Congress' Environmental Policy Toolbox: A Review 3

Environmental goals can be reached in many ways. Some ways are quite prescriptive, others are not. If one imagines a typical factory as having one or more pollution sources, it is easier to think of the many options available to Congress, EPA, and the states. Raw materials and products go into the factory, manufacturing processes within the factory are used to produce new products, and often some "nonproduct" residual—pollution—is generated and released to the air or water, or shipped offsite for disposal, treatment, or storage. Sometimes the product itself results in pollution, while or after it is used.

To lower the pollution reaching the environment, government can—

- specify the end result—the amount of pollution that each source in the facility is allowed to discharge;
- specify what the source is to do to achieve the end result, such as install certain kinds of pollution control technology;
- help the source through a technical assistance program or a subsidy for cleaning up;
- specify the end result for each source, but allow facilities to trade these requirements within or among facilities;
- charge a fee on pollutant emissions[1] to discourage releases to the environment;
- require only that the source publicly report emissions or risks to the human health and the environment;

[1] "Emissions" is a term typically used for pollutants released to the atmosphere, while "discharge" is the term used for pollutants released to water bodies. To avoid repetition of both words, this assessment uses the word "emissions" to denote releases of any type of pollutant to air, water, or land.

- require nothing in particular but hold sources liable for any resulting damages;
- or, as is often the case, some combination of two or three of the above.

All of these approaches are policy instruments, the topic of this OTA report. They are the means through which government encourages or forces sources to achieve society's environmental goals. Each of these policy instruments or tools has inherent strengths and weaknesses. Some address particular types of pollution problems better than others. Yet picking a tool does not merely involve identifying those that reduce emissions. Instrument selection also involves tradeoffs between values and interests commonly held by Congress and the public. For example, instruments most likely to provide significant assurance that an environmental goal will be met are equally likely to achieve that goal in a manner more expensive than some other instruments. A full toolbox allows the decisionmaker to select tools that most effectively address values and interests of particular concern at the moment. And combinations of complementary instruments may allow decisionmakers to address multiple concerns or to shore up weaknesses in a particular instrument.

Environmental policy tools could be categorized in any number of ways, depending on which attributes one wishes to emphasize. This assessment groups 12 tools according to whether or not they have fixed pollution reduction targets. Such a focus helps the decisionmaker address a common concern in environmental policy, namely, the extent to which particular behavior is mandated by regulation. Table 3-1 provides brief definitions of each of the tools discussed in this assessment, including:

- Tools with fixed pollution reduction targets:
  1. harm-based standards
  2. design standards
  3. technology specifications
  4. product bans and limitations
  5. tradeable emissions
  6. integrated permitting
  7. challenge regulation
- Tools without fixed targets:
  8. pollution charges
  9. liability provisions
  10. information reporting
  11. subsidies
  12. technical assistance

Policymakers in the United States have not relied equally upon these 12 policy instruments; some tools have been used frequently, while others remain largely experimental. Table 3-2 displays the primary policy instruments used to control air pollution, water pollution, and hazardous waste. For each of the approximately 30 pollution control programs addressed by the Clean Air Act (CAA), the Clean Water Act (CWA), and the Resource Conservation and Recovery Act (RCRA), the table displays primary instruments (marked with dark gray) as well as several auxiliary instruments (light gray) used under current law. Combinations of tools are common. Policymakers traditionally have relied most heavily on two regulatory tools that place direct pollution limits on single sources: design standards and harm-based standards. And yet, the other tools in the regulatory toolbox—while less frequently used—should not be considered unused and theoretical. Table 3-2 shows that we have turned to tradeable emissions, information reporting, and other tools for numerous programs.

Box 1-1 in chapter 1 highlights several programs over the last two decades that rely on some of the lesser used approaches, including tradeable emissions, integrated permitting, liability provisions, information reporting, subsidies, and technical assistance. Generally, familiarity and comfort level with such tools seem to be growing. For example, academics had been discussing tradeable emissions for several years before trading was incorporated into regulations in 1976. Trading became increasingly common in regulations after the 1976 offset policy, but not until the Clean Air Act Amendments of 1990 was trading incorporated into a statute. Tradeable emissions is now suggested often during the legislative debate.

A significant consideration when discussing environmental policy instruments is that the regulatory instrument Congress selects through legislation may look very different at the point its requirements are imposed on an individual source. Although statutes begin the process and influence what the source sees, they often leave a great deal of discretion to EPA, states, or localities actually implementing the requirement. For example, the Clean Water Act uses a design standard, best available technology (BAT), to describe the level of control that sources of toxic emissions must meet. EPA translates BAT into a more specific emissions limit that looks like a harm-based standard, typically specifying a numerical rate or concentration. States might incorporate the numerical limit directly into an individual permit, or negotiate with the source a compliance technology capable of meeting the numerical limit and specify that technology in the permit. Thus, in a permit, the Clean Water Act's design standard might look like a harm-based standard or technology specification.

However, the distinctions between regulatory instruments remain important. Consider the BAT example. Because BAT is a design standard, its requirements remain linked to the state of abatement technology at a particular time, and so may provide different incentives for cost-effective control or technology innovation than do other instruments. BAT might also be more dynamic, becoming more stringent as technology development makes "best" even better.

This report focuses primarily on the perspective from Congress. Nonetheless, the viewpoint from the source is also quite relevant because policy instruments are designed to affect source behavior. The report's discussion of each policy instrument seeks to reflect the fact that an instrument's ability to achieve many of society's objectives depends on both Congress' original tool selection and how the requirement is implemented.

The balance of this chapter will discuss each of these environmental policy instruments, describing each individual tool and how it is used. The chapter also highlights those criteria that may strongly affect a policymaker's choice—either because the tool is particularly effective at addressing a criterion, or raises issues that show it should be used with some caution if the criterion is important.

TOOLS WITH FIXED POLLUTION REDUCTION TARGETS

The government often uses regulation to place limitations on environmentally harmful behavior. Regulatory instruments vary in the extent to which they specify *how* a regulated entity should comply with these limitations. Technology specifications allow the regulated entity the least opportunity to select a compliance method—compliance is defined as installing a particular technology or using particular techniques. In contrast, harm-based standards describe a compliance target and regulated entities are free to choose their own method for complying with the limitation.

Policy instruments with fixed pollution reduction targets can be further divided into two groups. The first group of tools requires regulated entities[2] themselves to comply with the limitation or face associated civil and criminal penalties. Such tools are often called "traditional" or "command-and-control" approaches, because historically they are the most heavily used and are less flexible than other tools. Included in this group of single-source tools are harm-based standards, design standards, technology specifications, and product bans and limitations.

A second group of tools that also directly limit pollution focuses on multiple sources rather than single sources. Multisource tools allow a regulated entity additional flexibility in how it com-

[2] The rather awkward "regulated entity" is used interchangeably with "industry" or "firm," because this assessment is considering not only environmental regulation of the business sector but also instances in which the government itself must comply with regulatory requirements. "Facility" is used rarely because many regulatory requirements are imposed at points other than at the facility level.

TABLE 3-1: The Environmental Policy Toolbox

Tools *with* fixed pollution reduction targets

Focus on single sources or products	
Harm-based standards	A harm-based standard prescribes the end results, not the means, of regulatory compliance. Regulated entities are responsible for meeting some regulatory target but are largely free to choose or invent the easiest or cheapest methods to comply, Sometimes referred to as health-based standards or performance standards, harm-based standards are widely used, primarily in combination with design standards.
Design standards	A design standard is a requirement expressed in terms of the state of the art of pollution abatement at some point in time, for example, "best available" or "reasonably available" technology. in a permit, design standard requirements are typically, but not always, stated as the level of emissions control the model approach is capable of achieving. Design standards written as emission limits allow individual sources the freedom to achieve the required emissions control by using the model approach or equivalent means. Design standards are very widely used, most often as part of a technology-based strategy,
Technology specifications	A technology specification is a requirement expressed in terms of specific equipment or techniques, The standard is to be met by all entities; facilities are not free to choose their means of pollution abatement or prevention. Explicit technology specifications in statutes or regulations are very rare. However, some designs standards can be considered *de facto* technology specifications when it is extremely difficult to prove to the regulatory agency that an alternative to the model technology is equivalent.
Product bans and limitations	This regulatory approach bans or restricts production, processing, distribution, use, or disposal of substances that present unacceptable risks to health or the environment, It focuses on the commodity itself rather than polluting by-products. As a result, the instrument is used most heavily under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and other statutes where the hazard is the commodity.
Focus on multiple sources or products	
Tradeable emissions	Emissions trading is achieved through government-issued permits that allow the owner to emit a specific quantity of pollutants over a specified period, and which can be bought from and sold to others. The government typically caps aggregate emissions from sources within a geographic region by issuing only the number of permits consistent with environmental goals. A relatively new approach to tradeable emissions is an "open market, " in which unregulated sources may opt into the program voluntarily, Emissions trading has been used most widely under the Clean Air Act and to a more limited degree to address water quality issues.
Integrated permitting	Integrated permits contain facility-wide emission limits, either for a single pollutant across multiple individual sources or media, or for several pollutants emitted to a single medium. An integrated permit might use one or several other environmental policy instruments. "Bubble" permits are used under the Clean Air Act, and to a very limited extent under the Clean Water Act. Other types of integrated permits are uncommon but are under study as part of several state pilot projects,
Challenge regulation	Challenge regulations ask target groups to change their behavior and work toward a specific environmental goal, with mandatory requirements imposed if the goal is not reached. The government identifies a goal and gives the groups time to select and implement an effective means of achieving it. Challenge regulations have the potential to be a less-intrusive way to achieve environmental goals. The concept of challenge regulation is attracting interest but is still uncommon as a stand-alone regulatory tool.

TABLE 3-1 (cont'd.): The Environmental Policy Toolbox

Tools *without* fixed pollution reduction targets	
Pollution charges	With pollution charges, a regulated entity must pay a fixed dollar amount for each unit of pollution emitted or disposed. Pollution charges do not set a limit on emissions or production. Instead, the government must calculate what level of charge will change the behavior of regulated entities enough to achieve environmental objectives. Sources are free to choose whether to emit pollution and pay the charge or pay for the installation of controls to reduce emissions. This report considers only those charges set high enough to significantly alter environmentally harmful behavior, *not* charges used primarily for raising revenues, In the United States, pollution charges have been used for solid waste control but rarely for control of other types of pollution.
Liability	Liability provisions require entities that cause environmental harm to pay those who are harmed to the extent of the damage. Liability can provide a significant motivation for behavioral change because the dollar amounts involved can be huge. This report focuses on statutory liability, *not* common law theories of liability or enforcement penalties, Several environmental statutes impose statutory liability, including CERCIA and the Oil Pollution Act.
Information reporting	Information reporting requires targeted entities to provide specified types of information to a government agency or to the public directly. Required information typically involves activities affecting environmental quality, such as emissions, product characteristics, or whether risk to the public exceeds a threshold. Information programs are widely used,
Subsidies	Subsidies are financial assistance given to entities as an incentive to change their behavior, or to help defray costs of mandatory standards. Subsidies might be provided by the government or by other parties, who thus bear part of the cost of environmentally beneficial controls or behavior. Government subsidies have historically been widely used, particularly in wastewater treatment. Subsidies from other parties are becoming more common as government budgets shrink.
Technical assistance	The government offers technical assistance to help targeted entities prevent or reduce pollution. These programs educate sources that might not be fully aware of the environmental consequences of their actions or of techniques or equipment to reduce those consequences. Technical assistance may take many forms, including manuals and guidance, training programs, and information clearinghouses. Some types of technical assistance, such as facility evaluations, are conditioned on facilities agreeing to respond with environmentally beneficial behavior. Technical assistance is very common, particularly in combination with other tools.

SOURCE: Office of Technology Assessment, 1995.

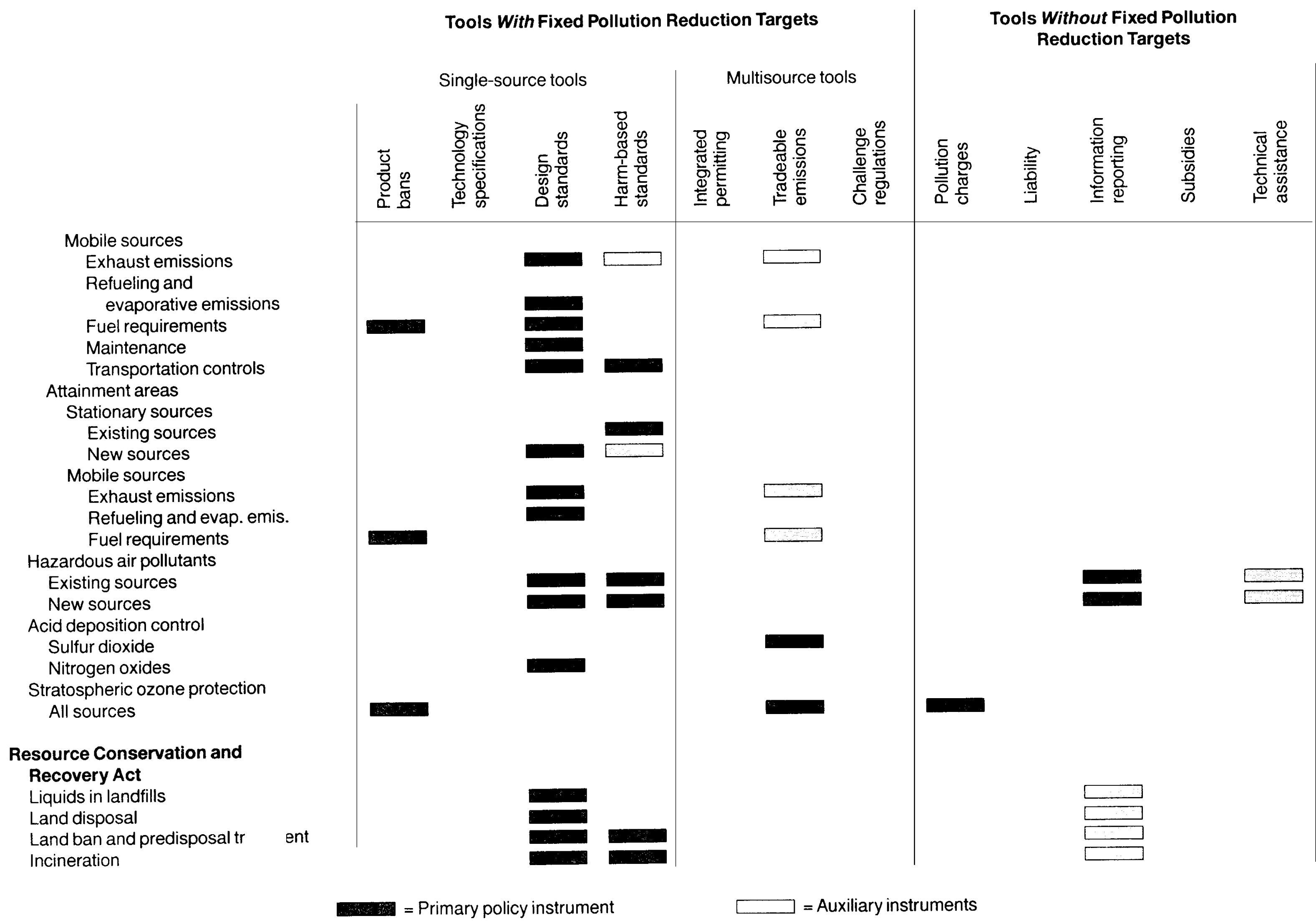
plies with emission limitations. A source can change its own behavior to fit within the limitations, or the source can make an arrangement with another entity for it to comply with the limitation on the source's behalf. This ability to transfer or negotiate responsibility among entities for changing behavior distinguishes multisource from single-source tools. Multisource tools include tradeable emissions, challenge regulation, and integrated permitting.

Harm-Based Standards

Harm-based standards prescribe the end results, not the means, of regulatory compliance. The desired end results are based on health and environmental effects of different pollution levels and patterns. With harm-based standards, regulated entities are responsible for meeting this regulatory target but are largely free to choose or invent the easiest or cheapest methods to comply.

TABLE 3-2: Primary Policy Instruments Used to Control Air Pollution, Water Pollution, and Hazardous Waste

	Tools *With* Fixed Pollution Reduction Targets							Tools *Without* Fixed Pollution Reduction Targets				
	Single-source tools				Multisource tools							
	Product bans	Technology specifications	Design standards	Harm-based standards	Integrated permitting	Tradeable emissions	Challenge regulations	Pollution charges	Liability	Information reporting	Subsidies	Technical assistance
Clean Water Act												
Point sources												
Industrial												
Existing sources												
Conventional pollutants			■	■								
Toxic/grey-area pollutants			■	■					■	■		
New sources												
Conventional pollutants			■	■								
Toxic/grey-area pollutants			■	■					■	■		
Indirect dischargers												
Existing sources												
Conventional pollutants												
Toxic/grey-area pollutants			■						■	■		
New sources												
Conventional pollutants												
Toxic/grey-area pollutants			■						■	■		
POTW's												
Conventional pollutants			■	■							■	■
Toxic/grey-area pollutants			■	■					■		■	■
Stormwater												
Industrial sources			■	■								
Municipal sources			■	■							■	
Nonpoint sources												
All sources						□					■	■
Clean Air Act												
Criteria air pollutants												
Nonattainment areas												
Stationary sources												
Existing sources			□	■	□	■						□
New sources			■	■	■	■						□



SOURCE: Office of Technology Assessment, 1995.

A harm-based standard is the most direct policy tool for implementing a risk-based strategy for achieving environmental goals. A regulatory agency typically establishes a harm-based standard by determining the amount of the pollutant in the ambient environment that will meet the health and environmental goal set by Congress. This determination involves making scientific judgments about the extent to which different concentrations of the pollutant harm human health or plants and animals the goal is intended to protect. After the agency establishes an acceptable concentration, it then uses a model to calculate an overall allowable pollution load for the region that results in this acceptable concentration. The model also must incorporate distribution and movement of the pollutant in the ambient environment, so as to avoid undesirable "hot spots."

Harm-based standards impose emission limitations on individual sources. Thus an agency apportions among individual sources what it has calculated as an acceptable pollutant concentration or loading. Some standards explicitly reserve part of the total acceptable loading for future sources, while others allocate only among existing sources. Harm-based standards might be expressed as an emission rate for the source (mass per unit time period), as a concentration of pollutant in a source's discharge, or as a percentage reduction in emissions from a source. Each of these types of harm-based standard might have short- or long-term averaging. An example of a source-specific harm-based standard is the Clean Water Act requirement that dischargers control their effluent at a level sufficient to maintain water quality standards, with emission rates expressed in a permit as tons per day and a maximum concentration.

In individual permits, emission limitations that describe a target without reference to specific technologies might in fact have originated from a harm-based standard, or might have begun as a design standard (discussed in detail in the next section).

The origin of the permit limitation is important. In contrast to harm-based standards, design standards typically start as a broad statutory term describing the level of control technology Congress expects pollution sources to implement, such as "reasonably available control technology." Such broad terms do not provide enough detail about what regulated entities must do to comply with the law. As a result, when implementing a design standard, a government agency will determine the reference technology's control capability and develop numeric emission limits based on this capability. Although they might look similar in a permit, harm-based standards and design standards are nonetheless different. For example, unlike harm-based standards, design standards can establish an implied regulatory preference for a model technology and may become stricter as new technologies are developed.

Extent of Use

Harm-based standards and design standards are the most heavily used environmental policy tools today. Typically, harm-based standards are used in combination with design standards, though occasionally harm-based standards have been used alone.

The Clean Water Act, for example, uses a combination of harm-based and design standards to attain water quality objectives. While design standards describe the baseline level of treatment to be met for all industrial discharges—a national "floor" for pollution control—the Act uses harm-based standards to place additional pollution control requirements on sources located on streams where design standards are insufficient to meet water quality goals. On these "water quality limited" streams, industrial sources must comply with a harm-based standard that calls for stricter pollution control, based on the stream quality and a level of risk identified as acceptable. Nationwide, the number of permits incorporating harm-based pollution limits is unclear; agency staff in Wisconsin and Massachusetts say they issue such permits very frequently.

