unlikely to be considered fair. These standards are seldom used and the evidence suggests that technology specifications are not adopted with efficiency in mind. They could only be considered fair in the sense of treating all sources the same.

Harm-based standards

Because **harm-based standards** are controlled on a source-by-source basis, they are only average in comparison to other instruments on cost-effectiveness, even though they allow firms or facilities to choose the means through which they comply. Firms are free to adopt new technologies to improve their productivity, costs, or environmental performance, yet there is no specific incentive for firms to do so.

In addition, the administrative burden for government is relatively high. (See the following section on demands on government for more detailed discussion of this issue.) For example, the analytical work required to establish harm-based standards is usually very demanding and resource intensive. Also, monitoring requirements for harm-based standards are more extensive than for other instruments.

With a harm-based standard, the ambient condition of the environment typically determines the ultimate emissions limit that all sources will face (e.g., tons per day out of the pipe, averaged over a 24-hour period).[8] On the one hand, since a harm-based standard is defined by what is good for human health or the environment, it treats all sources the same and, in that sense, may be considered fair. On the other hand, precisely because sources across industries are typically very different, some industries may believe that in a particular instance harm-based standards place a disproportionate burden on them in comparison to other industries. Firms can make a decision to shut down a facility in an area or move to another location to escape onerous standards in a particular area, but they may not save enough to make the move worthwhile.

The fact that sources are given the flexibility to meet a harm-based standard in whatever manner they choose may seem fair to industry. This is because firms value the increase in flexibility and slight decrease in government involvement in their facilities as a good thing, independently of the implications for efficiency.

Design standards

Design standards are usually based on a model technology or technologies, but are often expressed as emission limits. Thus, firms have some flexibility to meet the emissions level or to adopt the model technologies or an "equivalent" technology.

The original purpose of design standards was to require regulated entities to improve their pollution reduction technologies continuously, in part to provide markets for new technologies, but the reality has been that once a facility complies with the standard, there is no specific incentive to do anything more to save money (227), unless innovations with much improved performance or cheaper costs become available. In those cases, firms might adopt those innovations if the transaction costs of changing technologies were not prohibitive.

Since production and treatment technologies may differ across firms and facilities even within an industry, design standards may constrain a regulated entity's choices and thus reduce some opportunity for cost savings.

Design standards typically place a moderate to heavy burden on government for establishing the standards. Moreover, since they are typically implemented uniformly across similar firms, design standards are regarded as unfair because they ignore the current level of pollution, differences in

[8] In contrast, for a design standard the technological capability of the source type determines the kind of emissions limit (e.g., parts per million, maximum concentration level, no averaging).

facility designs, and often widely varying costs of control.

It is doubtful, however, that design standards have ever been utilized with efficient and fair use of resources as the primary concern, except to the degree that they incorporate balancing tests such as "achievable," "feasible," "available," etc. They are typically implemented because the government can define what it wants, at least as a minimum requirement, and they are comparatively easy to enforce.

Pollution charges

A **pollution charge** has long been advocated by economists as having the greatest potential for cost savings, both for industry and government. However, the use of charges as an instrument to force pollution abatement, rather than to raise revenues, has not been widely adopted anywhere.[9] Moreover, the hope that a charge can be based on an individual source's marginal damages at the optimal level of pollution or emissions in relation to the environmental goal is probably impossible for an agency to realize.

The open-endedness of charges does offer a "second best" type of efficiency by providing firms the discretion to determine how to reach as cheaply as possible the level of pollution discharges it decides it must. Depending on how the program is established, the open-endedness could also provide an incentive to continue to reduce discharges, at least up to the point at which it would be cheaper to prevent or control pollution than to pay the charge.

The analytical burden to government of this approach could be relatively moderate, especially if the pollution charge is technology based and remains fairly static. The more frequently the government decides to adjust the charge upward to keep pressure on firms to reduce emissions, the more analytically and politically difficult the charge program would become. In addition, as mentioned earlier, firms are not likely to consider it fair to pay for investments to meet the environmental goal and continue to pay for discharging the residual pollution.

Charges used to reduce solid waste, through making it very expensive for corporations or citizens to dispose of wastes (e.g., per-bag fees), are typically designed both to raise revenues and to change behavior. These kinds of charges, set through some sort of percent reduction targets, may be relatively inexpensive ways for society to induce desired behavior.

Liability

Theoretically, **liability** provides a rough signal to a firm of the costs of exceeding desirable pollution levels. Since liability provisions only require action when a party believes damage has occurred (post facto), the ongoing burden for administration of a program is relatively small. However, proving causality for damages may be quite burdensome for a range of the stakeholders. Firms do not always view such provisions as fair because they often have to retain insurance and take actions that are designed to protect themselves financially rather than directing that money toward protecting the environment. The uncertainty about both whether or not damage will occur and whether or not they will actually have to pay for damages in the future can lead sources to overcomply or undercomply, either of which would be inefficient (21).

Subsidies

Subsidies may offer an effective incentive for firms or other entities to adopt abatement measures because they reduce the financial impacts and provide an easy enforcement mechanism for the regulator. Because subsidies by definition are free, they will lower a firm's or municipality's cost to achieve the environmental goal in the short run. However, if the subsidy is restricted to certain methods for achieving a goal, it may not lead to the most cost effective approach from society's

[9] European countries have experimented with pollution charges, although the programs are primarily oriented toward revenue raising.

perspective. For this reason, subsidies might be most cost effective when restricted to use during transitional periods, for example, to speed adoption of new technologies.

The case of the deposit-refund system as a subsidy offers potential for efficient pollution control through the use of self-financing (the deposit) and a reward (refund) for proper disposal. The lowered costs of enforcement and reduced motivation for evasion would offer savings for government.

Demands on Government[10]

Demands on government concern the costs and administrative burdens placed on government by requirements to protect human health and the environment.

One of the most persistent complaints about current approaches to environmental protection is that they require too much involvement by government agencies, costing taxpayers money and often delaying companies ready to get on with the task of improving environmental performance. Rather than simply setting the targets and getting out of the way so that sources can choose the best strategies for meeting the targets, government agencies spend too much time and too many resources deciding what each type of source must do and then enforcing rather than facilitating compliance. According to this view, instruments that use incentives to reward improved environmental performance or rely on voluntary efforts by companies would be much cheaper for government to develop and administer.

Although much of this criticism is directed at the federal agencies, especially EPA, a majority of the oversight, implementation, and enforcement of federally mandated environmental regulations takes place at the state level. Moreover, states have discretionary authority in many areas to go beyond federal requirements. Thus, in comparing how effective the instruments might be at minimizing the demands placed on government, both federal and state governments are considered.

Factors for Comparing Instruments

In order to assess the relative demands placed on federal and state administrative agencies by the set of instruments, OTA uses the following two components:

- costs, and
- ease of analysis.

Costs

Governmental agencies expend considerable resources in the course of formulating and implementing environmental protection programs. The federal government spends more on environmental protection than the states. Yet, over the past 15 years, EPA's budget has decreased, while many of the states have held their expenditures at a constant level or actually increased in some areas (154). In 1992, the federal and state governments spent an estimated 1.8 billion in current dollars on regulation and monitoring activities, or 2 percent of estimated total expenditures on pollution abatement and control in the United States (171).

Even though this is a relatively small proportion of the overall expenditures, differences in the instruments' requirements for analytical support, rulemaking, ongoing administration and implementation, monitoring, and compliance activities suggest opportunities for reducing or reallocating expenditures. Information costs to government for becoming an expert on a particular industrial sector, for example, can be very high; in some instances, these costs may restrict the government's ability to know what it should in order to regulate effectively. Those instruments that must be established through the rulemaking process extract additional resources from the agency in the

[10] Parts of this section are based on T.O. McGarity, "Assurance of Meeting Environmental Goals," unpublished contractor report prepared for the Office of Technology Assessment, U.S. Congress, Washington, DC, May 1994; and S.A. Shapiro, "Rethinking Environmental Change: Policy Instruments and Adaptability to Change," unpublished contractor report prepared for the Office of Technology Assessment, U.S. Congress, Washington, DC, August 1994.

form of time and preparation of supporting documentation. For example, a major rule may take tens of thousands of pages of documentation, responses from industry and other stakeholders, and even trying to change mistakes in these rules can be a formidable undertaking.

In addition, multiple levels of government may also be involved in administering and enforcing the instrument. Some instruments may require a level of monitoring and enforcement by the state that is expensive for the agency in terms of personnel and documentation. Problems such as variability in processes, equipment malfunctions, and operator errors may compound the cost of monitoring for some instruments. For other instruments, the initial implementation may be relatively simple and straightforward but once in place more extensive enforcement efforts are required.

Ease of analysis

Ease of analysis concerns the degree of analytical complexity an instrument poses for the regulatory agency in translating the congressional goal into actions that sources can understand and implement. When Congress establishes risk goals, the task of determining the level of exposure that poses an acceptable risk to human health or the environment is usually left to the implementing agency. Congress most often states acceptable risk in general terms.[11] Occasionally, however, risk definitions have been quite specific (250). Similarly, when Congress enacts an abatement goal, usually stated in terms of "best efforts" for reducing pollution, the agency must identify those technologies that will satisfy the congressional language.[12]

Instruments used with a risk strategy may require more analytical work and be more controversial because of the scientific uncertainty involved and the need to update the goals continually after they are put in place. Those that are used with abatement strategies may also be resource intensive, but once in place require less continual revision.

Regardless of whether Congress chooses a risk or abatement goal or a mix of the two, EPA must usually complete a range of analyses to characterize the problem posed by the particular process or product and alternative ways to handle that problem. It must also document its analyses in sufficient detail to withstand the rulemaking process or other challenges to come in the implementation phase. Analyses might include scientific studies to establish pollutant pathways, engineering studies which document the best technological, designs, cost-benefit analysis of the potential regulatory impact, and cost-benefit analyses of postimplementation impacts. The uncertainty and/or difficulty of interpreting the technological, economic, scientific, and socio-political data can be daunting for regulators. At a minimum, analytical complexity can prolong the period required for translation, provide opportunities for challenges to the agency's efforts, and increase the opportunities for errors in translation.

