# ENVIRONMENTAL POLICY INSTRUMENT CHOICE: THE CHALLENGE OF COMPETING GOALS

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## I. INTRODUCTION

The search for "smarter" ways to prevent and control pollution has generated heated debate on almost every topic related to setting goals, improving institutional arrangements, and choosing the most effective means for achieving those goals. Given the need to balance other competing concerns, choosing the means or policy instruments to meet environmental goals can be a surprisingly complex task for decision-makers. Unfortunately, today's environmental policy toolbox contains numerous and varied instruments yet lacks a clear set of instructions for their use.

Richards' article, *Framing Environmental Policy Instrument Choice,*[1] proposes a new theoretical framework for choosing such instruments. He develops a taxonomy that provides the user with a list of characteristics for each policy tool,[2] and he suggests a normative criterion for evaluating the instruments applied to a specific problem: *minimize public and private costs in light of legal and political constraints*.[3]

In contrast to Richards' efforts, we adopted the perspective that *each decision-maker or stakeholder may prefer a different instrument*

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1. Kenneth R. Richards, *Framing Environmental Policy Instrument Choice*, 10 DUKE ENVTL. L. & POL'Y F. 221 (2000).

2. *See id.* at 230-54.

3. *See id.* at 226-30.

*choice depending on his or her values*. In fact, our experiences tell us that within the complex political process of choosing environmental instruments, it is unrealistic (even dangerous) to assume that all will subscribe to one, single criterion. Thus, we propose a list of more diverse evaluation criteria and suggest that each instrument should be evaluated in light of the fact that each criterion will be important to some, but not necessarily all, decision-makers. We also present a framework within which a decision-maker can consider the characteristics of a particular problem, along with his or her values, and choose one—or, more likely, more than one—instrument to help solve a problem. Our framework also presents a way for those who seek to promote a particular instrument for political or ideological purposes to scope out the advantages and disadvantages of their choice, given other stakeholders' preferences.

In this Comment, we draw from one of the analytical efforts cited by Richards, our 1995 Office of Technology Assessment (OTA) Report, *Environmental Policy Tools: A User's Guide*.[4] This OTA Report was prepared at the request of the Senate Committee on Environment Public Works to help Congress sort out the often conflicting claims about the effectiveness of major policy instruments. Congressional interest in what may, at first, appear to be a somewhat arcane topic grew out of experimentation with policy tools that use or improve market forces. For example, several of these experiments were contained in the Clean Air Act Amendments of 1990.[5] As Congress faced reauthorization of other major pieces of environmental legislation, many had high—sometimes too high—expectations of what these approaches could accomplish. Others were suspicious—sometimes too suspicious—about whether they could provide meaningful protection.

The "user's guide" that we developed presents a pragmatic set of instructions to help decision-makers narrow the choice of instruments for addressing a particular problem. First, the Report describes twelve policy tools and how and where they are currently being used.

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4. OFFICE OF TECH. ASSESSMENT, U.S. CONGRESS, REP. NO. OTA-ENV-634, ENVIRONMENTAL POLICY TOOLS—A USER'S GUIDE (1995), <http://www.wws.princeton.edu/~ota/> [hereinafter OTA REPORT]. Dr. Friedman, Ms. Downing, and Dr. Gunn were primary authors of this report. The following individuals contributed background analyses to the OTA Report: Gary C. Bryner, Damaris Christensen, Don H. Garner, George R. Heaton, Donald T. Hornstein, Barnett M. Lawrence, Jan Linsenmeyer, Stephen Lipmann, Thomas O. McGarity, Kirsten Oldenburg, Pat Parenteau, Barry G. Rabe, Clifford S. Russell, Sidney A. Shapiro, Daniel Tarlock, and Kathryn Wagner.

5. *See* 42 U.S.C. §§ 7651-7651o (1994).

Then, we rated the relative effectiveness of these tools in achieving each of seven criteria often considered when evaluating and creating environmental policy. The ratings were based on state, federal and international experiences, as well as on scholarly literature. Third, because the strengths and weaknesses of a policy tool depend greatly on the environmental problem being addressed,[6] we provided a series of key questions to be considered along with our judgments about "typical" instrument performance. Given a decision-maker's preferences for certain criteria, this framework draws attention to those instruments which might be particularly effective—or warrant some caution—in addressing a particular problem.

This Comment provides a brief comparison of how Richards' effort to frame instrument choice compares with our OTA Report's approach in order to help the reader see how the two are linked, yet clearly quite different in scope and intent. We then turn to the issue of how such instrument choice analyses can be made most useful to decision-makers who must address current and future environmental problems in the face of competing claims and interests.

## II. THE INSTRUMENT CHOICE PROBLEM

Both Richards' article and the OTA Report break the instrument choice problem into four distinct tasks: 1) identification of the instruments themselves, 2) a taxonomy or categorization of these instruments, 3) criteria for judging the desirability of instruments, and 4) a procedure for synthesizing all of the information above to help a policy-maker choose an instrument to solve a specific policy problem.[7] The relative emphasis, however, is quite different in each. For example, Richards stresses instrument taxonomy ("dimensions")[8] while we stress evaluation criteria as the key factor for framing instrument choice. First, we will explain what each task involves, borrowing heavily from the field of biology, and then we will compare how Richards and the OTA Report develop and use each task to inform choices.

Task 1 is to list—and in the OTA Report, define and describe—the instruments themselves. Taxes, marketable permits, and

6. *See* Giandomenico Majone, *Choice Among Policy Instruments for Pollution Control,* 2 POLICY ANALYSIS 589 (1976).

7. *See generally* Richards, *supra* note 1, at 226, 232, 254-55; OTA Report, *supra* note 4, at 7-29, 143-98.

8. *See* Richards, *supra* note 1, at 233-54.

emissions standards are all examples of the "phenomena" that we are trying to understand. In some senses, these instruments can be considered the equivalent of organisms: their existence is independent of the biologists that endeavor to classify them, but like organisms, they are often difficult to classify into species.

Although they do not look alike, Great Danes and Chihuahuas can both be easily identified as being of the same species because they meet the functional test of being able to interbreed. On the other hand, blackberries (subgenus *Eubatus* of the genus *Rubus*) are harder to categorize since they reproduce asexually, and thus cannot be classified based on a simple functional test. Consequently, they have been classified at various times into just a few species and at other times into a few hundred.

Richards presents sixteen different groupings of instruments (including his and OTA's)[9] that differ, not only in their categorization scheme, but also in their lists of instruments. Deposit/refund, the common name for the approach often used to encourage people to return their bottles and cans, is considered a separate instrument under several of the categorization schemes that Richards reviews.[10] In contrast, both Richards and OTA consider it a joint application of a tax and a subsidy. Either approach is viable: the task of naming instruments is important only insofar as it helps a policy- or decision-maker understand the suite of choices he or she faces without having to review hundreds of previous applications. And, much of this help comes from the information contained in other pieces of the puzzle. Comparing the entries in the sixteen groupings Richards lists reveals, surprisingly, more uniform "naming" for the market-oriented instruments than for the more traditional approaches under the Clean Air Act (CAA) and Clean Water Act (CWA).[11]

Task 2 involves further categorization of these instruments into a taxonomy (or "dimensions," as Richards prefers) in order to develop a useful decision-making framework. In biology, the purpose of classifying above the species level—into genus, family, and so on—is to

9. *See id.* at 238, 245, 284-85.

10. *See id.* at 253, 284-285.

11. *See id.* at 284-285. Indeed, Congress adds to the diversity of names. *See*, *e.g.,* Clean Air Act (CAA) , 42 U.S.C. § 7651(b) (provision "...to reduce ... annual emissions of sulfur dioxide ... by requiring compliance ... with prescribed emission limitations ... which ... may be met by an emission allocation and transfer system"); CAA, 42 U.S.C. § 7411(a)(1) (setting standards of performance for new sources which "reflect the degree of emission limitation achievable through the application of the best system of emission reduction which ... the Administrator determines has been adequately demonstrated").

capture the evolutionary relationships among species. Richards states that in his taxonomy, "the instruments are organized according to the role that the government plays in each."[12] Thus, his seven dimensions include, for example, whether the government is passive versus interventionist, how much government controls the selection of abatement practices, whether the costs are born by government/society or private parties, and whether the government controls prices or quantities.[13]

Our taxonomy is organized from a slightly different perspective—by looking at the flexibility of the instrument requirements from the perspective of the regulated entities. We ask: are the pollution quantities (or targets) fixed or not, and if fixed, must they be met by every single source, or cumulatively by multiple sources?

Richards' broad taxonomy applies to more environmental issues than the OTA study, such as natural resources management. The OTA study limited its purview to the major pollution control laws (CAA, CWA, Resource Conservation and Recovery Act (RCRA)).[14] Under these laws, regulated entities are generally responsible for cleaning up their own pollution. The study focuses on the rules governing these regulated entities (regardless of their status as a public or private entity), and ignores the aspect in which the federal government subsidizes pollution abatement projects, such as construction of sewage treatment plants by localities. Generally, the federal government provides clean-up services only in cases where government is the polluter (e.g., defense waste) or when the responsible parties cannot be found (Superfund), and there has been little support in recent Congresses to expand this role.

Richards points out that government may be expanding its role in the case of carbon sequestration to control atmospheric concentrations of carbon dioxide.[15] If true, his taxonomy is particularly appropriate. But even here, if the United States signs the Kyoto Protocol, it will be the regulated entity. Nevertheless, Richards' taxonomy is much more useful for resource management issues, where it is generally considered quite legitimate for the federal government to be the producer of goods and services.

Task 3 is to define the criteria by which instrument performance is judged. Richards states that the preferred instrument "minimize[s]

12. *See id.* at 232.
13. *See id.* at 233-54.
14. 42 U.S.C. §§ 7701-7671q; 33 U.S.C. §§ 1251-1387; 42 U.S.C. §§ 6901-6992k.
15. *See* Richards, *supra* note 1, at 275-77.

the social cost of achieving a given environmental goal" in light of certain legal and political constraints.[16] Richards' formulation of social costs includes the usual list of direct abatement costs and transactions costs, but adds another factor that is typically ignored—public finance impacts. He quite usefully points out that, with respect to this last criterion, subsidies are at the bottom of the heap.[17]

Richards asserts that instrument choice is, at its core, a *cost* optimization problem: choose the least cost instrument, unless it is not within the "feasible set" due to a legal or political constraint.[18] Our formulation of the choice issue is quite different. Certainly, instrument choice involves tradeoffs, but the list of criteria to be considered covers a much broader set of societal concerns than costs alone. The OTA Report grouped these criteria into three central, yet broad categories: environmental results, costs and burdens, and change.[19] No single criterion or group of criteria is paramount, as cost acts in Richards' approach. Nor is the relative importance of each criterion assumed to be the same among all decision-makers, or even among all environmental problems.

All else being equal, policy-makers will certainly favor lower costs, but all else is seldom equal.[20] For example, environmental goals are not inviolate constraints, as the history of slipped deadlines under every major piece of environmental legislation amply illustrates. Thus, some policy-makers will prefer the least-cost instrument, while others will be willing to trade higher costs for greater assurance of reaching the goal. Moreover, the willingness of an individual decision-maker to make this tradeoff may vary according to the characteristics of the problem, including riskiness, cost, and other concerns. Similarly, environmental equity concerns are of greater importance to some policy-makers than others, the ability to spur technological innovation is of greater importance for solving some environmental problems than others, and so on. The cost-minimization criterion favored by Richards does not square with our observations of Congressional decision-making.

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16. *See id.* at 228.

17. *See id.* at 271-272.

18. *See id.* at 230.

19. *See* OTA Report, *supra* note 4, at 144.

20. *See*, *e.g.*, Majone, *supra* note 6, at 602-603 (explaining that "[e]conomic efficiency is clearly inadequate as a criterion for choosing among policy instruments. We see this once we admit that efficiency and equity considerations, often usefully distinguished in more limited contexts, cannot be separated in policy-making.").