The Clean Air Act also uses harm-based standards. For example, harm-based standards are used in combination with design standards for air toxics control. The Act's toxics provisions call for a design standard, maximum achievable control technology (MACT), to be used to control toxics. However, if the MACT standard is insufficient to reduce lifetime risk to the most exposed individual to less than one in a million, EPA must develop additional control requirements sufficient to meet that harm-based standard. Harm-based strategies are also used to avoid overcontrol that results in no corresponding public health or environmental benefit. Some toxics have a well-established threshold, below which human exposure is presumably safe. This known threshold might be higher than the emissions limit established by MACT. In these situations, EPA may set air toxics emission limits using the well-established threshold with an ample margin of safety, instead of requiring MACT. To date, EPA has not set such limits.

RCRA also relies in part on harm-based standards to achieve its environmental and public safety goals. For example, the statute requires that methods of land disposal for hazardous wastes are acceptable only if the proponent of the method demonstrates "to a reasonable degree that there will be *no migration* of hazardous constituents from the disposal unit or injection zone for as long as the wastes remain hazardous" (254).

Key Criteria Affecting Tool Selection

Assurance of meeting goals

Harm-based standards require that individual sources achieve a specified level of pollution abatement. As a result, they arguably are more likely to provide a higher level of assurance than instruments that do not specify a pollution control target. In addition, EPA or the administering state agency can verify compliance by reviewing monitoring data and other records, because allowable emission levels are directly linked to a single source.

However, no policy tool can ensure goals will be met unless it is properly implemented in a timely manner. Harm-based standards can be difficult and time-consuming to set because of analytical uncertainties and gaps in available data. Development of a harm-based standard is laden with uncertainties inherent in predicting the effects of different patterns and levels of environmental releases. Also, an agency needs extensive data on ambient pollutant concentrations and health effects, which often is not available. An agency that lacks necessary data has the option of setting a standard based on speculative judgments, or delaying promulgation of the standard until data gaps are filled. Both approaches would significantly impair a tool's effectiveness.

EPA has tended to delay promulgating harm-based standards until necessary health effects data become available. For example, promulgation of harm-based standards for hazardous air pollutants was extremely slow—seven in the 20 years following the enactment of the Clean Air Act of 1970. Congress shifted in 1990 to a design standard approach for controlling hazardous air pollutants. In the five years since Clean Air Act reauthorization, EPA has promulgated 10 regulations affecting 55 industrial toxic source categories and has proposed an additional 14 regulations for 16 industrial categories (5).

The harm-based standards set prior to 1990 were calculated to achieve the public health goal, while the design standards after 1990 are based on maximum achievable control technology, which may or may not achieve the goal. Yet the relative ease of implementing design standards means that *some* level of control will be in place faster than is likely under a harm-based standard. Thus, harm-based standards may have a practical disadvantage relative to design standards and other single-source technology-based tools.

Demands on government

Harm-based standards can be an administrative headache to establish, because an agency frequently lacks the necessary information about pollutants. This problem occurs most often with toxics. For example, a recent EPA report found that for the 189 air toxics listed in the 1990 Clean Air Act Amendments, 38 percent completely lacked ambient concentration data, 67 percent had little or no information on emissions sources, 31 percent lacked carcinogenicity data, and 79 percent had no validated data on thresholds for noncancer effects (215). Collecting the data necessary to set an appropriate harm-based standard can be very resource-intensive for an agency. Congress or an agency could reduce demands on government by encouraging or requiring the targeted entities to provide necessary data. Some environmental statutes currently give EPA this authority, but it is rarely used to its fullest extent.[3]

Even when necessary data are available, setting a harm-based standard requires substantial analytical resources. Development of a harm-based standard requires an agency to determine what concentration or total loading of a pollutant will meet the legislative goal. The agency also needs to model the effects of different emission loadings, identifying the load that results in an acceptable pollution concentration throughout the target area with no undesirable hotspots. An agency must then translate the total allowable pollution load into individual source requirements. Some attribute the substantial delays in achieving the National Ambient Air Quality Standards (NAAQS) on the complexity of implementation faced by states.

Design Standards

A design standard is a requirement expressed in terms of the state of the art of pollution abatement at some point in time. A design standard might incorporate a reference point other than state-of-the-art, if the standard considers tradeoffs among effectiveness, capability, stringency, and cost. Unlike technology specifications, design standards allow individual sources the freedom to achieve the same degree of pollution control by equivalent means.

A statute prescribing design standards typically uses broad terms to describe the level of control technology it expects pollution sources to implement, such as "reasonably available control technology" or "lowest achievable emissions rate." However, such broad expressions of effectiveness do not provide enough detail about what regulated entities must do to comply with the law.[4] When implementing a design standard, EPA or the applicable state agency will determine what stringency of emission control is associated with the standard. If the design standard is, for example, reasonably available control technology, the agency first will decide whether the extent of variation within the target group justifies consideration of subgroups.[5] Then the agency identifies what entities are representative of the target group or subgroups and determines what technology is reasonably available based on those representatives. For each group or subgroup, the agency then calculates the level of emissions control that occurs when a source uses this model control technology.

Design standards are typically imposed on individual sources through permits with specific numeric or narrative emissions control requirements. These permit limits often look very similar to harm-based standards but might provide different incentives to the target entities. The limits are derived from an identified model technology or technologies, selected by the agency because they correspond to the general expression of effectiveness called for by the design standard. An entity may view that technology as the preferred one and not be as inclined to propose an alternative as it would with a harm-based standard where there is no model technology. Thus, design standards rep-

[3] For example, section 8(d) of the Toxic Substances Control Act requires that upon request a person who manufactures, processes, or distributes a chemical must submit to EPA lists and copies of health and safety studies conducted by, known to, or ascertainable by that person. The data from these studies are intended to be used in making regulatory decisions.

[4] Due process provisions in the U.S. Constitution require that requirements be detailed enough to alert a reasonable person as to what is and is not legally allowed. Requirements are unconstitutionally vague if they lack such detail.

[5] For example, EPA divided pulp-and-paper manufacturers into 25 subgroups, depending on the processes they used, when establishing design standard emission limits called for by the Clean Water Act. See 40 C.F.R. § 430.

BOX 3-1: Debates About Harm-Based Standards

Assurance of Meeting Goals

Promotes criterion: Pollution control requirements under harm-based standards are set at a level calculated to achieve a specified level of risk. Harm-based standards establish a less complex regulatory system than multi-source tools, and so are more likely to work as desired.

Impairs criterion: Data gaps and limited administrative resources often make it difficult or impossible to set harm-based standards at levels that will in fact achieve goals; in practice, standards are often set at levels hoped to be adequate, without the precise match between requirements and goals that the tool theoretically offers. Delays caused by difficulties in setting harm-based standards can mean control requirements are put in place later than they might have been under other policy tools. Because harm-based standards focus on performance, assurance depends on availability of effective emissions monitoring.

Pollution Prevention

Harm-based standards neither help nor hinder pollution prevention.

Environmental Equity and Justice

Promotes criterion: Harm-based standards respond to differences in exposure among communities. They offer communities an opportunity for input into standard-setting.

Impairs criterion: The standard-setting process is often discussed at such a technical level that nonspecialists may have difficulty participating.

Cost-Effectiveness and Fairness to Sources

Promotes criterion: Harm-based standards allow a specific source to pick a cost-effective means of compliance. They can be applied uniformly, and therefore are fair.

Impairs criterion: Because harm-based standards typically focus on individual source control, they limit a facility's ability to adopt facility-wide cost-effective measures.

Demands on Government

Impairs criterion: Harm-based standards can be administratively expensive to set, because of their substantial analytical requirements.

Adaptability

Promotes criterion: Entities are free to adopt new technologies for complying with requirements.

Impairs criterion: New scientific knowledge regarding pollution might force an agency to reevaluate and possibly adjust a harm-based standard, requiring time-consuming public notice-and-comment procedures required under the Administrative Procedures Act.

Technology Innovation and Diffusion

Promotes criterion: Harm-based standards allow sources to use innovative compliance approaches.

Impairs criterion: Harm-based standards may be relatively less effective at technology diffusion, since they do not refer to particular technologies.

SOURCE Off Ice of Technology Assessment, 1995.

resent a middle ground between technology specifications and harm-based standards with respect to the freedom a regulated entity has to expand the list of acceptable equipment or techniques.

Design standards typically are more dynamic than technology specifications. Technologies and emission limits associated with each design standard can change as the state of technology advances. Limits to be met using a "best available control technology" might become stricter as new, more effective technologies become available. Typically, an individual source receiving a new permit would need to meet these new limits at the time its emissions permit is renewed and updated.

Extent of Use

Design standards are very widely used in the Clean Air Act and Clean Water Act, and to a more limited extent in the Resource Conservation and Recovery Act. The resulting "alphabet soup" of requirements at times seems impenetrable. The degree of abatement required of a source often varies depending on whether it is 1) a new or existing source, 2) in an area that meets or fails to meet ambient standards, and 3) emitting conventional or toxic pollutants. Design standards also vary in the extent to which an agency may take economics into account when identifying the model technology and setting the corresponding emissions limitation.

The Clean Water Act uses design standards to describe the baseline level of treatment to be met for all discharges—in effect, a national floor for pollution control.[6] EPA sets a design standard for each relevant industry category based on representative facilities within the category. These standards are to be updated by EPA every five years. Existing sources must use best conventional technology (BCT) to control conventional pollutants.[7] Existing sources of nonconventional[8] and toxic pollutants are required to use best available technology economically achievable (BAT). EPA will determine when setting BCT whether the relationship between control costs and water quality benefits is "reasonable,"[9] while the agency need only determine that BAT is "economically achievable."

New sources of any type of water pollutant must meet best available demonstrated control technology (BADCT), also called new source performance standards (NSPS). NSPS pollution limits can be based on available demonstrated technologies, but also upon alternative production processes, operating methods, in-plant control procedures, and other alternatives to an "end-of-the-pipe" focus. EPA need only "consider cost" when setting NSPS. No cost-reasonableness consideration is required. As a result, new sources subject to NSPS almost always must meet a stricter level of emissions control than existing sources. In exchange, the Clean Water Act provides that such sources are exempt for 10 years from additional design standard requirements for nontoxic pollution.[10]

Where BCT, BAT, or NSPS design standards are not sufficient to meet water quality goals on a particular stream, the Clean Water Act calls for a stricter harm-based standard set at a level sufficient to meet water quality goals.

[6] More stringent treatment may be required if necessary to achieve water quality standards, or if the state chooses to implement a more stringent program than the national baseline requirements.

[7] These include fecal coliform, pH, total suspended solids, biochemical oxygen demand (BOD), and oil and grease.

[8] Nonconventional pollutants are also called "gray area" pollutants and include nitrogen, nitrates, phosphorus, chlorine, fluoride, some metals, and some pesticides.

[9] EPA adopted a two-part approach to this "cost-reasonableness" test. First, costs should be roughly similar to those imposed on publicly owned treatment works (POTWs). Second, costs should be analyzed in light of resulting water quality benefit. EPA's first effort at developing BCT regulations was reversed because the Agency did not sufficiently consider cost-effectiveness.

[10] The exemption is for 10 years, or until the facility is fully depreciated, whichever occurs first. Clean Water Act §306(d).

The Clean Air Act and implementing agencies rely heavily on design standards to meet ambient air quality goals. Existing major sources must meet reasonably available control technology (RACT) in areas that fail to meet ambient air quality standards. RACT acts as a national minimum level of control in nonattainment areas and is usually defined as the lowest emissions limitation that a source is capable of meeting by using a control technology that is reasonably available, considering technological and economic feasibility. In contrast, *new* sources in these "nonattainment" areas must adopt control technologies that achieve the lowest achievable emissions rate (LAER). LAER is often much stricter than RACT. LAER is to be based on the most stringent emissions limitation contained in any state implementation plan or achieved in practice by the same or similar source category, whichever is more stringent.

Sources in areas that already meet ambient air quality goals are subject to design standards under the Clean Air Act. For example, new sources in areas that meet ambient standards must install best available control technology (BACT), often a stricter level of control than required under RACT but less than LAER.

Sources of air toxics must meet an emissions limit comparable to that resulting from use of the maximum achievable control technology. MACT is based on the best technology currently available for the source category in question and must be at least as stringent as the level achieved in practice by the best controlled source in the source category (for new sources), or for the best performing group of sources (for existing sources).

RCRA also incorporates some design standards in its waste management requirements. For example, EPA uses best demonstrated available technology (BDAT) to describe the class of treatment technologies that must be used before a hazardous waste may be disposed on land. The Agency developed a BDAT treatment requirement for each group of wastes with similar physical and chemical properties and sought to base the requirements on technologies that furthered waste minimization and recycling.[11]

Key Criteria Affecting Tool Selection

Assurance of meeting goals

Design standards require a specified level of pollution control from each individual regulated entity. As such, design standards help ensure that *pollution reduction* goals are met, but cannot guarantee that *environmental quality* goals will be met. Design standards are less analytically complex and data intensive than harm-based standards and typically have been implemented at a faster rate. Their relative ease of implementation means that *some* level of control will be in place faster than is likely under harm-based standards. Similarly, some authors have argued that this form of regulatory system is less complex and therefore has a greater chance of success than market-based approaches (95).

Critics of design standards point out, however, that design standards very indirectly assure attainment of a risk-based goal. In places that do not currently meet environmental goals, design standards move things in the right direction by ensuring that those polluters that have not yet installed the required level of technology do so or adopt an alternative strategy that meets required emission limitations. This general movement will not necessarily ensure that a risk goal is achieved. First, existing technologies may not be capable of reducing discharges from a single source to the level necessary to achieve pollutant concentrations in the receiving media that meet the risk goals.

Second, even if a single plant's compliance with a design standard is capable of meeting the goal, the design standard approach does not prevent neighboring sources from discharging the

[11] EPA may select a technology that furthers waste minimization and recycling over more conventional treatment if the disparity in performance of the technologies is not too pronounced, and the technology selected minimizes threats to human health and the environment by substantially diminishing waste toxicity and reducing mobility of toxic constituents. 55 FR 22520, 22535 (June 1, 1990)(Third-Third final rule).

same pollutant. The cumulative effect of discharges from two or more facilities, all of which meet prescribed design standards, can be a concentration of pollutants that violates the risk-based goal. This characteristic weakness of a design standard is often shored up by combining it with a harm-based standard that takes effect if the design standard fails to attain the goal.

Pollution prevention

The effect of design standards on pollution prevention is ambiguous. Design standards typically are based on an end-of-the-pipe approach, and sources have an incentive to adopt the model technology that is familiar to the regulatory agency. However, design standards do offer an opportunity for a regulated entity to propose an alternative to the model technology or approach. Thus, if "moving up the pipe" and preventing pollution appears to be the least expensive way of achieving compliance, sources are free to do so.

A design standard can either promote or discourage the use of pollution prevention, depending on what approach was considered the model for calculating emissions. If the standard is based on an end-of-the-pipe technological solution, the instrument could act as a disincentive for pollution prevention. However, a design standard could base emission limits on particular pollution prevention measures, thereby encouraging pollution prevention. In practice, even when EPA wishes to establish a preference for pollution prevention, the signals might be mixed. For example, EPA prefers to base BDAT requirements for treating hazardous wastes on technologies that further the statutory goals of waste minimization and recycling.[12] Some pollution prevention specialists suspect the BDAT focus on technologies for minimizing waste fails to create a preference for preventing pollution in the first place.

Demands on government

Agency resources required to establish and revise a design standard are likely to vary, depending on how much is known regarding the targeted industry and its processes and pollutants. An agency would need to delineate appropriate target groups and subgroups, identify the appropriate model technology or strategy—"best," "conventional," "reasonable," or whatever the statute called for—and determine the emissions control levels associated with that technology or strategy. As with all regulatory approaches, an agency must be prepared to justify its determinations, both in court and to oversight agencies such as the Office of Management and Budget.

These analytical and data requirements typically are less than for a harm-based standard. EPA has found it easier to delineate appropriate target groups and model technologies than to determine the appropriate level of a harm-based standard. Data on facility characteristics, wastestreams, and plant processes are more readily available than pollutant effects data. Also, identifying the relevant "best," "reasonable," or other legislatively mandated model technology typically is easier than determining a "safe" level for a pollutant.

Again, the air toxics program under the Clean Air Act shows that design standards are easier for an agency to implement than harm-based standards. In the five years since the air toxics program has been based on a design standard, EPA has promulgated 10 regulations affecting 55 industrial toxic source categories and has proposed an additional 14 regulations for 16 industrial categories (5). During the previous 20 years, when a harm-based standard applied, EPA was able to issue only seven standards.

It is important to note that design standards still require significant agency resources to set and implement, even though they are more manageable

[12] EPA may select this type of technology as BDAT over more conventional treatment if the disparity in performance of the technologies is not too pronounced, and the technology selected minimizes threats to human health and the environment by substantially diminishing waste toxicity and reducing mobility of toxic constituents. 55 FR 22520, 22536 (June 1, 1990).

than harm-based standards. EPA recently estimated that it "traditionally takes about four years to develop national technology-based standards such as [air toxics] standards" (216). EPA recently proposed a streamlined approach to setting MACT control levels for air toxics to help reduce resources needed to set design standards.

Adaptability

A design standard accommodates technological development, but on a limited scale. If an agency decides to adopt a new technology as a replacement model technology, it must recalculate the corresponding emissions limitation. Such reformulation might occur if a new control technology becomes more effective or an existing one significantly less expensive. For example, under the Clean Water Act, EPA is required to review its design standards at least every five years and revise if appropriate (243). Revision would be subject to public notice and comment procedures, as required under the Administrative Procedures Act.

Technology Specifications

A technology specification is a requirement expressed in terms of specific equipment or techniques. The requirement is to be met individually by all regulated entities. Facilities are not free to choose their means of pollution abatement or prevention. Compliance focuses on whether or not the specified approach is in place and operating according to specifications—regardless of whether the approach is a particular control technology or a series of actions or techniques. Compliance does not depend on meeting a specified ambient environmental quality.[13]

At the permit level, technology specifications are expressed as a technology required in order to be in compliance with a permit, while harm-based standards and design standards would be represented by a numerical limit. Design standards provide greater freedom for a regulated entity to expand the list of acceptable compliance equipment or techniques. Harm-based standards leave regulated entities free to select their own compliance approach.

Differences between technology specifications and design standards are sometimes confusing and misunderstood. One source of confusion is the important distinction between a technology specification and "technology based." A technology specification actually requires regulated entities to use the stated technology, while "technology based" simply indicates the origin of the emissions limitation without requiring the model technology used to set the limitation. Many design standards are technology based.[14]

A second source of confusion is caused by *de facto* technology specifications. De facto technology specifications might exist in at least three circumstances. First, a de facto technology specification is created when the legislature or regulatory agency setting up a design standard fails to describe what parameters of a proposed technology must be "equivalent" to the model technology. This results in regulated entities' having no practical way to demonstrate equivalency of any alternatives to the model technology. Defacto technology specifications also might occur when only one technology is available to meet the standard even though it is not specified, or when an entity decides the technology used to develop a design standard is the safest and quickest compliance approach. Note, however, that in each of these circumstances firms still have flexibility to develop a new technology or to propose a technology different from that used to develop an emissions level.

[13] As a result, discharge or ambient monitoring is not necessary under a "pure" technology specification, unless necessary to determine the technology is being operated according to specifications.

[14] "Technology based" essentially indicates use of an abatement-based strategy and does not specify an instrument per se. For example, the emission limits imposed through tradeable permits or integrated permitting could be technology based.

BOX 3-2: Debates About Design Standards

Assurance of Meeting Goals

Promotes criterion: Design standards establish a less complex regulatory system than multi-source tools, and so are more likely to work as desired. They allow an agency to determine compliance by monitoring whether the model technology is used, rather than monitoring emissions directly.

Impairs criterion: Pollution control levels achievable by identified model technologies may not be stringent enough to achieve environmental goals. Design standards do not address cumulative effects of discharges from multiple sources.

Pollution Prevention

Promotes criterion: Design standards can create a preference for pollution prevention, if desired.

Impairs criterion: Design standards can inhibit pollution prevention efforts, if the agency picks an end-of-the-pipe technology as its model technology.

Environmental Equity and Justice

Promotes criterion; Design standards offer communities input into the standard-setting process.

Impairs criterion: Design standards do not address "hot spots, " or differential impacts on communities.

Cost-Effectiveness and Fairness to Sources

Promotes criterion: Entities are free to propose an equivalent, more cost-effective pollution control approach. Design standards are fair because they impose similar requirements on similar facilities.