The credibility and certainty of the supporting analytical work and documentation, the level of institutional resources committed to implementation, resistance by regulated entities or the public,

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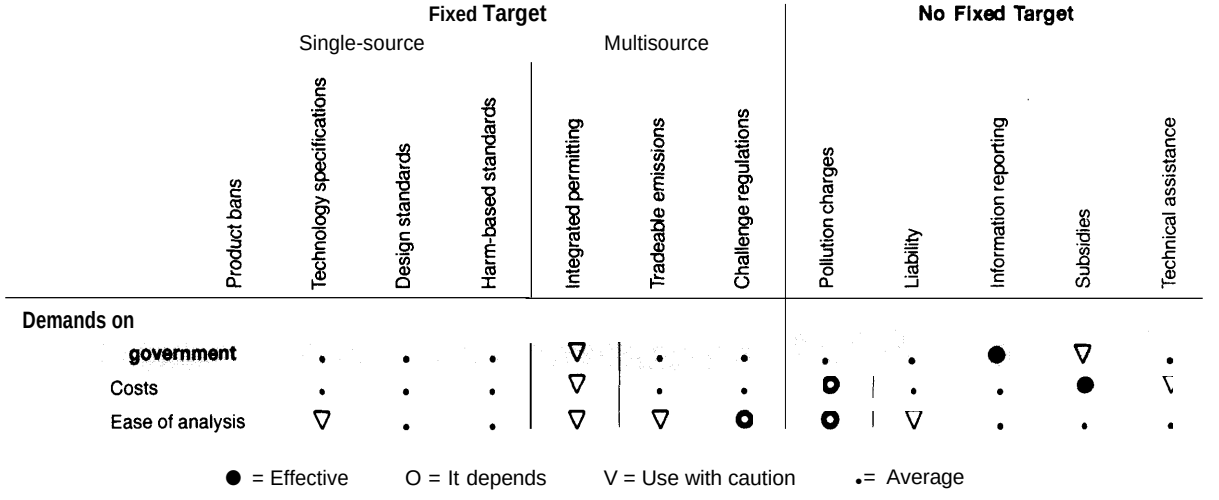
[11] Examples of this type of statutory goal include setting National Ambient Air Quality Standards (NAAQS) at a level that *protects the public health with an adequate margin of safety* [42 U.S.C. § 7409(b)(1)]; setting standards under the Clean Water Act that *protect the public health and welfare with an ample margin of safety* [33 U.S.C. § 1307(a)(2)]; prohibition in the Resource Conservation and Recovery Act (§ 3004) on the disposal of untreated hazardous wastes in land disposal facilities as long as the wastes remain hazardous, unless EPA approves a method that will be *protective of human health and the environment* [42 U.S.C. § 6924(g)(5)].

[12] For example, the Clean Water Act requires sources of listed toxic water pollutants to meet effluent limitations based upon the *best available control technology economically achievable* [33 U.S.C. § 1311 (b)(2)(A)]; the Clean Water Act and the Clean Air Act provide for standards reflecting *best efforts for new sources of pollution* [33 U.S.C. §1316 (best available demonstrated control technology); 42 U.S.C. §7411(a)(1) (best adequately demonstrated control technology)]; The 1990 Amendments to the Clean Air Act require EPA to promulgate standards for new and existing sources of listed hazardous air pollutants reflecting the *maximum degree of reduction achievable* [42 U.S.C. §7412(d)(2)].

TABLE 4-6: Demands on Government



NOTE: These ratings are OTA's judgments, based on theoretical literature and reports of instrument use. The evaluation of each instrument on a particular criterion is relative to all other instruments. Thus, by definition most Instruments are "average. " "Effective" means that the Instrument is typically a reliable choice for achieving the criterion "It depends" means that it maybe effective or about average, depending on the particular situation, but it is not likely to be a poor choice And '(use with caution" means that the instrument should be used carefully if the criterion is of particular concern.

SOURCE: Office of Technology Assessment, 1995.

and the opportunities for administrative, congressional, and judicial review are all factors with the potential to affect whether or not a particular instrument is implemented in a successful and timely manner.

Summary of Instrument Performance

- ● ***Effective: Information reporting***
- O ***It depends: Challenge regulations***
- v ***Use* with caution: *Harm-based standards, subsidies***

All of these instruments place primary responsibility on governmental agencies for the successful outcomes, although they vary considerably on the extent to which the agencies actually use their own resources to accomplish various program components. On a comparative basis, the one requiring the least from government agencies is an information reporting program (see table 4-6). The agency must flesh out the design and protocols of the program, but the implementation of the program essentially shifts to sources.

Challenge regulations also offer the potential for shifting responsibility for most of the implementation to the sources, thus reducing demands on governmental resources. However, our relative inexperience with implementing challenge regulations makes the potential gains in reducing governmental burdens somewhat unpredictable. Nonetheless, OTA expects that with challenge regulations, industries will assume more responsibility for design and implementation, thus alleviating some of these costs for government.

Tradeable emissions have the potential to reduce burdens. However, with RECLAIM, the front-end costs of the analytical work and program design have been very high (see chapter 2 case study). More experience with a variety of trading programs may reduce these types of costs.

We recommend using **harm-based standards** with some caution if the primary concern is reducing the burden on governmental agencies. Although harm-based standards have been heavily used, primarily because of their effectiveness for assurance of meeting goals, their analytical and

implementation requirements place very high demands on government.

One of the long-term goals for **integrated permitting** is to reduce the burden on facilities and on the state permit writers. Yet, in the near-term, the level of work required by state agencies in developing an integrated permit for each facility can be daunting. Also, while the concept of multimedia coordination through the permit process is attractive, the scientific and practical information and expertise essential for such decisionmaking is not fully developed.

Liability, if never invoked, is not terribly burdensome for government. But once an agency must develop an action against a firm, the costs and analytical demands can be very large, as demonstrated by the efforts to pursue liability for the Exxon Valdez case. In contrast, **subsidies** might not require much in the way of analysis or implementation but require direct outlays from the treasury. If lower cost to government is the criterion, subsidies should be used with caution.

Instrument-by-Instrument Comparison

● Information reporting

Information reporting is relatively inexpensive for government to implement because the primary burden for information gathering and reporting rests with sources. Government may or may not decide to take an active role in disseminating the information since the primary purpose of such programs is to induce companies to reduce emissions rather than face disclosure of what might seem large releases of pollutants.

The analytical demands of conceptualizing and designing the program adequately to accomplish the desired goal are at least as difficult as the analytical requirements for designing programs utilizing some of the other instruments—that is, they pose a moderate burden. However, the fact that the program then gets handed to sources for ongoing implementation makes it a particularly attractive instrument from the perspective of lowering government costs and implementation responsibilities.

○ Challenge regulations

Because experience with programs similar to challenge is limited, predicting the impact on use of governmental resources is difficult. However, **challenge regulations** could be very effective at reducing barriers to implementation by moving toward cooperative or negotiating processes for establishing implementation activities such as benchmarks and timetables.

Depending on how the particular challenge regulation is designed, however, it could easily end up changing the nature of the administrative activities in some ways without actually reducing the burdens. If the ultimate goal is a harm-based one, for example, the agency is likely to complete the same difficult analytical tasks it would have with a harm-based standard. On the other hand, if the goal is technology based, then the analytical task may be somewhat easier. It is possible that, even with a risk goal, the working relationship among sources, interest groups, and the government could be collaborative enough to make the overall task easier; but without some experience this kind of scenario is speculative.

▽ Harm-based standards

Harm-based standards, typically expressed as a media quality goal, depend on complicated models of performance and require more complex monitoring in order to establish significant progress. The level of scientific and technological expertise needed and the uncertainty typically present for setting or revising a harm-based standard requires considerable administrative resources.

The initial task of translating statutory language into a particular concentration of a pollutant in the receiving medium is exceedingly difficult. Methodologies are not sufficiently well developed to allow agencies to specify with a great deal of accuracy the degree of health and environmental risk posed by various concentrations of a toxic pollutant in a receiving medium (95,112). In addition, the value-laden questions and methodological uncertainties surrounding existing risk-

assessment techniques reduce the credibility and confidence that stakeholders can place in the agency's media quality goal as an equivalent for the established acceptable risk goal (101, 112,130).

Media quality goals in some cases are delegated to the states for implementation. At that point, states often develop source-by-source harm-based standards in order to be able to write permits for facilities spelling out the allowable emissions levels. In fact, sources themselves often seek this protection—as long as they are in compliance with their permit, they can not be held liable if the state does not meet its media quality goal.

Harm-based standards are also subject to executive and judicial review. For example, although only one relatively minor aspect of the original 1971 National Ambient Air Quality Standards (NAAQS) was challenged in court, every subsequent attempt to revise those standards or to write standards for new pollutants has been the subject of intense executive review (114,119) and later judicial challenges (132).

∇ Subsidies

Subsidies are obviously very costly to government because they require direct outlays. Thus, if reducing costs to government is a primary consideration, subsidies should be used with caution. The analytical difficulty of designing a subsidy program should not be particularly burdensome. And since implementation of the program would be shifted to firms participating in the subsidy program, the government would have minimal responsibility for activities other than evaluating the implementation by sources to ensure that they were meeting the program goals.

Product bans

Although **product bans** are only about average in overall demands placed on government in comparison to other instruments, completing the analytical work to justify their use can be quite demanding. Because of the implications of interfering with commerce, those choosing bans will want to have incontrovertible proof that such products pose serious health or environmental risks. However, barring a very dramatic causal episode, such information is usually quite time-consuming and costly to develop.

Technology specifications

Technology specifications are rarely used and when they are, Congress usually specifies the standard. This greatly reduces the political analytical efforts associated with design standards as well as the costs. The primary burden for governmental agencies is in the implementation phase, especially the permitting and enforcement aspects.