Task 4, undertaken by both Richards and OTA, is to devise a procedure for synthesizing all of the information above in a manner that will help a policy-maker choose an instrument to solve a specific policy problem. Richards does this by summarizing some "heuristic principles for environmental applications."[21] Richards' Table 3 presents a rough rating of the attractiveness of five instruments with regard to the cost criteria and legal constraints (eight criteria in total) discussed in the previous task.[22]

Similarly, the OTA report presents an evaluation of the twelve instruments it covers with regard to its seven major evaluation criteria;[23] it also includes a detailed table[24] containing twenty-six criteria breakdowns, reflecting the diversity of concern among business, environmentalist, and government stakeholders. In addition, it offers a series of "key questions for matching policy tools to problems" to help a policy-maker, or more likely his or her staff, navigate through the almost bewildering array of evaluations.[25]

The difference in the relative emphasis among the four tasks presented above might most easily be explained by the stated goals of the two efforts. Richards' purpose is "to provide a conceptual framework for understanding" policy instruments.[26] Our goal is to provide a framework for choosing, that is, a set of toolbox instructions that has been missing, and thus our OTA Report title—*Environmental Policy Tools: A User's Guide.*

## III. THE TOOLBOX

Environmental policy tools could be categorized in any number of ways, depending on which attributes one wishes to emphasize. One useful approach is to group twelve policy instruments into two major categories depending on whether or not they impose fixed pollution reduction targets. These two categories help focus attention on a common concern in environmental policy—namely, the extent to which particular behavior is mandated by regulation. Table 1 provides a brief description of each of the twelve policy tools. Figure 1 shows how frequently each instrument is used in the approximately

21. *See* Richards, *supra* note 1, at 278-281.
22. *See id.* at 280.
23. *See* OTA Report, *supra* note 4, at 198-200.
24. *See id.* at 199.
25. *See id.* at 34.
26. *See* Richards, *supra* note 1, at 224.

thirty major pollution control programs under the CAA, CWA and RCRA.

### TABLE 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 result, 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"[27] or "best practicable"[28] 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 emissions 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 design standards can be considered *de facto* technology specifications when it is extremely difficult to prove to the regulatory agency that an alternative is equivalent to the model technology. |
| **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 byproducts. As a result, the instrument is used most heavily under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)[29] and other statutes where the hazard is the commodity. |

27. *See*, *e.g.*, Clean Water Act, 33 U.S.C. § 1311(b)(2)(A).
28. *See* CWA, 33 U.S.C. § 1311(b)(1)(A).
29. 7 U.S.C. §§ 136-136y (1994).

**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 of time, 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" approach where unregulated sources may voluntarilly opt into the program. Emissions trading has been used most widely under the Clean Air Act,[30] and to a more limited degree to address water quality issues.[31] |
| **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.[32] Other types of integrated permits are still uncommon but are being studied 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. As a result, 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. |

30. *See, e.g.,* 42 U.S.C. §§ 7651-7651o.

31. *See, e.g.,* U.S. ENVIRONMENTAL PROTECTION AGENCY, EPA-800-R-96-001, DRAFT FRAMEWORK FOR WATERSHED-BASED TRADING (May 1996) [hereinafter WATERSHED-BASED TRADING] <http://www.epa.gov/owow/watershed/framework.html>.

32. *See* Emissions Trading Policy Statement: General Principles for Creation, Banking, and Use of Emission Reduction Credits, 51 Fed.Reg. 43814 (December 4, 1986) [hereinafter Policy Statement](describing the bubble policy under the CAA); Standards of Performance for New Stationary Sources, 40 C.F.R. pt. 60 (1987) (allowing an air bubble method as an alternative means of compliance); Iron and Steel Manufacturing Point Source Category Effluent Limitations Guidelines, Pretreatment Standards, and New Source Performance Standards, 40 C.F.R. pt. 420 (1982)(creating the iron and steel water bubble).

## 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 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. 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,[33] 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 the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Oil Pollution Act.[34] |
| **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. |
| **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. Historically, government subsidies have been widely used, particularly in wastewater treatment.[35] Subsidies from other parties are becoming more common as government budgets shrink. |

33. *See*, *e.g.*, DON FULLERTON & THOMAS KINNAMAN, HOUSEHOLD DEMAND FOR GARBAGE AND RECYCLING COLLECTION WITH THE START OF A PRICE PER BAG (National Bureau of Economic Research Working Paper No. 4670, 1994); SUMMARY OF PROJECT 88/ROUND II WORKSHOP PROCEEDINGS: INCENTIVE-BASED POLICIES FOR MUNICIPAL SOLID WASTE MANAGEMENT (Kennedy School of Government, CSIA Discussion Paper 91-7, 1991).

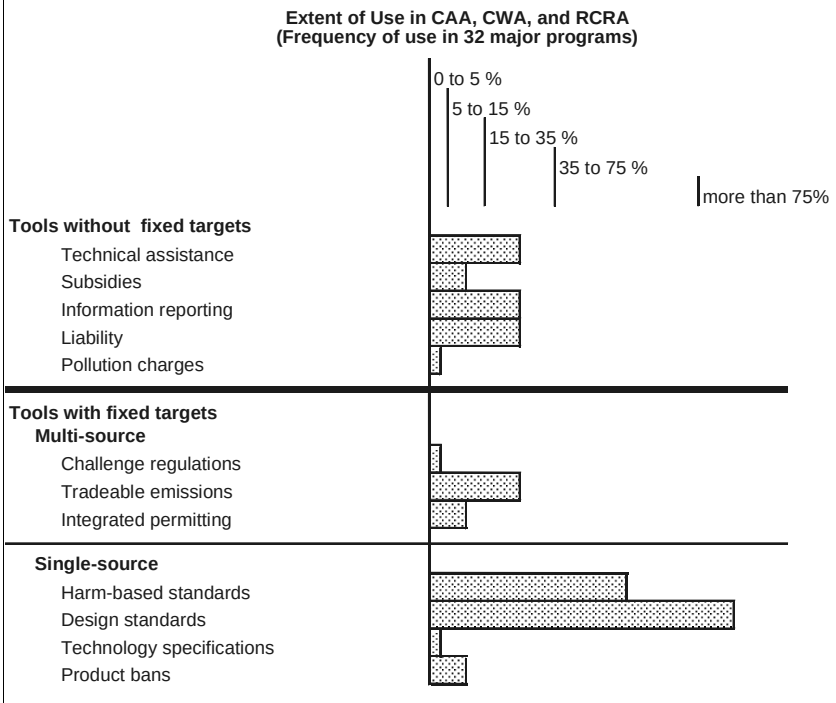
34. *See* 42 U.S.C. § 9607 (1994); 33 U.S.C. § 2702 (1994).

35. *See, e.g.,* Clean Water Act , 33 U.S.C. §§ 1281-1299, §§ 1381-1387.

**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.

**FIGURE 1: Policy Tools Used in the Clean Air Act, Clean Water Act, and the Resource Conservation and Recovery Act**




SOURCE: Office of Technology Assessment, 1995

### A. *Tools with Fixed Pollution Reduction Targets*

Policy instruments that impose regulatory limits on environmentally harmful behavior vary in the extent to which they specify *how* a target entity should comply with emission limitations. For example, technology specifications might require the use of a specific pollution control device, while a harm-based standard prescribes a compliance target and leaves regulated entities free to choose their own method of compliance. Another significant indicator of flexibility is whether the tool focuses on single sources, or sets limits on cumulative emissions from multiple sources.

Tools that focus on single sources of pollution require regulated entities themselves to comply with emission limitations or face associated civil or criminal penalties. These tools are often called "traditional" or "command-and-control" approaches because historically, they have been the most heavily used category of tools, and they often allow less flexibility than multi-source tools.

#### 1. Single-Source Tools

Tools that focus on single sources of pollution include product bans and limitations, harm-based standards, design standards, and technology specifications. *Product bans and limitations* ban or restrict 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 the polluting by-products from its manufacturing. *Harm-based standards* prescribe the end results of regulatory compliance, not the means. Desired end results are based on health and environmental effects of different pollution levels and patterns. In contrast, the end results required by *design standards* are based on what a model technology might achieve. Sources are free to use the model technology or demonstrate that another technology or technique achieves equivalent results. *Technology specifications* designate the technology or technique a source must use to control its pollution. In its "pure" form, the specification is explicit.

A brief note on the misunderstood policy tool of design standards is in order. Design standards can, and often do, present a much more flexible regulatory challenge to firms than the technology straitjacket they are frequently likened to. The confusion arises from how an agency uses model technologies when translating a general statutory standard into an enforceable limitation. 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 "maximum achievable control technology."[36] Such broad expressions of effectiveness do not provide enough detail about what regulated entities must do to comply with the law. When implementing a design standard, the Environmental Protection Agency (EPA) or the applicable state agency will have to determine what stringency of emission control is associated with the standard. If the standard is, for example, any "reasonably available control technology," the agency must first decide which entities are representative of the target group, and then determine what technology is reasonably available based upon those representative entities. The agency can then calculate the level of emissions control that occurs when a source uses the chosen model control technology. Design standards are typically imposed on individual sources through permits with specific numeric or narrative emissions control requirements. Because firms have the freedom to achieve those limits by using either the model control technology or an approach that achieves equivalent results, design standards do not explicitly dictate the technology that firms must use. The OTA team could not identify a single design standard that explicitly mandated a specific technology, without allowing equivalent approaches as an alternative. That said, firms may react to design standards as if they were a technology specification, if they choose to "play it safe" by picking the model technology known to achieve the required level of pollution control, or if they have no practical opportunity to demonstrate equivalency of alternative approaches. Note that this inflexibility arises primarily from how the policy tool is implemented, not from inherent characteristics of the tool itself.

Single-source tools seem to be effective choices where environmental results are of primary concern, and where there is less of a focus on costs. Although the tools provide varying levels of flexibility when telling sources "what to do," they all establish explicit emission targets for each source, and therefore, provide a relatively straightforward basis for verifying compliance. As a result, single-source tools are the most effective of the dozen tools that we consider in this article for providing assurance that environmental goals will be met. However, they are not as effective for addressing concerns about minimizing compliance costs because they are relatively less flexible than other instruments, and thus reduce opportunities for achieving

36. *See, e.g.,* Clean Air Act, 42 U.S.C. §§ 7502(c)(1), 7412(d)(2).

goals in a cost-effective manner. In addition, they can impose substantial administrative burdens on regulatory agencies and regulated entities.

2. Multi-Source Tools

Some policy instruments that impose regulatory limits on pollution focus on multiple sources rather than a single source. Multi-source tools allow a regulated entity additional flexibility in how it complies with emission limitations. A polluter has two options; it can change its own behavior to fit within the prescribed limitations, or it can arrange with another entity to have the second entity comply with the limitations on its behalf. This ability to transfer or negotiate responsibility among entities for changing behavior distinguishes multi-source from single-source tools.

Multi-source tools include tradeable emissions, challenge regulation, and integrated permitting. A *tradeable emissions* program often consists of government-issued permits that are transferable. The government agency sets a level of aggregate emissions consistent with environmental goals by issuing only the number of permits corresponding to that level of emissions. Entities are then allowed to transfer their permits; they might choose to do so if the relative costs of emissions control make it more profitable, or less expensive, to transfer the permit to another entity. A relatively new use of tradeable emissions is in "open markets," in which government does not issue permits up front, but where regulated or unregulated sources may voluntarily opt into the program.

With *challenge regulation*, the government establishes a clear, measurable target with a timetable for implementation, but the multiple sources in a target category are given responsibility for designing and implementing their own programs to achieve that target. Challenge regulation differs from other purely voluntary programs in that the government specifies a credible alternative program, or sanction that will be imposed should progress toward targets be unsatisfactory.

*Integrated permitting* incorporates multiple requirements into a single permit over an entire facility, rather than having a permit for each emissions source within the facility. A facility-wide integrated permit might list emissions limits for each source within the facility, or the permit might list a single limit per pollutant for the entire facility, allowing the facility to use any combination of controls to meet an overall emissions cap. A multimedia integrated permit also may combine limitations on emissions to air, water, and land in a single

permit, thereby taking into account the potential for pollution to move between media.

Multi-source tools are an effective choice when resource demands are of particular concern, and environmental results a close second. The tools allow facilities to seek the most cost-effective approach to achieving a particular level of aggregate emissions, whether through negotiation of emissions control responsibilities with other facilities or through use of an integrated permit with flexible source emission limits at a particular facility. Multi-source tools still require a particular level of pollution abatement, and thus provide a significant degree of assurance that environmental goals will be met, although perhaps less assurance than with the straightforward, single-source tools. The actual degree of assurance depends on the capability to monitor regulated pollutants.

B. *Tools Without Fixed Pollution Reduction Targets*

The second major category of tools shown in Table 1 comprises tools that encourage pollution prevention and control without setting specific emissions targets. Some of these instruments are nonregulatory in nature, while others require a particular action, such as payment per unit of emissions or submission of 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 move behavior in the desired direction fall into two subgroups: tools that make it easier or less expensive to lower pollution by providing knowledge or financial assistance, and tools that raise the financial stakes of continuing to behave in environmentally harmful ways.