Impairs criterion: Design standards may not be cost effective because they do not consider differences in cost across facilities. They can be unfair because they often differ across industries.

Demands on Government

Promotes criterion: Analytical requirements for setting design standards are less demanding than harm-based standards.

Impairs criterion: Design standards still require substantial analytical and data resources.

Adaptability

Promotes criterion: Entities are free to propose a new technology, if equivalent to the model technology.

Impairs criterion: If an agency adopts a new technology as the model technology, it must recalculate the corresponding emission limitations. Design standards are subject to time-consuming public notice-and-comment procedures required under the Administrative Procedures Act.

Technology Innovation and Diffusion

Promotes criterion: Design standards encourage suppliers of pollution control equipment to innovate, because the new technology might become the "model" technology and have an immediate market. Design standards promote diffusion of the "model" technology.

Impairs criterion: Regulated entities may use the existing model technology instead of innovating, because of the expense of proving a new approach is "equivalent." Regulated entities may feel disinclined to develop more effective control technology because it might cause tighter emission limits.

SOURCE. Off Ice of Technology Assessment, 1995.

Extent of Use

Explicit technology specifications appear to be rare. OTA was unable to identify any examples of their use to solve environmental problems.

The rarity might be explained by a reluctance of legislators and regulators to create a technological straightjacket on entities, which in most situations would not allow for technological improvements now or in the future. Some commenters argue that technology specifications might be desirable where the need for environmental control is strong and immediate, where a demonstrated compliance technology is at hand, and where administrative ease and enforceability are principal concerns. The instrument might also be useful where a small number of sources, or a single source, are responsible for an environmental problem.

De facto technology specifications exist, but data is lacking on how often they occur. Industry representatives assert they are far more common than necessary. Many critics of the current environmental regulatory structure assert that requirements are often de facto technology specifications, even if expressed using other instruments.

Key Criteria Affecting Tool Selection

Assurance of meeting goals

Defacto technology specifications offer a higher level of assurance than many other regulatory instruments because of their ease of enforcement. An inspector would need only to determine that the specified technology or technique is in place and operated appropriately. However, like design standards, technology specifications can only ensure that environmental quality goals are met if the standard is set appropriately.

Establishing a technology specification as part of a technology-based strategy would be analytically similar to design standards. Use of technology specifications for risk-based strategies offers a greater opportunity for a mistake, because the agency needs to identify the technology or techniques associated with a particular level of emissions.

Pollution prevention

A technology specification can either emphatically promote or discourage the use of pollution prevention, depending on what approach has been specified. If the requirement calls for an end-of-the-pipe technological solution, the instrument is a strong disincentive for pollution prevention. However, if the requirement specifies particular pollution prevention measures that must be taken in order to be in compliance, the instrument strongly encourages pollution prevention.

Cost-effectiveness and fairness

Technology specifications, in theory, are unlikely to achieve a cost-effective level of pollution control. They do not allow entities to substitute for the specified technology or approach a cheaper or more effective way to control emissions. Economic theory predicts that this lack of flexibility will inhibit achievement of a cost-effective control solution.

A technology specification might be viewed as fair because it imposes a uniform requirement on all entities. However, the application of such standards in an arena where entities have been previously regulated, or in other ways differ considerably, might achieve unfair results.

Adaptability

Technology specifications define compliance as using a specific technology. Rulemaking is required, therefore, if someone wants the standard to adapt to changing circumstances. Because explicit technology specifications are rarely if ever used, their adaptability to change is purely theoretical. De facto technology specifications are more commonly used, but data on their adaptability are limited and largely anecdotal.

Development of new control technologies does not require a technology specification to be changed, unless additional reasons for change exist. An agency could in theory continue to require the preexisting technology. However, the agency might conclude it must reformulate the technology specification if cost or control efficiencies of the new technology make it unreasonable to continue to require the old technology.

Similar to design standards, new scientific information might encourage reformulation of a technology specification if new information indicates underlying goals are unmet by the existing standard, but would not require it.

Product Bans and Limitations

This regulatory instrument bans or restricts manufacture, distribution, use, or disposal of substances that present unreasonable risks to health or the environment. Product bans and limitations focus on the commodity itself rather than on polluting byproducts from its manufacturing. As a result, they are used primarily where the hazard is the commodity.

Some products that provide societal benefits also cause environmental harm. Asbestos is a nonflammable substance used as heat and sound insulation in buildings and many products. The benefits of pesticides and other economic poisons have done much to prevent crop infestations, choking weeds, noxious animals, and disease. At the same time, however, there has been a growing awareness that these benefits are not without hazards, and that the products may be harmful to humans and the balance of nature. Product bans and limitations typically seek to balance benefits and costs of these products. A product ban may be appropriate where product use is intrinsically sufficiently damaging that zero use is a desirable outcome.

Product bans and limitations may be imposed prior to the product's sale and use in commerce, or after the product has been used and its harmful effects are observed. Premarket product approval systems seek to prevent excessively risky products from reaching the marketplace at all. Under product approval systems, a government regulatory agency reviews the effects of the new product before it is marketed, ultimately approving it or disapproving it for commercial introduction or placing limitations on its use that are designed to bring product risks to an acceptable level. The burden of producing information and of persuading regulators of product safety usually rests with the proponent of the new product.

Extent of Use

Because some products that provide societal benefits also cause environmental harm, Congress has enacted statutes empowering regulatory agencies to halt or otherwise restrict the manufacture, distribution, and use of such products (165). The policy approach has been used under the Clean Air Act and more widely adopted in other statutes for control of pesticides and chemicals.

The Clean Air Act Amendments of 1990 addressed the problem of stratospheric ozone depletion by establishing a program that gradually introduced a ban on use of ozone- depleting substances (240). The statute established initial lists of substances that were to be phased out, grouped as Class I[15] and Class II substances.[16] EPA is directed to list additional substances as necessary. The statute begins reducing allowable production of these substances in 1991 and imposes outright bans a number of years later. For example, production of Class I substances begins to phase out in 1991, and as of 2000 production of all Class I substances is prohibited.[17] Class II substances are prohibited after 2030.

The chlorofluorocarbons (CFC) phaseout and ban is an illustration of how policy instruments might be combined to limit undesirable effects. During the phase-in period of the ban, the statute establishes a pollution charge based on tonnage produced and weighted by the harmfulness of each chemical. In addition, the statute directs EPA to establish transferable "allowances" for the production and use of the Class I and II substances.

[15] Class I substances include chlorofluorocarbons, halons, carbon tetrachloride, and methyl chloroform.

[16] Class II substances include hydrochlorofluorocarbons.

[17] The ban on methyl chloroform takes effect in 2002.

BOX 3-3: Debates About Technology Specifications

Assurance of Meeting Goals

Promotes criterion: Technology specifications are relatively easy to administer and monitor, and so are less likely to fail than other tools.

Impairs criterion: The specified technology may not be adequate to meet goals.

Pollution Prevention

Promotes criterion: A technology specification can promote pollution prevention if it specifies pollution prevention measures.

Impairs criterion: A technology specification that specifies an end-of-the-pipe technology approach discourages pollution prevention,

Environmental Equity and Justice

Promotes criterion: Technology specifications are fair because they impose uniform requirements on all entities.

Impairs criterion: The lack of flexibility available under a technology specification makes cost-effective pollution abatement unlikely. Technology specifications can be unfair because they do not take into account differences among entities' prior control behavior or equipment.

Cost-Effectiveness and Fairness to Sources

Promotes criterion: Monitoring compliance with technology specifications is relatively easy.

Impairs criterion: Technology specifications limit choice and thus can be expensive,

Demands on Government

Promotes criterion: Monitoring compliance with technology specifications is relatively easy.

Impairs criterion: Technology specifications can be administratively difficult to establish because of the need to identify a technology that can achieve goals.

Adaptability

Promotes criterion: Development of new technologies does not require the agency to change a technology specification, unless the new technology clearly is superior.

Impairs criterion: A new or altered technology specification would be subject to time-consuming public notice-and-comment procedures required under the Administrative Procedures Act.

Technology Innovation and Diffusion

Promotes criterion: Technology specifications cause wide dissemination of the specified environmentally beneficial technology or approach.

Impairs criterion: Technology specifications discourage innovation in pollution control and prevention.

SOURCE: Office of Technology Assessment, 1995

Presumably the pollution charge is intended to encourage more rapid shift from use of CFCs, and trading is provided to soften the economic impacts of a ban. The phase-in of the ban has occurred more rapidly than expected. For example, by the end of 1992, CFC production was less than 50 percent of 1986 production levels, when those levels were viewed as very difficult to achieve prior to 1999 (193).

A ban was used to address the adverse health effects from airborne lead emitted by gasoline-powered automobiles. The lead ban was implemented gradually over several years. EPA began lowering the allowable lead in gasoline as early as 1973, although the phaseout of leaded gasoline began in earnest in 1985. EPA established a limit of 1.1 grams per gallon for the content of leaded gasoline beginning in July 1985 and 0.1 grams per gallon after January 1, 1986 (265,266). This aggressive phase-down schedule was combined with an EPA program allowing trading in lead credits among refiners. The Clean Air Act Amendments of 1990 prohibit the use of any gasoline which contains lead or lead additives after 1995 (238).

Key Criteria Affecting Tool Selection

Assurance of meeting goals

Product bans or limitations can be an effective way of achieving risk-based goals for the immediate consumers of the product. If the product poses unacceptable risks to consumers, the agency can prohibit its sale, distribution, and use and thereby eliminate those risks. Or, an agency can place limitations on the sale, distribution, and use of the product sufficient to reduce those risks to acceptable levels.

The degree of assurance provided by a product ban or limitation depends on availability—now or in the near future—of safer alternative products. An agency cannot be certain that substitute products will not have their own environmental problems. For example, the ban on lead paint has led to use of alternative rust-inhibiting coatings for steel that may involve other metals, such as chromium, that can have deleterious effects on human health.

Product bans or limitations historically have been used "when the cows are already out of the barn"—after the products are well-distributed through commerce and already causing environmental problems. Banning or limiting polychlorinated biphenyls (PCBs) in transformers does little to reduce the risk posed by the PCBs that have already drained from discarded transformers. In such cases, abatement programs are necessary to address risks posed by past use of products. An example is the asbestos abatement program that Congress established for schools (203).

Pollution prevention

Product bans and limitations can lead to pollution prevention, by preventing products with adverse environmental effects from being manufactured and used.

Cost-effectiveness and fairness

No empirical data, and almost no technical economic literature, explores the cost-effectiveness of product bans and limitations as a tool to reach human health and environmental goals.

Theory would imply that, to be cost-effective, the ban or limitation must be well-tailored to the situation. A ban is best used where all uses of a product pose unacceptable risks. A ban might be overly broad if some product uses did not pose those risks, suggesting that product limitations might be more appropriate in those circumstances. For example, a complete ban on lead paint as a means to protect children from ingesting lead-laden paint chips might be overly broad if there are uses extremely unlikely to give children access to the lead paint, such as shipboard and other outdoor uses of red lead as a rust inhibitor. A selective ban or product use limitation might achieve the objective of preventing children's exposure to lead. An agency rarely has the analytical resources to set up such a cost-effective ban or the enforcement resources to prevent unauthorized uses.

Adaptability

Product bans or limitations require time-consuming proceedings if scientific developments or new political priorities indicate that more or less regulation is appropriate. Rulemaking procedures would be necessary if the constraint were imposed by regulation. If the constraint were imposed by legislation, such as the CFC ban in the Clean Air Act, Congressional action would be required for significant programmatic change.

Technology innovation and diffusion

In markets in which no substitutes are available, the product ban or limitation has the potential to induce technological innovation by stimulating rapid research aimed at products that are capable of filling the void left by the limited ban or product. This form of "radical technology forcing" takes a leap of faith on the part of the regulatory agency. For example, when EPA initiated cancellation proceedings against the pesticide mirex, its manufacturer argued that 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 to cancel. In phasing out mirex use, EPA assumed that other companies would develop new alternative fire ant killers to replace mirex. Four substitutes did in fact become available before the end of the phaseout period (117).

The fact that a product ban results in rapid development of alternatives in one context, however, does not necessarily guarantee that a similar result will occur in all contexts. Banning a proposed product or technology at the pre-marketing approval stage could result in deeper entrenchment of an old product or technology. Using bans or limitations to induce innovation may not work as well for environmental problems with complex causes, and may be too risky to employ in contexts in which the consequences of the failure to inspire technological innovation are very high. The approach seems best suited for the converse situation in which the risks of doing nothing are high.

Integrated Permitting

Environmental laws make extensive use of permits. Permits make individual sources[18] subject to general statutory requirements. In many instances, entities may not legally emit pollutants other than in compliance with a permit. Monitoring and reporting requirements often are imposed through permits. Pollution control or other requirements might be expressed using a variety of different policy instruments, including technology specifications, harm-based standards, tradeable emissions, and other instruments discussed in this assessment.

Concern about multimedia effects and potential burdens of the permitting process has led EPA and many state agencies to consider making changes in the way permits are issued. Often called "consolidated permitting," these permitting approaches can be divided into two groups based on their principal purposes: 1) streamlined permitting, and 2) integrated permitting.

Streamlined permitting is used by many agencies to make the administrative process less burdensome by providing permit coordinators, "one-stop permit shopping," and similar measures to lessen time delays and paperwork. With integrated permitting—far less common of the two—the government considers comprehensive environmental impacts when making decisions regarding emission limits for an individual permit.

Integrated permitting can take two approaches: 1) single medium, and 2) facility-wide cross-media. Agencies have used integrated permits to combine all sources of pollution to a particular medium, rather than having a permit for each individual emissions point at a facility. A facility-wide permit might list emission limits for each source within the facility. Or, a facility-wide permit might list a single limit per pollutant for the

[18] The definition of "source" varies from regulation to regulation. It may connote an entire facility, or a single pipe or smokestack.

BOX 3-4: Debates About Product Bans and Limitations

Assurance of Meeting Goals

Promotes criterion: Product bans or limitations remove excessively risky products from the market, or prohibit use of the product in risky situations. They can be implemented very quickly, in a perceived emergency.

Impairs criterion: There is no guarantee that a less risky product will be developed as a substitute.

Pollution Prevention

Promotes *criterion:* Bans or limitations can in effect require pollution prevention, by preventing products with adverse environmental effects from being manufactured and used.

Environmental Equity and Justice

Promotes criterion: Bans and limitations place constraints on the distribution and use of excessively risky products, that apply uniformly among communities.

Impairs criterion: Product bans and limitations do little to remediate problems created by prior use of risky products.

Cost-Effectiveness and Fairness to Sources

Promotes criterion: Product bans or limitations are fair, when applied uniformly.

Impairs criterion: Bans and limitations can be expensive if applied more broadly than the risk posed. Pre-manufacturing review is unfair, since it subjects new products to stricter standards than existing products (which are re-reviewed only sporadically).

Demands on Government

Impairs criterion: Administrative resources to analyze data in support of a product ban or limitation can be very large, because of the draconian nature of the tool. This approach requires a credible enforcement presence to be effective, which in the case of tailored bans or limitations will need significant administrative resources.

Adaptability

Impairs criterion: An altered product ban or limitation would be subject to time-consuming public notice-and-comment procedures required under the Administrative Procedures Act.

Technology Innovation and Diffusion

Promotes criterion: Product bans and limitations can spur rapid innovation, by highlighting a market in need of substitutes for the affected product.

Impairs criterion: Banning or limiting a product at the pre-market stage can further entrench existing products.

SOURCE. Office of Technology Assessment, 1995.

entire facility, creating a bubble-like performance standard that requires the facility to meet an overall emissions cap through any combination of controls. Unlike EPA's current Bubble Policy, which effectively freezes an initial reallocation of control responsibilities among sources (267), an integrated permit might allow flexibility to alter on an ongoing basis the mix of control levels for sources within a facility.

Another form of integrated permitting combines limitations on emissions to air, water, and land in a single permit, taking into account the potential at a facility for pollution to move between media. This multimedia type of integrated permitting may allow an agency to trade off reliance among policy approaches, if emission limits in the different media use different instruments.

Table 3-3 illustrates the wide variety of integrated and streamlined permitting approaches that have been described as elements of "consolidated permitting." Many permit reforms focus on lowering administrative burden for the regulatory agency and the permit applicant. Other permit reform efforts seek to improve both the administrative burden and adequacy and cost-effectiveness of environmental protection. This OTA assessment is focusing primarily on programs that pursue both goals.

The strengths and weaknesses of integrated permitting will depend in part on the specific design and implementation of the permit program, and in part on the instruments used to express the requirements the permits impose. As a result, integrated permits as a regulatory tool should always be considered from the perspective of the other instruments they incorporate.

Extent of Use

Integrated permitting has been used only on a limited scale, although it is not a new idea. In 1980, EPA consolidated permit procedures for several programs under the Clean Air Act, the Clean Water Act, the Resource Conservation and Recovery Act, and the Safe Drinking Water Act. The rule focused on streamlining measures, such as use of a single general permit application form, but also sought a "more comprehensive management and control" of pollution through "consolidation of permit requirements and processing procedures. . ." (262). This more integrated approach to permitting was fiercely resisted in some quarters, and the Agency abandoned the effort in the mid 1980s as part of its regulatory relief activities. In the Federal Register notice that repealed the consolidated permitting rule, EPA noted "[t]he fact that the various permit programs regulate inherently different activities and thus must impose generally different sorts of requirements has limited commonalties across permit programs" (264). The Agency felt that consolidated processing of multiple permits had been very rare.

Integrated permitting once again is receiving growing attention from states and EPA. Some states recently have begun to experiment with integrated permitting. For example, the 1991 New Jersey Pollution Prevention Act establishes requirements for pollution prevention plans, and sets up a pilot program to integrate a wide array of environmental permits and approvals into a single permit. The legislation authorized up to 15 participants. As discussed in chapter 2, the state issued its first cross-media integrated permit in late 1994, to a pharmaceutical firm, and two other permits are in the final development stage.

New York has attempted to integrate some of its permitting activities for large industrial facilities, by setting up a 12-person permit team to examine cross-media transfers and explore pollution prevention opportunities. The Minnesota Pollution Control Agency has established a voluntary flexible permit program, that offers firms the option of obtaining a single, integrated facility-wide permit for all of its sources for a particular emission or for various emissions. The program is in early stages; the only integrated permit issued thus far is for a 3M tape manufacturing plant that emits volatile organic compounds (VOCs) into the air. The permit allows 3M to shift emission controls among the sources within its facility, so long as the aggregate VOC control levels are satisfied.

TABLE 3-3: The Varied Approaches To "Consolidated Permitting"

Permitting type	Permitting approach	Key element(s)	Example jurisdictions
Integrated	Multi-Media Permitting	Single permit incorporates all emissions from a facility to air, water, and land.	New Jersey (pilot)
Integrated	Facility-wide "bubble"	Single permit sets an aggregate emissions limit to one medium for the entire facility, allowing the facility to shift control responsibilities among individual sources at the facility.	Minnesota (pilot)
Integrated	Facility-wide permit specifying limits for each source.	Single permit incorporates emissions to one medium from every source at the facility, specifying a limit for each source.	Permits under EPA's "Bubble Policy"
Streamlined	One-Stop Permitting	Single office or person has final authority for all relevant permits.	Georgia, Kentucky, South Dakota
Streamlined	Permit Assistance Offices	Office or liaison available to provide information re: requirements, assist during permit process,	Indiana, California, Michigan, New York
Streamlined	Permit Coordinator	Single office or person has formal duty to coordinate specific project proposals. Have less authority than under one-stop system.	Michigan, Tennessee, Michigan
Streamlined	Permit Deadlines	Fixed deadlines for permit issuance or denial, often 60-90 days. Frequently, automatic permit issuance if deadline missed by agency.	Maine, Montana, North Carolina, New Jersey (common, roughly half the states have permit deadlines)
Streamlined	Permit Information	Efforts to coordinate information from various programs for prospective permit applicants, usually as guidebooks or brochures	California, New York (very common; virtually every state)

SOURCE Off Ice of Technology Assessment, 1995

Key Criteria Affecting Tool Selection

Assurance of meeting goals

Proponents of integrated permits argue that multimedia permits are necessary because present regulatory efforts to control pollutants in one environmental medium can result in merely transferring the pollutant to other environmental media (56,131). Others are skeptical that significant amounts of pollutants go unregulated. They note that with today's extensive environmental statutory structure, it is much more difficult for emissions to slip through the regulatory cracks (169).

