

Frontiers of Environmental Economics Conference
Airlie House, Virginia
October 23-25, 1998

**EMPOWERING THE COMMUNITY:
INFORMATION STRATEGIES FOR POLLUTION CONTROL**

by

Tom Tietenberg*
David Wheeler

* The authors are respectively Mitchell Family Professor Of Economics, Department of Economics, Colby College, and Lead Economist, Development Research Group, World Bank. We are indebted to H. Landis Gabel, Robert U. Ayres and Howard Kunreuther for helpful comments.

ABSTRACT

Disclosure strategies, which involve public and/or private attempts to increase the availability of information on pollution, form the basis for what some have called the third wave in pollution control policy (after legal regulation--the first wave--and market-based instruments --the second wave). While these strategies have become commonplace in natural resource settings (forest certification programs, for example), they are less familiar in a pollution control context. Yet both the research on, and experience with, this approach is now growing in both OECD and developing countries. This paper will review what we know and don't know about the use of disclosure strategies to control pollution.

Following a review of the conceptual foundations for disclosure strategies, the paper considers how the policy setting influences the type of information strategy employed. Examples of innovative disclosure strategies in the U.S., Latin America and Asia, and the channels through which they operate, is followed by a review of the empirical research on their effectiveness. Finally we close with our sense of where further research would be particularly helpful.

INTRODUCTION

THE DEMAND FOR DISCLOSURE STRATEGIES

The first phase of pollution control involved applying traditional legal remedies such as emissions standards. Over time however, it became clear that these traditional regulatory approaches to pollution control were excessively costly in some circumstances (Tietenberg 1985) and incapable of achieving the stipulated goals in others. (Tietenberg 1995). Failures have been especially common in developing countries, where legal and regulatory institutions are often weak (Afsah, et. al. 1996a). In response to these deficiencies the second phase of pollution control focused on market-based approaches such as tradable permits, emission charges, deposit-refunds and performance bonds. (Hahn 1989; OECD 1989; Tietenberg 1990; OECD 1994; OECD 1995) In some instances they have substituted for traditional remedies, but in most cases they have complemented them. In the OECD and Easter Europe, these approaches have added both flexibility and improved cost-effectiveness to pollution control policy. Pollution charges have also contributed to improved environmental performance in developing Asia and Latin America, with particularly noteworthy examples in China (Wang and Wheeler, 1996), Malaysia (Vincent, 1993), and Colombia (Arbeláez, 1998).

Even the addition of market-based approaches, however, has not fully solved the problem of pollution regulation. In the industrialized countries the system remains overburdened by the sheer number of substances to be controlled. Neither staffs nor budgets are adequate for the task of regulating all of the potentially harmful substances that are emitted by firms and households. In many developing countries, these difficulties are compounded by the problems associated with designing, implementing, monitoring and enforcing market-based regulations.

To counter these problems, phase three in the evolution of pollution control policy involves investment in the provision of information as a vehicle for making the community an active participant in the regulatory process. The timing of this increasing role for disclosure strategies seems to emanate from the increasing perceived need for more regulatory tools (as described above); the falling cost of information collection, aggregation and dissemination; and the rising demand for environmental information from communities and markets. Rising benefits and falling costs imply that public disclosure merits a close look, even if it has been perceived as inefficient in the past.

The disclosure strategies considered in this paper involve public and/or private attempts to increase the availability of information on pollution to workers, consumers, shareholders and the public at large. Provision of greater information may either complement or replace traditional regulation strategies. Disclosure strategies seek to enlist market forces in the quest for efficient pollution control. And in so doing they interact in sometimes complex ways with traditional standard setting and enforcement strategies. Whether they complement phase one and two strategies or substitute for them, they involve a rather different role for government--one which seems to offer the possibility of fulfilling the large and growing need for pollution control despite limited budgets and staffs. But how real is this promise?