Tools that encourage facilities to prevent or control pollution include technical assistance and subsidies. Both approaches assume that polluters will be more willing to change once they know of the benefits of alternative types of behavior, and more likely to change if the expense is, at least partially, offset by others. *Technical assistance* helps entities to make better environmental choices by clarifying the environmental harms that are consequences of their actions, and discussing what techniques or equipment reduce those harms. Technical assistance may also be focused on educating the general public about the environmental implications of existing and proposed programs and policies. *Subsidies* provide various forms of financial assistance that can act as incentives for entities to change their behavior or can help entities having financial difficulty to comply with imposed stan-

dards. Subsidies might be provided by the government or by other parties. They come in many forms: grants, low- or no-interest loans, preferential tax treatment, and deposit-refund systems.

Tools that increase the cost to those engaging in 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. *Pollution charges* require a regulated entity to pay a fixed dollar amount for each unit of pollution emitted or disposed of. 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. Then, entities 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. In its assessment, OTA focused on pollution charges that create behavioral incentives and do not merely raise revenue.[37]

By helping to increase public awareness of entities' pollution, *information reporting* affects target entity behavior somewhat less directly than pollution charges. Here, the hope is that the public's heightened awareness will increase public support for pollution control programs, and thus entities will be encouraged to be "good neighbors" and reduce their pollution.

*Liability* provisions require polluting entities to pay those who are harmed by their pollution to the extent of the damage incurred. Liability can provide entities with a significant motivation to engage in environmentally sound behavior because of the huge dollar amounts involved. Liability is imposed two ways: by common-law theories like negligence or nuisance, or by statute, such as in the CERCLA. The OTA Report considered only statutory liability, explicitly placing enforcement and compliance penalties as beyond its scope.[38] Obviously, however, enforcement and penalties are a necessary component of any of the regulatory instruments described above and can greatly increase the cost of environmentally harmful activities.

Behavior-modifying tools that do not set fixed pollution control targets, are particularly appropriate if the decision-maker desires an

37. *See* OTA REPORT, *supra* note 4, at 13.

38. *See id.*

environmental program that can readily adapt to changing science and control capabilities. Because these tools do not mandate any particular behavior, they should be used with caution where assurance of meeting environmental goals is a primary criterion.

## IV. CRITERIA FOR EVALUATING INSTRUMENTS

In contrast to Richards, we aim a substantial portion of our "instrument choice" effort at identifying and describing the key criteria that stakeholders use to determine the best instrument to apply to a specific problem. Experience indicates that instruments are seldom chosen on the basis of their formal or theoretical properties, but rather, are chosen for their known or perceived performance with regard to those criteria decision-makers and their constituents value most.[39]

Looking broadly at various environmental literatures and talking with a wide range of experts, we can identify three broad themes that have been the most prominent. The first—*environmental results*—addresses the public's demand, not only that we meet our goals, but also that we pursue these goals in appropriate ways. The second—lower *costs and burdens*—addresses the public's concern that we pursue our environmental goals at the lowest possible cost and with the fairest allocation of burdens among companies and between government and industry. The third—*change*—reflects a growing consensus that adaptable programs, which facilitate continual improvements in policies, may be essential for encouraging new scientific and technological solutions. Turning to particular details, Table 2 identifies seven criteria that policy-makers typically consider when adopting environmental programs.

39. For an earlier argument of this point, see Majone, *supra* note 6, at 603.

## TABLE 2: CRITERIA AND FACTORS USED FOR COMPARING INSTRUMENTS

| CRITERIA | FACTORS |
|---|---|
| ***Costs and Burdens*** | |
| **COST-EFFECTIVENESS AND FAIRNESS** | |
| Are we protecting human health and the environment at the lowest possible cost and with the fairest allocation of burdens for sources? | • Cost-effectiveness for society<br>• Cost-effectiveness for sources<br>• Fairness to sources<br>• Administrative burden for sources |
| **DEMANDS ON GOVERNMENT** | |
| Are we protecting human health and the environment at the lowest possible cost and with the best use of resources for government? | • Cost<br>• Ease of analysis |
| ***Environmental Results*** | |
| **ASSURANCE OF MEETING GOALS** | |
| Do stakeholders have confidence that environmental goals will be or have been met? | • Action forcing<br>• Monitoring capability<br>• Familiarity with use |
| **POLLUTION PREVENTION** | |
| Can the approach promote use of strategies for preventing rather than controlling pollution? | • Giving prevention an advantage<br>• Focusing on learning |
| **ENVIRONMENTAL EQUITY AND JUSTICE** | |
| Does the approach seek equality of outcomes, full participation by affected communities in decision-making, and freedom from bias in policy implementation? | • Distributional outcomes<br>• Effective participation<br>• Remediation |

***Change***

**ADAPTABILITY**

How easily can the approach be adapted to new scientific information or abatement capability?

- Ease of program modification
- Ease of change for sources

**TECHNOLOGY INNOVATION AND DIFFUSION**

Are we encouraging new ways to achieve our environmental goals that lead to improved performance in quality and costs?

- Innovation in the regulated industries
- Innovation in the EG&S industry
- Diffusion of known technologies

## A. *Environmental Results*

Congress sometimes chooses *voluntary* approaches for accomplishing environmental goals; at other times, it requires specific actions to improve human health and the environment. Yet, even when Congress has required specific actions, results have often fallen short of achieving the desired goal.[40] Thus, for many stakeholders in the environmental policy community, the most important priority continues to be working toward satisfactory environmental results.

### 1. Assurance of Meeting Goals[41]

When it comes to very serious environmental risks, the public is likely to want assurance that goals will be met. In fact, such assurance may be the "bottom line" criterion for many stakeholders, especially when the environmental problem poses serious risks to human health. In recent years, for example, community scrutiny of facilities using toxic or hazardous substances has increased, and has even included efforts to block siting. In such a context, choosing policies that provide assurance of achieving the desired results may seem more impor-

40. *See*, *e.g.*, COUNCIL ON ENVTL. QUALITY, EXECUTIVE OFFICE OF THE PRESIDENT, ENVIRONMENTAL QUALITY: TWENTIETH ANNUAL REPORT (1990) [hereinafter CEQ Report].

41. Parts of this section are based on THOMAS O. MCGARITY, ASSURANCE OF MEETING ENVIRONMENTAL GOALS (May 1994) (unpublished contractor report prepared for the Office of Technology Assessment, U.S. Congress, Washington, D.C.) (on file with authors).

tant than satisfying criteria that might otherwise be favored. At the national level, reports assessing progress toward protecting human health and the environment indicate that we are still far short of our desired goals.[42]

a. Degree of Action-Forcing

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

b. Monitoring Capability

Monitoring capability has two components: the capacity to determine whether or not the source is doing what is required for compliance, and the capacity to determine whether or not progress is being made toward the overall environmental goal. The level of confidence that goals will be met is influenced by how easy or difficult it will be to monitor results. For example, a technology-based strategy utilizing "percent reductions" in emissions or a "best available technology" approach is inherently easier to monitor than a risk-based strategy that designates an ambient environmental quality goal across multiple sources. Instrument performance that is relatively easy to monitor increases the opportunities for eventual accountability, enforcement, and evaluation of instrument effectiveness.

A stakeholder's *sense* of assurance may also be influenced by the availability of adequate monitoring technologies, and the type of monitoring regime used. For example, continuous monitoring may be considered by some to be essential for individual sources even though

42. *See*, *e.g.*, CEQ Report, *supra* note 40.

systematic, yet less sophisticated and less frequent monitoring, may be sufficient for others.

c. Familiarity Through Use

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

2. Pollution Prevention

The public is also concerned with *how* society meets its goals. For example, there has been increasing support for the idea that polluters should be asked to try their best to prevent, rather than control, pollution. Polluters can use pollution prevention strategies to meet or exceed environmental goals—strategies that seek the reduction of *all* non-product outputs, regardless of medium, restricted only by the limits of current process and product technology.

At the federal level, the Pollution Prevention Act of 1990 (PPA) does not mandate complete pollution prevention, but does require pollution prevention when *feasible*.[43] In addition, it requires certain firms to report, through the Toxics Release Inventory system,[44] on their "source reduction" activities.[45] At the state level, as of 1994, thirty states had enacted pollution prevention statutes, over half of which included provisions for pollution prevention facility planning. Some had also set statewide numerical pollution reduction goals.[46]

Despite these initiatives, both policy-makers and firms fail to adopt pollution prevention strategies as an alternative to pollution control in many instances, even when they may be less expensive in

43. *See* The Pollution Prevention Act of 1990, 42 U.S.C. § 13101(b) (1994) [hereinafter PPA].

44. *See id.* at § 13106.

45. *See id.* at § 13102. The PPA defines "source reduction" as any practice "which reduces the amount of any hazardous substance, pollutant, or contaminant entering any waste stream or otherwise released into the environment (including fugitive emissions) prior to recycling, treatment, or disposal; and…reduces the hazards to public health and the environment…"

46. *See* OTA Report, *supra* 4, at n. 195.

the long run. Continued reliance on control strategies may stem from a lack of awareness or information about pollution prevention, regulatory disincentives (or lack of incentives), or economic and institutional issues.[47] Therefore, in order for policy-makers to encourage pollution prevention strategies, some of the changes discussed below should be made.

a. Give an Advantage to Prevention

For both regulators and regulated entities, staying with known control technologies is the least risky choice. Even when regulations provide some flexibility of choice, the costs, operational conditions, and monitoring capabilities of known technologies are all predictable. Requiring or facilitating the use of pollution-prevention strategies over pollution-control strategies could improve the effectiveness of instruments.

b. Focus on Organizational Learning

Both private and public sector experts typically specialize in either air, water or waste management, areas that involve unique terms, technologies and institutional concerns. Moving away from this pattern of specialization toward broad prevention strategies may require a considerable shift of thought within organizations. Such a shift brings organizational issues to the forefront, issues including: how a firm is structured to make decisions about environmental issues; who makes the key decisions; whether top management demonstrates a commitment to prevention, makes resources available and rewards workers for their efforts; and the firm's capacity for flexibility in production processes.[48]

In most medium- to large-sized industrial firms, links between the production and environmental units have been weak.[49] Since pollution prevention seeks to integrate the idea of prevention into

47. *See*, *e.g.*, JOEL S. HIRSCHHORN & KIRSTEN U. OLDENBERG, PROSPERITY WITHOUT POLLUTION: THE PREVENTION STRATEGY FOR INDUSTRY AND CONSUMERS (1991); MINNESOTA OFFICE OF WASTE MANAGEMENT, REPORT ON BARRIERS TO POLLUTION PREVENTION (March 1991).

48. *See*, *e.g.*, Randy S. Price, *Benchmarking Pollution Prevention: A Review of Best-In-Class Facility Programs*, 4 POLLUTION PREVENTION REV. 93 (Winter 1993-94).

49. *See* Peter B. Cebon, *The Myth of Best Practices: The Context Dependence of Two Waste Reduction Programs*, *in* ENVIRONMENTAL STRATEGIES FOR INDUSTRY 167 (Kurt Fischer & Johan Schot eds., 1993).

production design, organizational leadership or even an agent of change at the facility level may be essential for accomplishing this objective.

3. Environmental Equity and Justice

Community-based groups have been increasingly successful in their efforts to raise awareness about environmental justice and equity concerns at all levels of policy-making. Traditionally, concern about the distributional effects of environmental protection policies focused primarily on either the relative costs and burdens placed on particular industries, or on the differential impacts on control sources because of size or age.[50] Less attention was given to understanding how these policies might redistribute environmental risks and benefits among individuals.[51] In fact, the thrust of much of the theoretical literature has been that environmental protection might hurt low-income individuals by eliminating jobs or forcing facilities to relocate.

Over the past decade, however, even these traditional concerns about environmental equity have been refocused on determining the extent to which specific groups of Americans may bear a disproportionate burden of environmental risks. This new focus is now widely referred to as "environmental justice."[52]

The body of empirical research investigating this focus is also relatively new. However, initial studies indicate that some minority and low-income communities have experienced adverse impacts from discriminatory siting of facilities and from the implementation of environmental laws.[53] These studies generally conclude that minorities

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50. For further explanation, see discussion *infra* Part IV.B.4 Cost Effectiveness and Fairness to Sources.

51. *See*, *e.g.*, Richard J. Lazarus, *Pursuing 'Environmental Justice:' The Distributional Effects of Environmental Protection*, 87 NW. U. L. REV. 787 (1993).

52. The literature remains unsettled about which words best identify this new focus. *See*, *e.g.*, Deeohn Ferris, *A Challenge to EPA*, 18 EPA J. 28 (Mar.-April 1992); Robert D. Bullard, *The Threat of Environmental Racism*, 7 NAT. RESOURCES & ENV'T 23 (1993) [hereinafter Bullard, *Threat*].