Determining whether or not pollutants do indeed become unregulated by crossing environmental media is beyond the scope of this assessment. However, the extent of the cross-media problem has a strong effect on the degree to which integrated permits would improve assurance that environmental goals are met.

One common criticism of multimedia integrated permitting is the analytical complexity of modeling cross-media emissions and risks. The fear is that integrated permitting may create an elaborate shellgame that obscures pollution emissions that could have been more effectively regulated under traditional permitting. Ideally, accurate and adequate data would be available to weigh all facility inputs and outputs and consider all possible cross-media transfers. A 1990 EPA report on data requirements for integrated permitting found such data were lacking (80,149).

Integrated permits addressing releases to a single environmental medium are likely to require less sophisticated analysis. For single-medium integrated permits that establish fixed limits for each source, assurance is likely to be the same as the instrument used to express the requirement. For those single-medium permits that establish a plant-wide bubble, monitoring must be sufficient to track emissions of the pollutant from all sources. Lack of monitoring capability can discourage use of flexible plant-wide bubbles. For example, during early development of EPA's Bubble Policy, staff were concerned that monitoring capabilities were not sophisticated enough to track movement of emissions between multiple sources within a single facility (94). As a result, permits under the Bubble Policy specify limits for each source (267).

Minnesota has recently adopted an integrated air permit program that requires facilities to propose a method to ensure continuous compliance with each facility-wide emissions limit through monitoring or an equivalent tracking system (149). While an integrated permit need not be conditioned on continuous monitoring, the Minnesota program illustrates an approach designed to increase assurance environmental goals will be met.

Cost-effectiveness and fairness

Limited data is available on control cost savings from integrated permitting. Integrated permit programs with a single aggregate emissions limit for an entire facility would allow significant process and emissions flexibility which, in theory, a firm could use to help find a more cost-effective means to comply with requirements. Integrated permits issued under EPA's Bubble Policy include specific limits for each individual source within a facility and do not allow limits to "float" among sources. As of 1986, $132 million in reported cost savings were achieved by 20 firms through bubbles (72).

This flexibility can make integrated permits attractive to regulated entities. For example, one of the principal reasons 3M sought an integrated permit in Minnesota was to have the flexibility to change the mix of source controls used to meet requirements for VOC emissions control, without time-consuming agency approvals (149). Some forms of integrated permits include limits to all sources in one permit, but do not allow the facility to shift control responsibilities between sources. With this form of permit, control cost savings are strongly affected by the regulatory instruments incorporated into the permit and the terms of the permit itself.

Demands on government

A major issue with integrated permitting is the government administrative resources required to issue permits. Proponents say that integrated permitting can achieve administrative cost savings for both the regulatory agency and the permit holder, due to fewer permits and a less fragmented process. Others note that administrative costs might increase, because an integrated permit is typically much more complicated than a conventional permit and takes longer to evaluate. Experience to date is very limited but shows signs that to some degree each of these views might be correct, depending on whether the short-run or long-run timeframe is considered.

Some states have estimated that in its early stages an integrated permitting program can require substantial resources and delay. For example, the schedule for completing the first pilot multimedia permit in New Jersey allowed 12 to 24 months for input and review by both agency and applicant (149). The time period for issuing a conventional permit varies from around five months for a routine emissions permit under the Clean Water Act, six to 12 months for air permits, to up to three years for an interim RCRA permit and much longer for a final RCRA permit.

Whether these administrative costs of processing the integrated permit are greater than the aggregate costs of the multiple permits it is replacing is uncertain; the New Jersey permit was for a facility that previously had 897 permits just for air quality.[19] Minnesota similarly found that negotiating its first facility-wide permit was resource intensive. "We had to devote multiples of our normal resources for such a project," explained one official. "It involved more people, more research, more drafts, more visitation of site, and more everything" (149).

However, the long-term effect of integrated permitting on administrative burden is unclear. Both New Jersey and Minnesota state agencies attribute these extensive resource needs to the novelty of the integration process rather than a fundamental characteristic of integrated permits should they be used more widely. They felt that efficiencies are likely to increase (149). In addition, existing integrated permit programs seem also to incorporate elements of streamlined permitting, such as one-stop permitting and a permit coordinator. If included in the permit program, such provisions have the potential to cut down on duplicative effort and time delays.

Tradeable Emissions

Under tradeable emissions, the government first sets a level of aggregate emissions over a specified time period, consistent with environmental goals by issuing only the number of permits corresponding to that level. The total allowable emissions are then allocated to individual sources through government-issued permits. Unlike under conventional permit systems, however, each regulated entity can buy and sell permits from others. The entity might choose to do so if the relative costs of emissions control make it less expensive to buy (or profitable to sell) the permit to another entity. In theory, trading would continue until the cost of controlling yet another pound of pollution is the same for all entities and is equal to the cost of a permit. In practice, other factors strongly affect the amount and results of trading.

Not all trading systems are alike. For example, the level of government involvement in trading can be an important determinant of potential benefits and costs of a program. In some tradeable permit regimes, the government agency must preapprove transfers and determine whether the impact on the environment from the trade is equivalent or acceptable. In other regimes, entities are free to trade without government approval. Greater government involvement might increase the level of assurance that environmental goals will be met, but also could increase transaction costs and regulatory uncertainty and so discourage trading. Also, some programs allow only entities targeted by the regulation to trade emissions, while other programs allow unregulated sources to "opt into" the market voluntarily.

Trading systems may vary due to a variety of factors, including the nature of the pollutant being traded, and how and if the program incorporates an existing regulatory structure. For example, the

[19] New Jersey found the early stages more time- and resource-consuming than expected. The DEPE found it took three months to review the first application for a facility-wide permit, rather than the estimated 30 days.

BOX 3-5: Debates About Integrated Permitting

Assurance of Meeting Goals

Promotes criterion: Integrated permits can help highlight requirements from multiple statutes that might conflict or otherwise hinder compliance. Multimedia integrated permits can reduce currently unregulated pollutants moving between media.

Impairs criterion: An integrated permit has such enormous data and analytical requirements that the tool faces a higher likelihood of failing to meet goals than simpler approaches. This approach requires monitoring sophisticated enough to track emissions between multiple sources.

Pollution Prevention

Promotes criterion: Integrated permits encourage agencies and applicants to look closely closely at facility processes, which may give pollution prevention an advantage.

Environmental Equity and Justice

Promotes criterion: An integrated permit program enables citizens groups to have input into numerous permitting decisions during a single comment period and hearing. The agency can consider multiple exposures from different environmental media as it develops and implements an integrated permit.

Cost-Effectiveness and Fairness to Sources

Promotes criterion: Integrated permits can achieve cost-effective abatement at the facility level, if they specify aggregate limits for entire facility.

Impairs criterion: The technical analysis required in support of a permit application can be burdensome, and beyond the capabilities of some firms.

Demands on Government

Promotes criterion.' Integrated permits may result in administrative cost savings in the long-run, The permits make it easier to evaluate a facility's compliance record, and whether enforcement actions are advisable, by combining all requirements in a single permit,

Impairs criterion: Integrated permits are likely to require additional administrative resources, at least in the short-run, They require analytically complex technical analysis to develop.

Adaptability

Promotes criterion: Integrated permits readily accommodate change in technology or market conditions, if the permit incorporates performance-based source limits,

Impairs criterion: Integrated permits can make changes to reflect new circumstances both difficult and resource-intensive, because of the permits' increased complexity.

Technology Innovation and Diffusion

Promotes criterion: Integrated permits might cause agencies and facilities to identity better-integrated technological solutions to pollution control.

SOURCE Office of Technology Assessment, 1995.

size of the geographic area over which trades are allowed will vary between trading programs because of the type of pollutant being traded. Widely spreading pollutants such as CFCs, with adverse effects at low concentrations found at distant points, are likely to have larger markets than pollutants such as carbon monoxide, with adverse effects primarily on a small local area. The larger the geographic scope, the more potential participants there are and a greater likelihood of a flourishing market. However, geographic scope inappropriate to the type of pollutant could decrease the likelihood that environmental goals will be met.

Another key variant is the extent the trading program's design and implementation accommodates existing regulatory structures. Many economists propose and analyze a trading system with few or no restrictions on trading. Yet, existing trading systems often require all sources to meet a minimum level of pollution control and allow trading of emissions only above and beyond that point. The effect of this limitation is that some of the emissions control cost savings available in theory are unavailable in practice.

Because emissions trading programs differ in design and in results, purported advantages and disadvantages of the regulatory tool should be viewed in the context of underlying assumptions about program design.

Note also that many evaluations of emissions trading include bubbles and netting. These regulatory alternatives involve transfers of emissions control responsibilities among sources in a single facility and not between facilities. Bubbles and netting are therefore outside the definitional scope of trading as used in this assessment and are considered as a form of integrated permit. However, discussions regarding cost-savings estimates and other potential program effects of trading often include bubbles and netting.

Extent of Use

Emissions trading has been extensively discussed in academic and applied literature, incorporated into environmental programs occasionally but with increasing frequency, and less often actually used by target entities. Empirical data is limited regarding the extent and effects of trading.

Emissions trading is most widely used under the Clean Air Act. The 1990 Clean Air Act Amendments broadly encourage the use of market-based approaches, including tradeable emissions. For example, states are authorized to use economic incentives as part of their air quality plans (232), the oxygenated fuels provisions allow trading of fuel characteristics, and chlorofluorocarbon provisions allow transfer of production allowances.[20] These programs are in their early stages, and so it is difficult to say how frequent trading is likely to be.

The 1990 Amendments also established the largest-scale tradeable emissions program to date, the acid rain program. The program seeks to impose a national cap on SO_2 emissions of 8.95 million tons. Utilities are issued tradeable allowances, with each allowance authorizing a source to emit one ton of SO_2 during or after a specified calendar year. To be in compliance, sources must have at least as many allowances as tons of SO_2 emitted. The first phase of reductions began in January 1995 for the highest-emitting utility units. The Chicago Board of Trade has held two allowance auctions, and utilities and other sources have announced a few dozen private trades (229). Generally, however, the level of trading activity has been lower than expected, though it is still too early to judge.

While the acid rain program was the first statutory environmental trading program, emissions trading actually first was proposed 14 years earlier

[20] EPA issued a temporary final rule pursuant to these provisions that permits transfer of CFC allowances among firms. 56 FR 49548 (Sept. 30, 1991) and 56 FR. 67368 (Dec. 30, 1991).

as an instrument for achieving air quality goals. EPA's 1976 Emissions Offset Interpretive Ruling allowed major new firms to locate in areas not meeting air quality standards, provided they "offset" their emissions with emission reductions obtained from existing facilities in the area (267). Modified and expanded in 1986, the air emissions trading policy has been less widely used than expected. Firms purchased offsets from others approximately 200 times between 1976 and 1986, and found offsets within their own preexisting facilities an additional 1800 times (72). Data are sketchy regarding trading since 1986.

Emissions trading has been used to address a number of other air quality problems, as well. For example, EPA used trading as part of its program to phase lead out of gasoline by 1987, to help reduce compliance costs and balance burdens between small and larger refineries (263,265,266). Telluride, Colorado, uses tradeable permits for fireplaces and wood stoves as a way to reduce particulate matter (29). Spokane, Washington, is implementing a program of tradeable grass burning permits to attain and maintain compliance with particulate matter standards (182).

The Regional Clean Air Incentives Market (RECLAIM) relies on trading to achieve cost-effective air emissions reduction in the South Coast Air Quality Management District (SCAQMD) of southern California. RECLAIM establishes an emissions trading market for stationary sources within the jurisdiction of SCAQMD that emit four tons or more of nitrogen oxides (NO_x) or sulfur dioxides (SO_2) per year.[21] Participating sources receive a permit that establishes regulatory obligations and includes an annual allocation of Regional Trading Credits (RTCs). An RTC represents one pound of either SO_2 or NO_x emissions and is a tradeable commodity available for sale or use within the year of its creation. Facilities must hold enough RTCs to cover their actual emissions. When initially implemented in January 1994, sources participating in RECLAIM included 41 SO_2 facilities representing approximately 85 percent of reported SO_2 stationary source emissions, and 390 NO_x facilities representing about 65 percent of permitted sources of NO_x (180). The program is designed to require emission reductions by 8.3 percent per year for NO_x and 8.6 percent for SO_2 from 1994 through 2003. SCAQMD estimates that the cost of emission reductions with RECLAIM would be one-quarter to one-third less than nontrading alternatives (181). RECLAIM is discussed further in chapter 2 of this assessment.

EPA and some states have considered emissions trading as a possible approach under the Clean Water Act, although the statute does not explicitly address such market-based approaches. Wisconsin established a program in 1981 that allowed trading of biochemical oxygen demand (BOD) between pulp-and-paper mills (38,275). The Wisconsin trading provisions have not been used. EPA worked closely with Colorado to demonstrate trading between point and nonpoint sources of phosphorus at Dillon Reservoir and Cherry Creek, Colorado. North Carolina has adopted a similar approach at Tar-Pamlico River Basin to control nutrients. These programs have not been widely used, but are expected to act as a safety valve as control requirements become more stringent (10).

Neither EPA nor the states appear to have used trading as an instrument to achieve goals under the Resource Conservation and Recovery Act. Most academic discussions of market incentives and waste management focus on pollution charges rather than trading.

Although regulatory agencies are adopting an increasing number of emissions trading programs, actual use of the programs by target entities has thus far been less than expected. Several factors may have contributed to the limited number of trades. For example, the trading program it-

[21] Separate trading markets exist for NO_x and SO_2. A volatile organic compound (VOC) market is in development and scheduled for adoption by fall, 1995.

self may limit trading. Limitations may arise from the existing regulatory structure, such as requirements that all sources meet a minimum level of control or that no permit control requirements be relaxed. Limitations may also stem from the trading program's design, which might geographically limit the market or specify that control cost savings alone are insufficient justification for a trade.[22] Another factor that may have helped to limit trading is the lack of clear property rights in traded emissions. Regulated entities might be discouraged from investing in additional controls or credits when the government may change the program at any time with no compensation for the lost traded emissions.[23] A third factor could be that the difference in control costs between facilities is less than originally estimated, thus reducing financial incentives to trade. Finally, transaction costs may discourage trading, including costs incurred to identify a willing buyer or seller and obtain any necessary government approvals.

Key Criteria Affecting Tool Selection

Assurance of meeting goals

One of the most hotly debated issues about emissions trading is whether the approach will achieve environmental goals. In theory, an emissions trading program should achieve environmental goals because the program places a cap on the total amount of permitted emissions, with the cap consistent with the goal. In practice, the environmental effects of trading are more complicated.

Trading increases the complexity of emissions monitoring, because of interfacility emission exchanges. To provide adequate assurance that environmental goals are being met, agencies must have adequate monitoring capability to track compliance with a trading program's multisource limits.

Trading programs may retain emissions that would otherwise be eliminated. For example, under some emissions trading programs, firms that are closing a facility may sell its emissions rather than retiring the emission reduction and creating a benefit to the environment. With trading, individual entities are not required to control pollution to the best of their abilities. Finally, compliance responsibilities of individual facilities may be more difficult to determine if a central register of emission permits and trading is not carefully designed.

Proponents of emissions trading note that, in some circumstances, trading may be the only method for achieving environmental goals. Where the remaining contamination problems stem largely from unregulated sources, trading offers an incentive for a regulated source to accept responsibility for controlling these sources in exchange for emissions control credit at its own facility. Also, many trading programs require a greater than 1:1 ratio between emission reductions and emission increases. While such trading ratios are typically adopted as a safety margin for environmental quality, potentially compensating for imperfect models and other uncertainties and not as a means to reduce emissions, such ratios could potentially have that effect.

Experience with trading programs indicates that trading may improve an agency's ability to determine compliance and environmental progress because requirements for increased monitoring have often been coupled with a trading program. For example, the acid rain allowance trading program requires continuous emission monitors (CEMs) on most regulated sources. However, it is important to note that the policy de-

[22] For example, the Wisconsin water discharge trading program does not allow trades solely to reduce treatment costs. Instead, dischargers are allowed to trade only if they are increasing production or are unable to meet current discharge limits using existing treatments. Wisconsin Stat. §212 (1981). See R.W. Hahn, "Economic Prescriptions for Environmental Problems: How the Patient Followed the Doctor's Orders," *Journal of Economic Perspectives* 3:95, spring 1989.

[23] For example, the acid rain trading program clearly states an allowance is not a property right, and Congress or EPA can change the terms of the program at any time. Clean Air Act, §403(f).

cision to require increased monitoring is independent of trading as a regulatory instrument.

Environmental equity and justice

The effect of emissions trading on environmental justice is speculative, at best, because little analysis has been done regarding trading's distributive impacts. Several public interest groups are concerned that emissions trading may result in an inequitable distribution of health risks and environmental contamination. These groups argue that the dirtiest companies, which tend to be located in poor and minority communities, will find it cheaper to purchase credits allowing them to maintain emission levels rather than to make the investment in emission reductions. At EPA hearings, environmental justice advocates have emphasized that "the money [from emissions trading] would go to Wall Street, the clean air would go to Westchester County and the pollution would go to East Saint Louis" (45). Some commenters argue that the only way to make trading programs environmentally just is to provide sufficient compensation to "victims of localized concentrations" (1), while others believe that adequate compensation is not always possible.

However, trading might result in exactly the opposite result: dirty sources in poor and minority neighborhoods would find emissions control cheaper than purchasing permits since their incremental control costs may be cheaper than cleaner sources. No evaluative data are available to indicate whether this actually occurs.

Some emissions trading programs attempt to address the problem of geographic inequities by requiring agency preapproval of all trades and conditioning approval on a finding that the trade will not adversely impact local air quality. For example, the air emissions trading program requires a greater than 1:1 emissions reduction, a showing of environmental equivalence, and a demonstration that the trade helps progress towards environmental goals (267). Trading programs also typically consider the nature of the pollutant being traded when setting geographic scope of the market. For example, the acid rain trading program places no geographic restrictions on trading, based on a conclusion that acid rain is a long-range transport problem rather than a local air quality issue.

Emissions trading may have a potentially adverse effect on a community's ability to shape environmental policy outcomes. Most environmental programs not incorporating trading provide an opportunity for public notice and comment on proposed permits, allowing a community to voice its views and potentially affect the terms of the permit. That voice could be lost if the distribution of emissions is allowed to shift according to market forces and not as the result of administrative processes. In theory, such communities are able to lower the magnitude of pollution by entering the market and purchasing emissions for retirement. The potential expense of such purchases may make this option to affect environmental outcomes unavailable.

Cost-effectiveness and fairness

One of the primary motivations for use of tradeable emissions is to achieve a given level of emissions control at the lowest cost. In theory, regulated entities should continue trading emission permits until their incremental costs of controlling pollution are the same, resulting in the lowest possible level of aggregate control costs. The magnitude of predicted savings depends on program design, treatment cost differentials across sources, the number of sources, the cost-effectiveness of the base case to which trading is compared, and other factors.

In practice, trading programs probably have not resulted in the cost savings that theory would predict. Most estimates of cost savings presume active trading until the economically efficient distribution of emissions control responsibilities is achieved. However, it appears that no program yet has had that level of trading, most have had limited trading, and some have had no trades at all. Thus savings estimates generally should be considered the likely upper bound of control cost savings from a particular trading program.

Even limited participation in a trading program might achieve a significant percentage of estimated cost savings if the program allows extreme results to be avoided. For example, trading might allow firms with very high relative incremental costs of control to meet emission requirements by the less expensive means of trading, rather than spending large sums to meet a uniform requirement with very little pollution reduced per dollar expended. In effect, much of the cost savings from trading might come from preventing very unwise actions rather than promoting clever, economically efficient ones.

Estimates made prior to program implementation often are the only indicators available as to cost savings from tradeable emissions programs. Actual cost savings data is lacking, in part due to an absence of program evaluation and because trading prices and control costs are often confidential (76). Table 3-4 illustrates cost savings from the most often-cited emissions trading programs. The table includes only actual programs and legislative proposals, not simulations of "ideal" trading programs. Note also that estimates for emissions trading include anticipated cost savings from bubbles and netting, which do not involve exchanges between facilities and so fall outside the definition of trading as discussed in this assessment.[24]

The fairness of emissions trading programs has received somewhat less discussion than its cost effects. Whether a trading program treats regulated entities fairly depends on such issues as initial allocation of emission credits, relative control costs imposed on different entities, and the rate of emissions reduction required for each entity.