THE CONCEPTUAL FOUNDATION FOR DISCLOSURE STRATEGIES

The starting point for thinking about information approaches to pollution control is the Coase Theorem. (Coase 1960) In his landmark essay Coase pointed out that pollution control situations have a certain symmetry. Inefficient pollution imposes costs on victims which exceed the costs of controlling that pollution. In other words the marginal benefits of pollution control exceed the marginal costs. The existence of inefficient pollution damage therefore provides a motivation for the victims to take corrective action, even in the absence of any such incentives by the polluters.

What economists have learned rather recently is that the list of victims can be very large indeed, much larger than originally thought. The list of potential victims includes not only the traditional categories of those harmed directly by the pollution, but also those who may

be disturbed by it even if they are not directly affected. The fact that this “nonuse” value of pollution control can be quite large has become a familiar result to those conducting contingent value surveys. The pressure to control pollution therefore can arise from victims experiencing both use and nonuse damages.

One standard precondition for decentralized processes to work efficiently is for the decision-makers to have full information. In the case of victims taking action to control pollution, this precondition is not likely to be met.

Information about environmental risks is asymmetrically distributed. In a typical case the best knowledge about emission profiles is held by the polluters and/or regulators, not the victims. Furthermore the polluters are unlikely to share the information with victims in the absence of outside pressure to do so. In addition, bureaucratic inertia and/or legal constraints have frequently prevented information sharing by regulators.

However, even if information on emissions is provided, this may not be sufficient for victims to understand the severity of the risk they face. Such understanding can only occur when knowledge of emission levels is combined with information on exposure and on the exposure/risk relationship.

In the past the Coasian insight has been dismissed as a foundation for policy¹ for several reasons.

- In multiple victim circumstances it ignores the public good nature of information. When coupled with the very real transactions costs associated with the collection and dissemination of information, this characteristic tends to undermine the incentive of any individual to derive and to share information on the nature and extent of pollution damage with other victims.
- The approach appears to force the victim to pay for controlling pollution damage which he/she did not cause, an outcome which violates the well-established “polluter pays” principle of pollution control.

Since, as discussed below, both of these flaws turn out to be remediable, the traditional lack of interest in Coasian approaches may have been misplaced.

OVERVIEW

While disclosure (particularly labeling) strategies have become common in natural resource settings (organic agriculture and forest certification programs, for example), they are less familiar in a pollution control context. Yet the number of applications in this new arena is increasing in both OECD and developing countries.

Generally these disclosure strategies are justified on ethical grounds. Victims are seen as having the right to know the environmental risks to which they have been exposed. In this paper we explore quite a different justification--that providing greater information can be part of a larger strategy to promote efficient pollution control.

This paper will review what we know and don't know about the use of disclosure strategies to control pollution. It is important to note that this review shall not cover two related fields. First, we shall not examine the rather large literature on the relationship between regulator and polluter when the stakeholders have private information. (Lewis 1996) Second, we shall not examine the literature on the role of strategies (e.g. auditing) for increasing the amount of information available to the firm itself. (Sinclair-Desgagné and Gabel 1997) Our focus is rather on information made available to consumers, workers, shareholders and the public at large.

¹ I was one of those who was quick to dismiss it. See Tietenberg (1992)

Following a review of the conceptual foundations for disclosure strategies, the paper will consider how the policy setting influences the type of information strategy employed. Examples of innovative disclosure strategies (in the U.S., Latin America and Asia), and the channels through which they operate, will be followed by a review of the empirical research on their effectiveness. The paper will close with the authors' sense of what we have learned and where further research would be particularly helpful.

THE CONTEXT

Tailoring disclosure strategies to the specific context requires an understanding of the various types of situations that can arise and the policy-relevant characteristics which differentiate them. For the purposes of this study we shall consider two broad pollution types (product pollution and process pollution) and four specific settings (the household setting, the consumption setting, the employment setting, and the community setting).