53. *See generally* COMMISSION ON RACIAL JUSTICE, UNITED CHURCH OF CHRIST, TOXIC WASTES AND RACE IN THE UNITED STATES: A NATIONAL REPORT (Public Data Access, 1987); Paul Mohai & Bunyan Bryant, *Environmental Injustice: Weighing Race and Class as Factors in the Distribution of Environmental Hazards* 63 U. COLO. L. REV. 921 (1992); GENERAL ACCOUNTING OFFICE, U.S. CONGRESS, RCED-83-168, SITING OF HAZARDOUS WASTE LANDFILLS AND THEIR CORRELATION WITH RACIAL AND ECONOMIC STATUS OF SURROUNDING COMMUNITIES (June 1, 1983); AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY, U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, THE NATURE AND EXTENT OF LEAD POISONING IN CHILDREN IN THE UNITED STATES (1988); D. R. Wernette & L. A. Nieves, *Breathing Polluted Air: Minorities Are Disproportionately Exposed*, 18 EPA J. 16

and low-income communities are more likely to be exposed to higher levels and multiple sources of environmental risks than are whites and high-income neighborhoods. A number of other interpretations of this data have been offered, and further attempts are being made to verify the data and, where possible, to clarify the reasons for and extent of disparities.[54]

Advocates of environmental justice seek to institute the following set of "principles" for decision-making regarding environmental issues: the "right to protection, prevention of harm, shifting the burden of proof, obviating proof of intent to discriminate, and targeting resources to redress inequities…."[55] These principles address the concerns of minorities and other vulnerable populations by restating environmental issues as issues of equity, social justice, and public health, rather than conflicts requiring trade-offs between health and economic well-being.[56]

Environmental equity and justice is now one of the standards against which environmental protection policies are measured.[57] For example, federal agencies are now required to address the "disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations."[58] The EPA, which has characterized environmental justice as concerned with identifying and addressing disproportionately high and adverse human health or environmental effects in minority populations and in low-income populations, has incorporated it as one of its six "guiding principles" for strategic planning.[59] More recently, the Clinton Administration's "10 Principles for

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(Mar.-April 1992) ; B. H. Wright, *The Effects of Occupational Injury, Illness, and Disease on the Health Status of Black Americans: A Review*, *in* RACE AND THE INCIDENCE OF ENVIRONMENTAL HAZARDS: A TIME FOR DISCOURSE (Bunyan Bryant & Paul Mohai eds., 1992).

54. *See*, *e.g*, Vicki Been, *What's Fairness Got To Do with It? Environmental Justice and the Siting of Locally Undesirable Land Uses*, 78 CORNELL L. REV. 1001 (1993); Vicki Been, *Locally Undesirable Land Uses in Minority Neighborhoods: Disproportionate Siting or Market Dynamics?* 103 YALE L. J. 1383 (1994).

55. *See* Bullard, *Threat*, *supra* note 52, at 23.

56. *See* ROBERT D. BULLARD, DUMPING IN DIXIE (1994); Robert D. Bullard, *Overcoming Racism in Environmental Decision-making*, 36 ENVIRONMENT 10, 12-20, 39-44 (May 1994).

57. *See*, *e.g.*, OFFICE OF POLICY, PLANNING, AND EVALUATION, U.S. ENVIRONMENTAL PROTECTION AGENCY, ENVIRONMENTAL EQUITY: REDUCING RISKS FOR ALL COMMUNITIES, (June 1992).

58. *See* Exec. Order No. 12,898, 59 Fed. Reg. 7629 (1994).

59. *See* OTA REPORT, *supra* note 4, at n. 213.

Reinventing Environmental Protection" incorporated ideas of environmental equity and justice, as well.[60]

Environmental equity and justice encompasses multiple issues, ranging from funding additional research, to identifying the disparate impacts of environmental policies, and developing more effective strategies for achieving certain goals. Key to securing environmental justice is being able to determine the direct and indirect means of discrimination.[61] One major concern is that, through their neighborhoods, jobs, and diet, these minority and low-income groups are exposed to larger amounts of pollution than are other members of the public.

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

a. Distributional Outcomes of Policies

The redistribution of risks and benefits through implementation of environmental laws occurs at varying geographic scales. For example, some areas of the country, notably urban areas such as Los Angeles, have much higher concentrations of air pollutants, such as ozone, than do rural areas. Within a local community, there may be large differences among neighborhoods in the relative exposure to hazardous or toxic substances. These types of inequities, especially in the absence of compensating benefits, are a primary concern for achieving environmental equity and justice.[62]

We considered two specific types of distributional outcomes that are central in efforts to protect all members of the public. First, environmental equity and justice must seek to address the issue of protection for the most vulnerable populations, especially since evidence exists that environmental regulatory agencies have failed to protect

60. *See* WILLIAM J. CLINTON & ALBERT GORE, JR., REINVENTING ENVIRONMENTAL REGULATION (Mar. 16, 1995) <http://www.epa.gov/reinvent/notebook/clinton.html>.

61. *See*, *e.g.*, Michel Gelobter, *The Meaning of Urban Environmental Justice*, 21 FORDHAM URB. L. J. 841 (1994).

62. Economists have assumed that winners will pay losers to "wash out" the distributional inequities which ultimately develop in any real-world implementation of policies. Generally, this has not happened, although the idea of direct compensation for siting has been adopted by some states. *See* Vicki Been, *Compensated Siting Proposals: Is it Time to Pay Attention?* 21 FORDHAM URB. L. J. 787, 811 (1994).

these populations adequately in the past.[63] In establishing water quality standards, for example, fish consumption data are usually averaged across populations and may miss special sensitivity within smaller subgroups, such as Native Americans.[64] According to environmental justice advocates, it is on the characteristics of this more sensitive group that regulations should be established since they not only eat more fish, but also more of each fish, often including the head and tail, parts that bioaccumulate higher levels of some toxic substances.[65]

Second, once that level of protection is set, the actual levels of exposure to pollutants should not differ across individuals or groups. For example, if national standards are set for air pollution emissions, this should be done to ensure that no individual be any more exposed than any other individual. Thus, differential exposure across areas of the country or within local communities—so called "hot spots"—would not be acceptable because everyone should have a "civil right to equal protection" from environmental harm.[66]

b. Effective Participation in Policy-making

Another major component of environmental equity and justice is the establishment of informed and meaningful participation in all decision-making arenas where specific environmental policies are developed.[67] By forcing policy-makers to consult with communities and local grass-roots leaders, proponents expect to achieve higher visibility for their ideas and change the regulatory culture for environmental policy-making at the federal level.[68] Often, a major difficulty

63. *See* Samara F. Swanston, *Race, Gender, Age, and Disproportionate Impact: What Can We Do About the Failure To Protect the Most Vulnerable?* 21 FORDHAM URB. L. J. 577, 586 (1994).

64. *See* Patrick C. West, *Health Concerns for Fish-Eating Tribes: Government Assumptions Are Much Too Low*, 18 EPA J. 15 (Mar.-April 1992).

65. *See* Robert J. Knox, *Environmental Equity*, 55 J. ENVT'L HEALTH 32, 32 (May 1993).

66. *See*, *e.g.,* Luke W. Cole, *Environmental Justice Litigation: Another Stone in David's Sling*, 21 FORDHAM URB. L. J. 523 (1994); Rachel D. Godsil, *Remedying Environmental Racism*, 90 MICH. L. REV. 394 (1991); Gerald Torres, *Environmental Burdens and Democratic Justice*, 21 FORDHAM URB. L. J. 431 (1994).

67. *See generally* Deeohn Ferris, *Communities of Color and Hazardous Waste Cleanup: Expanding Public Participation in the Federal Superfund Program*, 21 FORDHAM URB. L. J. 671 (1994).

68. *See generally* Robert W. Collin, *Environmental Equity: A Law and Planning Approach to Environmental Racism,* 11 VA. ENVTL. L. J. 495 (1992); Robert H. Frielich & Derek B. Guemmer, *Removing Artificial Barriers to Public Participation in Land-Use Policy: Effective Zoning and Planning by Initiative and Referenda*, 21 URB. LAW. 511 (1989); Torres, *supra* note 66.

is the inability of minority and low-income communities to participate as equals with industry and government. Language barriers, convenience of the forums, and lack of technical preparation are examples of problems which may have to be overcome in order for individuals to get involved in neighborhood and community problem-solving.[69]

c. Remediation of Existing Problems

Some minority and poor communities have also experienced discrimination when decisions have been made about siting hazardous facilities and when priority sites for clean-up have been chosen.[70] Yet efforts to establish remediation through equal protection suits have been generally unsuccessful.[71] While remediation will continue to be a concern in the short-run because communities cannot simply move away from their problems, the ideal is to eliminate the need for remediation efforts in the future by emphasizing pollution prevention strategies.

B. *Costs and Burdens*

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

One of the most pervasive concerns about environmental protection programs in the United States has been that they are costly to implement and thus reduce productivity and place firms at a competitive disadvantage. Certainly, identification and implementation of policies that effectively improve both cost-effectiveness and fairness

69. *See generally* CALIFORNIA COMPARATIVE RISK PROJECT, CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY, TOWARD THE 21ST CENTURY: PLANNING FOR THE PROTECTION OF CALIFORNIA'S ENVIRONMENT, SUMMARY REPORT AND FINAL REPORT (1994).

70. *See* Marianne Lavelle & Marcia Coyle, *Unequal Protection: The Racial Divide in Environmental Law*, NAT'L L. J., Sept. 21, 1992, at S1.

71. *See generally* Godsil, *supra* note 66.

has not been easy. Richards' examination of a cost minimization framework is clearly a significant contribution to half of this puzzle.[72]

Concerns about demands on government have also intensified, especially claims that some alternatives for protecting human health and the environment place a significantly lighter burden on government, either by shifting the burdens onto other groups (industry or consumers) or by loosening the level of control altogether. Richards' "implementation costs" capture some of these ideas and his analysis of public finance impacts deepens our understanding of the complexity of costs and burdens. On the other hand, his dimensions lack adequate analysis of the many and complex differences that firms, or regulated entities, present for the decision-maker.

1. Cost-Effectiveness and Fairness to Sources[73]

Concern about the impact of environmental regulations on United States productivity, as well as the impact of compliance costs on polluters, has been a recurring theme in the environmental policy community since the 1970s. However, the impact of environmental policy choices on cost-effectiveness and fairness has come under increased scrutiny as the United States attempts to improve its economy with respect to other countries.[74]

One of the most pervasive criticisms of environmental regulations in the United States has been that they force very inefficient activities on sources and place heavy administrative demands on regulatory agencies.[75] Such criticisms often assert that using different policy instruments, particularly "economic incentives," would accomplish the same goals at lower costs for both polluters and the government.[76]

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72. *See generally* Richards, *supra* note 1.

73. Parts of this section are based on CLIFFORD S. RUSSELL & PHILIP T. POWELL, EFFICIENCY AND FAIRNESS OF CANDIDATE APPROACHES TO ENVIRONMENTAL POLLUTION MANAGEMENT, (unpublished contractor report prepared for the Office of Technology Assessment, U.S. Congress, May 1994) (on file with the authors).

74. *See* Robert W. Hahn & John A. Hird, *The Costs and Benefits of Regulation: Review and Synthesis*, 8 YALE J. ON REG. 233 (1991); Steven J. Kline, *Styles of Innovation and their Cultural Basis*, CHEMTECH, August 1991, at 472-480 [hereinafter Kline, *Styles of Innovation*]; September 1991, at 525; and November 1991, at 654; OFFICE OF TECH. ASSESSMENT, U.S. CONGRESS, REP. NO. OTA-ITE-586, INDUSTRY, TECHNOLOGY, AND THE ENVIRONMENT: COMPETITIVE CHALLENGES AND BUSINESS OPPORTUNITIES (1994) [hereinafter OTA-ITE-586].

75. *See generally* OTA-ITE-586, *supra* note 74.

76. *See, e.g.,* Bruce Ackerman & Richard B. Stewart, *Reforming Environmental Law: The Democratic Case for Market Incentives*, 13 COLUM. J. ENVTL. L. 171 (1988); STEPHEN G. BREYER, REGULATION AND ITS REFORM (1982); PUBLIC POLICIES FOR ENVIRONMENTAL PROTECTION (Paul R. Portney, ed.., Resources for the Future, 1990); SCIENCE ADVISORY

Evaluating which instruments use resources in the most efficient and fair way, given an environmental goal, has sparked considerable academic and political debate over the past two and a half decades.[77] However, a major barrier to adequately comparing the efficiency of policy instruments has been the paucity and poor quality of information on the social benefits of pollution abatement in comparison to the availability of reasonable, if imperfect, estimates of compliance costs.[78]

Moreover, there is little systematic empirical evidence that economic incentives are effective in changing the behavior of polluters in the desired direction.[79] In fact, experiences with real-world implementation of these instruments suggest that the conclusions about relative performance on efficiency that are derived from theoretical studies, including those drawn in Richards' article, should be interpreted cautiously.[80] Yet, even when political compromises and negotiation among stakeholders in a particular context make pure efficiency unreasonable to seek, it may be possible to identify second-best strategies, which allow at least some potential for cost-savings.