The initial allocation of pollution control responsibilities will in large part determine whether emissions trading programs result in an equitable distribution among regulated entities. Trading will reallocate emissions among buyers and sellers, but the means of initial distribution must be decided by Congress or the regulating agency. The difficulty arises from the fact that large amounts of money potentially are at stake. The most commonly used initial allocation approach is a type of "grandfathering," in which tradeable emission permits are distributed according to some aspect of historical operations or emissions.

For example, Congress based the allocations of acid rain allowances on historical fuel use and sulfur content (196). RECLAIM allocated its emission credits based on "historic use" of each piece of NO_x- and SO_2-emitting equipment at a facility and subtracted the emission reductions necessary to comply with adopted rules. Grandfathering has the advantage of causing the least disruption to the status quo. Yet this approach might also be somewhat inequitable, as new entrants to the emissions market will have to pay for permits while grandfathered firms obtain them free. Other approaches to initially distribute emission allocations are possible, but have yet to be tried.

In theory, the method of initial allocation has no effect on the ultimate efficiency of the emissions trading program, so long as it does not create a monopoly by giving all emission permits to one firm.

Technology innovation and diffusion

One of the most often cited advantages of emissions trading is that it fosters technological innovation. Since emission reductions should be considered the equivalent of valuable and marketable emission permits, the incentives created by the trading program could stimulate innovation in the strategies and technologies used to reduce emissions. However, no actual data are available about the effects of tradeable emissions on technology innovation.

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[24] Bubbles and netting historically have been considered alongside emissions trading because they allow transfer of control requirements within a single facility. The 1986 Emissions Trading Policy Statement also discussed bubbles and netting. 51 FR. 43814 (Dec. 4, 1986).

TABLE 3-4: Potential Control Cost Savings From Existing Trading Programs And Legislative Proposals

Project name	Status of project	Nature of "data"	Control cost saving (compared to no trading)
Air emissions trading	In place; less use than expected	Retrospective estimation	$5.5-$12.5 billion since 1976a
Air acid rain trading	Early implementation; less use than expected	Prospective estimation	Between 40-45% ($.7-$1 billion) annually in SO_2 control[b]
RECLAIM	Early implementation	Prospective estimation	Between 25% and 33% lower in NO_x and SO_2 controls[c]
Lead phase-down in gasoline	Completed	Prospective estimation	Over $9.9 billion during 5-year program[d]
Wisconsin water trading program between point sources	In place; unused	Prospective and retrospective estimation	$6.8 million per year[e]; revised to $0 due to nonuse of program[f]
Dillon Reservoir point-nonpoint trading	In place; little used	Prospective estimation	51%9
Tar- Pamlico point-nonpoint trading	In place; unused	Prospective estimation	Between $188 and **$444** per kg nutrients controlled; 90%-75% in control costs[h]

[a] See A. Carlin, "The United States Experience With Economic Incentives to Control Environmental Pollution" (EPA Document No. EPA-230-R-92-0011 July 1992) at 5-14.
[b] 56 Fed, Reg. 63002, 63097 (Dec. 3, 1991).
[c] SCAQMD, "RECLAIM, Socioeconomic and Environmental Assessment," Final, v. Ill, p. 6-10, October 1993.
[d] S. Kerr, "The Operation of Tradeable Rights Markets: Empirical Evidence from the United States Lead Phasedown", paper presented at the AWMA Meeting "New Partnerships: Economic Incentives for Environmental Management", November 1993)
[e] O'Neill, David Moore and Joeres, "Transferable Discharge Permits and Economic Efficiency: The Fox River", 10 *Journal* Of *Environmental Economics and Management 346* (December 1983).
[f] Interview with E, David, Economist, Wisconsin Dept. Natural Resources, June 21, 1994.
[g] Apogee Research, "Incentive Analysis for Clean Water Act Reauthorization: Point Source/Nonpoint Source Trading for Nutrient Discharge Reductions" (Prepared for EPA Off Ice of Policy, Planning and Evaluation, April 1992) at 20.
[h] Apogee Research, "Incentive Analysts for Clean Water Act Reauthorization: Point Source/NonPoint Source Trading for Nutrient Discharge Reductions" (Prepared for EPA Office of Policy, Planning and Evaluation, April 1992) at 29.

SOURCE: Office of Technology Assessment, 1995.

Economic models have been used to predict the impact of tradeable emissions, and generally have found weaker links between trading and innovation than often asserted. One model showed no difference in incentive to innovate among tradeable emissions, pollution charges, and harm-based standards imposing similarly stringent standards (109). Another found that the incentive to innovate would vary from firm to firm, and that many firms would have less incentive to innovate under a tradeable emissions regime than under harm-based standards because they could buy their way around the need to reduce emissions (111).

Challenge Regulation

This policy instrument take its name from the fact that government *challenges* a group of sources to take the lead in designing and implementing a program for meeting environmental goals. Challenge regulation is distinguishable from other ap-

BOX 3-6: Debates About Tradeable Emissions

Assurance of Meeting Goals

Promotes Criterion: Trading can bring otherwise unregulated sources under control.

Impairs Criterion: Trading can result in "hot spots. " Noncompliance is hard to detect because of interfirm pollutant movement, unless monitoring is improved.

Pollution Prevention

Promotes Criterion: Trading can leave sources free to choose between control equipment or process changes for emission reductions,

Impairs Criterion: Trading tends to focus on reductions in releases more than on reductions in pollution generated,

Environmental Equity and Justice

Promotes Criterion; "Dirty" sources, which are often in poor/minority neighborhoods, are likely to find control cheaper than purchasing permits, since their incremental control costs may be lower than cleaner sources.

Impairs Criterion: Trading distributes emissions according to market forces, not by an open administrative process that allows community input, and might perpetuate an existing inequitable pollution distribution,

Cost-Effectiveness and Fairness to Sources

Promotes Criterion: Trading provides incentives for regulated entities to identify cheaper ways to control emissions beyond their own "target." Large cost savings might result from even limited use of trading, if entities with the worst ratio of cost to environmental benefit participate.

Impairs Criterion: Estimated cost savings assume a heavy volume of trading, which has not occurred in practice. "Grandfathering" as an initial permit allocation method can result in an inequitable distribution.

Demands on Government

Promotes Criterion: Trading reduces the need for government to identify control technologies.

Impairs Criterion: Agencies implementing trading have found increased workloads in the early stages of implementation.

Adaptability

Promotes Criterion: Trading allows entities to adopt a new technology, so long as it meets emission requirements. Agencies can change aggregate emissions by not reissuing expired permits or by issuing additional permits.

Impairs Criterion: Property rights raise questions about government's ability to adapt the number of permits to changing circumstances.

Technology Innovation and Diffusion

Promotes Criterion: Trading fosters innovation, because a potential to reduce emissions below any individual source's allocation has market value.

Impairs Criterion: Some economic models show trading is neutral or discourages innovation, because entities holding tradeable credits might not want their value diffused by new cheaper control technologies,

SOURCE: Office of Technology Assessment, 1995, proaches by its configuration of the following key elements:

- government establishes clear, measurable targets, either risk-based or technology-based, with a timetable for implementation;
- the targets are defined for multiple sources, usually at the industry sector or geographic level, rather than for individual facilities;
- these sources are given the collective responsibility for designing and implementing a program for meeting the targets; and
- government specifies a credible alternative program or sanction, which will be imposed should progress toward targets be unsatisfactory.

The shift in responsibility for program design and implementation—toward the sources themselves and away from government—is the truly distinguishing feature of challenge regulation. With this responsibility, the group of sources also accepts the costs and administrative burdens of developing a program that will be effective in meeting the targets. Challenge regulations are *not* voluntary.

For the sources, a challenge regulation functions like a "meta-performance standard" (104) for which a targeted group of sources has the flexibility to choose whatever means—not only technological, but institutional as well—they believe would be best for meeting the target. Although the sources may choose to adopt a familiar approach such as design standards, they may also come up with innovative or varied approaches, such as a trading program or a fee system to meet the established targets. If allocation of responsibility for reductions in emissions or discharges is required, the sources will have to determine how to make those allocations themselves. The industry may also decide to use the challenge to share information, technologies, or personnel to solve common problems.

Under challenge regulation, a major governmental task is to set clear, measurable targets, either risk-based or technology-based, with a timetable for implementation. These targets, combined with a reasonable compliance schedule and specific monitoring protocols, may reduce some of the uncertainty which sources have identified as a barrier to investing in innovative solutions. These targets would be defined for multiple sources, typically for an industry sector, rather than for individual facilities. However, multiple sectors could also be challenged to meet goals.

Government also retains the responsibility and authority to specify a credible alternative program or sanction to be implemented should industry fail to meet the targets within the specified timetable. In addition, depending on the problem being addressed, the government might be involved in providing information, technical support, or other assistance during the design and implementation phases. Industry may seek clarification, for example, regarding the kinds of monitoring protocols which will be acceptable to the government agency for measuring progress toward the target.

Extent of Use

Challenge regulation has not yet been extensively adopted by any country, although OTA has identified several programs with similar elements. In the United States, the program most similar to a challenge regulation is the 33/50 program associated with the Toxics Release Inventory, EPA's annual measure of toxic chemicals, releases, transfers, and waste generated by manufacturing facilities. The major difference between 33/50 and OTA's challenge regulation is the fact that 33/50 is a voluntary program.

When announcing the 33/50 program, EPA suggested that it was thinking about issuing regulations to control emissions but wanted to see how far industry could go on its own. For 17 high-priority toxic chemicals, EPA backed the voluntary targets of 33 and 50 percent reductions in emissions in 1992 and 1995 compared to a 1988 baseline, implying that the agency would issue rules and regulations should industry fail. This is similar to challenge, albeit a much softer "stick" than the sanctions or alternative regulatory programs associated with a challenge regulation.

EPA's Common Sense Initiative uses an industry-by-industry approach, similar to that used by challenge regulation in some circumstances, and relies on negotiations with industry and company officials to determine feasible improvements for environmental performance. This approach is often used in European countries where the tradition of working closely with industry groups is well established. In the United States, explicit cooperation with industry has been more difficult than in Western Europe, primarily because of conflict-of-interest concerns. EPA's Common Sense Initiative goes beyond its voluntary public-private partnership approach by incorporating strong enforcement efforts into the agreement.

A number of other European nations, Canada, and Japan, have also implemented programs with some of the same elements of challenge regulation for dealing with both process and product regulation. The most widespread use of challenge approaches has been to establish producer responsibility for various forms of wastes to encourage source reduction and recycling.

The most ambitious of these programs to date has been Germany's Green Dot program which incorporated all of the elements of challenge regulation. The federal government's 1991 Packaging Ordinance was enacted to reduce the volume of packaging waste and improve the overall materials policy. The government established a regulatory approach outlining industries' obligations to take back packaging from customers. However, the government then gave industries the opportunity to establish an alternative program of their own for meeting the targeted rates. In addition to shifting the responsibility for source reduction and recycling of packaging materials to the industries producing the materials, the government required them to develop a system for handling the materials entirely separately from the existing public solid waste system. The industries cooperated to establish the Green Dot program based on an industry-imposed fee system to support and manage the recycling system. In addition, firms began to work internally as well to reduce the quantity of disposable packaging (53).

The German program has experienced a number of difficulties and been widely criticized (53). For example, the very short timetable for industries to comply and the stringent recycling targets may have contributed to an emphasis by industry on recycling rather than source reduction. The industries also underestimated the costs of managing such a recycling effort, resulting in the threat of bankruptcy of the Green Dot program. In addition, some companies printed the green dot label on their products, indicating they were participating in the program and had paid their fee when, in fact, they were free riders. According to Inform, about 90 percent of the packaging carried green dots but fees were only paid for about 50 to 60 percent of the packaging.

The Netherlands' National Environmental Policy Plan (NEPP), initiated in 1989 and revised in 1993, is implemented in part using elements similar to challenge regulation. The Dutch government adopts medium- and long-range measurable targets and timeframes (usually between five and 15 years) and identifies the industry sectors or firms responsible for changes. It then asks these targeted sources—usually industry sectors—to develop implementation strategies for solving problems, and enforces the targets and timeframes.

The national government usually negotiates with industry groups, and often with larger individual firms, to establish the implementation plans for meeting targets. These plans are then formalized through covenants or formal, written agreements between government and industry. The purpose of these agreements is to allow some flexibility for learning and experimentation. However, even though the approach begins as a "voluntary" agreement, the negotiated covenant is typically enacted into law to increase the dependability of the agreements. In addition, industry must comply with local authorities' licensing and permitting requirements until the covenant provisions can be incorporated into the local requirements.

The Netherlands' use of target groups—such as agriculture, traffic and transport, and refineries—as the basis for implementing emission reductions is similar in concept to the EPA's Common Sense

Initiative described above. Within these larger target groups, the Dutch identify subgroups that they characterize as heterogeneous or homogeneous industries, according to industry characteristics. The printing industry, for example, is considered homogeneous in terms of process technologies; thus a fixed target can be set for the entire industry and a plan for reaching the goal worked out and signed with the entire group of sources. In contrast, the chemicals industry, which is more heterogeneous, requires that the government negotiate on a firm-by-firm basis to develop implementation plans for meeting a particular target and timetable.

Transferring the European experiences to the United States would require some caution. For example, the small size of the Netherlands, the relatively few large companies, the substantial membership in trade associations, and most important, the tradition of "corporatism" or acknowledged cooperation between government and those with the expertise and a clear stake in policy development, are quite different from the United States. In addition, it is too early to be sure that the Dutch NEPP approach has been completely successful (39). Like the United States, the Dutch are struggling to find the best way to involve localities in defining an acceptable covenant with industry when programs are being developed to meet national targets. Existing permits and licenses at the local level, for example, continue to take priority over covenant agreements until they can be reconciled as they come up for renewal or can be revised. In addition, the scale of the Dutch experiment may make it less reliable as a benchmark for the United States. Nonetheless, as with the German Green Dot experiment, much can be learned from the experiences of other countries in using challenges to sources as an instrument for meeting environmental goals.

Key Criteria Affecting Tool Selection

Environmental equity and justice

Since industry is responsible for designing and implementing the program, there is no guarantee that distributional concerns about the effects of pollution will be adequately considered. Thus, challenge regulation must be used with care for reducing pollutants or solving other problems for which exposures vary widely across locations. The outcome, of course, depends on the approach actually chosen by the affected industry. If the chosen approach relies on emissions trading or pollution charges, then the cautions identified for each of these instruments would apply. If the affected industry opted for a program employing the single-source tools described earlier, the outcome with respect to environmental justice would be about average.

However, use of a challenge regulation approach may have a potentially adverse effect on economically disadvantaged and minority communities' ability to shape environmental policy outcomes. While the goal and deadlines set by the government would be subject to notice and public comment, what industry chooses as the means to reach those goals and deadlines generally would not be.

Cost-effectiveness and fairness

The major advantage of challenge regulation is that it shifts the responsibility for designing and implementing programs to a group of sources—that is, to the individuals, firms, and networks—with the expertise and experience to develop the most cost-effective ways to meet environmental goals. Challenge regulation creates flexibility both in terms of scheduling and the means of meeting ultimate targets. This flexibility allows industry to change those sources and methods with the least expensive abatement costs, and to experiment with process changes that might have a high payoff in performance and lower costs.

By emphasizing negotiation and bargaining among firms within an industry rather than adversarial contacts between government and industry, challenge regulation is likely to reduce overall transaction costs as well. Although the costs for industry are likely to increase for planning and coordination of the program, presumably the costs of implementation will be cheaper than had the government imposed a program on firms—or at the least, firms would have been given the opportunity to design a more cost-effective program, if possible. In addition, the overall administrative costs may actually be lower because there are fewer opportunities to participate in rulemaking procedures.

In any case, industry is likely to believe that it can design a program that would be better than any alternative regulatory program government would develop. Limited experience with the challenge approach makes it difficult to know whether or not this will always be true.

In terms of fairness, industry groups could be expected to prefer having control over determining how to meet targets rather than allowing government to direct their activities. However, competition among firms may sometimes make it difficult to satisfy all of the firms who have responsibility for meeting the targets, no matter how fairly the targeted group tries to be in allocating responsibilities.

Demands on government

The overall demands on government for implementing challenge regulations may be less than for programs using approaches such as source-by-source standards, because the role for government narrows to one of assistance, oversight, and enforcement. Also, government agencies generally would not be required to submit the proposed means of achieving goals to public notice and comment, thereby making their administrative costs lower.

However, the agency must design an alternative regulatory program or sanctions to be used should industry fail to meet its targets. In addition, developing capacity for implementing challenge regulations may require reorientation of personnel toward such skills as providing technical support and assistance, and negotiation and bargaining. The agency would continue its enforcement efforts and devote more resources to developing monitoring and information reporting data systems, and inspection and compliance regimes.

Adaptability

Another potential advantage of challenge regulation is that if industry so chooses, it can make its approach more adaptable to new information or technologies. Rather than waiting for EPA or state agencies to recognize new technologies or approve process changes, industry could choose to design a program with some flexibility for experimenting and identifying new opportunities for improvements.

Given the lack of experience in implementing challenge regulations, it is difficult to know what kinds of programs industry would choose. It is possible that an industry would develop a very flexible program that could adapt easily to changing scientific and technological information. It is also possible that industry would put in place a program that guarantees a relatively high level of certainty to firms regarding what they have to accomplish in order for industry to meet the targets on schedule. Once a structured program is place—whether it is a parallel waste system like that set up under the Green Dot program, a technology-based design standard, or an allocation of emission reductions for each firm—industries may find it just as difficult to adapt to new information as they would had government imposed the program.

Technology innovation and diffusion

Although challenge regulation will not force innovation or diffusion of technologies, it does offer industry an opportunity to reduce some of the barriers to those activities. For many firms, the most crucial barrier to incremental innovations, which are so important for firm competitiveness and profitability, is a delay in implementation caused by external factors such as the need to obtain permit revisions or waivers.

Another advantage of challenge regulation is that it can result in firms within an industry organizing in the manner they believe the most effective in reaching the goals. In the chemicals industry, for example, firms may want to hold process technologies closely rather than disseminate corporate information. However, through a trade association like the Chemical Manufacturers' Association, industries may be able to share information about control technologies or best practices.

TOOLS WITHOUT FIXED POLLUTION REDUCTION TARGETS

A second major category of environmental policy tools encourages pollution prevention and control without setting specific emissions control requirements.

Some of these instruments are non-regulatory in nature, while others require a particular action, such as payment per unit of emissions or an emissions report. Note that even the regulatory tools in this category require something other than a specific level of pollution prevention or control. Tools that encourage environmentally sound behavior fall into two groups: 1) tools that make it easier or less expensive to lower pollution by providing knowledge or financial assistance, and 2) tools that raise the financial stakes of continuing to behave in environmentally harmful ways.

Tools that increase the cost of environmentally harmful behavior include pollution charges, information reporting, and liability. These tools are based on the assumption that sources will emit less if their pollution costs them something, either as direct payments to an agency or harmed parties or indirectly in terms of reputation.

Tools that encourage facilities to prevent or control pollution include subsidies and technical assistance. Both approaches assume that sources will be willing to change once they know of the benefits of alternative types of behavior, and are more likely to change if the expense is at least partially offset by others.

Pollution Charges

With pollution charges, a regulated entity is required to pay a fixed dollar amount for each unit of pollution emitted or disposed; these charges may, to some extent, be considered the "price" to be paid for pollution. Pollution charges do not set a limit on emissions or production. Instead, the government must calculate what level of charge will change the behavior of regulated entities enough to achieve environmental objectives. Sources are free to choose whether to emit pollution and pay the charge, or to pay for the installation of controls to reduce emissions subject to the charge. When used as a policy instrument, pollution charges are set at a sufficiently high level to provide significant financial incentives to reduce or even eliminate environmentally harmful behavior.

Pollution charges raise revenue that can be used to operate the program or go to general revenues. Pollution charges are used widely as a revenue-raising instrument, set at a level adequate to help fund regulatory programs but too low to significantly change behavior. This OTA assessment is not focusing on pollution charges designed only to generate program revenue.

Much of the economic literature focuses on the potential of pollution charges to send accurate signals to entities about the cost of using the environment's capacity to assimilate waste and to force entities to pay for the full societal costs of their pollution—"internalizing the externalities," in economic jargon. However, setting a pollution charge at a level that accurately reflects full societal costs—neither higher or lower—is probably impractical because of the enormous analytical and data requirements required.