Design standards

Most **design standards** are associated with an abatement or a "best efforts" goal and can be recognized by the alphabet soup descriptions, such as BACT (best available control technology), BAT (best available technology), BPT (best practicable technology), LAER (lowest achievable emissions rate), MACT (maximum achievable control technology), etc. When Congress mandates that new sources in nonattainment areas meet the lowest achievable emissions rate or when it requires new and existing sources of toxic air pollutants to install maximum achievable control technology, it is establishing the framework in which sources must use their best efforts to reduce emissions of the relevant pollutants. The language allows individual sources the flexibility to achieve the same degree of pollution control by other acceptable means, but the processes of demonstrating equivalency or obtaining waivers not only place demands on sources but on government resources as well (113). The benefits of this flexibility are discussed in the section on *cost-effectiveness and fairness to sources*.

Instruments associated with technology-based strategies such as BAT are usually less complicated to establish and the results less complicated to measure than those associated with risk-based strategies; but they are nonetheless moderately difficult. To support and document its decisions about abatement technologies, the agency must

study the industries' production processes, product and waste streams, facilities, control technology costs, and other factors that appear relevant to the agency and its engineers. In order to select a model technology capable of reaching the abatement goal, the agency must incorporate economic judgments as well as engineering judgments, yet the technological feasibility of reducing emissions of pollutants is the *primary* consideration. Finally, the agency establishes pollution limits designed to induce dischargers to implement the specified control technology or any other technology or practice capable of achieving the same degree of pollutant reduction.[13]

If an agency attempts to use design standards to achieve a very ambitious abatement goal, it may have difficulty developing a record capable of supporting its prediction that the model technology is capable of achieving a particular level of performance. If EPA proposes to press technology in the slightest, it must engage in a leap of faith that the model technology will reach a generic effluent limitation in all regulated contexts. The agency often has a difficult time persuading reviewing institutions, such as the Office of Management and Budget (OMB) and the courts of appeals, to take the same leap of faith (3,113).

Agency efforts to write design standards for existing sources of pollution may encounter resistance from the owners of those sources and their employees. The model technologies used in most design standards are often capital intensive, and the investments in pollution control are generally not offset by increased profits (7). However, there is no reason that pollution prevention approaches cannot be used as the model technologies, with more capital-intensive end-of-line technologies being allowed as substitutes if their performance is equivalent.

Since design standards are nearly always challenged in court, the agency must be prepared to meet every conceivable technical and legal objection to its standard-setting initiative before it issues the final regulation. The possibility of judicial review continues to influence agency administrative practices, adding to the level of resources allocated to documentation.

Integrated permitting

The most common arguments for **integrated permitting** are its potential to reduce the administrative efforts for both the sources and the governmental agencies in issuing and revising facility permits. However, to date, rather than reducing the overall government burden, they may have actually increased the burden in the short-term as facility managers and government officials gain experience in writing these types of permits and implementing them (149). Thus, if the primary criterion is reducing the burden on government, it is important to recognize that at least initially, agencies may actually have to dedicate a higher level of resources to implementing this instrument.

One advantage of these permits may be in reducing the complexity and costs of monitoring and enforcement. Being able to approach a facility as a whole with better understanding of its overall strengths and weaknesses for emission problems may improve overall efforts to detect violations and develop plans for improved monitoring capability.

Another advantage associated with the concept of integrated permits is their potential for incorporating multimedia tradeoffs. A few efforts in Minnesota, New Jersey, and Wisconsin have indicated that this approach has potential for using a multi-

[13] Examples of the technology-based approach include "best available technology" and "best conventional technology" effluent guidelines and limitations promulgated under section 301 of the Clean Water Act; new source performance standards promulgated under section 306 of the Clean Water Act and section 111 of the Clean Air Act; "best available control technology" for new sources in clean air areas promulgated under section 165 of the Clean Air Act; "lowest achievable emissions rate" requirement for new sources in nonattainment areas promulgated under section 173 of the Clean Air Act; and "best demonstrated available technology" for treatment of hazardous wastes under section 3004(m) of the Resource Conservation and Recovery Act.

media framework in tackling pollution reduction by facilities. These initial experiments have required considerable investment of resources by state agencies and have been analytically complex, although state officials with experience in working with these permits are optimistic about their potential (149).

Tradeable emissions

One of the key arguments for using **tradeable emissions** is that they will greatly reduce the role of government. Although we do not yet have enough experience with this approach to evaluate fully how much they reduce the level of governmental involvement characteristic of other approaches, thus far trading programs have required considerable efforts by governmental agencies. For example, the initial allocation of allowances or permits and the schedule of reductions has been contentious.

However, when government is determined to make something work, as in the case of the RECLAIM tradable emissions program for NO_x and SO_2, it can concentrate resources effectively. What might have been close to a decade of rulemaking was condensed into two years. However, the time and effort invested in designing the program over those first two years was extraordinary.

Critics have objected to the delays introduced by trading programs requiring pre-approval of proposed trades by agencies. Current efforts to establish open markets stem in part from frustration over the implementation difficulties that have slowed other trading efforts (16). As conceptualized and implemented to date, these trades do not require prior approval from government officials and do not require revisions of state implementation plans (SIPs), thus minimizing the delays encountered when waiting for government approval. However, many issues such as inter-pollutant trading and cross-regional trading are beginning to emerge. Taking time to resolve these may slow the programs down.

Thus, while trading programs may introduce flexibility for sources and encourage more cost-effective ways for sources to reduce pollution, concern over other criteria such as *assurance* and the *equity and justice* of the outcomes of trading choices for various areas suggests the need for care in designing and implementing trading programs. Weighing these concerns will require continuing involvement by federal and state agencies.

Pollution charges

Pollution charges are likely to place moderate burdens on governmental agencies—much less than harm-based standards but considerably more than information programs. After all, the United States has considerable experience in administering tax programs at all levels of government. Yet the potential for political difficulties in initiating and revising "taxes" on pollution discharges suggests the potential for at least a moderate level of administrative effort by agencies responsible for the programs.

The uncertainty of predicting the impact of a particular charge on receiving media (7,123,186) is perhaps the greatest analytical demand in using this approach to meet goals. Determining the optimum charge under a risk-based strategy can be very difficult for an agency and requires continuous monitoring and adjustments to keep the fee at the desired level. The agency must predict how individual companies will react to a charge, translate that prediction into an estimated reduction in the pollution load, and determine whether that reduction will result in acceptable media quality. Given sufficient regulatory patience, the appropriate fee can be determined by trial and error, but political and administrative efficiency considerations generally preclude that strategy. Environmental groups are likely to object to an iterative process that begins with a modest fee and works upward. Pollution sources can be expected to resist vigorously a process that works in the other direction, arguing that once pollution controls have been installed or manufacturing processes changed it is small consolation when the fee-setting entity acknowledges that it overshot the acceptable risk mark (7,156,160,161).

If the environmental goal is to achieve a specified level of environmental quality, continuous

monitoring would be needed as new discharging facilities are constructed and existing facilities expanded, and the charge adjusted when the overall pollution load increases (57,160,220). A constantly changing charge might generate considerable administrative costs and political opposition (123,160,220). However, these difficulties might be offset by the ease of enforcement once the system is in place.

Liability

Since **liability** defines the consequences of environmental damage, it theoretically places little burden on governmental agencies until damage actually occurs. At that point, the burden for agencies to characterize and estimate the damages, costs for remediation, and support the legal work required to make a successful case are substantial. Moreover, when they win the case, it affects just that one company. Although it serves as a warning or deterrent, devoting similar efforts and resources to create a general rule or regulation might have a more certain effect.

Technical assistance

Technical assistance, depending on how a program is designed, is about average on the level of demands placed on government. These programs can vary widely in form, ranging from direct service delivery by the states or federal government to contracted service arrangements. They may be hands-on assistance provided through site visits or the design and maintenance of databases on technical issues or technologies.

However, since they do not require the government to regulate, monitor, or enforce fixed targets for pollution reduction, technical assistance programs place relatively moderate demands on agencies. In addition, they currently represent a relatively small proportion of the resources committed to environmental protection policies.

CHANGE

Almost all parties involved in environmental issues express a desire to improve their capacity to encourage and take advantage of new technological capabilities that can improve environmental protection. Yet, both industry and government often express frustration at the complexity and lack of responsiveness to **change** that characterize the decisionmaking processes.

Sometimes, having to proceed slowly may be what we intended to accomplish. For example, the Administrative Procedure Act (APA), the proposed congressional "waitover" period, legislative veto, and mandate for risk assessment all encourage deliberation before action to protect the rights of those affected by government actions. And when choosing instruments for implementing policies, we often bet on a "sure thing," even though it may restrict opportunities to learn about new technologies or to respond to new information about environmental risks.

Yet in a world dominated by increasing complexity and uncertainty, there are many advocates for making environmental policy both easier to change and more responsive to change. The following two sections discuss **adaptability** and **technology innovation and diffusion**, criteria that capture this interest in creating a future-oriented policy framework that both encourages and accommodates change.

Adaptability[14]

Adaptability considers how easily the policy instruments, once implemented, can be modified, either by government or by regulated entities, to accommodate new scientific information or abatement capability.

A key criticism of current approaches for protecting the environment is that they are not very adaptable to important and rapid changes in the base of scientific information or technological capabilities (49,54,163). According to this view, the

[14] Parts of this section are based on S.A. Shapiro, "Rethinking Environmental Change: Policy Instruments and Adaptability to Change," unpublished contractor report prepared for the Office of Technology Assessment, U.S. Congress, Washington, DC, August 1994.

only sensible way to address the uncertainty associated with complex environmental policies is to use instruments that give government agencies and sources the needed flexibility to adapt to changing circumstances and to learn from experimental efforts.

Critics believe the policy instruments we typically use unnecessarily restrict options for effective solutions. Companies express frustration, for example, at their inability to make even minor product or process changes to improve performance and maintain competitiveness without seeking administrative approval for variations—no matter how slight or temporary—from environmental requirements. Government officials are similarly frustrated when innovative policies they wish to support are blocked by statutory restrictions or the objections of special groups.