Despite continuing efforts to implement strategies that are both cost-effective and fair across the board, most situations seem to require tradeoffs among some of the following components.

a. Cost-Effectiveness for Society

Our framework does not attempt to assess the benefits or value of a legislatively determined goal, but rather assumes that Congress has chosen a statutory goal that captures the desirable level of social benefits.[81] Thus, cost-effectiveness for society is defined as the total

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BOARD, U.S. ENVIRONMENTAL PROTECTION AGENCY, REDUCING RISK: SETTING PRIORITIES AND STRATEGIES FOR ENVIRONMENTAL PROTECTION (September 1990).

77. *See, e.g.,* Linda M. Cropper & Wallace E. Oates, *Environmental Economics: A Survey*, 30 J. ECON. LITERATURE 675 (1992).

78. *See* Richard N. L. Andrews, *Summary*, *in* WORKSHOP ON EFFECTS OF ENVIRONMENTAL REGULATION ON INDUSTRIAL COMPLIANCE COSTS AND TECHNOLOGICAL INNOVATION (1981); CONGRESSIONAL BUDGET OFFICE, U.S. CONGRESS, ASSESSING THE COSTS OF ENVIRONMENTAL LEGISLATION—STAFF WORKING PAPER (1988).

79. *See generally* ADAM B. JAFFE & ROBERT N. STAVINS, EVALUATING THE RELATIVE EFFECTIVENESS OF ECONOMIC INCENTIVES AND DIRECTION REGULATION FOR ENVIRONMENTAL PROTECTION: IMPACTS ON THE DIFFUSION OF TECHNOLOGY (Center for Science and International Affairs, Discussion Paper 91-1, 1991).

80. *See* OTA-ITE-586, *supra* note 74, at 279-85.

81. *See generally* LESTER B. LAVE, BENEFIT-COST ANALYSIS: DO THE BENEFITS EXCEED THE COST? (Center for Science and International Affairs, Environment and Natural Resources Program, Project 88/Round II Project Report 91-04, 1991); DAVID W. PEARCE & ANIL

industry and government expenditures per unit of pollution abatement required to meet the environmental goal. The "maximum net benefits" to society for accomplishing a particular goal would be achieved by the instrument producing the lowest total of expenditures by industry, government costs to implement the program and transfers of money to and from government—for example, through taxes or subsidies.

b. Cost-Effectiveness for Individual Sources

Another measure of cost-effectiveness is at the firm level—that is, whether the instrument allows a firm to minimize its costs for compliance. In most studies, the goal is assumed to be unchanging; thus the regulator and the firm are interested in finding the least-cost solution in that particular context.[82] Also important is the potential to achieve cost-effectiveness over the long run, where an instrument allows a firm the flexibility to continue seeking least-cost adjustments over a period of time. Richards acknowledges that the costs of monitoring, for example, may be a necessary condition for sources to gain more flexibility in deciding how to meet environmental goals.[83] Some instruments may be cost-effective for society, but not for a firm, and vice versa. This is particularly true for those instruments that transfer money from firms to government (taxes), or government to firms (subsidies), which Richards underscores as duds for our public finance system.[84]

c. Administrative Burden for Sources

Another concern for regulated industries is the extent to which various instruments add burdens, especially burdens that do not seem necessary to accomplish the environmental goal. Firms' most typical responsibilities are problem-solving (e.g., information, technologies, prices, expertise, etc.) and monitoring (auditing and reporting emissions of pollutants). Unless they expect changes to a regulatory program to be particularly efficient compared to other options, polluters

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MARKANDYA, ENVIRONMENTAL POLICY BENEFITS: MONETARY VALUATION (1989); CLIFFORD S. RUSSELL, COMPLEX REGULATION AND THE ENVIRONMENT: AN ECONOMIST'S VIEW (unpublished paper presented at the *Conference on Governing Our Environment*, Copenhagen, Denmark, November 17-18, 1994) (on file with the authors).

82. *See generally* Peter Bohm & Clifford S. Russell, *Comparative Analysis of Alternative Policy Instruments*, *in* HANDBOOK OF NATURAL RESOURCES AND ENERGY ECONOMICS (Allen V. Kneese & James L. Sweeney eds., 1985).

83. *See* Richards, *supra* note 1, at 257-59.

84. *See id.* at 268-72.

may resist taking on such costly, additional activities, such as new analytical studies, extensive reporting requirements, fees for service, or certification costs. Resistance may be particularly strong when polluters believe the requirements are unrelated to achieving environmental goals, add legal costs, or delay production schedules. On the other hand, they may be supportive of an alternative which, although adding initial costs, gives the firm greater responsibility for, and control over, the development and implementation of solutions.

d. Fairness to Sources

Fairness is usually found "in the eye of the beholder." Accordingly, our framework assesses instrument choice from the perspective of sources that are concerned with how particular instruments might affect either their choices or their competitive position, vis-à-vis other similar firms.[85] When trying to choose among environmental policy instruments, an agency typically confronts the inherent tension between treating all sources as if they were the same (uniformity of treatment) and trying to assure that all sources experience the same outcomes (uniformity of outcomes). Few policies, if any, can achieve both results at the same time.

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

Another dimension of fairness to sources is the extent to which a policy instrument allows the firm some autonomy in choosing environmental strategies for themselves. While firms may only argue that

85. For a consideration of fairness from the perspective of how instrument choice affects individuals and communities, see discussion *supra* Part IV.A.3. on Environmental Equity and Justice.

this autonomy gives them the requisite flexibility to achieve least-cost solutions, the principle of retaining private sector control over internal decisions regarding process and product related changes is also a powerful ideological issue in American culture.

Because of these difficulties, it is not common to find government policies that can satisfy all of involved interests. Most approaches that are satisfactory across the board involve some tradeoffs between equality of treatment and reaching roughly equal outcomes.[86]

2. Demands on Government[87]

One of the most persistent complaints about current approaches to environmental protection is that they require too much involvement by government agencies, which costs taxpayers money and often delays companies in their attempts to improve their environmental performance. Rather than simply setting the targets and stepping back so that firms can choose the best strategies for meeting the targets, government agencies spend too much time and too many resources deciding what each type of source must do, and then concentrate on enforcing rather than facilitating compliance. According to this view, instruments that use incentives to reward improved environmental performance or rely on voluntary efforts by companies would be much cheaper for government to develop and administer.

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

a. Costs

Governmental agencies expend considerable resources in the

86. *See generally* ALAN P. LOEB, REGULATORY REFORM IN THE REAGAN ERA AND THE ADOLESCENCE OF MARKET-BASED INNOVATION (unpublished paper presented to the Environmental Law Society, The Law School at the University of Chicago, May 20, 1993) (on file with the authors).

87. Parts of this section are based on McGarity, *supra* note 41, and on SIDNEY A. SHAPIRO, RETHINKING ENVIRONMENTAL CHANGE: POLICY INSTRUMENTS AND ADAPTABILITY TO CHANGE (unpublished contractor report prepared for the Office of Technology Assessment, Aug. 1994) (on file with the authors).

course of formulating and implementing environment protection programs. The federal government spends more on environmental protection than the states. Yet over the past fifteen years, EPA's budget has decreased, while many of the states have held their expenditures on environmental protection at a constant level, and in some areas have actually increased expenditures.[88] In 1992, the federal and state governments spent an estimated $1.8 billion in current dollars on regulation and monitoring activities—or two percent of the estimated total expenditures on pollution abatement and control in the United States.[89]

Even though this is a relatively small proportion of overall expenditures, differences in instruments' requirements for analytical support, rulemaking, on-going administration and implementation, monitoring, and compliance activities suggest opportunities for reducing or reallocating expenditures. For example, information-gathering costs to government when attempting to gain expert knowledge of a particular industrial sector can be very high; in some instances, these costs may restrict the government's ability to know what it should do in order to regulate effectively. In addition, instruments, which must be established through the rulemaking process, extract additional resources from the agency in the form of time spent on preparation of supporting documentation. For example, the complete rule-making process to establish a major rule may require the production of tens of thousands of pages of documentation, including responses from industry and other stakeholders. Even the amendment process, when trying to change mistakes in these rules, can be a formidable undertaking.

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

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88. *See* EVAN J. RINGQUIST, ENVIRONMENTAL PROTECTION AT THE STATE LEVEL (Sharpe, 1993).

89. *See* Gary L. Rutledge & Christine R. Vogan, *Pollution Abatement and Control Expenditures, 1972-92,* 74 SURVEY OF CURRENT BUS. 36 (May 1994).

b. Ease of Analysis

Ease of analysis concerns the degree of analytical complexity an instrument poses for the regulatory agency in translating Congressional goals into actions that polluters can understand and implement. When Congress establishes risk goals, the task of determining the level of exposure that poses an acceptable risk to human health or the environment is usually left to the implementing agency. Congress most often states acceptable risk in general terms.[90] Occasionally, however, risk definitions have been quite specific.[91] Similarly, when Congress enacts an abatement goal, usually stated in terms of "best efforts" for reducing pollution, the agency must identify those technologies that will satisfy the Congressional language.[92]

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

Regardless of whether Congress chooses a risk or abatement goal, or a mix of the two, EPA must usually complete a range of analyses to characterize the problem posed by the particular process or product, and examine alternative ways to handle that problem. It must also document its analyses in sufficient detail to withstand the rulemaking process and other challenges that may be raised in the implementation phase. Analyses might include scientific studies to establish pollutant pathways, engineering studies that document the

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90. Examples of this type of statutory goal include setting National Ambient Air Quality Standards (NAAQS) at a level that *protects the public health with an "adequate margin of safety," see* 42 U.S.C. § 7409(b)(1); setting standards under the CWA that will *protect the public health and welfare with an ample margin of safety," see* 33 U.S.C. § 307(a)(4); prohibition in the Resource Conservation and Recovery Act (RCRA) on the disposal of untreated hazardous wastes in land disposal facilities as long as the wastes remain hazardous, unless EPA approves a method that will be "*protective of human health and the environment*," *see* 42 U.S.C. § 6924(g)(5) (emphasis added).

91. *See generally* FIFRA, 7 U.S.C.A. § 136; Emergency Planning and Community Right-to-Know Act of 1986, 42 USC § 11001 (1994).

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

best technological designs, cost-benefit analysis of the potential regulatory impact, and cost-benefit analyses of post-implementation impacts. The uncertainty and/or difficulty of interpreting the technological, economic, scientific, and socio-political data can be daunting to regulators. At a minimum, analytical complexity can prolong the period required for translation, provide opportunities for challenges to the agency's efforts, and increase the opportunities for errors in translation.

The credibility and certainty of the supporting analytical work and documentation, the level of institutional resources committed to implementation, resistance by regulated entities or the public, and the opportunities for administrative, congressional, and judicial review, are all factors with the potential to affect whether or not a particular instrument is implemented in a successful and timely manner.

### C. *Change*

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

Sometimes, proceeding slowly may be what Congress intended. For example, the Administrative Procedure Act (APA), the Congressional "waitover" period, and the mandate for risk assessment all encourage deliberation before action to protect the rights of those affected by government actions.[93] And when choosing instruments to implement policies, decision-makers have often bet on "a sure thing," even though it may restrict opportunities to learn about new technologies or to respond to new information about environmental risks.

However, in a world dominated by increasing complexity and uncertainty, there are many advocates for making environmental policy both easier to implement and more responsive to change—two criteria that capture the nation's interest in creating a future-oriented policy framework to encourage and accommodate change.[94]

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93. *See* Administrative Procedure Act, 5 U.S.C. § 553(c)-(e) (1994); *see also* Small Business Regulatory Enforcement Fairness Act, 5 U.S.C. § 601 (1997); Marc Landy & Kyle D. Dell, *The Failure of Risk Reform Legislation in the 104th Congress*, 9 DUKE ENVTL. L. & POL'Y F. 113, 115-119 (1998).