In order to act as an incentive, pollution charges must vary according to the amount of pollution produced. Such variation can provide a direct incentive for sources to cut back on their emissions and waste. Flat rate structures provide little incentive to reduce pollution. For example, a uniform solid waste disposal fee per household that is unrelated to the amount generated does not provide an incentive to reduce waste.

Extent of Use

Pollution charges set at a level sufficient to change behavior are not often used in the United States, except for solid waste management. They are widely used to generate program revenue in Europe and, to an increasing extent, in the United States.

BOX 3-7: Debates About Challenge Regulation

Assurance of Meeting Goals

Promotes *criterion:* The "credible threat" component provides a basis for mandatory compliance at a later date if industries do not cooperate. Challenge regulation has the potential to promote a less adversarial style among interested parties,

Impairs criterion: Allowing industry temporary discretion risks "lost time" toward achieving environmental goals if they fail.

Pollution Prevention

Promotes criterion: Challenge regulation leaves sources free to choose between control equipment or process changes for emission reductions.

Impairs criterion: Challenge regulation provides no particular incentive to prefer reductions in pollution generated over abatement technologies.

Environmental Equity and Justice

Impairs criterion: Challenge regulation does not provide the kinds of explicit mechanisms for third-party participation in decisionmaking that other regulatory tools do provide.

Cost-Effectiveness and Fairness to Sources

Promotes criterion: Challenge regulation provides opportunity for industries to find interfirm solutions and lowest control cost. It allows interfirm negotiation on the means for accomplishing goals in a way the firms believe is fair.

Impairs criterion: Industries may not pursue cost-effective approaches as diligently as individual firms might. Some firms, especially small ones, may not believe they are treated fairly by dominant firms in their industry.

Demands on Government

Promotes criterion: Personnel can be directed towards providing technical support and assistance, Resources and time previously required for rulemaking under the Administrative Procedures Act are reduced.

Impairs criterion: Initial efforts to implement challenge regulations maybe difficult, Government must invest resources in designing an alternative program as a backstop should industry fail to meet goals by the deadline.

Adaptability

Promotes criterion: Industries can adjust their strategies more quickly to new information than can government agencies. Industry expertise and networks are attuned to anticipating changes or new opportunities.

Technology Innovation and Diffusion

Promotes criterion: Allowing or encouraging industry collaboration may facilitate technology innovation or diffusion.

Impairs criterion: Challenge regulation may require changes in antitrust rules to allow collaboration among firms.

SOURCE Office of Technology Assessment, 1995.

Pollution charges are most often used in the United States for collection and disposal of commercial, industrial, and household waste. Commercial and industrial sources typically pay charges that rise as waste volume rises, while most households face flat fee schedules unrelated to the amount of waste generated. Volume-based charges are becoming more common for household waste. In approximately 100 jurisdictions, charges for waste collection are based on volume, rather than a fixed price per month. Charges are typically levied by subscription for a specific number of containers, or by stickers that must be placed on any bag left for pickup. Lubricating oils, lead-acid batteries, and car hulks have been proposed as possible candidates for user charges in the United States.

Pollution charges are used less commonly under the Clean Water Act. Charges for National Pollutant Discharge Elimination System (NPDES) permits are typically set at a level intended to raise program revenue and not to provide a significant incentive to reduce emissions. Publicly owned treatment works (POTWs) charge fees for industrial facilities and households that discharge into their systems. The charge for industrial sources may be based on the types and amounts of pollutants present or on volume. Generally, only larger sources pay pollutant-based charges, because of high monitoring costs (29).

In 1992, the New York legislature considered Senate Bill 1081, which would have established a pollution charge program for point sources of water pollution. The program was intended to achieve defined goals for the reduction of pollutant loadings, and not to meet a budget-based revenue target. The bill proposed a charge schedule with rates based on toxicity, quantity, and heat content. The pollution charge would be adjusted for inflation annually and would automatically increase by 25 percent if the environmental goals were not achieved by a specified date (151). The bill was not enacted; however, interest in pollution charges appears to be growing.

Air emission charges most often are set at a level designed to recover administrative costs of state air quality programs, rather than to provide a significant incentive for sources to reduce their emissions. The South Coast Air Quality Management District in the Los Angeles area has what may be the highest air emissions fees in the country.[25] Annual permit fees for the largest sources can amount to $2 million or more, an amount likely to attract attention of source managers. However, a source's ability to respond to the pollution fee incentive is limited in the SCAQMD jurisdiction because the incremental control costs for most sources in the region are so high (29).

The Clean Air Act Amendments of 1990 provided for a variety of pollution charges. Most of these, such as the permit charge of $25 per ton of regulated pollutants, are designed to recover administrative costs. Another provision requires sources in extreme ozone nonattainment areas—currently only the SCAQMD area—not attaining standards by 2010 to pay emission charges of $5,000 per ton (adjusted for inflation) for each ton of VOC emitted that exceeds 80 percent of a baseline quantity (236). Depending on the cost of incremental emission controls, such a charge might provide a significant incentive to reduce emissions. Pollution charges are also specifically authorized under the Economic Incentive Program Rules (234).

The charge on CFCs appears to be set at a level sufficient to cause change in target entities' behavior (193). During the CFC phaseout period beginning in 1990, users must pay a charge per pound of CFCs, multiplied by an ozone depleting factor.[26]

[25] Major sources (emitting over 75 tons per year) must pay $596 per ton for organic gases, $343 per ton for nitrogen oxides, $413 per ton for sulfur oxides, and $456 per ton for particulate matter. A. Carlin, *The United States Experience with Economic Incentives to Control Environmental Pollution*, EPA-230-R-92-001(Washington, DC: July 1992).

[26] The tax began in 1990 at $1.37 per pound, was increased to $3.35 per pound in 1993 and to $4.35 in 1994, and is scheduled to increase to $5.35 in 1995.

By the end of 1991, CFC production was down to 60 percent of 1986 production levels. This decline in CFC use is a much more rapid phasedown than originally anticipated. The role of the CFC tax in this decline in use is believed to be extensive, particularly in industrial sectors where the CFC cost is itself the major cost factor (193).

Pollution charges are used more frequently in Europe than in the United States. The Organisation for Economic Cooperation and Development (OECD) reports that member countries are using emission fees to address a variety of air pollutants, primarily SO_2 and NO_x, as well as household or industrial waste and hazardous waste. For example, Sweden has placed charges on NO_x emissions, in order to speed up compliance with new emission guidelines to be imposed in 1995. Charges are levied on the actual emissions of heat and power producers with a capacity of over 10 MW and production exceeding 50 GWh. The fees are then rebated to the facilities subject to the charge, but on the basis of their energy production. Thus funds are redistributed between high- and low-emitting facilities. In 1992 the actual emissions reduction was between 30 and 40 percent, exceeding the predicted 20 to 25 percent reduction. Several OECD member countries are also levying a pollution charge on landfilled and incinerated wastes, as well as experimenting with pay-per-bag systems.

Key Criteria Affecting Tool Selection

Assurance of meeting goals

Pollution charges do not dictate with certainty how much control will occur. Firms can choose to pay the charge for emissions or to control emissions; their decision depends on the specifics of their own situation.

The degree of assurance strongly depends on how accurately an agency has set the fee. For a fee to be set at a level to achieve a particular environmental goal, an agency would need detailed information about targeted entities' internal economics and control costs in order to predict firms' pollution control strategies, and must understand the relationship between emissions, health effects, and the environmental goal. As a result, agencies would probably set a charge level believed to be roughly high enough to achieve program objectives, with the expectation that the fee would be adjusted as monitoring and other data indicate is desirable. The more approximate the fee level, the lower the degree of assurance.

The ability of pollution charges to achieve environmental goals also is influenced by many of the same issues affecting other policy instruments. First, target entities do not always react to economic incentives or potential noncompliance penalties the way economists predict that rational economic actors will behave (224).

Second, monitoring emissions of the relevant pollutant must be easy to do and hard to circumvent. If emissions are hard to monitor, some emissions will go untaxed and the incentive to install pollution control technologies will be reduced. If emissions monitoring is easy to circumvent, some sources might choose to control less and avoid additional charges via inaccurately recorded emissions. Similarly, incentives for illegal dumping might be created if the pollution fee was imposed at the point of disposal rather than automatically at an earlier point of the product manufacturing, use, and disposal chain (40). It is important to remember that unpredictable responses and compliance avoidance are hardly unique to pollution charges.

No empirical data are available on the effects of pollution charges on air or water emissions or environmental quality. The pollution control literature does not discuss actual experience of commercial and industrial waste generator responses to varying charges for hazardous waste (29). Some data are available for the effects of pollution charges on solid waste collection and disposal. As illustrated by table 3-5, pollution charges based on volume of waste collected and disposed appear to create a significant incentive to reduce waste.

Environmental equity and justice

Pollution charges may have a potentially adverse effect on economically disadvantaged and minority communities' ability to shape environmental

TABLE 3-5: Effects of Pollution Charges on Solid Waste Collection and Disposal

Program	Type of fee	Type of pollutant	Nature of "data"	Environmental results
High Bridge, NJ	Emissions (pay-per-bag)	Solid waste	Empirical	24% reduction in tonnage[a]
Perkasie, PA	Emissions (pay-per-bag)	Solid waste	Empirical	50% reduction in tonnage; **30%** increase in recycling
Seattle, WA	Emissions (pay-per-bag)	Solid waste	Empirical	20% reduction in tonnage[c]

[a] L. Lave and H. Gruenspecht, "Increasing the Efficiency and Effectiveness of Environmental Decisions: Benefit-Cost Analysis and Effluent Fees", 41 *Journal of Air and Waste Management 680,690* (May 1991).

[b] A. Carlin, "The United States Experience With Economic Incentives to Control Environmental pollution" (EPA Doc. No. EPA-230-R-92-001 , July 1992) at 3-3.

[c] A. Carlin, "The United States Experience With Economic Incentives to Control Environmental Pollution" (EPA Doc. No. EPA-2 at 3-3

SOURCE: Off Ice of Technology Assessment, 1995.

policy outcomes. While the regulatory decision of what the fee level is set at is likely to be subject to public notice and comment, a facility's decision about its emission levels would not be. Thus, pollution charges might lessen the opportunity for communities to voice their views and potentially affect emission levels.

Technology innovation and diffusion

Pollution charges, like emissions trading, allow firms enormous flexibility in deciding the level and means of emissions control. Pollution charges can create a continuing internal incentive to develop cheaper and more effective ways of controlling pollution so as to reduce the size of the charge payable. However, because pollution charges are not widely used, little actual data exists regarding their effects on technology innovation.

Pollution charges levied on polluting inputs may provide an incentive to develop safer new products or less harmful substitutes, as well as raise product price, which reduces the amount demanded (193). Similarly, increased charges for collection and disposal of household solid waste might lead to new types of consumer products packaging that create less waste.

▮ Liability Provisions

Liability provisions require those entities undertaking activities that impose pollution or other environmental harms on others to pay those who are harmed to the extent of the damage. Liability can provide entities with a significant motivation for environmentally sound behavior because the dollar amounts involved can be huge. Liability is imposed two ways: 1) by common-law theories like negligence or nuisance, or 2) by statute, such as in the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA).

Liability provisions are different from enforcement. Liability compensates those who are harmed, while enforcement penalties and incarceration discourage and punish noncompliance.

Liability as a policy tool may vary widely, depending on the specifics of a program. Some forms of liability arise only if an entity is shown to be "negligent," that is, as not having exercised reasonable care in its activities. Alternatively, liability might be "strict," where one who engages in an activity that causes a harm is liable even if shown to have used reasonable care. Federal environmental statutes most often contain strict liability provisions. For either type of liability, a successful claim typically requires an established causal link between the harm and the pollution, which has been traced back to its source. Claimants might be parties seeking reimbursement for remediating a pollution problem, or injured parties, or any member of a group specified in the statute establishing a liability system. Forums where liabil-

BOX 3-8: Debates About Pollution Charges

Assurance of Meeting Goals

Promotes *criterion:* Charges provide incentives to control emissions beyond their own "target."

Impairs criterion: Charges do not dictate with certainty the level of pollution control.

Pollution Prevention

Promotes *criterion:* Charges leave sources free to choose between control equipment or process changes for emission reductions.

Impairs criterion: Charges provide no particular incentive to prefer reductions in pollution generated over abatement technologies.

Environmental Equity and Justice

Promotes criterion: Charges can provide revenues for offsetting disproportional negative environmental impacts.

Impairs criterion: Charges set emissions levels and distribution according to market forces, not open administrative processes. Uniform charges do not address "hot spots."

Cost-Effectiveness and Fairness to Sources

Promotes criterion: Charges set a uniform upper bound on control costs. Economically rational entities will achieve a target level of emissions at least cost.

Impairs criterion: Once an environmental goal is reached, entities still must pay for emissions.

Demands on Government

Promotes criterion: Once set, charges can be simple to administer, particularly if charges are uniform. Charges can generate revenue for administration and other public purposes.

Impairs criterion: Setting charges at level calculated to achieve a particular emission reduction goal is analytically burdensome and data-intensive. Charges may require ongoing "finetuning" to get desired pollution abatement level.

Adaptability

Promotes criterion: Entities are free to adopt new technologies.

Impairs criterion: Pollution charges are subject to time-consuming public notice-and-comment procedures required under the Administrative Procedures Act.

Technology Innovation and Diffusion

Promotes criterion: Charges provide a continuing incentive to innovate, as a way of reducing the size of the charge, and provide considerable flexibility as to control techniques.

SOURCE: Office of Technology Assessment, 1995.

ity claims might be asserted include government administrative proceedings, private claims disbursement processes, and courts.

A facility is not insulated from future liability even if in full compliance with today's regulatory requirements, including discharge limits or disposal practices specified in a permit. Statutes can authorize retroactive liability, as did CERCLA for wastes disposed prior to its enactment. Also, commen-law claims might be successful even where an entity was fully in compliance and a statute exempted permitted discharges from its liability scheme. Potentially enormous financial exposure could encourage entities to reduce their use, generation, emission, and disposal of hazardous substances or other pollutants, and to implement controls and safety procedures beyond those required by direct regulation. Liability also may provide incentives for environmental auditing and other self-appraisals, in order to gauge the potential financial exposure and correct problems before they grow.

Like most policy tools, liability is an effective incentive for environmentally beneficial behavior only to the degree liability impacts the decisionmaker. Factors that might affect such incentives include whether decisionmakers bear responsibility within their organizations for their decisions, if it is foreseeable that others might be harmed, the time lag between managerial decisions and eventual lawsuits, and the extent insurance protects the organization from the effects of liability (120,162). The likelihood of being held liable is also affected by whether the contamination is traceable back to its source, if impacts are sufficiently concentrated to make a claim worthwhile to the injured party, and if the contamination stems from one or multiple sources.

This OTA assessment is focusing on liability provisions established by statute and not upon common-law foundations. However, the policymaker establishing statutory liability should consider how those provisions interact with the common-law system. For example, should the statutory scheme preempt, supplement, or coexist with common-law claims?

Extent of Use

CERCLA or Superfund is an example of strict retroactive liability that can cost millions if an entity is found liable for a Superfund site cleanup. Under CERCLA, governments may collect cleanup costs and the value of damages to natural resources from any or all waste producers[27] that used a particular site, entities that arranged for waste disposal or treatment, those who transported waste to the site, and present and past "owners or operators" of the site (248). Private individuals also can sue to recover cleanup costs; however, liability is restricted to damages to publicly owned or controlled natural resources and does not include harm to private parties. As a result, claims for private property damage or personal injury cannot be brought under CERCLA. As of 1994, the average cost of cleaning up a Superfund site was approximately $30 million.

Other federal statutes address harm to private parties and impose liability on entities that have caused the harm. For example, entities that spill petroleum into surface waters are strictly liable under the Oil Pollution Act (OPA) for cleanup, natural resource damages, and third party damages caused by the spill (244,253). The OPA places limits on liability. However, these limits probably do little to impair incentives for environmental compliance, because the liability limits are so high and can be overcome by a showing that a release resulted from violation of a safety or operating standard. In addition, the OPA does not preempt states from imposing more stringent liability schemes.

The Clean Water Act (CWA) makes responsible parties liable for cleanup costs for a spill of hazardous substances into surface waters. Liability is capped at $50 million unless the discharge was the result of willful negligence or willful misconduct (245). The CWA does not preempt stricter state liability provisions.

Liability costs, therefore, can be extremely large under the CWA and the OPA, as illustrated by Exxon's experience following a large oil tanker spill into Prince William Sound in Alaska in March 1989. As of September 1994, Exxon had already spent $3.4 billion to clean up the spill and settle federal and state suits for cleanup reimbursement and natural resource damages. In addi-

[27] This type of liability is known as "joint and several," where each party who contributed to the problem is responsible for the entire cost of cleanup, and not just its proportionate share.

tion, a jury awarded $5 billion to Native Alaskans and fisherman for third party damages—roughly equivalent to a year's worth of Exxon profits.[28]

CERCLA, CWA, and OPA all contain defenses to liability, which if applicable could allow the source of a pollution emission to avoid responsibility for reimbursement and compensation to injured parties. These defenses apply only in narrow circumstances. Liability is avoided only if the source can prove that an emission was caused solely by an act of God, an act of war, an act or omission by a third party, or (under the CWA only) negligence on the part of the U.S. government.

Key Criteria Affecting Tool Selection

Pollution prevention

Liability probably provides a moderate incentive for entities to practice pollution prevention. Data on actual effects are lacking, however.

When effectively implemented, liability creates an incentive to reduce pollution. Firms theoretically will seek out pollution reductions wherever they are cheapest. Thus, like many other instruments, whether liability results in pollution prevention or control will vary from site to site, depending on the relative costs of different pollution reduction strategies.

However, liability might offer encouragement for pollution prevention if available end-of-the-pipe solutions result in residuals that could become a source of future, retroactive liability. In such a situation, entities have an incentive to prevent pollution in the first place rather than risk potential future liability.

Demands on government

Liability imposes demands on government in essentially two contexts: as a claimant seeking compensation, and as operator of the court or administrative system through which claims are made.

The government is often in a position to claim compensation for cleanup costs and natural resource damages. The likelihood of collecting depends in part on the government resources expended pursuing claims and administering the liability program. The more resources expended, the more likely it is that a claimant will establish the required elements of a successful claim. Anecdotal evidence indicates that some types of successful claims can be very expensive to make.

Causality—that the injury is caused by pollution that comes from actions of a particular entity—can be particularly difficult and expensive to prove for some kinds of damages. Linking pollution with cleanup costs or with injuries to natural resources may not be that difficult in circumstances where the pollution is traceable. Identifying the source may be difficult if pollutants are broadly dispersed, or if the damage is believed to come from diffuse mass exposure with a long latency risk.

While scientific developments in the last 30 years have shown convincingly that man-made pollutants can cause serious health and environmental problems, conclusions are often expressed as statistically likely cancers per number of population. As a result, it is still very difficult to conclusively demonstrate that a particular individual's harms stem from a particular exposure.

Assessing the extent of damages also can be administratively expensive, sometimes exceeding the extent of damages themselves. For example, a study of the December 1985 Arco Anchorage crude oil spill of 5,700 barrels could detect damages of only $31,930, while assessment costs amounted to about $245,000 (69,219). Other types of damage, such as cleanup costs, should prove simpler to demonstrate provided that good accounting records were kept during the remediation operation.

Several environmental statutes have adopted liability provisions that help reduce the costs of

[28] As of this writing, Exxon is preparing an appeal. "Long Shadow of the Exxon Valdez," *New York Times*, p. A22, Sept. 21, 1994.

making claims and administering the liability regime. For example, strict liability means that the proponent of a claim does not need to demonstrate the defendant entity was negligent, or failed to take adequate precautions. Some statutes spell out a method of calculating damages for which parties are liable, relieving the forum in which claims are made from having to develop such a methodology. Some require entities that admit to causing the pollution to establish private claims procedures, reducing or eliminating court or other costs of making a claim. And joint and several liability provisions —where all contributing parties are liable for the whole damage, not just for the portion they actually caused—relieve claimants from having to prove which of several entities caused what pollution. These and similar techniques may help to lower the costs of successfully bringing a claim.