However, when tradeoffs between adaptability to change and other public values have emerged, policymakers have sometimes given adaptability the back seat. For example, they may decide that they are more interested in assuring a high level of protection from hazardous waste storage and in providing opportunities for full public participation in siting decisions than in using an approach that might be easily adapted to changing information.

Once the level of protection is in place, federal and state agencies have often been reluctant to reopen such a decision because of the institutional difficulties of modification. In addition, some companies may prefer a high degree of certainty over adaptability in situations where a rule or regulation protects their investments or enhances their competitiveness. However, if policymakers agree that the capacity to accommodate change is desirable, then basing the choice of policy instruments on a strategy that is either not likely to require modifications or is relatively easy to modify makes the most sense.

This section evaluates the difficulty or "marginal grief" for government of modifying a particular instrument. It also assesses the extent to which a targeted entity has some autonomy to adapt its responses to changes that affect its environmental performance without waiting for approval from a regulatory agency.

Factors for Comparing Instruments

The two major sources of change that trigger a need to modify policy instruments are a change in the perception of risk from a pollutant or activity or a change in abatement capability. A change in risk perception typically comes from new scientific information or from changing interpretations of existing information. Both can affect the assumptions of an underlying risk assessment or cost-benefit analysis by demonstrating that a pollutant poses a greater or lesser risk than was previously understood. A revised risk assessment might suggest that a different level of risk is socially appropriate.[15]

Pollution abatement innovations can affect environmental regulations by producing techniques that are less expensive to install and/or utilize than existing technologies or that are capable of greater pollution abatement. Ideally, technologies offering lower costs or improved capacity could be readily adopted by firms without agency intervention if the changes could improve their overall performance.

Since both types of change are inevitable, all policy instruments would ideally be either unaffected or easily adaptable. However, the potential administrative and political constraints involved in revising a regulatory decision may make it difficult for policymakers to achieve such adaptability in every circumstance. Nonetheless, if adaptability to change is a priority, policymakers can choose and use instruments strategically to im-

[15] For example, new information on risk pathways indicating greater risks from pollutants than previously understood might trigger reevaluation of acceptable risk levels. Also, the public's willingness to accept risks from a particular activity might change even though scientific knowledge about such risks has not changed. For example, such knowledge may simply become more widespread or the public may perceive the benefits from the activity as diminishing or becoming less important in comparison to perceived risks.

prove their overall performance in achieving this criterion.

The simplest way to ensure adaptability is to use a strategy and instrument combination that remains, as much as possible, unaffected by such change. For example, since harm-based standards are tied to risk, sources have complete flexibility to respond to favorable changes in cost, availability or new capability in abatement technologies without waiting for a revised standard.

Similarly, when the perception of risk changes, it may not be necessary to modify a technology-based standard, such as a design standard, especially if no significant changes in the performance of technologies have occurred. If, given the current state of technology, overcontrol is not likely to be a problem in the near future, then sidestepping the need to justify a risk-based standard for each pollutant has advantages.

Nevertheless, sometimes change makes modification of the instrument itself desirable. The ease of such change depends more on the decisionmaking procedures required, in particular those associated with the administrative decisionmaking requirements and congressional and judicial review requirements than on any inherent characteristics of the instrument. These complex procedures usually apply to those instruments that require sources to take specific pollution reduction actions. Thus, there is often a tradeoff between improving performance on *adaptability* to change and maintaining *assurance of meeting environmental goals*.

Before comparing each of the instruments, the sections below explore two factors important for assessing adaptability to change:

- ease of program modification, and
- ease of source changes.

Ease of program modification

Policy instruments vary in the degree of difficulty for the regulatory agency in completing the steps required for their modification. Some believe that even the most inherently adaptable of instruments is likely to become difficult to modify once it is embedded in the current institutional configuration of agencies and decisionmaking processes for environmental policymaking (95).

EPA is required by both statutes and Executive Orders to evaluate risks to health and the environment and to consider the feasibility of alternative solutions for reducing those risks (231,251,257). When EPA modifies an instrument, it must identify and resolve the scientific, engineering, and legal issues that the changes have raised. Because EPA employs a relatively small number of scientists, engineers, and economists capable of undertaking rigorous scientific and policy analyses, the number of difficult projects that the agency can undertake at any given point in time is limited.

The legal and procedural requirements of the Administrative Procedure Act, while providing important guarantees for due process to sources and agency accountability to the public, nonetheless can restrict EPA's ability to respond to changes in a timely manner. In addition, instruments for which a large number of waivers must be individually handled can also be resource intensive.

Ease of source changes

For many firms, the ability to make product or process changes quickly can be essential for competitiveness. Having to wait for decisions by administrative agencies regarding permit modifications or waivers can be frustrating, especially when the facility managers believe the impact on environmental performance will be nonexistent or negligible.

Continuous, incremental innovations are often the lifeblood of companies in highly competitive industries. Giving these industries the flexibility to adapt how they meet goals without having to seek preapprovals from an agency official before acting on process or product modifications could spur improvements in technologies and increase opportunities for the most cost-effective solutions.

TABLE 4-7: Adaptability

	Fixed Target							No Fixed Target				
	Single-source				Multisource							
	Product bans	Technology specification	Design standards	Harm-based standards	Integrated permitting	Tradeable emissions	Challenge regulations	Pollution charges	Liability	Information reporting	Subsidies	Technical assistance
Adaptability	V	V	V	.	.	.	O	.	●	●	.	●
Ease of program modification	V	V	V	V	V	V	.	V	●	●	O	●
Ease of change for sources	V	V	V	.	O	●	●	O	●	●	.	●

● = Effective O = It depends V = Use with caution . = Average

NOTE: These ratings are OTA's judgments, based on theoretical literature and reports of instrument use. The evaluahon of each instrument on a particular criterion is relative to all other instruments Thus, by definition most instruments are "average." "Effective" means that the instrument is typically a reliable choice for achieving the criterion. "It depends" means that it maybe effective or about average, depending on the particular situation, but it is not likely to be a poor choice And "use with caution" means that the instrument should be used carefully if the criterion is of particular concern.

SOURCE: Office of Technology Assessment, 1995

Summary of Instrument Performance

- ● **Effective:** ***Liability, information reporting, technical assistance***
- O **It depends:** ***Challenge regulations***
- V **Use with caution:** ***Product bans, technology specifications, design standards***

Two general conclusions about adaptability emerge from a comparison of the policy instruments. First, almost all of these instruments are difficult for an agency to modify primarily because of administrative complexities associated with rulemaking and the potential for congressional and judicial review. And second, if policymakers anticipate and want to accommodate certain kinds of changes, they could choose those instruments that would be most resilient or least affected by the expected changes.

Instruments tightly wedded to either a risk- or technology-based strategy—such as harm-based standards or design standards-almost always have to be modified when faced with changes from that particular source (see table 4-7). Exceptions—liability, information reporting, technical assistance, and depending on the particular program provisions, challenge regulations—tend to be tied to broad strategic goals rather than to specific models of acceptable risk levels or performance of technologies. In addition, several of these instruments can be relatively easily modified without rulemaking or adjudication, using agency discretion after consultation with stakeholders. Of course, major changes in the statutory basis for any of these programs would require congressional action.

If policymakers expect and want to accommodate changes in abatement capability but also want to limit pollution, using a harm-based standard provides a context in which technological changes have the least effect. Sources are free to adopt the technology or not and the agency does not have to rewrite instruments to incorporate the new capability. For example, if a tradeable emissions program is established with a risk-based cap

on emissions, a firm can decide whether or not to adopt any changes in abatement capability, without an agency having to rewrite regulations.

This same type of tracking occurs for instruments associated with risk-based strategies. Harm-based standards, tradeable emissions, and perhaps challenge regulations would typically have to be modified if knowledge or public perception related to their particular goals were to change significantly. For example, if the tradeable emissions program's risk-based cap is now believed to be inadequate to protect human health, then the overall harm-based standard or emissions cap for the area would have to be rewritten.

Design standards, technology specifications, integrated permitting, and pollution charges would be much less affected since they are not usually as tightly linked to acceptable risk levels. However, even technology-based instruments may have to be modified if new information about risks makes decisions about what is achievable, practicable, or available no longer seem valid. Most policy instruments under this strategy face some sort of balancing test about what constitutes the state of abatement capability.

Instrument-by-Instrument Comparison

● Liability

Although Congress normally defines **liability** through individual statutes, once that regime is in place it is generally able to respond to changes in new information or abatement capability through interpretations by the agency and the courts rather than through statutory revisions. New scientific information could suggest, for example, that a pollutant posed previously unknown risks. If this were the case, it would improve the ability to establish a causal link between the discharge and the damage it caused. The information would be presented as part of the case against the polluter.

Firms are able to make pollution abatement choices based on their own needs and evaluation of risks. Thus liability is effective at leaving firms free to respond and adapt to new information and capabilities.

● Information reporting

Information reporting is highly adaptable because once such requirements are imposed, their value does not depend on marginal changes concerning what risk exists or what level of risk is appropriate. A source's obligation to tell EPA or the public how much of a pollutant it emits is unaffected by changes in the perceived level of risk that pollutant presents except in the unlikely circumstance regulators decide that the pollutant is no longer dangerous. However, an obligation to report to the public the known dangers of a pollutant might be affected by new scientific developments about its impacts. The agency might have to reformulate the reporting program to convey this new information and, of course, the sources would have to adapt their reporting accordingly.

● Technical assistance

These programs are usually unaffected by specific changes in risk perception or new technologies. EPA's choices concerning **technical assistance** are normally exempt from rulemaking as a "policy statement" or "a rule of organization" (277). If new scientific developments or a change in political priorities leads to a decision to scrap one of these goals, the entire assistance program might have to be reformulated to achieve a different goal. But it would take a dramatic shift in scientific information or political priorities to merit scrapping an assistance program altogether. Such a change is more likely to cause Congress, or EPA if it had the necessary discretion, to change the resources committed to these instruments.