POLLUTION TYPES

Pollution can arise either from the consumption or use of products ("product" pollution) or the production of those products ("process" pollution). Examples of the former include the consumption of foods contaminated with pesticides, the use of aerosol sprays with ozone depleting chemicals, driving automobiles, heating homes with polluting fuels, etc. Examples of the latter include water pollution from pulp and paper mills, air pollution from steel mills, hazardous waste pollution from chemical plants, radiation from nuclear power plants, etc.

THE SETTING

The point of departure for disclosure strategies is understanding the economic incentives which face the parties to an environmental pollution situation. Do they have incentives to take actions to control pollution? Are these incentives compatible with an efficient outcome, or do the incentives create a bias toward too little or too much control?

Analyzing the answers to these questions begins with isolating the role of information in the process. In the absence of government intervention, will the efficient amount of information be generated? Or will the amount of information supplied normally be inefficiently large or small? Will it normally be made available to victims?

Given the answers to the above questions, what possible role for government is involved? Does this role complement or substitute for traditional regulation?

The Household Setting

Indoor pollutants, though increasingly recognized as significant contributors to human health problems, have not traditionally been addressed by conventional regulation. Two classic examples of dangerous indoor pollutants are radon gas² and lead paint³.

Do homeowners have an incentive to control these forms of pollution? Assuming they have full information, homeowners have three major possible responses when confronted with the

² The Environmental Protection Agency has estimated that between 5,000 and 20,000 lung cancer deaths per year in the United States can be attributed to exposure to radon gas. This colorless, odorless gas (a product of natural radioactive decay) tends to enter homes from the ground or through the water supply.

³ The USEPA has also estimated that more than 1.7 million American children under the age of six have unsafe blood-lead levels, making lead poisoning a significant environmental health hazard for young children. Most of those children are poisoned by deteriorated lead-based paint and the contaminated soil and dust it generates. Children with too much lead in their bodies can experience lowered IQ, reading and learning disabilities, impaired hearing and other problems. More than 80 percent of the U.S. housing stock built before 1978 -- some 64 million residences -- is estimated to contain lead paint.

risk of radon or lead contamination. They can decide not to control; they can undertake some control; or they can attempt to solve the problem by selling the house to someone else.

For the first two choices, homeowner incentives are compatible with efficiency. Because those who would bear the damage and those who would pay for the control are in the same household, theory would lead us to expect an efficient balancing of the benefits and the costs. Control would be undertaken until the marginal cost of additional control equaled the value of the marginal damage reduced by the expenditure.

The third choice, however, opens the possibility of an inefficiency. The cheapest solution may well be selling the home to an unsuspecting buyer, thereby passing any control costs onto them. This is a clear externality; what is cheapest for the homeowner is not cheapest for society as a whole.

Do households have efficient incentives to invest in information? Information on radon or lead has one of the characteristics of a public good--indivisibility. Information shared with one party does not diminish the stock of information available to be shared with many other parties. Information about radon or lead, however, does not automatically have the second characteristic of a public good--nonexclusivity. The establishment of exclusive rights could be possible, at least in principle.

What does this suggest about the role for government? For the externality case it seems necessary to assure that only full information transfers of property take place. Once good information is available on safe levels and a test is developed, sellers with low/no radon have a clear incentive to disclose that fact, via a test certificate that is verifiable. They can sell their house for more. This is just like termite damage.

An informed buyer should reduce the offer price by an amount that reflects the cost of controlling the radon or lead. Linking the selling price to the pollution situation by full disclosure would restore efficient incentives and by offering the seller a choice--controlling the pollution (and raising the price) or accepting a lower selling price.

In fact, current policy in the U.S. corresponds closely to this recommendation. As of December 6, 1996, all home buyers and tenants have the right to know about potential lead-based paint hazards before they buy or rent older housing under a program jointly sponsored by the U.S. Environmental Protection Agency and the U.S. Department of Housing and Urban Development. Prospective tenants or buyers of pre-1978 residential dwellings -- including single-family-home owners -- can ask for and receive information on known lead-based paint hazards before purchasing or renting.⁴

The U.S. government has also played an important R&D role in this context. It has conducted basic research to discover appropriate risk thresholds for lead and radon⁵ and has widely disseminated this information. It has also made sure that low cost test kits are available. However, it has been up to the market to supply the test kits at a reasonable price, and up to households to decide what they should do with the results.