94. *See*, *e.g.*, Gerald Andrews Emison, *The Potential for Unconventional Progress: Complex Adaptive Systems and Environmental Quality Policy,* 7 DUKE ENVTL. L. & POL'Y F. 167 (1996)

1. Adaptability[95]

A key criticism of current approaches for protecting the environment is that they are not very adaptable to important and rapid changes in scientific understanding or technological capabilities.[96] According to this view, the only sensible way to address the uncertainty associated with complex environmental policy issues is to use instruments which give government agencies and polluters the needed flexibility to adapt to changing circumstances and to learn from experimental efforts.

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

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

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

(discussing the implications of complexity theory for environmental policy).

95. Parts of this section are based on SHAPIRO, *supra* note 87.

96. *See generally* Daniel A. Farber, *Environmental Protection as a Learning Experience*, 27 LOY. L.A. L. REV. 791 (1994); Alyson C. Flournoy, *Coping with Complexity*, 27 LOY. L.A. L. REV. 809 (1994); Ronald H. Rosenberg, *Evolving Consensus: The Dynamic Future of Environmental Law and Policy*, 27 LOY. L.A. L. REV. 1049 (1994).

require modifications or is relatively easy to modify makes the most sense.

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

The two major sources of change which trigger a need to modify policy instruments are a change in the perception of risk from a pollutant or activity, or a change in abatement capability. A change in risk perception typically comes from new scientific information or changing interpretations of existing information. Both can affect the assumptions of an underlying risk assessment or cost-benefit analysis by demonstrating that a pollutant poses a greater or lesser risk than was previously understood. A revised risk assessment might suggest that a different level of risk is socially appropriate.[97]

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

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

The simplest way to ensure adaptability is to use a strategy and instrument combination that remains, as much as possible, unaffected by such change. For example, since harm-based standards are tied to risk, polluters have complete flexibility to respond to favorable

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

changes in cost, availability, or new capability in abatement technologies, without waiting for a revised standard.

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

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

a. Ease of Program Modification

Policy instruments vary in the degree of difficulty the regulatory agency has in completing the steps required for their modification. Some believe that even the most inherently adaptable of instruments is likely to become difficult to modify once it is embedded in the current institutional configuration of agencies and decision-making processes for environmental policy-making.[98]

EPA is required both by statutes and Executive Orders to evaluate risks to health and the environment and to consider the feasibility of alternative solutions for reducing those risks.[99] When EPA modifies an instrument, it must identify and resolve the scientific, engineering, and legal issues that the changes have raised. Because EPA employs a relatively small number of scientists, engineers, and economists capable of undertaking rigorous scientific and policy analyses, the number of difficult projects that the agency can undertake at any given point in time is limited.

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98. *See, e.g.,* Howard Latin, *Ideal Versus Real Regulatory Efficiency: Implementation of Uniform Standards and "Fine-Tuning" Regulatory Reforms*, 37 STAN. L. REV. 1267 (May 1985).

99. *See* Clean Air Act, 42 USC § 7408; Federal Insecticide, Fungicide, and Rodenticide Act, 7 U.S.C. § 136d; Toxic Substances Control Act, 15 USC § 2605(d).

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

b. Ease of Source Changes

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

Continuous, incremental innovations are often the life-blood of companies in highly competitive industries. Giving these industries the flexibility to adapt how they meet goals without having to seek pre-approvals from an agency official before acting on process or product modifications could spur technological innovation and increase opportunities to use the most cost-effective solutions.

2. Technology Innovation and Diffusion[100]

Technology innovation[101] and diffusion[102] can be a major source of economic growth and a cleaner environment. From an environmental perspective, innovation and diffusion offer ways to deliver goods and services with less environmental pollution, and provide new ways to trap or clean up pollutants.

Concern persists, however, that environmental regulations may hurt the competitive position of U.S. firms in the global economy by increasing production costs and impeding performance and cost innovations.[103] Examples of these concerns include that: 1) regulation-

100. Parts of this section are based on GEORGE R. HEATON, JR., ENVIRONMENTAL POLICY INSTRUMENTS AND TECHNOLOGY INNOVATION (1994) (unpublished contractor report prepared for the Office of Technology Assessment, U.S. Congress) (on file with the authors).

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

102. Technology diffusion is the adoption of an existing technology by others.

103. Some critics note that these estimates often fail to incorporate that environmental policy 1) may stimulate economic growth by creating new markets in some sectors, and 2) may

driven costs place U.S. firms at a competitive disadvantage; 2) compliance costs divert money from commercial innovation; and 3) rigid regulations are incompatible with the trial-and-error processes essential for economic success in many technology sectors.[104]

Criticisms directed at specific policy instruments include that: 1) technology-based instruments favor known technologies; 2) permits create barriers to innovative improvements; and 3) end-of-pipe, media-specific standards restrict innovative process solutions. The categories we use to evaluate instruments each offer opportunities for furthering technological solutions to environmental problems. Emphasizing one path however, can sometimes constrain opportunities for utilizing another.

a. Innovation in the Regulated Industries

Environmental regulations can have both direct and indirect impacts on manufacturing firms or governmental entities, like sewage treatments plants, for example, by creating preferences for a type of technology, generating new markets, raising the costs of production, or diverting capital from other investments and businesses. Whether individual firms innovate is based on many complex factors, both internal and external to that firm. Especially for large complex facilities, incremental innovations may offer a relatively low risk route to profitability.[105] But, for smaller firms, diffusion may be a better strategy.

b. Innovation in the Environmental Goods and Services Industry

The environmental goods and services (EG&S) industry is comprised of firms whose primary business is the supply of environmental equipment and services that control, treat, cleanup, and/or prevent pollution and waste.[106] Government regulation has created and sustained most of the markets for the EG&S industry. Thus, any

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prevent decreasing productivity in sectors dependent on a healthy environment, such as agriculture or fisheries.

104. *See generally* Steven J. Kline & Don E. Kash, *Government Technology Policy: What Should It Do?* 22 THE BRIDGE 12 (Spring 1992); Roy Rothwell, *Industrial Innovation and Government Environmental Regulation: Some Lessons from the Past*, TECHNOVATION 12(7): 447-457 (1992); OTA-ITE-586, *supra* note 74.

105. *See generally* DON E. KASH, PERPETUAL INNOVATION: THE NEW WORLD OF COMPETITION (1989); Kline & Kash, *supra* note 104; NATHAN ROSENBERG, THE ECONOMICS OF TECHNICAL CHANGE (1971).

106. *See* OTA-ITE-586, *supra* note 74, at 2.

changes in the way regulations are written may affect the health of the industry.

c. Diffusion of Known Technologies

Technology diffusion is the common follow-on to successful innovations. Diffusion occurs because firms find technologies beneficial and often essential to their competitiveness. Subsequent producers or users of an innovation may modify the technology or the context into which it will fit in order to gain some competitive advantage. Such adaptations are an important part of the process of technological change, and they commonly provide known solutions, or "best practices," to firms that do not have the resources for in-house innovation. Some instruments that promote technology diffusion, however, may delay or impede a firm's search for innovations.

Diffusion may be an ideal strategy when technological solutions for environmental problems are available, but are not widely known or have not been widely adopted. This is especially true for small to medium-sized firms that find the costs of information-searching, and research and development prohibitive. For these companies, diffusion may provide a way to reduce costs, and at the same time, achieve state-of-the-art abatement practices.

When trying to understand how policy tools impact technology innovation and diffusion, we face at least three basic challenges: 1) technology innovation tries to do what no one yet knows how to do;[107] 2) policy impacts occur within complex and unique institutional arrangements;[108] and 3) little research is available on the effects of specific regulatory instruments on technology innovation.

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

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107. *See generally* Steven J. Kline, *A Numerical Index for the Complexity of Systems: The Concept and Some Implications*, *in* MANAGING COMPLEXITY AND MODELING REALITY—CONFERENCE PROCEEDINGS (ACM Press, 1991).

108. *See generally* CHALMERS A. JOHNSON, JAPAN, WHO GOVERNS?: THE RISE OF THE DEVELOPMENTAL STATE (1995); Kline, *Styles of Innovation, supra* note 74; DANIEL I. OKIMOTO, BETWEEN MITI AND THE MARKET: JAPANESE INDUSTRIAL POLICY FOR HIGH TECHNOLOGY (1989).

While environmental regulations can be important, they are, in most cases, a relatively small factor among many that firms consider when choosing to innovate.[109] This suggests that if technology innovation is a high priority, there may be many more direct and effective ways to encourage it than reforming the particular regulatory instruments used to implement environmental goals. In the case of technology diffusion, effective regulations may reduce incentives for companies to innovate.[110]

## V. COMPARING TOOLS: DESIGN STANDARDS AND TRADEABLE EMISSIONS

In this section, we explore how design standards and tradeable emissions compare when looking at four of the criteria discussed above—assurance of meeting goals, environmental equity and justice, cost effectiveness and fairness to sources, and technology innovation and diffusion. A summary of how each instrument option both promotes and impairs these four, as well as three additional, criteria is included in Boxes 1 and 2.

### BOX 1: DEBATES ABOUT DESIGN STANDARDS

**Assurance of Meeting Goals**

*Promotes criteria:*

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

*Impairs criteria:*

- 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.

109. *See* OTA-ITE-586, *supra* note 74, at 81-87.

110. However, a company could always choose to innovate for performance or cost reasons related to productivity.

**Environmental Equity and Justice**

*Promotes criterion:*

• Design standards offer communities input into the standard-setting process.

*Impairs criterion:*

• Design standards do not effectively address problems of "hot spots," or differential impacts on communities.

**Cost-Effectiveness and Fairness to Sources**

*Promotes criteria:*

• 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, regardless of location.

*Impairs criteria:*

• Design standards are not cost effective because they do not consider differences in cost across facilities.

• Design standards can be unfair because they often impose different requirements among industrial sectors.

**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, although relatively less than harm-based standards.

**Adaptability**

*Promotes criterion:*

• Entities are free to propose a new technology, if equivalent or superior to the model control technology.

*Impairs criteria:*

• 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 criteria:*

• 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 criteria:*

- 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 of the danger that it could cause tighter emission limitations.

## BOX 2: DEBATES ABOUT EMISSIONS TRADING

**Assurance of Meeting Goals**

*Promotes Criterion:*

- Trading can bring otherwise unregulated sources under control.

*Impairs Criteria:*

- Trading can result in "hot spots."
- Noncompliance is hard to detect because of inter-firm 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 Criteria:*

- Trading distributes emissions according to market forces, not by an open administrative process that allows community input.
- Trading might perpetuate the existing inequitable pollution distribution.

**Cost-Effectiveness and Fairness to Sources**

*Promotes Criteria:*

- 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 Criteria:*

- 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 Criteria:*

- 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.

### A. *Assurance of Meeting Goals*

Assurance of meeting the environmental goal may be the bottom-line criterion for many policy-makers and stakeholders, especially when the environmental problem poses serious risks to human health. Debates about policy tool selection typically focus on asking, "will it do the job?" The answer to that question, however, is not always clear. Both design standards and tradeable emissions offer sig-

nificant assurances—but no guarantees—that the environmental goal will be met. Each tool poses different challenges.

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 very commonly used and have been found to be less analytically complex and data intensive than other tools, such as harm-based standards. As a result, they have typically been implemented at a faster rate. Their relative ease of implementation means that *some* level of control will be put in place faster than under other tools. Similarly, some authors have argued that this form of regulatory system is less complicated and therefore has a greater chance of success than certain of the market-based approaches.[111]

Proponents of emissions trading also stress the tool's ability to achieve environmental goals and argue that, in some circumstances, trading may be the only method suitable for achieving those goals. Where 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.[112] While such trading ratios are typically adopted as a safety margin for environmental quality, potentially compensating for imperfect models and other uncertainties, such ratios could potentially have the effect of reducing emissions.

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. However, it is important to note that the policy decision to require increased monitoring is independent of trading as a regulatory instrument.

Both design standards and tradeable emissions have their critics, however. For example, design standards only 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

111. *See, e.g.,* Howard Latin, *Ideal Versus Real Regulatory Efficiency: Implementation of Uniform Standards and 'Fine-Tuning' Regulatory Reforms*, 37 STAN. L. REV. 1267 (1985).

112. *See, e.g.,* Policy Statement, *supra* note 32; WATERSHED-BASED TRADING, *supra* note 31.

required level of technology do so or adopt an alternative strategy that meets required emission limitations. This general movement, however, 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 achieves the goal, the design standard approach does not prevent neighboring sources from discharging the 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 alleviated by combining the design standard with a harm-based standard that takes effect if the design standard fails to attain the goal.

Emissions trading can be similarly controversial with regard to certainty. 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. The variation in emission rates from facility to facility can be quite large. Hence, trading programs are often judged as unacceptable for toxic pollutants where high local concentrations would be a concern.