○ Challenge regulations

The adaptability of **challenge regulations** probably depends on how the program is developed, although the potential to change such programs appears to be easier than for most of the other instruments. For example, if long-term targets are based on a consensus of stakeholders, the basis exists for accommodating new information relatively easily. However, if there are significant differences among interested parties about the lev-

el or timing of targets, pressure for modification of the program may emerge in the face of new information or capability.

Changes in risk perception pose the most difficult issue for challenge regulations. Those sources attempting to comply with the original target could be expected to oppose a new target, especially if they have already relied on the old goal by investing in a particular abatement approach. Indeed, a change by EPA in the target might cause the sources to end their compliance efforts altogether.

▽ Product bans

Product bans and limitations are generally used only after a regulator determines that existing scientific information indicates that a product poses sufficient risk to justify total or partial prohibition of its use. Product limitations are usually established through regulations, while some bans have been established by Congress (e.g., CFCs). Thus, efforts to modify them would not be easy, requiring rulemaking or legislative action.

New abatement capability such as better product substitutes or better control technologies might not require the agency to change harm-based bans or limitations. Industries would be able to adopt these new capabilities according to their own needs. However, if product limitations are put into place based on technological capability or the available of adequate substitutes, then new capabilities might be sufficient to justify reopening the restrictions.

▽ Technology specifications

Although seldom used, **technology specifications** would have to be completely reformulated to accommodate improvements in abatement capability. Otherwise, firms adopting the new technology would risk being out of compliance. Changes in technology specifications may face serious challenges from sources because they dislike such specifications intensively and already have "sunk costs" in existing technologies.

Changes in risk perception would generate the same kind of uncertainty about modification as design standards. That is, if a "balancing" test has been done to determine the feasibility of a particular technology, then new information or perceptions about risk might change the outcome of that calculation.

▽ Design standards

A **design standard** gives sources the option of adopting the technology specified in the regulation or another that "performs like the model technology." Sources might take advantage of this option if new control technologies were marketed that were less expensive. EPA would have to verify that the new technology performs like the model, but it would not have to reformulate its standard. A source would not have the same incentive to adopt a new technology if it were more expensive, even if it would reduce emissions more than its existing abatement method. In this case, EPA might decide to reformulate its design standard to force sources to adopt the new technology.

The model technologies approach does permit firms some discretion to seek approval for a different design on a case-by-case basis. Such approvals provide the opportunity for firms to use innovative technologies. Although any particular case might not be as difficult as a rulemaking, resolving technology choices on a firm-by-firm basis could be burdensome (see the section on *cost-effectiveness and fairness*). Design standards modifications must be made through the rulemaking process, making them vulnerable to the usual delays and challenges.

When abatement capability changes, design standards established for a risk-based strategy, such as a backup to harm-based standards, might remain unaffected and allow firms the choice about whether or not to adopt the new capability. The agency might decide to modify the standards for new sources. If the design standard was written as a technology-based strategy to characterize the state-of-the-art technology, then the agency would eventually have to modify the standard,

particularly for new sources. However, if a balancing test is required by the statute, then the agency would have to reconsider that test to determine the model technology.

Harm-based standards

Modifying a **harm-based standard** is never easy because the agency must use the rulemaking process. The analytical complexity and likelihood of contentiousness by various stakeholders will depend on the nature of the new information. A harm-based standard would not have to be rewritten to accommodate new abatement capability. Sources would be free to take advantage of the new abatement capability, and they might do so if it is cost effective. In fact, given the choice between a design and a harm-based standard, sources usually prefer the latter because they have flexibility to design and implement the means for compliance.

If a change in risk perception occurs that suggests that current standards are not adequate, then a harm-based standard would probably have to be rewritten. If the analytical work required to support the original standard is considered sound, then much of the agency's modeling work can be used to recalculate the appropriate new standard. However, even with that step simplified in comparison to the original standard setting, going through rulemaking requires considerable time and agency resources.

Integrated permitting

Most current efforts to write **integrated permits** involve learning how to do the first ones. It is possible that the complexity of writing these types of permits will result in making changes in any one part more difficult than if a single-medium permit existed. However, it is also possible that once a permit captures the relationships and tradeoffs within a facility, making incremental changes will be easier for sources. The need for modification of the permit will depend primarily on the type of instruments on which the integrated permit is based and the nature of the change.

Tradeable emissions

Tradeable emissions programs are complicated to establish and the prospect of modification once implementation has begun might be difficult politically. However, once the market rules are in place, sources have considerable flexibility to adapt their strategies. Firms would be free to choose the course of action that meets their own strategic interests; firms generally like **tradeable emissions** because of this aspect.

Current efforts to implement tradeable emissions programs (e.g., RECLAIM) suggest that modifying the overall standard for a particular pollutant would be very difficult, although with more experience the difficulties may lessen.[16] When abatement capability improves, an emissions cap based on acceptable level of risk would not have to be modified. However, if the original strategy and allocations were based on an agreement about abatement capability, there might be pressure to modify the program to reflect the new capability.

Proposed changes in tradeable emissions programs might face particularly difficult political resistance. Changing a tradeable emissions regime would probably involve more than the usual amount of oversight and organized interest involvement. Environmentalists would likely oppose an increase in the number of permits, while regulated sources would likely oppose a reduction. The opposition of the latter group might be especially strong because the modification of per-

[16] The experience with RECLAIM has been described as "condensing 10 years of rulemaking into 2 years." Thus, although establishing these kinds of programs looks formidable, future programs may be less difficult.

mits could destabilize market expectations.[17] The possibility of additional trades in emission permits might soften this opposition, but it is unlikely to eliminate it.[18]

Judicial review can also be expected, but it may be more complex than the usual challenge to an EPA decision. Litigants might argue that a reduction in the number of permits constitutes a taking in violation of the Fifth Amendment. Although this argument may not ultimately prevail,[19] resolution of the issue will require a Supreme Court ruling, which would likely take a considerable amount of time.

Pollution charges

Modifying **pollution charges** is probably not easy regardless of the initial strategy used, although setting a new charge based on an abatement strategy might be easier than trying to make changes based on a harm-based approach. Any attempt to establish, track, and iteratively modify charges based on the marginal costs to facilities in order to achieve fairly certain ambient levels of pollutants would be very difficult.

EPA is likely to face more than the usual degree of oversight. The agency is likely to be scrutinized by the tax committees in Congress in addition to committees responsible for environmental protection (22). In fact, there is some question whether EPA even has the authority to set a pollution charge. The Supreme Court has approved the delegation of the authority to set user fees, suggesting that Congress can delegate the authority to set pollution charges as long as it clearly establishes the limits of EPA's authority.[20]

One key difficulty is how bargaining and compromise might occur. A student of the European experience with pollution charges concludes that

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[17] In comparing pollution charges (or taxes) and tradeable permits, Sanford Gaines and Richard Westin note: "Because pollution control entails long-term capital investment, the market will work well only when the total amount of rights can be held stable for many years. If new scientific data require the government to reduce the number of rights unexpectedly, confidence in the market will be undermined. . . . [I]f the amount of acceptable pollution is subject to rapid change, or if regulation of the market becomes necessary to prevent abuses [i.e., wealthy firms buying up rights in order to drive out competition] public policy would favor a tax." S. Gaines and R. Westin, *Taxation for Environmental Protection: A Multinational Legal Study* (New York, NY: Quorum Books, 1991).

[18] Firms with high abatement costs could lower those costs by purchasing additional permits from firms with low abatement costs. Nevertheless, a reduction in permits would increase costs for both sets of firms. Firms with low abatement costs would have to pay for additional abatement, while firms with high abatement costs would have to pay for additional pollution permits.

[19] The Clean Air Act states that SO_2 allowances granted to power plants do not constitute property rights, 42 U.S.C. § 7651 b(f). Whether this statement would bind a court is unclear. The statement should reduce the legitimate investment-backed expectations of the allowance holder, thus reducing the chances of a taking occurring.

[20] In *Skinner* v. *Mid-American Pipeline Co.*, 490 U.S. 212 (1989), which concerned fees to recover the costs of inspection of natural gas pipelines, the Court applied the standard that "Congress must indicate clearly its intention to delegate to the executive the discretionary authority to recover administrative costs not inuring directly to the benefit of regulated parties . . . whether characterized as 'fees' or 'taxes' on those parties." *Id*. at 224. In upholding the fees, the Court cited that the agency could only apply criteria set by Congress and could not establish a fee schedule that does not bear a reasonable relationship to these criteria. These restrictions satisfied the nondelegation doctrine according to the Court.

Skinner clarified that *National Cable Television Assn.* v. *United States*, 415 U.S. 336 (1974), did not prohibit the delegation of user fees even if the benefits of such fees were for public purposes rather than for the benefit of the entity that was charged the fees. According to *Skinner*, *National Cable s*tands for the proposition that Congress must clearly delegate the authority to charge fees that benefit the public.

United States v. *Rohm and Haas Co.*, 2 F.3d 1265 (3rd Cir. 1993), drew on the distinction made in *Skinner*, when the court overturned EPA's attempt to collect oversight costs at Superfund sites as unauthorized by Congress. Because oversight costs were "'administrative costs not inuring directly to the benefit of regulated parties but rather to the public at large," *id*. at 1273, the court declared, "To the extent that the fee was used to further the benefit of the public, it was more appropriately considered a tax and required explicit congressional authorization." *Id*. at 1274 n. 12.

If Congress *expressly* authorized EPA to collect user fees, it should satisfy *National Cable* and *Rohm & Haas*. Moreover, if Congress "provides [the] administrative agency with [sufficient] standards guiding its actions, no delegation of legislative authority trenching on the principle of separation of powers [will] occur." *Skinner*, 490 U.S. at 218.

"nothing in the nature of a charge makes it immune to the political virus" (168). Another study finds, "Contrary to the expectation of some American economists that a system of charges 'would reduce the scope for administrative discretion and bargaining,' bargaining and negotiations play a major role in the French system" (110).