This is a very different policy than would be implied by traditional regulation. The regulatory solution would involve the definition of a standard, which would then have to be applied, with appropriate monitoring and enforcement, to every "at risk" household. Even if physically possible, which is doubtful, this approach would not normally be expected to produce

⁴ In the case of sales transactions, home buyers can also request up to 10 days to conduct a lead-based paint risk assessment or inspection at their own expense prior to finalizing a sales contract. The new requirements apply to sales and rentals of residences built before 1978, the year the sale of residential lead-based paint was banned. Specific notification and right-to-know language must be included in the contract or lease, along with signed statements from all parties verifying that the requirements have been met.

⁵ For the analysis behind the radon standard see Marcinowski and Napolitano (1993)

efficient outcomes. The homeowner would not generally be free to balance the benefits and costs of remediation.

The Product Consumption Setting

Consider now a situation of product pollution in which damage is inflicted directly on consumers of that product. Examples might include fruits or vegetables with residues of pesticides, heating systems that leak harmful gases, carpets or dry cleaning which emit toxic fumes left over from the manufacturing or cleaning process, etc.

Here we have a case where the polluter and the pollutee are different. Yet the apparent conclusion that an externality is present is not necessarily valid.

Since consumers and producers are linked by the purchase decision, pollution inflicted on consumers is not necessarily an externality. Consumers who are aware that a product is exposing them to an environmental risk can either avoid purchasing it (if, for example, a riskless substitute is available) or purchase it only at a lower price which reflects the associated damage or the cost of preventing or mitigating it. In either case, the producer has an incentive to alter its products and/or pricing to balance the potential loss of sales against the costs of eliminating or mitigating the pollution problem.

Will the market supply the proper amount of information about the risk to assure that consumers are fully informed? Not necessarily. Since producers have something to lose by providing this information (a loss of sales or lower prices), they will only provide it if prodded by some outside force.⁶ Individual consumers normally do not have an incentive to acquire the information, since their individual gains are so small (even when societal gains are large) in comparison to the costs of an appropriate product-testing program.⁷ Hence, even in cases where the costs of assuring informed consumers can be justified on efficiency grounds, private incentives will not necessarily produce that outcome.

What is the implied role for government? If the environmental risk is so large that rational consumers would not purchase the product, the government typically bans it. A common case, however, arises when the environmental risk exceeds the benefits of the product for some consumers, but not for others. In such a case, firms should offer products which pose varying environmental risks, leaving the market to sort out the market share going to each type of product. Under reasonably competitive conditions, product labeling should provide the requisite information. For example, vegetable producers which use no pesticides will label their produce as “organic”, thereby affording consumers the opportunity to make an informed choice. In general, produce labeled as organic has been able to command a price premium for the lower environmental risk it poses.

However, it is clear that consumers need reliable benchmarks for evaluating producers’ claims. Without an enforceable standard by which the term “organic” is defined, its credibility will be rapidly undermined under competitive conditions. Here the government may have a role in standardizing the information provided and sanctioning those who misrepresent their products.