In addition, trading programs may retain emissions that would otherwise be eliminated. For example, under some emissions trading programs, a firm that is closing a facility may sell its emissions rather than retire the emissions reduction and create a benefit to the environment. With trading, individual entities are not required to control pollution to the best of their abilities.[113] Moreover, compliance responsibilities of individual facilities may be more difficult to determine if a central register of emissions permits and trading is not carefully designed. Trading increases the complexity of emissions monitoring because inter-facility emission exchanges are also allowed.[114] 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.

113. *See, e.g.,* Clean Air Act, 42 U.S.C. §§ 7651-7651o; Policy Statement, *supra* note 32.

114. *See, e.g.,* Clean Air Act, 42 U.S.C. § 7651k(a).

In summary, both design standards and tradeable emissions offer a reasonable degree of assurance that an environmental goal will be met, although for different reasons. Decision-makers who prefer well-understood and familiar approaches are likely to find design standards more attractive than tradeable emissions. Decision-makers may consider tradeable emissions desirable when faced with environmental contamination that regulatory approaches have been unable to reach because of the potential for encouraging non-regulated sources to "opt-in" to environmental control requirements. Neither design standards nor tradeable emissions directly address the issue of aggregated environmental impacts from multiple emissions sources that are located geographically close together.

B. *Environmental Equity and Justice.*

Environmental equity and justice addresses the issue of whether specific groups may bear a disproportionate burden of environmental risks, especially adverse impacts from discriminatory siting of facilities and from the implementation of environmental laws. Design standards and tradeable emissions can address some of the distributional effects of pollution, but both also have the potential to result in "hot spots."

Design standards typically set minimum pollution control requirements at levels that are the same for all facilities in an industrial category, regardless of where in the country they are located. Such minimum control requirements can help ensure that all communities receive some environmental protection. However, design standards do not address the problem of concentrated sources, which can lead to aggregated emissions at unhealthy and environmentally unsound levels. Data indicate that source concentration occurs more frequently in minority and low-income communities.[115] In these circumstances, a decision-maker may need to turn to other tools as an alternative to, or in combination with, design standards to adequately protect the community.

Little analysis has been undertaken regarding the effect of emissions trading on environmental equity and justice. 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

115. *See* sources cited *supra* note 53.

purchase credits allowing them to maintain emission levels rather than to make the investment in emission reductions. 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. Economic theory suggests that dirty facilities would be net sellers, although no evaluative data are available to indicate whether this actually occurs.

Careful implementation of tradeable emissions may be necessary to avoid "hot spots" of pollution. Some emissions trading programs attempt to address the problem of geographic inequities by requiring agency pre-approval of all trades and conditioning approval on a finding that the trade will not adversely impact local air quality.[116]

### C. *Cost-Effectiveness and Fairness to Sources*

One of the most consistent criticisms of environmental regulations in the United States has been that they often require sources to adopt inefficient pollution control approaches and thus fail to attain environmental goals in the least costly fashion. Tradeable emissions are a policy tool often applauded for flexibility and potential to achieve pollution control in a cost-effective way. Design standards also offer some flexibility in choosing the specific technology used to meet an emissions control requirement. However, design standards focus on individual sources and tend to aim emitters towards a "model" control technology. As a result, decision-makers who are particularly concerned about cost-effectiveness and fairness to emitters may find tradeable emissions more attractive than design standards.

Design standards are typically based on a model technology but are expressed as emissions limits. Firms, therefore, have some flexibility to lower the costs of complying with an emissions limit by selecting the cheaper of either the model technology or an "equivalent" technology. In addition, the original purpose of design standards was to require regulated entities to improve their pollution reduction technologies continuously, with "best available" technology becoming better—in terms of performance and cost—over time. In reality, design standards have not given facilities an incentive to search for cheaper compliance techniques once they have complied with the

116. *See, e.g.,* sources cited *supra* note 112.

emissions limit,[117] and these standards will not do so unless advances providing much improved performance or cheaper costs become available.

Design standards establish minimum levels of pollution control for categories and subcategories of sources. To the extent sources are treated alike and required to meet the same minimum control levels, this tool could be characterized as fair. Note, though, that firms may have to face different costs to achieve the same design standard, depending on factors such as a facility's design and current pollution levels.

Emissions trading is often described as the tool used to achieve a given level of emissions control at the lowest cost. In theory, regulated entities should continue trading emissions permits until their incremental costs of controlling pollution are the same; this would result 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 achieved all 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 has yet reached that level of trading, that many have had only limited trading, and that 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. However, it should be noted that 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 actions.

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117. *See generally* Dennis A. Yao, *Strategic Responses to Automobile Emissions Control: A Game-Theoretic Analysis*, 15 J. ENVTL. ECON. & MGMT. 419 (1988).

The fairness of emissions trading programs has received somewhat less discussion than their 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 are potentially 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.[118] The South Coast Air Quality Management District allocated emission credits in the Los Angeles area based on "historic use" of each piece of $NO_x$- and $SO_2$-emitting equipment at a facility and then 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 for free. Other approaches to the initial distribution of emission allocations are possible but have yet to be tried.

In summary, decision-makers who are primarily interested in achieving environmental goals in a fair and cost-effective manner appear likely to consider the adoption of tradeable emissions more frequently than design standards.

### D. *Technology Innovation and Diffusion*

Technology innovation and diffusion can be a major source of both economic growth and a cleaner environment. Decision-makers may seek a policy tool that encourages such innovation. While both design standards and tradeable emissions can create significant incentives for new technologies, many believe that a tradeable emissions

118. *See* COMMITTEE ON PUBLIC WORKS AND TRANSPORTATION, U.S. CONGRESS, CLEAN AIR ACT AMENDMENTS OF 1990, H. Rpt. 101-952 (1990).

program has greater potential to encourage technology innovation and diffusion.

One of the original goals for design standards was to spur continual innovation by revising regulations as the state-of-the-art of technologies improved.[119] Some statutory language incorporating design standards—such as "best available technology"[120]—reflects an assumption that regulated facilities and suppliers of pollution control equipment would continue to innovate over time. In effect, the "best" would become better and the "lowest" would get lower still. In practice, however, this desired link between design standards and continuous innovation has seldom materialized. For example, Clean Water Act standards considered to be technology-forcing over a 5- to 10-year timeframe were met by industry on time using existing technologies.[121]

The common use of a "model" technology for design standards can sometimes be viewed as a "de facto" technology specification, which thereby impedes incentives for innovation. Since most environmental laws do not require a source to achieve pollution control beyond what the regulatory agency finds can be done with existing technologies, innovation is not necessary to satisfy many design standards. However, if the model technology would be very expensive for a source to adopt, there might be an incentive to find a more cost-effective "equivalent" technology. In practice, many firms report that the effort to establish an alternative's equivalency is often difficult or risky. This is especially true when the model technology has been written into a source's permit so that pre-approval of a change, rather than a demonstration of equivalent performance after installation, is required. Moreover, the conventional wisdom has been that, contrary to original expectations, firms have not been inclined to develop new technologies because of concerns that a new technology would result in more stringent emissions control requirements the next time an agency updates the design standard.[122]

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119. *See generally* Nicholas A. Ashford et al., *Environmental, Health, and Safety Regulation and Technology Innovation*, *in* TECHNOLOGICAL INNOVATION FOR A DYNAMIC ECONOMY 161 (Christopher T. Hill & James M. Utterback eds., 1979).

120. *See* Clean Water Act, 33 U.S.C. § 1311(b)(2)(A).

121. Telephone Interview (by Elizabeth Gunn) with Gladys Meade, American Lung Association (Oct. 7, 1994).

122. *See generally* Ashford et al., *supra* note 119; STEVEN LIPMANN, INDUSTRY VIEWS OF ENVIRONMENTAL REGULATIONS, (unpublished contractor report prepared for the Office of Technology Assessment, U.S. Congress, 1994) (on file with the authors).

Design standards specify a clear and uniform emissions limit for each source category using a model technology. Uniform limits developed from identified technology create a clear target for the Environmental Goods & Services (EG&S) industry when it is interested in developing new control technologies. An EG&S company also has an incentive to develop cheaper or more effective technologies, in the hope that the new technology would become the new "model" technology used when developing the next round of design standards. EG&S firms can also play a large and effective role in promoting diffusion of the technologies.

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.

In theory, tradeable emissions should promote innovation. A significant advantage of a tradeable emissions program is that it allows firms with widely varying marginal costs of abatement control to cooperate in meeting environmental standards with lower overall costs. Facilities with high marginal costs could be expected either to innovate to reduce pollution, or to purchase emission credits from other facilities that possess the capability for less expensive reductions; this also creates incentives for potential sellers to innovate. Note, however, that several economic models have found weaker links between trading and innovation than often asserted.[123] The degree of innovation will strongly depend on the stringency of the emissions cap faced by the facilities.[124] To the extent that tradeable emissions improve the cost effectiveness of control, incentives for innovation are reduced.

The effect of a tradeable emissions regime on the EG&S industry will depend on the structure of the particular regulated industry. If the industry relies heavily on suppliers for compliance technologies or services, it may have indirect incentives for innovation or increased opportunities for diffusion of known solutions to more clients. For example, if imposed on the automobile or electric power industries,

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123. *See*, *e.g.*, Wesley A. Magat, *The Effects of Environmental Regulation on Innovation*, 43 LAW & CONTEMP. PROBS. 4 (1979); D. A. Malueg, *Emission Credit Trading and the Incentive To Adopt New Pollution Abatement Technology*, 16 J. ENVTL. ECON. & MGMT. 52 (1989).

124. *See* OTA-ITE-586, *supra* note 74, at 214-216.

such a regime might create pressure on the suppliers for innovations; if imposed on the chemicals industry, which relies strongly on in-house expertise, the EG&S industry would be less affected.

## VI. CHOOSING INSTRUMENTS

Whether Congress prefers to specify the choice of policy tools itself or delegate the choice to EPA, states, localities, or even the private sector, someone is faced with the difficult problem of matching tools to problems. Table 3 summarizes the OTA Report's judgments about how well each instrument addresses each of the seven criteria.[125]

Such a table is probably most helpful to a decision-maker or stakeholder with strongly held beliefs about the primacy of a single criterion or clear preferences for a subset of instruments. For example, many decision-makers will agree with Richards' stated preference for choosing the least-cost instrument, unless it is not within the "feasible set" due to a legal or political constraints. He or she can focus on the series of rows in the table that isolate the various aspects of "costs and burdens," such as cost-effectiveness for sources or cost to government. Similar to Richards' evaluation, emissions trading is an attractive option when costs are the primary criteria. But information reporting is attractive too, as long as certainty of achieving a fixed target is not, in Richards' parlance, a "political constraint."[126]

Others decision-makers may have far different priorities and choose to focus on assurance of meeting environmental goals or incentives for technology innovation. As can be seen from the table, different instruments will be preferred.

For most decision-makers, however, the strengths and weaknesses of a particular policy tool will depend on the context of a particular environmental problem. The importance of assuring that environmental goals will be met depends on the level of risk. Cost effectiveness of control is clearly more of an issue when the cost of lowering emissions is high.

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125. *See* OTA Report, *supra* note 4, at 143-200 (Chapter 4 includes detailed discussions of how each judgment was reached).

126. *See* Richards, *supra* note 1, at 229-30.