Changes in abatement capability would not require modifications to pollution charges. If the improved capability would lower payments for a particular firm, then presumably the firm would adopt it. However, if an agency has used payments as a source of revenues, then it may want to consider raising the charge. For example, pollution charges in the form of per-bag fees on household wastes are not set according to a calculation about the level of acceptable risk but rather on the capacity of the system to handle trash and estimates of the customer's willingness to pay.

If the agency is using charges to force firms to reduce levels of pollutants to meet an ambient goal based on acceptable risk, then any changes in risk perception will require the agency to raise the fee to force more reductions. If the charges are based on estimates of the levels that can be reached with the best abatement capabilities, then changes in risk perceptions would provide pressure to reconsider the balancing test or to consider moving to a technology-forcing strategy.

In contrast to the difficulty that EPA might face modifying a charge in response to changes in technology or risk perceptions, sources have considerable freedom to make changes as they see fit. Again, sources might object to the prospect of EPA's making adjustments to a charge, but once a charge is set, the only interaction the source must have with the agency is to monitor and report emissions and to pay the charge.

Subsidies

Subsidies usually provide financial assistance to sources, who can choose whether or not to take advantage of them, with the purpose of stimulating environmentally beneficial behavior. If tax allowances are to be used as the subsidy, Congress would normally establish new eligibility rules (62,143,223). EPA can originate grants and loans only for purposes and amounts legislated by Congress. If EPA has the authority to change subsidies, it can avoid rulemaking under an exception for rules concerning "public property, loans, grants, benefits, and contracts" (230). The Administrative Conference, however, has recommended that agencies use notice and comment rulemaking for these functions (260).

It would take a dramatic shift in new information to change an existing subsidy program and proposed changes would be likely to generate more than the usual degree of legislative oversight. Any such changes would be of interest to any member of Congress who has eligible constituents affected by the proposed changes. For example, the degree of political infighting that surrounds reallocation of grants under the Clean Water Act (such as sewer construction grants) is quite high.

Technology Innovation and Diffusion[21]

Technology innovation and diffusion seeks improved environmental performance—in quality or cost—through changes to or widespread adoption of existing technologies.

Technology innovation and diffusion[22] can be a major source of both economic growth and a cleaner environment. From an environmental perspective, innovation and diffusion offer ways to

[21] Parts of this section are based on G.R. Heaton, Jr., "Environmental Policy Instruments and Technology Innovation," unpublished contractor report prepared for the Office of Technology Assessment, U.S. Congress, Washington, DC, June 1994.

[22] Technology innovation is the first commercial application of a technical idea or method. Innovations can be classified as radical or incremental improvements, depending on the degree of change from the status quo. Although radical or new innovations often receive the most attention, the majority of innovations involve small improvements to existing technologies.

deliver goods and services with less environmental pollution and to provide new ways to trap or clean up pollutants.

Concern persists, however, that environmental regulations may hurt the competitive position of U.S. firms in the global economy by adding to production costs and impeding performance and cost innovations.[23] Examples of the concerns include: 1) regulation-driven costs place U.S. firms at a competitive disadvantage; 2) compliance costs divert money from commercial innovation; and 3) rigid regulations are incompatible with the trial-and-error processes essential for economic success in many technology sectors (89,166,197).

Examples of specific criticisms directed at specific policy instruments include: 1) technology-based instruments favor known technologies; 2) permits create barriers to innovative improvements; and 3) end-of-pipe, media-specific standards restrict innovative process solutions.

Yet when trying to understand exactly how policy tools affect technology innovation and diffusion, we face at least three basic challenges: 1) technology innovation is trying to do what no one knows how to do (87); 2) it occurs within complex and unique institutional arrangements (84, 88,140); and 3) little research is available on the effect of specific regulatory instruments on technology innovation.

We do know that establishing regulations in a way that provides reasonably certain targets and clear timetables reduces uncertainty, making investments in innovation less risky. Further, if innovation is a key purpose, targets and timetables must also put the kind of financial or technological pressure on companies that will stimulate a search for new ways of meeting environmental goals.

While environmental regulations can be important, they are in most cases a relatively small factor among many that firms consider when choosing to innovate (197). This suggests that if technology innovation is a high priority, there may be much more direct and effective ways to encourage it than reforming the particular regulatory instruments used to implement environmental goals.

Factors for Comparing Instruments

In this section, we use three factors for evaluating and comparing the impact of policy instruments on technology innovation and diffusion:

- innovation in the regulated industries;
- innovation in the environmental goods and services (EG&S) industry; and
- diffusion of known technologies.

Each of these categories offers opportunities for furthering technological solutions to environmental problems. Emphasizing one path, however, can sometimes constrain opportunities for utilizing another.

Innovation in the regulated industries

Environmental regulations can have both direct and indirect impacts on manufacturing firms or governmental entities like sewage treatments plants by, for example, creating preferences for a type of technology, generating new markets, raising the costs of production, or diverting capital from other investments and businesses. The response of individual firms regarding innovation will be based on many complex factors, both internal and external to that firm. Especially for large complex facilities, incremental innovations may offer a relatively low risk route to profitability (85,89,164). In smaller firms, diffusion may be a better strategy.

Innovation in the EG&S industry

This industry is comprised of firms whose primary business is the supply of environmental equip-

[23] Some critics note that these estimates often fail to incorporate that environmental policy 1) may stimulate economic growth by creating new markets in some sectors, and 2) may prevent decreasing productivity in sectors dependent on a healthy environment, such as agriculture or fisheries.

ment and services that control, treat, clean up, and/or prevent pollution and waste (197). Government regulation has created and sustained most of the markets for the EG&S industry and thus any changes in the way regulations are written may affect the health of the industry.

Diffusion of known technologies

Technology diffusion is the common follow-onto successful innovations. Diffusion occurs because firms find technologies beneficial and often essential if they are to be competitive. Subsequent producers or users of an innovation may modify the technology or the context into which it will fit, in order to gain advantage. Such adaptations are an important part of the process of technological change, and they commonly provide known solutions or best practices to firms that do not have the resources for in-house innovation. Some instruments that promote technology diffusion, however, may delay or impede a firm's search for innovations. A company could, of course, always choose to innovate for performance or cost reasons related to productivity.

Diffusion may bean ideal strategy when technological solutions for environmental problems are available but are not widely known or have not been widely adopted. This is especially so for small-to medium-sized firms that find the costs of information searching and R&D prohibitive. For these companies, diffusion may provide a way to reduce costs and achieve state-of-the-art abatement.

Summary of Instrument Performance

- **Effective:** ***Product bans, pollution charges***
- **O It depends:** ***Tradeable emissions, challenge regulations***
- V **Use with caution: —**

As indicated above, the empirical basis for understanding the relationships between policy instruments and technology innovation in sources and the EG&S industry is not well developed (197). Activities related to the diffusion of known technologies have been more widely discussed, but seldom with a focus on the impacts of specific policy instruments on these activities.

Innovation is essentially done in firms or within the networks to which the firm or its personnel are connected. And, even if a firm wants to innovate, it can not always accomplish its goal. Thus, the role of government in spurring innovation is necessarily limited to a set of important but ultimately insufficient activities (89). Nonetheless, it is possible to draw some tentative conclusions about differences among the 12 instruments in promoting technology innovation or diffusion.

As shown in table 4-8, the most effective instruments for promoting innovation are **product bans** and **pollution charges.** By removing a product or limiting its use in commerce, the agency creates a market for some other product or process. The consumer could be an end-user or a manufacturing facility that is using the product as part of an intermediary process in which value is being added along the way. **Pollution charges,** although not widely used in the United States, have the potential to keep steady pressure on firms to innovate to reduce the fees they must pay for residual discharges.

Tradeable emissions and **challenge regulations** increase the flexibility firms have to solve pollution problems and thus may be more likely to spur innovation. Depending on how they are used, however, these instruments also run the risk of being simply average or comparable to the performance of the other instruments.

The remaining instruments do not provide the same encouragement to innovate as those mentioned above, although none of them are necessarily barriers. In our overall strategy we weight innovation somewhat more heavily than diffusion. Thus, an instrument like a design standard, which can promote diffusion of technologies and provide incentives for the EG&S industry to innovate but which may reduce incentives for a regulated industry to innovate, might be approached cautiously.

Instruments that specify examples of technologies that would constitute compliance or make adoption of experimental technologies very risky

TABLE 4-8: Technology Innovation and Diffusion

	Fixed Target							No Fixed Target				
	Single-source				Multisource							
	Product bans	Technology specifications	Design standards	Harm-based standards	Integrated permitting	Tradeable emissions	Challenge regulations	Pollution charges	Liability	Information reporting	Subsidies	Technical assistance
Technology innovation and diffusion	●	•	•	•	•	O	O	●	•	•	•	•
Innovation in regulated industry	●	V	V	•	•	0	0	●	.	.	.	.
Innovation in EG&S industry	.	V	●	•	.	O	O	●	•	•	•	V
Diffusion of technologies	.	●	0.		.	•	•	●	•	•	●	●

● = Effective O = It depends V = Use with caution •= Average

NOTE: These ratings are OTA's judgments, based on theoretical literature and reports of instrument use. The evaluation of each instrument on a particular criterion is relative to all other instruments. Thus, by definition most instruments are "average."" Effective" means that the instrument is typically a reliable choice for achieving the criterion "It depends" means that it may be effective or about average, depending on the particular situation, but it is not likely to be a poor choice And "use with caution" means that the instrument should be used carefully if the criterion is of particular concern.

SOURCE: Office of Technology Assessment, 1995

may make innovation a less attractive option for some firms. However, many of the instruments that are rated not quite as high for innovative technologies tend to promote diffusion of known technologies, which can also increase productivity and help meet environmental goals. Moreover, firms could still choose to innovate or to adopt known technologies for cost or performance improvements under a regime using almost any of these policy instruments.

Instrument-by-Instrument Comparison

● Product bans

Product bans are the instrument with the best chance of promoting technology innovation simply because they prohibit "business as usual." They represent at the time they are implemented a very stringent and certain action. However, because the industry response is left open, some type of innovation may occur, ranging from simple substitutions for an existing product or component to new products or processes. In markets where no substitutes are readily available, the product ban has the most potential to induce radical innovation.