A different sort of information is needed when the pollution arises from the use of the product. For example, pesticides are clearly toxic by design, not default. Banning pesticides

⁶ In principle one such outside force could be liability law. If producers are held liable for the pollution damages caused by their products, they will have an incentive to balance the expected liability costs against the costs of controlling the pollution. In practice, however, this channel does not work very well. For a detailed assessment of why not, see Dewees (1992)

⁷ Another interesting possibility would be for a competitor to supply the information, thereby diverting sales to his/her own product. One example of this involves milk. Distributors which have specifically prohibited their suppliers from milking cows injected with growth hormone advertise the absence of this hormone in their milk, thereby assigning significance to the silence of their competitors.

simply because they are toxic to some species is not practical. Effective government policies in this case will recognize that risks to pesticide users will vary with their application practices. Typically, government-mandated labels provide detailed instructions on “proper” (damage minimizing) application procedures. Application of especially risky pesticides may be limited to licensed applicators who are required to undergo special training.⁸

Like their counterparts in the household setting, disclosure strategies in the product consumption setting provide an alternative to traditional regulation. In some cases disclosure strategies can substitute for traditional regulation (as when private labeling produces informed consumers), and in some cases can complement traditional regulation (as when pesticides posing an unacceptable risk are banned, but others are controlled by requiring precautionary labels or licensed applicators).

The Occupational Setting

The employment setting provides a very different set of interactions between polluters and pollutees. Employers typically control the overall production process, which includes decisions about the toxicity of the substances employees face. However, employees have at least some control over their actual exposure to risk.

What incentives do fully informed employers and employees have with respect to controlling those risks? Are those incentives likely to be compatible with efficiency? Consider first the incentives of the employees. If they bear both the cost of taking precautions and the expected damage from exposure, employees will maximize their welfare by taking all cost-justified precautions to reduce risk, and by seeking wage increases to compensate for the remaining risk.⁹

The employer must choose how much to invest in risk reduction. Since fully informed employees will demand compensation for any remaining risk, a cost-minimizing employer will invest to the point where the incremental cost of risk reduction is equal to the wage increment which will compensate employees for the residual risk.

All of this, however, depends on fully informed workers (and employers). Will normal market processes guarantee the efficient generation and sharing of occupational risk information?

The answer seems to depend on the nature of the employment situation. Individual employees are unlikely to be willing to bear the cost of acquiring information about the risk, since their expected individual benefits are likely to pale in the face of their individual costs. When employees band together, however, as in labor unions, providing that information may become desirable because the collective benefits will outweigh the cost of acquiring the information.¹⁰

How about employers? In general, employers do not have an incentive to inform their workers about environmental risks. Fully informed workers are likely to demand higher wages; workers who are ignorant of the risks they face are not.

⁸ This strategy will not be sufficient if the risky chemicals are readily available to nonlicensed applicators. In the U.S. the state of Mississippi had to evacuate a record 281 households in response to the spraying of methyl parathion, a toxic farm pesticide, in hundreds of Gulf Coast homes and businesses. Five day-care centers, a motel and a restaurant were also closed. Two men face charges of spraying commercial pesticides without a license. (GREENWIRE, 11/18/96)

⁹ Not all occupational risk situations, however, fit this description. In some cases the cost of taking precaution may be borne by the employer (as when special equipment is involved). In others the damage may be borne by other workers instead of, or in addition to, the worker who controls the risk. In either case no presumption of efficient behavior can be made.

¹⁰ Unions would be expected to produce more efficient information flows since they represent many workers and can take advantage of economies of scale in the collection, interpretation, and dissemination of information. Available evidence suggests that most wage premia for risk are found for unionized workers. See Viscusi (1983).

What role does this suggest for the government? It may be minimal when labor organizations such as unions are large and well-organized. However, the recent decline of unionization in the U.S. has produced a growing need for other sources of information.

The original thrust of U.S. government policy (in 1970) was strictly regulatory. The government promulgated thousands of very detailed standards, which in many cases prescribed specific actions to be undertaken by employers. Empirical analysis performed up to the mid-1970s clearly indicated that this approach was ineffective. (Viscusi 1992, pp. 181-205) In response to this lack of success, the Carter and Reagan administrations proposed major reforms. The evidence on that period is more mixed. Analysts have found some statistically significant effects of OSHA on worker safety, but these effects were neither dramatic in magnitude nor robust across different measures of risk. (Viscusi 1992, pp. 206-222)

Risk communication became an important element of the policy in 1983, when the “Hazard Communication Standard” introduced uniform hazard communication requirements for manufacturers. Under this standard, each employee who is, or may be, exposed to hazardous chemicals in the workplace must receive information and training tailored to the nature of the risk. The act prescribes three different types of risk communication instruments: container labels, Material Safety Data Sheets (MSDS)¹¹ and training sessions. In this case risk communication is designed to complement, rather than substitute for, other policies.