Proponents of liability as an environmental policy tool stress that in theory liability systems can be administratively inexpensive to administer because they might rely on the existing court system, thereby avoiding the need for institution building. Furthermore, proponents argue that liability systems are administratively less expensive than other regulatory approaches where the probability of harmful emissions is low, since they need only come into play when damage occurs. Without damage, the only administrative costs of liability are those to add such provisions to a statute. It is unclear whether, on balance, the savings from having to deal with only those harms that occur outweigh the high costs of pursuing a claim.

Adaptability

A liability program is unlikely to require reformulation in the event of new technologies or scientific discoveries. The results of such a program may change, however. For example, scientific discoveries may give rise to new perceived harms and more claims. Or new scientific data might indicate that effects previously believed to be harmful do not in fact occur. Improved monitoring could expand the class of individuals exposed to previously undetected pollutants. And new pollution abatement technologies might change the standard of care an entity must meet to avoid liability, or to be protected by statutory strict liability caps.

Prolonged inflation or a change in economic circumstances might require a modification of the program's liability limits, if the compensation dollar amounts begin to look insignificant in light of potential profits from the polluting activity.

Information Reporting

Information reporting is a regulatory instrument that requires firms to provide specified types of information, either to a government agency or to the public directly. Required information typically involves activities affecting environmental quality, such as emissions, product characteristics, or ambient environmental data.

Information reporting programs fall into three basic categories: 1) required emissions reporting to the government for compliance and enforcement purposes; 2) reporting to the government to help both government and polluters better understand and respond to problems; and 3) informing the public of human health risks or environmental consequences posed by a firm's products or activities. These categories are not necessarily exclusive and in many cases a program designed to meet one of the objectives may also meet another. While information reporting for compliance and enforcement is common for environmental protection purposes, we are not focusing on it in this assessment. Instead, this analysis looks closely at information reporting for public use and for government and industry understanding of problems.

Information reporting for public use is based on the theory that disclosure of polluting activities by firms will raise public concern; it is then assumed that firms will change their behavior, when possible, to directly respond to the public's concern.

Although changes in pollution practices are not made mandatory by these right-to-know laws, firms face a variety of motivations to reduce pollution. These include the desire to be good neighbors and responsible corporate citizens, as well as

BOX 3-9: Debates About Liability

Assurance of Meeting Goals

Promotes criterion: Liability poses an incentive to reduce pollution, in order to avoid paying potentially large sums to injured parties.

Impairs criterion: Liability does not prohibit pollution by itself, but merely requires compensating those harmed, Establishing the degree of harm and chain of causation can be very complex, particularly if harm develops over many years.

Pollution Prevention

Promotes criterion: An entity has incentive to prevent pollution, because it maybe liable in the future even if in compliance with permit control requirements now.

Impairs criterion: Liability does not require pollution prevention.

Environmental Equity and Justice

Promotes criterion: Liability provides an opportunity for those who are harmed by emissions to seek compensation and cleanup of the problem.

Impairs criterion: Those harmed do not receive compensation unless they first expend resources to assert and prove a claim, which can be expensive and out of reach of many low-income people.

Cost-Effectiveness and Fairness to Sources

Promotes criterion: Liability is fair because entities are required to bear the costs of their emissions, even if those emissions are allowed under a permit.

Impairs criterion: Compensation occurs only after injured parties successfully establish claim for recovery, i.e., expend resources (which may or may not be available). A significant share of compensation may go to each party's lawyers and experts, rather than to those harmed. Strict liability can be unfair, because it need not acknowledge prior and ongoing pollution control activities.

Demands on Government

Promotes criterion: Liability programs might have low administrative costs, because they need come into play only when damage occurs.

Impairs criterion: Administrative resources needed to prove all elements of liability can be high. Determining the extent of damages can be very expensive, sometimes exceeding the cost of the damages themselves.

Adaptability

Promotes criterion: Sources are free to control pollution as they wish. Because liability can be retroactive, new scientific discoveries and priorities are readily accommodated.

Technology Innovation and Diffusion

Promotes criterion: Liability is probably neutral with regards to technology innovation.

Impairs criterion; Entities that develop innovative control and remediation equipment might curtail their activities, if they perceive themselves as a potential target for liability claims.

SOURCE: Office of Technology Assessment, 1995, fear of adverse publicity or loss of sales. In addition, the public's heightened awareness of polluting activities due to information disclosure increases the possibility of regulatory agencies establishing stricter or more comprehensive regulatory requirements, another incentive for firms to pursue more proactive pollution reductions. For example, California's Air Toxics "Hot Spots" Information and Assessment Act set up a toxics reporting program that required facilities to identify potential health risks posed by emissions. The "Hot Spots" Act was amended five years after implementation. Instead of simply reporting risks, owners of "significant risk" facilities are now required to reduce the risk posed by toxics below the state-determined level of significance.

The appropriate form and extent of public information is part of an ongoing debate among those concerned with risk communication and the public's right to know. Some stakeholders, especially industry, are concerned with the public's perception of disclosed information, especially of raw emissions data such as pounds of pollutants per year. In these cases, the possibility for misunderstanding the actual risk related to exposure is high. However, translating emission data into possible impacts on human health and the environment increases the cost (burden) on industry. And as more kinds of information reporting are required, the risk of information overload is high. Too much information may dilute the intended impact on the public, either by confusing the important elements or by minimizing the impact of any warning because it simply becomes one of many.

Information reporting programs can be characterized by the method and extent of information dissemination. The more accessible the information, the more likely it is that the program will inform the public, raising awareness of environmental or health factors and possibly assisting in better decisionmaking. Some programs, such as the federal Toxics Release Inventory (TRI), require the government to actively distribute information, including access to the data in printed and computerized form. In contrast, in an earlier program, New Jersey's Community Right-to Know Act of 1984, industry emissions data is available to the public, but citizens are required to submit written requests in order to acquire the desired information.

Another aspect of information reporting is who should be responsible for its generation and distribution. Government agencies have long been involved in information collection and distribution. The value of the information for government and public use depends on how often the industries are required to submit emissions release information, the accuracy of the information, and the timeliness with which the data are made available.[29] Current programs vary as directed by regulation or legislative mandate, although reports are most frequently required annually. Regular reporting requirements are also useful over a given time period in order to better track changes.

Concern about trade secrets and confidentiality is another aspect of information reporting that influences the use and effectiveness of a program. Government agencies are sensitive to business concerns in these matters and try to include flexibility in some programs in order to diminish possible negative impacts from disclosure. However, the firm or industry is typically responsible for proving the need for confidentiality in reported data.

The effectiveness of information reporting programs is particularly difficult to evaluate due to the difficulties of isolating a firm's exact motivation for changing its polluting behavior. Typically,

[29] The data made available through information reporting may support efforts to enact new legislation, develop pollution prevention and reduction strategies, and adopt new enforcement strategies. TRI data has also been found to help state agencies manage their own environmental programs. S.G. Hadden, *A Citizen's Right To Know: Risk Communication and Public Policy* (Boulder, CO: Westview Press, 1989); National Academy of Public Administration, *The Environment Goes to Market: The Implementation of Economic Incentives for Pollution Control* (Washington, DC: July 1994).

a firm's changed behavior is the result of many factors. The firm may need to comply with other environmental or health regulations. It may be anticipating new regulations. The firm may be responding to technology innovation or production engineering considerations. Though it may be difficult to find direct relationships between information reporting and firm behavior, the fear of negative publicity and threat of additional regulation probably encourage increased efforts to reduce risks associated with pollution (17).

Extent of Use

Information reporting programs—both those designed to inform the public and those designed to assist the government and industry in managing pollution—have become more common over the last 10 years. Until 1984 there was no public accounting of toxic chemicals used in facilities or discharged into air, water, and land. The first major efforts to require information reporting came on the heels of public reaction to the chemical accident in Bhopal, India. This disaster alerted many in the United States to the need to know more about the chemicals used and stored at facilities across the country.

Information reporting programs designed to alert the public to the risks of pollution are often referred to as community "right-to-know" laws. New Jersey's 1984 Community Right-to-Know Act was the first information reporting program in the country and served as the model for the national Toxics Release Inventory. Based on a survey conducted in the mid-1970s, it requires information on the use, storage, and discharge as waste of listed toxic chemicals.

The Emergency Planning and Community Right-To-Know Act (EPCRA), enacted as part of the 1986 Superfund Amendments, requires states to receive and disseminate information on hazardous chemicals present at facilities within local communities. Section 313 of EPCRA established the Toxics Release Inventory. TRI calls for owners or operators of certain manufacturing facilities to submit annual reports on the amounts of listed "toxic chemicals" released (routinely or accidentally) into the environment. Sections 311 and 312 of EPCRA require the owner/ operator of facilities with hazardous chemicals on site to report these chemicals to state and local agencies responsible for emergency response programs.

California's Safe Drinking Water and Toxic Enforcement Act, otherwise known as Proposition 65, is one of the better known state information reporting programs.[30] It is spelled out in two simple steps. First, it targets those chemicals "officially known to the state to cause cancer or reproductive toxicity" and requires they be identified and compiled in a list. Second, it requires that businesses should not knowingly and intentionally expose any individual to any one of the listed chemicals without first providing a clear and reasonable warning.[31]

These programs have been followed by increasing numbers of pollution prevention and toxics use reduction programs, which also incorporate reporting requirements to assist both government and industry understand and respond to potential problems. The programs include New Jersey's Pollution Prevention Act and California's Air Toxics "Hot Spots" Information and Assessment Act ("Hot Spots"). The Pollution Prevention Act requires firms to develop a publicly available five-year pollution prevention plan.

"Hot Spots" requires sources to collect emissions data and report it to the state. Sources that the state determines may cause localized impacts are required to ascertain potential health risks and inform nearby residents of these risks; "high-risk"

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[30] The law also requires that businesses should not discharge any listed toxic chemicals into any present or potential source of drinking water, but as this is not an information reporting program it is not addressed in this section.

[31] No warning is required if the amount of the listed chemical present in ambient environmental exposures, exposures from consumer product use, and discharges into current or future sources of drinking water fall below a level which would pose "no significant risk" for carcinogens.

facilities must prepare and implement risk-reduction planning within six months.

Key Criteria Affecting Tool Selection

Assurance of meeting goals

Information reporting provides less direct assurance than many other tools that goals will be met, because it does not mandate explicit pollution limits or place an explicit price on pollution. Instead, it relies solely on indirect incentives to achieve goals. Anecdotal information indicates that these incentives may have real power in particular situations where business profits are sensitive to public opinion.

A California EPA questionnaire attempting to determine the effects of Proposition 65 found that many businesses indicated that Proposition 65 was a factor in their own toxic emissions reductions. However, it was not clear to what extent these reductions were due to Proposition 65 as opposed to other laws and legal trends imposing liability for the use of toxics.

Information reporting programs may allow regulatory agencies to address risks which, although relatively easy to mitigate, are not on a scale to have been prioritized by other programs, For example, Proposition 65 has been used to eliminate lead in foil wrappings on wine bottles.

An information program designed primarily to alert firms and regulators to possible pollution problems may be slightly more effective at ensuring that environmental goals will be met. Pollution prevention plans and risk planning at least provide an "approved" framework for firms to make changes that will benefit the environment. For example, emissions data collected through "Hot Spots" has helped to more comprehensively manage toxic air contaminants in California by identifying localized risks and providing a basis for prioritizing further regulatory efforts.

Information programs can also be very important for highlighting environmental progress and successful strategies for pollution prevention or abatement. As such, information programs can help increase familiarity with particular tools used in combination with information programs.

Environmental equity and justice

Information reporting promotes environmental equity and justice, at least to a certain extent. The increased availability of information improves the opportunity for effective public participation. Theoretically, the information available under reporting programs can help citizens or regulatory agencies identify significantly affected populations. Citizens may be motivated by concerns about reported pollution levels or potential toxic chemical exposures and work for change by promoting additional regulatory controls, contacting or boycotting offending businesses, or pursuing enforcement actions.

However, there are few, if any, formal institutions or mechanisms for public participation within an information program alone. In addition, reporting programs do not address the issues of multiple exposures or toxic hot spots, nor do they do anything to remediate existing problems.

The type and accessibility of the information are important factors in determining the likelihood of its use. Public interest groups may also fill gaps in information interpretation and use. These groups often target particular problems and utilize available information through reports to widely publicize their concerns (210). A common complaint is that the "right to know" isn't necessarily "right to understand," so information is often uninterpreted raw data, and not necessarily linked to data about safe levels. More recent information reporting laws, such as California's "Hot Spots" and Proposition 65, have tried to address this confusion by requiring industry to report health risks rather than emissions data. However, this does increase the complexity of the program and the burden on industry.

In the end, while information programs may better equip citizens to work for greater protection of human health and environmental impacts, they may not go far enough. By providing only indirect incentives to polluters to improve environmental performance, actual results will be mixed. Some firms will make changes while others will not. Therefore, impacts on some communities may continue and be greater than in others.

Cost-effectiveness and fairness

An information reporting program is likely to be a less onerous form of regulation than direct requirements for pollution control. However, the burden on industry rises as more information is required of polluters—especially as the information demands increase beyond what is already required for compliance monitoring.

In theory, information reporting programs could improve the cost-effectiveness of risk management if they replace a current regulation at lower cost, or the efficiency if they correct a market failure not addressed by current regulations and the benefits of correction exceed the costs. In practice, the cost-effectiveness of information reporting programs is difficult to evaluate because it is almost impossible to clearly link a firm's changed behavior directly to reporting programs.

The cost-effectiveness of any reductions depends on how much information reporting changes the behavior of the reporting firms. If a high percentage of firms report, but very few of them change their behavior to reduce pollution, then the total cost-effectiveness is very poor. If polluting behavior changes, presumably it will be no less cost effective than if the same level of reduction was required. Since firms have complete flexibility in how they reduce emissions, it is possible that reductions from information reporting programs are more cost effective than those obtained from direct regulation. How much more cost effective is unknown, however.

When considering net benefits, one cannot simply assume that firms will control to a more efficient level. They may either overcontrol or undercontrol in comparison to environmental objectives. Because firms at least theoretically have an eye on the bottom line, the chance of significant overcontrol is probably modest, although some might include examples such as reformulating the correcting fluid Wite-Out, a measure often chalked up to Proposition 65, in this category (187).

Demands on government

The burden information reporting places on government depends on the type of program and the level of responsibility assumed by the implementing agency. Government roles vary widely among information reporting programs. Their responsibilities may include the following: information collection; information management; data interpretation and analysis; information dissemination; and enforcement. The more labor intensive the government role is, the greater the demand will be on agency resources and expertise.

Comparing administrative costs associated with information reporting programs is not particularly instructive since program characteristics vary widely. California's Proposition 65, one example of an information reporting program, involves relatively minimal responsibility for the implementing agency (271). By law, the state agency helps to manage the list of chemicals used for reporting purposes, provides some technical guidance, and pursues enforcement activities. There is no central collection or dissemination of information in the program. Instead, Proposition 65 shifts the burden of proof from government to producers or sellers to show that their activities do not exceed the "no significant risk" level.[32] Under typical regulatory approaches, the law is not in force until the government determines how much is too much; therefore, the regulated entities have no incentive to assist the government in drawing this line.

[32] For carcinogens, California has established that threshold at the level that would produce one excess cancer per 100,000 humans exposed over a 70-year lifetime at that level. For chemicals with possible reproductive effects, regulations require there is less than a 1/1000 chance of exceeding the "no observable effect" level (NOEL).

In contrast, warning labels are required under Proposition 65 unless a company proves that the amount it emits is not a significant risk. Thus it is in industry's interest to have clarity and certainty when it comes to setting acceptable levels for chemicals, so that companies know how to comply—and once such levels are set, they are generally accepted. Possibly as a result of industry assistance, California's regulators defined risk levels for more chemicals in the first 12 months than EPA has managed to address under the federal Toxic Substances Control Act (TSCA) in the past 12 years (158).

The limited nature of government intervention in Proposition 65 is somewhat unique. New Jersey's Community Right-to-Know Act of 1984 requires substantial government activity including data collection, information management, data analysis, and public disclosure.

Adaptability

Information reporting programs are likely to be capable of adapting to change. When new scientific information or technological developments occur, sources are free to modify their operations or not, as they choose.

Changing the program itself is somewhat more difficult, but probably not as difficult as changing many other types of policy instruments. Recent discussions on proposals for changing the Toxics Release Inventory highlighted several major issues.[33] Overall, industry is primarily concerned with confidentiality and the added burden of collecting more information. The EPA expressed concerns about additional costs associated with data entry and the need to modify the current database to facilitate new data points. Although the industry's increasing interest for electronic reporting addresses some of the problems with data entry, EPA accrued significant costs gearing up their program and equipment to accept electronic data. Though issues such as these could be resolved, they are nonetheless factors which influence adaptability to change.

Subsidies

Subsidies are policy instruments that provide various forms of financial assistance, which can act as an incentive for entities to change their behavior or help entities having difficulty complying with imposed standards. Subsidies are the inverse of pollution charges: instead of an entity paying a fee for polluting behavior, the entity is given funds to engage in environmentally beneficial behavior. Subsidies might be provided by the government or by other parties. In essence, subsidies provide the means for the government or other parties to bear part of the cost to stimulate adoption of new or proven environmentally beneficial controls or behavior.

Subsidies can come in many forms: grants, low- or no-interest loans, preferential tax treatment, and deposit-refund systems. Note, however, that the recipients of such largess are generally not free to spend it in accordance with their own priorities. Prospective grantees and borrowers must fit their requests to stringent government procurement regulations, and recipients must comply with fairly detailed requirements governing how the money must be spent. Similarly, entities taking advantage of available tax breaks must be prepared to demonstrate in detail how the claimed expenditures come within the eligibility criteria. Deposit-refund systems require the article to be properly returned before a refund is given.

The use of subsidies historically has been affected by the "polluter pays" principle, which says that entities should be responsible financially for cleaning up the pollution they cause. Subsidies run counter to this principle. As a result, many public grant programs have subsidized public facilities' pollution control efforts, such as publicly owned wastewater treatment plants, but left pri-

[33] Proposed changes have included: requiring materials accounting data; expanding the chemical list; expanding the number of regulated industries; and requiring peak emissions data.

BOX 3-10: Debates About Information Reporting

Assurance of Meeting Goals

Promotes criterion: Information reporting helps to determine progress and goal achievement, and can encourage otherwise unregulated sources to lower emissions.

Impairs criterion: Because information reporting does not require a level of pollution abatement, it provides little assurance goals will be met (unless combined with other tools).

Pollution Prevention

Promotes criterion: Product warning labels may encourage industries to reformulate.

Impairs criterion: Information reporting does not guarantee that reductions will be made; if made, they might be accomplished with additional control equipment.

Environmental Equity and Justice

*Promotes criterion:*More easily available information may encourage public participation in matters affecting human health and environmental protection. Information programs can promote greater awareness of the risks posed by pollutants.

*Impairs criterion:*Information reporting programs provide no guarantee that communities will receive any additional protection from pollutants.

Cost-Effectiveness and Fairness to Sources

Promotes criterion; If reductions are made, industry has complete flexibility in deciding how to do so. Industry considers information reporting programs less intrusive than tools with fixed pollution control requirements.

Impairs criterion: Information generation may be very time- and labor-intensive, especially for smaller firms.

Demands on Government

Promotes criterion: Typically, demands on government are comparatively light.

Impairs criterion: Collection and distribution of information can bean additional burden for government.

Adaptability

Promotes criterion: Sources are free to control as they wish. If an agency requires new information, it can request it relatively easily.

Technology Innovation and Diffusion

Information reporting programs are probably neutral with regards to technology innovation,

SOURCE: Office of Technology Assessment, 1995.

vate sources of pollution largely on their own. Justifications for this differential treatment tend to focus on the public nature of pollution from public sources, arguably appropriate candidates for the use of public funds. Also, public sources generally are not operating to make a profit, unlike private facilities which at least in theory could consider pollution control as part of the cost of doing business. Note that this public-private treatment is hardly absolute. For example, states are authorized to use Clean Water Act federal grants to help farmers pay for the cost of best management practices (BMPs) to control polluted runoff.

In contrast to grants, tax breaks tend to be almost exclusively aimed at private sources of pollution.[34] Deposit-refund programs affect whoever purchases and returns the items covered by the program.

Extent of Use

Subsidies are very widely used as a tool to promote environmentally beneficial behavior. The examples below are illustrative, and by no means exhaustive, of the various federal, state, and local subsidy programs. Subsidies may also be provided by private parties, although such programs are less common.