In the case of consumer or industrial products such as polychlorinated biphenyls, phosphate detergents, asbestos, CFCs, etc., the affected industries have responded with environmentally superior products. However, this form of "radical technology forcing," requires a leap of faith on the part of the regulatory agency and reviewing institutions (118). Substitutes may not become available by the deadline or their costs may be much higher than anticipated.

For important products for which there are no substitutes, the approach invites a degree of brink-

manship that is sometimes difficult to manage in a regulatory setting. For example, when EPA initiated cancellation proceedings against the pesticide Mirex, its manufacturer protested that farmers and ranchers throughout the southeastern United States would be left defenseless against imported fire ants, because the only registered substitute for Mirex was a pesticide that was also the subject of an EPA notice of intent to cancel. In phasing out Mirex use over an 18-month period, EPA took the risk that other companies would come forward with alternative fire ant killers to fill the void left by the absence of Mirex; four substitutes did in fact become available before the end of the phaseout period (117).

● Pollution charges

The reason that economic studies rank **pollution charges** high on their ability to spur innovation is clear: firms pay more to achieve the same level of control than under direct controls, hence they can save more by innovating. Firms pay more under charges because they must still pay for pollution discharges, even after desired control levels have been reached, in addition to their control costs. By making pollution itself one of several production costs, pollution charges build in an incentive to innovate (59).

Pollution charges allow firms substantial flexibility to decide how to respond to signals about the costs of pollution. This flexibility includes an option to buy out of the system—that is, to pay to discharge if the firm wishes to do so.

In addition, while it is tempting to say that firms will innovate if EPA simply sets the charge high enough, setting the charge at the right level to get innovation rather than diffusion or continuing discharges is far from simple. In the past, pollution charges have not been widely used because of the political difficulties of establishing a fee high enough to achieve the desired level of pollution control. Charges have been widely used to fund pollution control agencies, but have not been set high enough to change behavior (193).

○ Tradeable emissions

In theory, **tradeable emissions** should promote innovation. The primary advantage of a tradeable emissions program is that it allows firms with widely varying marginal costs of abatement control to cooperate in meeting environmental standards with lower overall costs. Since they are used infrequently, not much is known about how firms will respond in terms of innovation. Yet, firms with high marginal costs could be expected to innovate to reduce pollution instead of buying emission credits. However, firms facing relatively high control costs can also buy credits instead, thus reducing the pressure for innovation (111). The degree of innovation will strongly depend on the stringency of the emissions cap faced by the facilities (197).

Although tradeable emissions might initially promote adoption of technologies among firms for which the technology achieves the standard, the degree of stringency in later emission reductions for the program might actually impede *diffusion* of new technologies. For example, under an increasingly competitive trading process, a firm that developed effective and relatively cheap technologies for pollution abatement might try to protect its position through secrecy or patenting because diffusion would reduce the value of the firm's credits. However, it could also choose to recoup the costs of innovation by selling the innovation at a very high price (121).

The effect of a tradeable emissions regime on the EG&S industry will depend on the structure of the particular regulated industry. If the industry relies heavily on suppliers for compliance technologies or services, it may have indirect incentives for innovation or increased opportunities for diffusion of known solutions to more clients. For example, in the automobile or electric power industries, such a regime might create pressure on the suppliers for innovations; in the chemicals industry, the EG&S industry would be less affected.

Tradeable emissions, in comparison to uniform standards that would apply under a design stan-

dard, clearly widens the field of available technologies. For example, analysts expect to see a wider array of control approaches under the acid rain tradeable emissions program than if a uniform standard had been adopted. This also applies to other multisource instruments such as integrated permitting or challenge regulations. Again, this may be more likely to encourage diffusion than innovation, especially if the EG&S industry plays a major role.

Challenge regulations

The setting of long-range goals and scheduled targets allows industry to see where an agency is going with its policy and in that way provides some level of certainty or stability that can help firms decide about the risks involved in innovating. A major difficulty for the United States is the degree and frequency to which political pressures can affect the stability of such national environmental policy setting.

Like most of the other instruments, **challenge regulations** do not ensure that innovation will occur. Instead, the strategy incorporates and implements the idea that the knowledge and expertise required to solve problems in an innovative way generally resides in the companies and not in the regulatory agency. A possible advantage for spurring innovation is the degree to which challenge regulations can encourage an industry or set of firms to find that balance between cooperation and competition that results in low-cost, innovative solutions for meeting the targets.

The frequent duplication of environmentally oriented R&D among companies in some industries was mentioned by technical experts in a 1991 survey as a key opportunity for cost savings while still promoting innovation (74). Other countries, such as Germany, the Netherlands, and Japan, that have encouraged such cooperation in R&D and information sharing on innovative environmental technologies have a positive track record. In the United States, a range of nonenvironmentally related policies such as antitrust regulations and the lack of strong organizations or institutions such as trade associations constrain opportunities for such collaboration.

Harm-based standards

Companies report a preference for harm-based standards over design standards because of the flexibility they provide in choosing a compliance strategy for the source (105). A standard expressed, for example, as an allowable emissions rate or pollutant concentration in effluents, but without a restriction on how to meet it, gives firms the freedom to develop the best solution for that source.

If the standard is set to achieve a desired level of environmental quality, then sources may face nonuniform requirements. For those facing a more stringent control requirement, innovation may be the best way to achieve compliance. However, it is also possible that existing technology is available for meeting the standard, either from an EG&S firm or from another firm. Competition among EG&S firms for clients might also result in innovations to reduce the costs of meeting harm-based standards.

If the difference between the acceptable risk goal which must be attained and the current capability of technologies to meet that goal is substantial, firms have an incentive to innovate. However, once that goal has been met, productivity concerns rather than meeting the goal become the key source of continuing pressure on a firm to innovate, although some firms may decide to improve environmental performance for other reasons.

Examples of **harm-based standards** that have been studied for their impact on technology innovation include SO_2 standards for copper smelters (108) and mercury in the chloralkali industry, vinyl chloride, asbestos, cotton dust, and lead (14). These studies concluded that major innovations tended to come from newer firms or from firms more heavily affected by the regulations. Diffusion of innovations were faster when the new technologies were developed by the EG&S industry.

For small firms, combining harm-based standards with other instruments such as technical assistance can promote diffusion of known technologies that can meet the standard or that would be considered best controlling technologies at the time.

Design standards

One of the original goals for **design standards** was to spur continual innovation by revising regulations as the state of the art of technologies improved (13). Moreover, some argue that the legislative language developed for design standards (e.g., BAT, MACT, LAER, BACT, etc.) was intended to provide incentives for firms to continue innovating incrementally over a period of time until the unwritten goal—or, in the case of the CWA, the written goal—of zero or near zero emissions was achieved.

In practice, however, this desired link between design standards and continuous innovation has seldom happened. For example, under CWA standards that considered technology forcing five and 10 years out from the statute, industry was able to meet nearly all of the five-year standards and most of the 10-year standards with existing technologies (117). Agencies may also be reluctant to reopen rulemakings on design standards once they are in place for many reasons, including some of the political and analytical difficulties outlined in the sections on *assurance* and *adaptability* to change (30).

The common use of a "reference" technology for design standards probably hurts efforts to spur innovation. Since no source is required to achieve pollution control beyond what the regulatory agency knows can be done with existing technologies, innovation would not be necessary to satisfy the standard.

However, if the reference technology would be very expensive for a source to adopt, there might be an incentive for innovation. While the "or equivalent" provision accompanying design standards allows a firm or the EG&S industry to substitute an innovative technology, most firms report that the effort to establish equivalency is often difficult or risky. This is especially true when the model technology is written into the permit so that preapproval of a change is required rather than a demonstration of equivalent performance after installation. Moreover, the conventional wisdom has been that, contrary to original expectations, firms have not been inclined to seek innovations because of concern that new facilities would be forced to adopt them or that old facilities would have to adopt them when their permits are renewed (13,105).

The designation of uniform technology requirements for source compliance has been very important for establishing and maintaining markets for the EG&S industry, since any reconsideration of the technologies listed or not listed may create uncertainty for suppliers in that industry as well (153). Particularly when available technologies were not widely used prior to issuance of the standard, EG&S firms can play a large and effective role in promoting diffusion of the technologies.

Technology specifications

Technology standards, rarely used, are based on known technologies and thus could promote wide diffusion of technologies or restrictions of others. This type of uniform standard can create a relatively stable set of market conditions for the EG&S industry.

Once the technology is specified, however, and adopted by sources, the pressure for technical improvements in environmental performance is reduced. Unless the standards are revised to track technological developments, pressure to innovate will come from productivity concerns or from the desire to escape the regulatory net altogether (13,105).

Integrated permitting

Integrated permitting, almost by definition, allows the regulation of facilities in new ways. The task of considering the facility as a whole gives both the regulatory agency and the firm the opportunity to develop new techniques or processes for meeting environmental goals. It does not neces-

sarily lead to innovation, but the firm is free to find innovative solutions. For example, the integrated permit for VOCs issued to the 3M facility in St. Paul, Minnesota, gave the firm complete flexibility to identify reductions that could be made more cost effectively than others and to trade off those sources. The price 3M paid for this flexible permit was significantly lowered allowable emissions and the investment and implementation of an innovative continuous emissions monitoring system for VOCs (149).

Looking across media may provoke some innovation in technical processes. The innovation literature suggests that firms faced with having to rethink how they do business are currently using such opportunities to go back to the drawing board and redesign entire processes to capture efficiencies—that is, it is often cheaper to solve 10 problems at once than separately, one at a time. This conclusion suggests that integrated permits may offer a good opportunity for spurring innovation (150).

However, as long as integrated permitting is tied to the facility level and to the permit process, the firm is limited to choosing what is best for it in a particular facility setting. The impact of this type of permitting on diffusion for EG&S firms is uncertain, depending on the particular relationship of a facility to suppliers and to the particular problems being solved.