**Table 3: Comparison of the Effectiveness of Policy Instruments**
**Tools *With* Fixed Targets**

| | | Single-source | | | | Multi-source | | |
|---|---|---|---|---|---|---|---|---|
| | | Product bans | Technology specifications | Design standards | Harm-based standards | Integrated permitting | Tradeable emissions | Challenge regulations |
| **Environmental Results** | Assurance of meeting goals | ● | ● | ● | ● | ● | ⊙ | . |
| | action forcing | ● | ● | ● | ● | ● | ● | ⊙ |
| | monitoring capability | ● | ● | ⊙ | . | ⊙ | ∇ | ∇ |
| | familiarity with use | . | ∇ | ● | ● | . | . | ∇ |
| | Pollution prevention | ● | ⊙ | ⊙ | . | . | . | . |
| | gives prevention an advantage | ● | ⊙ | ⊙ | . | ⊙ | . | . |
| | focuses on learning | . | ∇ | ∇ | ∇ | . | . | ⊙ |
| | Environmental equity and justice | . | . | . | . | . | ∇ | ∇ |
| | distributional outcomes | . | . | . | ● | . | ∇ | ∇ |
| | effective participation | . | . | . | . | . | ∇ | ∇ |
| | remediation | . | . | . | . | . | . | . |
| **Costs and Burdens** | Cost effectiveness and fairness | ∇ | ∇ | . | . | ⊙ | ● | ⊙ |
| | cost effective for society | ∇ | ∇ | . | . | . | ● | ⊙ |
| | cost effective for sources | ∇ | ∇ | . | . | ⊙ | ● | ⊙ |
| | fairness to sources | ∇ | ∇ | . | . | . | ● | ● |
| | administrative burden to sources | . | . | . | . | ∇ | ∇ | ∇ |
| | Demands on government | . | . | . | ∇ | . | . | ⊙ |
| | costs | . | . | . | ∇ | . | . | ⊙ |
| | ease of analysis | ∇ | . | . | ∇ | ∇ | ⊙ | ⊙ |
| **Change** | Adaptability | ∇ | ∇ | ∇ | . | . | . | ⊙ |
| | ease of program modification | ∇ | ∇ | ∇ | ∇ | ∇ | ∇ | |
| | ease of change for sources | ∇ | ∇ | ∇ | . | ⊙ | ● | ● |
| | Technology innovation and diffusion | ● | . | . | . | . | ⊙ | ⊙ |
| | innovation in regulated industry | ● | ∇ | ∇ | . | . | ⊙ | ⊙ |
| | innovation in EG&S industry | . | ∇ | ● | . | . | ⊙ | ⊙ |
| | diffusion of technologies | . | ● | ● | . | . | . | . |

●= Effective, ⊙= It Depends, ∇= Use With Caution, . = Average

**Table 3 *(continued)*: Comparison of the Effectiveness of Policy Instruments Tools *Without* Fixed Targets**

| | | Pollution charges | Liability | Information reporting | Subsidies | Technical assistance |
|---|---|---|---|---|---|---|
| **Environmental Results** | Assurance of meeting goals | . | . | ∇ | ∇ | ∇ |
| | action forcing | . | . | ∇ | ∇ | ∇ |
| | monitoring capability | ∇ | ∇ | . | . | . |
| | familiarity with use | ∇ | . | ● | ● | ● |
| | Pollution prevention | . | ⊙ | . | . | ● |
| | gives prevention an advantage | . | ⊙ | . | ⊙ | ⊙ |
| | focuses on learning | . | ⊙ | ⊙ | . | ● |
| | Environmental equity and justice | ∇ | . | ● | ● | ● |
| | distributional outcomes | ∇ | . | . | . | . |
| | effective participation | ∇ | . | ● | ● | ● |
| | remediation | . | ● | . | ● | ● |
| **Costs and Burdens** | Cost effectiveness and fairness | . | . | ⊙ | . | ⊙ |
| | cost effective for society | ● | . | ⊙ | ∇ | . |
| | cost effective for sources | . | . | ⊙ | ● | ● |
| | fairness to sources | ∇ | ∇ | . | . | . |
| | administrative burden to sources | . | ∇ | . | . | . |
| | Demands on government | . | . | ● | ∇ | . |
| | costs | . | . | ● | ∇ | . |
| | ease of analysis | ∇ | . | . | . | . |
| **Change** | Adaptability | . | ● | ● | . | ● |
| | ease of program modification | ∇ | ● | ● | ⊙ | ● |
| | ease of change for sources | ● | ● | ● | . | ● |
| | Technology innovation and diffusion | ● | . | . | . | . |
| | innovation in regulated industry | ● | . | . | . | . |
| | innovation in EG&S industry | ● | . | . | . | ∇ |
| | diffusion of technologies | ● | . | . | ● | ● |

●= Effective, ⊙= It Depends, ∇= Use With Caution, . = Average

The OTA Report presented a two-part framework to help policy-makers first narrow down the choice of instruments based on how they perform on each of the seven criteria presented previously, and then, if needed, to help them buttress weaknesses of any single tool by using more than one instrument. A series of key questions about

the particular problem can provide answers that may point—in combination with the evaluations presented in Table 3—to one set of instruments rather than another. These are summarized in Box 3 (below).

A decision-maker is likely to first ask, "*Is there a reason to specify a fixed environmental target for this pollutant?*" Do the quantities and location of a pollutant, or the characteristics of its sources, provide a reason to prefer a fixed control target? To answer this, one needs to know how harmful or risky the pollutant is in the quantities that are being released. Again, the more serious the problem, the more heavily one weights "assurance of meeting goals." The first rows in Table 3 display OTA's judgments of the assurance provided by each of the instruments.

**BOX 3: KEY QUESTIONS FOR MATCHING POLICY TOOLS TO PROBLEMS**

**Given the pollutant and the quantities and location of release, is there a reason to specify a fixed environmental target? If so, do these targets need to be source specific?**

1.) How harmful or risky is the pollutant in the quantities that are being released?
2.) Is this problem typically quite localized or regional in nature?
3.) Does the technology exist to monitor the pollutant at a reasonable cost?

**Given the pollutant and its sources, are we likely to be particularly concerned about costs and burdens to industry, individuals, or government?**

1.) Are the sources of the pollutant reasonably similar or do they vary considerably from source to source even within industrial categories?
2.) Are there large differences in control costs among sources?
3.) Are there either very many sources or very few?
4.) Do we just not know very much about how to control the problem, the costs of control, or how to set environmental targets?

**Given the pollutant and its sources, do we anticipate or hope that tomorrow's understanding of this problem or its solution will be significantly different than today's?**

1.) Is our uncertainty about the nature of the risk relatively high? Are the environmental goals very much in flux or are they likely to remain fixed for a reasonable period of time?
2.) Is technology changing rapidly--either the technology to prevent or control pollution or within the industry or sector itself?
3.) Can we achieve congressional environmental goals with today's technology at an acceptable cost?

Not at all surprising, those tools without fixed targets are marked with a caution. One cannot say that goals will not be met—there are

certainly instances when these instruments have been quite effective in the past. However, there is decreased certainty that environmental goals will be met if tools without fixed targets are used alone.

If one prefers a fixed environmental target, the next question to ask is, "*Does this target need to be source-specific?*" Some environmental problems are regional in nature—for example, urban ozone and acid rain—and thus, can be successfully addressed by regulatory programs that incorporate marketable emissions or another multi-source tool. For those problems that are local in nature, such as exposures to some toxic air pollutants, many will judge multi-source instruments to be inappropriate. Similarly, the more difficult it is to monitor sources, the harder it is to use multi-source tools.

The desire to allow sources to retain as much autonomy as possible leads one to prefer instruments with no fixed target—those on the second page of Table 3. The desire for greater assurance pushes one further towards instruments placing direct limits on pollution. However, many other concerns complicate the decision. Foremost among these issues is, "*Will costs and burdens to industry and government be acceptable?*"

Increased autonomy to sources often can improve the cost-effectiveness and fairness of pollution prevention or control. However, government burdens might increase along with source flexibility if increased oversight appears necessary to keep the same level of assurance that goals will be met. We highlight several questions that help assess the overall costs and burdens in the context of a specific pollution problem. Some questions focus on the nature of targeted sources, including question such as: "*Are there large differences in control costs among sources?*" "*Are there very many sources, or very few?*" Other questions consider our knowledge basis by asking: "*Do we know how to set environmental targets, how to control the problem, or what it would cost to control?*"

Government burdens are affected greatly by available knowledge and the complexity of required analytical tasks. For example, a potentially risky pollutant that one might otherwise wish to control with a harm-based standard may be so poorly understood that a different choice might be necessary. Identifying available methods of control under a design standard poses fewer analytical difficulties than determining acceptable pollutant concentrations under a harm-based standard, though a design standard might require a less-than-ideal level of pollution control. Such tradeoffs are not theoretical; Congress changed the harm-based approach to air toxics to a design stan-

dard in the 1990 Clean Air Act Amendments because the harm-based approach had proven virtually impossible to implement.

Most of Richards' Table 3 corresponds to the "costs and burdens" section of our Table 3, except for the last rows that are legal factors. Richards quite usefully adds another cost consideration that the OTA Report overlooked—the cost of public funds for those instruments, such as subsidies, with high cost to government

There is one more related concern that may alter one's choice of instrument: *given the pollutant and its sources, do we anticipate or hope that tomorrow's understanding of this problem or its solution will be significantly different than today's?*

If the uncertainty about the nature of the risk is relatively high or if technology is changing rapidly, one might be drawn to those instruments that are most adaptable to change. Technical assistance programs, information reporting, and liability usually push sources to make changes without government approval and can be relatively easily modified by government when the need arises.

If, for a particular problem, Congress' environmental goals just cannot be achieved with today's technology at an acceptable cost, one might choose those instruments that spur technology innovation. Pollution charges can be effective because of the continuing pressure they exert. Product bans also spur innovation, but they are typically avoided unless the risks from the pollutant are quite high. Multi-source instruments, such as tradeable emissions or challenge regulations, offer sources additional flexibility for using new technologies and thus may also help. Richards' Table 3 includes this criterion as a production cost factor and highlights this as a concern when choosing an instrument.[127]

## VII. USING MORE THAN ONE INSTRUMENT

As one can readily glean from our Table 3, or Richards' Table 3, it is indeed rare that one instrument alone will satisfy all of the desires that policy-makers may have when attempting to solve an environmental problem. Thus, one finds historically a reliance on the use of multiple instruments when addressing a problem. The single most common combination is the use of design standards in conjunction with harm-based standards. About half of the 30 major pollution control programs under the CAA, the CWA, and RCRA follow this ap-

127. *See* Richards, *supra* note 1, at 280.

proach. Control of conventional water pollutants, such as biological oxygen demanding materials (BOD) and suspended solids, is typical of this combination. For water bodies that meet the desired level of water quality set by each state, sources that discharge directly into lakes and streams are required to control discharges to a level defined by a design standard specific to each source category and pollutant.[128] Municipal sewage treatment plants are required to control to a level equivalent to "secondary treatment," and industrial dischargers must control equivalent to "best available technology economically achievable."

However, if the water body does not meet the desired level of water quality, sources are subject to a harm-based standard; that is, sources are required to clean up their effluent to a level that allows the lake or stream to maintain the specified water quality. The simpler design standard becomes a "floor" or minimum level of control. However, if the desired water quality is not achieved, the more analytically complex harm-based standard then applies. This mix of instruments is a compromise allowing the relative speed, simplicity, and lower administrative burden of design standards in cleaner areas and the potential for more efficient controls using a harm-based approach in areas where more stringent and expensive controls are needed.

Our Table 3 rates both design standards and harm-based standard about the same for cost-effectiveness and fairness of control, but design standards have an edge when it comes to demands on government. The key difference is the ease of analysis. For example, the difficulty of setting harm-based standards was probably the primary reason for the slow pace of regulating air toxic emissions since the 1970s, which led Congress to change strategy in the 1990 CAA amendments. As discussed earlier, Congress abandoned a strategy based primarily on the use of harm-based standards and adopted an approach that directs EPA to first issue a design standard (emissions equivalent to those achieved by using "maximum achievable control technology") and then to analyze whether "residual-risk" goals are exceeded, and if so, to require additional controls. Thus, by using a multi-source approach, Congress attempted to buttress the weaknesses of harm-based standards with the simpler approach of design standards.

However, both the "single-source" design and harm-based standards are merely average with respect to efficiency and fairness of

128. *See, e.g.*, Clean Water Act, 33 U.S.C. § 1311.

control, though harm-based standards are probably the better of the two. Hence, the reason for the great attention being given to multi-source instruments, which have the potential for improved cost effectiveness. As can be seen in Table 3, we rate "multi-source" instruments such as tradeable emissions and integrated permitting (which, in our definition, includes facility-wide "bubbles" or emission caps) as potentially more cost effective. Several problems addressed by the CAA currently combine tradeable emissions with more traditional single source approaches. To date, these have primarily been limited to emissions of pollutants such as sulfur dioxide and nitrogen oxides—pollutants whose effects are regional as opposed to the more localized impacts of toxic air pollutants. For example, trading has been extensively used to allow new sources to locate in nonattainment areas—areas that do not meet ambient air quality standards. New sources can locate in nonattainment areas if they "offset" their emissions with reductions from existing sources. Another area where trading has been used is compliance with exhaust emission standards for heavy-duty diesel engines.

The topic of instrument choice is important precisely because it is so rare for one instrument alone to satisfy all of the desires that policy-makers may have when attempting to solve an environmental problem. Moreover, it is even difficult to choose a *mix* of instruments that achieves high marks on all seven of the criteria considered in this study. As societal values and priorities change, and as new problems emerge to challenge our existing taxonomies and frameworks, we agree with Richards that, far from being an academic exercise, the issue of instrument choice is in fact worth our collective efforts to help move the nation's environmental performance in the right direction.