One of the largest public works program in history was accomplished through subsidies, the Clean Water Act's construction grant program. Congress established the program in recognition that localities would need to spend large sums of money to comply with Clean Water Act regulatory requirements. Construction grants were made available for the building of publicly owned wastewater treatment works. From inception in 1972 through 1994, over 60 billion federal dollars were spent. Grant recipients were initially required to match federal funds with 25 percent, increasing to 45 percent in 1981.

The construction grant program was phased out by the 1987 Amendments to the Clean Water Act, and replaced with a state revolving loan fund (SRF). Currently, the Act provides federal capitalization grants to SRFs—seed money—that provide state loans to localities for constructing publicly owned wastewater treatment plants, implementing nonpoint source management plans, or developing and implementing a national estuary program (247). Within those general statutory guidelines, a state is free to structure its specific programs in the way that it determines best pursues the goal of clean water. Some states, such as New York, provide "negative interest" loans to financially strapped small communities (effectively, a grant coupled with a loan). The Act authorized between $1.2 billion and $2.4 billion for each of five years; since 1989, $7.8 billion has been appropriated. States must provide a minimum of 20 percent matching funds to establish the SRF.

The Clean Air Act also authorizes several grant programs. For example, section 105 grants EPA the authority to award grants to state and local governments to develop and implement air pollution control programs. Since 1963, the federal government has awarded states and localities over $2 billion in air pollution control grants. EPA may pay up to 60 percent of grant costs, but states must provide the remaining 40 percent (214).

Grants and low- or no-interest loans are used in other contexts, as well. For example, EPA operates a small grant program called Pollution Prevention Incentives for States (PPIS), which has awarded over $23 million since 1989 to promote pollution prevention activities (107). EPA also provided grants to six universities, totaling over $330,000 in 1992, for research on alternative chemical manufacturing methods that would reduce the generation of waste while increasing productivity. The grants were part of Design for Environment (DFE), a voluntary program to promote the use of safer chemicals, processes, and technologies in the earliest design stages (67).

States also use grants and low- or no-interest loans to promote environmentally beneficial behavior. For example, Wisconsin provides cost-share grants for up to 70 percent of the costs for corrective measures necessary to clean up agricultural runoff, a type of nonpoint source water pollution. Project grants average about $15,000 and usually are accompanied by technical assistance provided by county-based conservation technicians (138).

Tax breaks and other preferential tax treatment have also been used to accomplish environmental goals. For example, for many years private com-

[34] One potential exception is the tax-free nature of interest from state and municipal bonds, which can—but need not necessarily—be for building public pollution control facilities.

panies were allowed to take accelerated depreciation of investments aimed at reducing water pollution (58). Under the tax law in effect from 1979 to 1985, employer-provided transportation—vanpools—between an employee's residence and place of work was not considered taxable compensation. Thus an employer could provide a greater net benefit to employees if it set up vanpools.[35]

States are also using the tax code to promote environmentally beneficial behavior. For example, in December 1990, Louisiana enacted a new tax rule that ties the amount of business property taxes a firm pays to its environmental record. For almost 70 years, Louisiana has exempted new equipment and capital expenditures from local property taxes, as a way to encourage industry to locate in the state. Under the new rule, a firm applying for an exemption or seeking a renewal of an exemption from property tax was rated on a scale according to the number of environmental violations it had received, the volume of chemicals it released into the environment, and similar factors. Firms with good records received higher scores and a larger tax exemption. The program was terminated by Governor Edwards in 1992 (64,79, 203).

Deposit-refund programs are another example of subsidies. On a small scale, deposit-refund systems have been in place for decades in grocery stores, where customers or others who returned empty soda containers were refunded a small deposit paid when the soda was purchased. Currently, at least nine states have enacted deposit-refund programs—"bottle bills"—to reduce littering with beverage containers.[36] In effect, purchasers of potentially polluting waste pay a surcharge which is paid to whoever returns the container for recycling or proper disposal. Thus the subsidy is represented by the refund. Rhode Island and Maine have adopted deposit-refund systems for automobile batteries, and Maine has a system for commercial-sized pesticide containers (184).

Key Criteria Affecting Tool Selection

Assurance of meeting goals

Subsidies are capable of achieving risk-based and abatement goals to the extent that the government or others are willing to pay to achieve those goals. However, subsidies do not require a particular level of pollution control, because targeted entities can refuse the subsidy and associated obligations.

When the government pays for abatement and requires as a condition of payment proof that the desired action has been taken, officials know that emission reductions will almost certainly take place. Private firms and local governments are generally willing to install pollution control technologies if somebody else will pay for it. If the subsidy is not for the full amount of the pollution control device, private companies and localities may still be willing to invest in pollution control technology, but they must perceive some benefit to them from the investment.

Tax breaks can reduce the cost of compliance with environmental requirements. Like pollution charges, they can be "tuned" through a process of trial and error to achieve pollution reduction goals. Since they can be tied to a preexisting enforcement regime, tax incentives may be easier to enforce. In practice, however, tax breaks are often too small to inspire a company to install a technology that it would not otherwise have considered (123,165). A tax break may be altogether meaningless to a company that is operating at a loss. Still, if tax breaks can be used to offset expenditures on technologies that both increase plant efficiency and reduce pollution, they may offer a

[35] All that is left now is a general purpose tax provision that renders *de minimus* fringe benefits nontaxable. Employee-provided public transit passes often come under this provision. S. Gaines and R. Westin, *Taxation for Environmental Protection: A Multinational Legal Study* (New York, NY: Quorum Books, 1991)

[36] These states are, in order of adoption: Oregon, Vermont, Maine, Michigan, Iowa, Connecticut, Delaware, Massachusetts, and New York.

significant incentive to invest in such technologies.

One problem with subsidies is that they typically are for capital costs, not operating and maintenance expenses. Some economists and others have theorized that end-of-the-pipe technologies paid for by the government will not be operated effectively if the government does not assume responsibility for some portion of the operating costs (58,123).

A second potential problem with subsidies is their effect on industry turnover. By making marginal firms more profitable, subsidies might even encourage new entrants into the polluting industry or discourage old ones from leaving, thereby causing larger aggregate emissions than there otherwise might be.

Environmental equity and justice

Subsidies can be used to promote environmental justice because they can be targeted to specific pollution sources affecting poor or minority neighborhoods. Subsidies can also have a progressive income effect. For example, construction grants for publicly owned wastewater treatment works shifted much of the burden of complying with the Clean Water Act from individual communities to the national tax base. Thus, sewage treatment became available to communities that otherwise would have faced great difficulty raising sufficient funds.

Unless targeted specifically for community outreach and activism, subsidies appear to have little effect on communities' abilities to affect policy outcomes. Most individual subsidy grants are not subject to notice-and-comment rulemaking, and so do not offer an opportunity for community concerns to be heard.

Subsidies can help remediation of existing environmental problem because they can provide a revenue source for necessary clean-up procedures.

Demands on government

If the subsidy is funded by tax dollars, obviously direct outlays by government can be high. If the program is funded by other means, analytical demands are probably average or somewhat lower than other types of policy instruments.

Some organization needs to determine which entities are selected or entitled to receive a subsidy and to ensure that actions for which the subsidy is paid have in fact occurred. In the case of deposit-refund subsidies, these functions are easy—pay whoever walked in with the refundable item.

Ensuring under other types of subsidies that required actions are taken is somewhat more complicated. Government organizations that make grants or loans to industrial entities could monitor the funds' use to ensure that they are expended upon pollution controls and not on reducing manufacturing costs generally (7,123).[37] Alternatively, the government could make payment of subsidies contingent on the recipient proving it has undertaken the desired pollution prevention or abatement action, thereby reducing government resource requirements for monitoring and enforcement.

Technical Assistance

The government offers technical assistance to help target entities in a number of ways. Entities might not be knowledgeable about whether existing regulations apply to them, be fully aware of the environmental consequences of their actions, or know what techniques or equipment reduce those consequences. Government technical assistance programs are intended to educate entities to make better environmental choices. Technical assistance may also be focused on the general public, to help educate them about the environmental implications of existing programs, proposed rules, and policy tradeoffs.

[37] For example, firms might exaggerate baseline pollution levels in order to maximize their subsidies.

BOX 3-11: Debates About Subsidies

Assurance of Meeting Goals

Promotes criterion: Full subsidies are capable of achieving environmental goals to the extent that those funding the subsidies are willing to pay.

Impairs criterion: Subsidies when used alone do not require a particular level of pollutant abatement, They can encourage new businesses to open and old ones to remain, thereby increasing aggregate emissions.

Pollution Prevention

Promotes criterion: Subsidies can be awarded expressly for pollution prevention,

Impairs criterion: Preferential tax treatment or other subsidies can be awarded for end-of-the-pipe control, which can discourage pollution prevention.

Environmental Equity and Justice

Promotes criterion: Subsidies can promote environmental justice, by being targeted to specific pollution sources affecting poor or minority neighborhoods.

Cost-Effectiveness and Fairness to Sources

Promotes criterion: Subsidies can be used to compensate for unfairness caused by regulatory programs.

Impairs criterion: Subsidies' purposes are sometimes stated so specifically that they can lead to choices that are not cost effective for society. They can create financial inequities among entities.

Demands on Government

Impairs criterion: Government subsidies cost money.

Adaptability

Promotes criterion: Subsidies can have enough flexibility to adapt to new science or technology.

Impairs criterion: The scope of many subsidies' mandates is so narrow that rulemaking or legislation is required to accommodate new science or technology.

Technology innovation and Diffusion

Promotes criterion: Subsidies can help diffuse new technologies.

Impairs criterion: There is little or no data to prove subsidies cause innovation,

SOURCE Office of Technology Assessment. 1995,

Technical assistance may take many forms, ineluding manuals and guidance, training programs and materials, information clearinghouses, facility evaluations, and technology R&D. The latter may be conducted in house or through grants or loans to regulated entities or universities. Many junctions of environmental agencies can be called technical assistance. For example, the Oregon Department of Environmental Quality (DEQ) identified 35 separate programs as providing technical assistance, noting that technical assistance played a large role in day-to-day environmental management activities.[38] Most technical assistance services are provided at no cost to the user. Yet sometimes technical assistance is offered in exchange for a prior agreement from the facility to implement any recommendations. For example, in the federal Green Lights program, EPA performs an onsite evaluation to identify ways in which a facility could reduce energy consumption, in exchange for a promise from the facility to install recommended equipment.

Participation in technical assistance programs typically is voluntary, not mandatory. However, these programs often offer significant incentives to participate. Such incentives include the benefits of the knowledge or services provided, favorable public relations, and perhaps, a positive working relationship with a regulatory agency.

Extent of Use

Before the 1970s, the federal government's primary environmental role was to provide technical assistance to states and private firms, offering them the benefit of federal agency expertise in solving what were viewed as largely local problems. While the federal government's role grew dramatically in the intervening years, with the passage of major environmental legislation, it still performs an important technical assistance function. In the 1990s these technical assistance programs are increasing both in number and variety.

Some technical assistance programs have been developed in response to congressional mandates, while others have been initiated by EPA and other agencies.

An example of a congressionally mandated technical assistance programs is the section 507 program established by the Clean Air Act Amendments of 1990 (239). The Act requires states to establish Small Business Stationary Source Technical and Environmental Compliance Assistance Programs. These Section 507 programs are targeted particularly at those small businesses that are newly subject to regulation, are non-major sources as defined under the Clean Air Act, and which might otherwise lack the technical expertise and financial resources to evaluate regulatory requirements and determine appropriate compliance approaches (202). The programs include onsite auditing, information packets, information clearinghouses, and other forms of technical assistance.

Similarly, CERCLA establishes the Technical Assistance Grants (TAG) Program. TAGs are intended to assist the affected community at Superfund sites to understand and evaluate problems posed and to help assure cleanup methods were chosen appropriately. "[A]ny group of individuals which may be affected by a release or threatened release" is eligible for a TAG.[39]

Some technical assistance initiatives are intended to help implement mandated environmental programs. For example, section 319 of the Clean Water Act calls for states to manage diffuse nonpoint sources of water pollution. EPA and the U.S. Department of Agriculture have developed extensive guidance documents describing BMPs that nonpoint sources might use to control their pollution. Both federal and state agencies distribute this guidance widely and also have sponsored a series of field evaluations.

Other technical assistance programs do not respond directly to statutory mandates, but are derived from the general objective to improve environmental quality. A recent example of federal technical assistance is EPA's Green Lights Program. EPA conducts an energy audit of participat-

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[38] DEQ concluded that two-thirds of the programs were compliance oriented, while the remaining one-third focused on pollution prevention. The amount of assistance ranged from comprehensive technical help, including on-site evaluations, to more limited technical assistance such as telephone hotlines. DEQ's technical assistance programs cover a wide variety of audiences, including the general public; federal, state, and local government agencies; schools; and regulated and nonregulated businesses. Oregon Department of Environmental Quality, *Enhancing Technical Assistance and Pollution Prevention Initiatives at the Oregon Department of Environmental Quality,* (Salem, OR: April 1994).

[39] A TAG may not exceed $50,000 per grant recipient unless the President finds that the purposes of the program require the limit to be waived. CERCLA § 117, 42 U.S.C. § 9617.

ing Green Lights Partners, and makes specific recommendations for more energy-efficient lighting systems, in exchange for an agreement from participants to install the recommended equipment.[40] Participants receive the benefit of an energy audit and lower utility bills, favorable publicity, and a cooperative working relationship with a regulatory agency (41,68).

A similar EPA program, Water Alliance for Voluntary Efficiency (WAVE), is designed to encourage participants to install water-efficient fixtures in exchange for an EPA audit of their facilities. A number of similar programs have sprung up in recent years and are receiving additional attention in the wake of Vice President Gore's reinventing government initiative. They include the "energy star" program aimed at encouraging the development of energy-efficient products such as green computers and super-efficient refrigerators, and Wastewi$e and Climate-Wise, which provide technical assistance for reductions in, respectively, solid waste and greenhouse gasses. Such programs are often supported by hotlines, information packets, and onsite evaluations.

Hotlines are a form of technical assistance heavily used for both mandated and discretionary federal environmental programs. Hotlines generally provide free technical assistance to both the regulated community and the public, usually either by providing information directly over the telephone or by mailing requested materials. Examples of EPA hotlines functioning in late 1994 include—

- the Control Technology Center (CTC) Hotline providing technical support and guidance concerning air emissions control technologies;
- Emergency Planning and Community Right-To-Know and Superfund Hotline, providing regulatory, policy, and technical assistance to government agencies, the public, and the regulated community;
- Pollution Prevention Information Clearinghouse, providing pollution prevention information to the public; and
- the Safe Drinking Water Hotline, providing assistance and information to the regulated community and the public.[41]

State governments have been very active in developing technical assistance programs, especially for pollution prevention. In fact, until recently states have relied almost exclusively on technical assistance as the instrument for pollution prevention. The size of state technical assistance programs varies widely.[42] Since the late 1980s, EPA appropriations have included special grants funds for Pollution Prevention Incentives For States (PPIS) grants, which offer a 50-percent federal match for state assistance program funding (195).[43]

Key Criteria Affecting Tool Selection

Assurance of meeting goals

Technical assistance programs do not require target entities to control their emissions. Instead, these programs seek to achieve environmental goals by increasing the understanding of pollution

[40] Green Lights Partners must also submit an annual reporting form, specifying the number of fixtures, wattage per fixture, the number of kilowatt hours, and other energy-related data. M. Arnold, Green Lights Program, U.S. Environmental Protection Agency, Washington, DC, personal communication, Dec. 15, 1994.

[41] For a complete list, see U.S. Environmental Protection Agency, *Headquarters Telephone Directory*, EPA 208-B-94-001 (Washington, DC: August 1994).

[42] Nationwide, the programs average three to four staff people although some are considerably larger. For instance, Massachusetts' Office of Technical Assistance and North Carolina's Pollution Prevention Program each have about 30 staff.

[43] The Pollution Prevention Act of 1991 authorized $8 million per year in grants. Between 1989 and 1993, about $20 million in PPIS grants was awarded by EPA.

problems and potential solutions. Assistance can always be rejected, and likely will be if the solutions identified are expensive or if the promised paybacks do not fit with a particular firm's economic horizon. Anecdotal and evaluative data indicate that technical assistance programs improve environmental quality (129).

Available data are less clear about whether environmental goals are in fact achieved. Technical assistance programs are often used in combination with other environmental policy tools.

Pollution prevention

Technical assistance has a 10-year history as an instrument for pollution prevention. There is a growing body of anecdotal evidence that when the government provides onsite evaluations, increased use of pollution prevention is more likely (55).

What is less clear, however, is whether technical assistance alone can realize the goals of the Pollution Prevention Act of 1991. States have been the leaders in using technical assistance for pollution prevention. Many are now moving toward more prescriptive means, integrating pollution prevention into regulations and requiring facility planning. As a result, technical assistance is becoming less of a stand-alone instrument and being used more in combination with others to achieve pollution prevention goals.

Environmental equity and justice

Some forms of technical assistance can help poor and minority groups have meaningful input in the public notice and comment rulemaking procedures. Often, proposed rules have very technical and complex foundations that are difficult for nonspecialists to evaluate and comment upon. Technical assistance targeted at such groups could highlight a proposal's implications, and help groups better understand and comment on the underlying issues. For instance, CERCLA Section 117 authorizes EPA to make technical assistance grants to any group of individuals affected by a Superfund site (249). The grant enables citizen groups concerned about a particular Superfund cleanup site to hire technical expertise to help them understand the issues and evaluate alternative cleanup proposals.

Technical assistance to regulated entities would only indirectly pursue environmental justice goals because it does not call for a particular level of pollution abatement. However, technical assistance might assist in remediation of existing pollution problems, if those responsible for cleanup are uncertain as to the most effective and timely remediation techniques.

Cost-effectiveness and fairness

Technical assistance programs can help attain least-cost pollution reductions if they are targeted at the appropriate entities and are at an appropriate intensity. Firms operate with limited information concerning the nature and impact of their emissions and the approaches which they might take to reduce emissions. Technical assistance can help reduce these information gaps that otherwise might impair achievement of cost-effective pollution control.

However, to help attain a least-cost solution, technical assistance must be at an appropriate intensity and targeted at groups with significant information gaps. Information and its dissemination are not costless. If technical assistance programs focus on onsite evaluations when informational brochures would have as effectively educated the target audience, the program does not attain environmental goals cost effectively. Similarly, a technical assistance program would not be cost effective if most participants in technical assistance programs are those entities who are already well informed and with other sources of necessary information. Cost-effectiveness is ultimately determined by how well the resources devoted to technical assistance motivate positive changes in the environment.

Data on the cost-effectiveness of technical assistance programs are not extensive, in part be-

BOX 3-12: Debates About Technical Assistance

Assurance of Meeting Goals

Promotes *criterion:* When combined with other instruments, technical assistance can lead to improved environmental quality.

Impairs criterion: Technical assistance does not require reduction in pollution

Pollution Prevention

Promotes criterion: Technical assistance can help firms identify opportunities for pollution prevention, and change attitudes towards pollution prevention.

Impairs criterion: Technical assistance alone might not be enough to achieve pollution prevention goals, but may be better used in combination with other instruments.

Environmental Equity and Justice

Promotes criterion: Technical assistance to communities can help to increase public awareness of the environmental implications of existing programs and proposed rules.

Cost-Effectiveness and Fairness to Sources

Promotes criterion: Technical assistance can help reduce information gaps which otherwise impair achievement of cost-effective control.

Impairs criterion: While technical assistance can result in savings to the target entities, it mayor may not be cost effective for society.

Demands on Government

Impairs criterion: Technical assistance is a resource commitment by government.

Adaptability

Promotes criterion: Technical assistance can accommodate new scientific or engineering information, without structural programmatic changes.

Technology Innovation and Diffusion

Promotes criterion: Technical assistance diffuses knowledge of pollution control technologies.

Impairs criterion: Technical assistance does little if anything to foster technology Innovation.

SOURCE, Off Ice of Technology Assessment, 1995

cause it is often difficult to attribute observed environmental progress to a particular technical assistance program. Data does exist, however, that indicate cost savings to firms from onsite technical assistance exceed the cost of providing the assistance. This was the case, for example, for the Massachusetts Office of Technical Assistance (MassOTA), discussed in chapter 2 of this assessment.

Adaptability

Technical assistance programs, compared to other instruments, are easily modified in light of a change in scientific knowledge, abatement capability, or budget. The modifications might be to the information disseminated by the program or to the structure of the program itself, depending on the nature of the change.