Liability

The uncertainty **liability** creates about outcomes can encourage firms to innovate to reduce or control pollution rather than take a chance on disposal or control of wastes. However, if signals about accountability are too inconsistent, liability might become counterproductive. Except for CERCLA provisions, that have been widely criticized, there is very little systematic evidence about how firms behave in the face of statutory provisions (as opposed to the body of common law known as torts or the issues of enforcement of civil and criminal penalties).

Theoretically, the possibility of suffering large judgments for compensatory damages if found in violation of environmental standards is regarded as an incentive for every firm to comply. Neither governmental entities nor companies, however, strictly comply with all environmental regulations, usually because the laws require more than a regulated entity knows how to do (100). Moreover, firms may vary regarding how risk-averse they are.

Liability can create both direct and indirect pressures on firms to innovate. The direct responsibility for remediation of environmental damage can promote problem solving by firms to reduce hazards. At a minimum, most firms want to avoid the negative publicity that can accompany the types of environmental degradation that result in efforts to secure compensatory damages.

The more indirect pressures are increasingly being seen in requirements by lenders and insurance companies who want assurances that firms are behaving in an environmentally responsible way or that property they are buying or insuring is free from liability under environmental laws. Liability provisions, especially associated with remediation efforts under CERCLA, have created a significant market for the EG&S industry. Banks and insurers themselves are now developing more in-house capability to evaluate environmental performance and to diffuse technical information to clients about how to prevent or solve environmental problems.

Information reporting

For technology innovation, the major impact of **information reporting** is likely to come from the way the sources interpret and act on the information they gather. Several firms have said that they were surprised by the results of the information they compiled for programs such as TRI and used the information to make changes in their facilities to reduce emissions (105). To the extent that information reporting, such as TRI or self-audits, can improve a firm's knowledge of its facility's emissions, that knowledge may be linked by the firm to other productivity concerns to produce innovations (159). However, the response does not have to be innovative; an incentive to lower emis-

sions is by no means equivalent to an incentive to innovate.

Subsidies

Subsidies are widely used in many countries to promote technology development, although support for environmental technologies has been used only recently in the United States (133). There are two major approaches to subsidizing technology innovation and diffusion. In the first, the government offers to pay firms well enough to spur reduced discharges through innovation. For example, subsidies could be used to promote diffusion of best practices to reduce nonpoint source pollution by subsidizing landowners, particularly farmers, who cooperate with guidelines.

The other major approach is to subsidize front-end research and development activities such as generic R&D, consortia arrangements, or specific products. For example, the CWA used to contain an Innovative and Alternative Technologies Program intended to promote innovation and diffusion of new sewage treatment technologies. The United States has used this approach most frequently in the agricultural, aircraft and aerospace, defense, and pharmaceutical industries, with a pattern of widespread subsidies rather than narrowly targeted project subsidies.

While experience indicates that these kinds of subsidies are indeed successful in promoting technology innovations (85), the record has been mixed, with some projects judged as failing to deliver desirable results (33). With either approach there is likely to be disagreement about whether it produces innovations that would not otherwise have occurred and, consequently, whether the redistribution of public monies into private hands is desirable or effective.

Technical assistance

Technical assistance is an effective instrument for promoting technology diffusion. These programs are not regarded as particularly effective in promoting innovation, particularly in large sources where considerable in-house expertise is available.

The typical clients targeted by technical assistance programs are companies or governmental entities that have lagged behind the state of the art. These programs have been widely favored for diffusing known techniques and methods, especially among smaller and medium-sized firms.

The federal government has considerable experience in using technical assistance to improve performance in an industry. For example, technical assistance programs were the backbone of the federal agricultural extension service's efforts to diffuse best practices and the evidence seems conclusive that it has been an extremely effective policy instrument in that setting. More recently, the federal government has been using the concept of technical assistance to promote cooperation among companies with similar technical environmental problems. For example, the Industry Cooperative for Ozone Layer Protection has developed standardized approaches to CFC substitution that are being disseminated to companies in other countries.

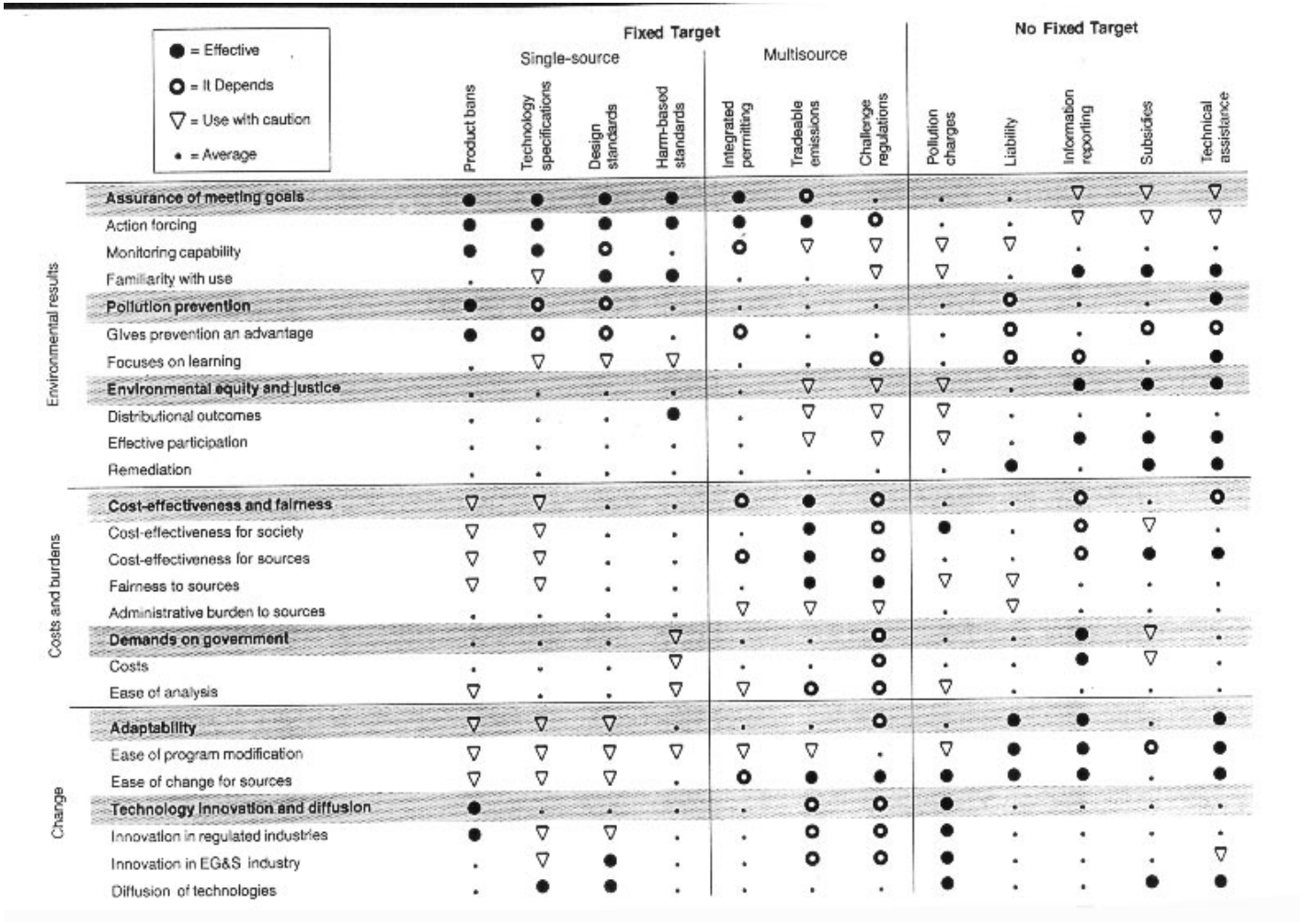
Government-sponsored technical assistance programs to support diffusion may either complement or actually compete with efforts within the EG&S industry. For example, some federal efforts at technical assistance are contracted out to the EG&S industry, using those firms as agents for diffusion.

SUMMARY

This chapter presented a criterion-by-criterion comparison of the effectiveness of the 12 policy instruments or tools. Our composite picture of instrument performance on all seven of the criteria and their underlying components, shown in table 4-9, underscores that trying to satisfy several, much less all, of these when addressing a particular environmental problem may be quite frustrating.

Yet policymakers are typically faced with these difficult tradeoffs among broad concerns such as lowering the *costs and burdens* for industry and government, achieving the desired *environmental results*, and spurring the development and use of new *technologies*. Choosing the most effective

TABLE 4-9: Strengths and Weaknesses of Policy Instruments



NOTE: These ratings are OTA's judgments, based on theoretical literature and reports of instrument use. The evaluation of each instrument on a particular criterion is relative to all other instruments. Thus, by definition most instruments are "average." "Effective" means that the instrument is typically a reliable choice for achieving the criterion. "It depends" means that it may be effective or about average, depending on the particular situation, but it is not likely to be a poor choice. And "use with caution" means that the instrument should be used carefully if the criterion is of particular concern.

SOURCE: Office of Technology Assessment, 1995.

policy instruments to achieve a goal can thus become a very complicated task for policymakers whether at the state, local, or federal level.

Clearly, choosing an instrument for its strength on any one criterion may diminish the chances of achieving any of the other criteria on which it performs poorly. The single-source tools that can be so effective at providing assurance of meeting goals, for example, are much less effective at addressing concerns about cost-effectiveness and fairness or adaptability to change. However, multisource tools that facilitate lower costs and burdens for industry and may spur technology innovation can be more difficult to monitor and raise concerns about the distribution of costs and benefits among various communities.

Chapter 1 of this report discusses one approach for narrowing the choice of instruments by posing a set of questions about both the problem itself and the preferences of the policymakers. After working through these questions, policymakers may find the perfect instruments for dealing with the problem. However, they are just as likely to be faced with the kinds of tradeoffs discussed in this chapter. Rather than depend on a single instrument, policymakers may want to combine two or more instruments to shore up the weaknesses of one with the strengths of the others.