The Community Setting

From an economic point of view, the most difficult setting for pollution disclosure involves situations where the polluter and pollutee have no formal contractual relationship and large numbers of parties are involved.

The relationship between polluters and their neighboring communities provides a good example of this problem. Whereas disclosure strategies can build upon the purchase relationship for consumption-related pollution, and the wage relationship for employment-related pollution, community-polluter relationships are not mediated by specific behavioral linkages.

The community case is the large numbers case where the basic Coase theorem is most problematic, not only because of the high bargaining costs due to the large number of parties and the public good nature of information supply, but also because of the free-rider motive in the large numbers case even in the presence of perfect information. (Kennedy, LaPlante, et. al. 1994) How important is the free rider problem in practice in the disclosure context? Just how empowering is disclosure when the benefits from taking action are not exclusive. That is one of the questions we seek to answer.

DISCLOSURE STRATEGIES FOR THE COMMUNITY SETTING

The typical information strategy involves four separate functions: (1) establishing mechanisms for discovering environmental risks, (2) assuring the reliability of the information, (3) publicizing or sharing the information, and (4) acting on the information.

DETECTING ENVIRONMENTAL RISKS

The necessary first step in an efficient information approach is discovering the extent and magnitude of environmental risks. Environmental risks will normally be detected only after

¹¹ MSDS are required of all chemical manufacturers and importers. Employers using such substances must obtain the relevant sheets from their suppliers and make them available to employees. These sheets contain information on the characteristics of the substance, proper handling procedures, and emergency and first aid procedures.

some investment in information is made. Who should make that investment? What incentives do they face?

Assessment of environmental risk requires knowledge of a complex causation process. Relevant considerations include the emissions volumes of pollutants, the resulting degree of exposure, and the sensitivity of the population to this exposure.

Full information requires knowledge of all these links in the process, but notice that the types of information involved are quite different. Some information is general – for example, atmospheric pollutant concentrations apply to the population at large -- while other information is specific to individual polluters.

The government may be in the best position to identify the general elements of environmental risk. These elements are of interest to the largest number of citizens, and one-time collection of risk-related information by a central body eliminates duplication of effort.

Polluters themselves are an obvious source of firm-specific risk information. They have the best information about their inputs, products and processes, and they may be well-positioned to assess exposure of third parties to harmful emissions. However, they normally do not have the proper incentives to detect or to reveal the risks that they generate, in the absence of the threat of liability or some other outside force.

The polluters are not the only possible source of firm-specific information. In the U.S., for example, an alternative approach to monitoring places some responsibility on private enforcers. An example is provided by the "riverkeepers" system. Typically hired by associations of citizens who live along the river, riverkeepers constantly oversee a network of monitoring stations, usually with help from many volunteers. These associations are funded by voluntary dues from the members.

ASSURING RELIABLE INFORMATION

Information has both a quantity and quality dimension. Effective risk communication requires that the requisite information be reliable, as well as available. Inaccurate or partial information can be worse than no information at all, if it promotes either a false sense of security or unjustified fears. And firms have incentives to mislead the public, either by overstating their environmental accomplishments or by selective omission (noting the positive outcomes and ignoring or burying the negative ones.)

Accurate information can be promoted by standardizing the method of collection (specifying acceptable collection instruments and procedures, for example, as well as the nature of the information to be gathered) and by assuring significant losses for those who falsify information.¹² The ISO 14000 process, a set of voluntary environmental management standards crafted by the International Standards Organization, represents one international attempt to standardize the requirements for certification of good environmental practice.

When allegations of a potentially actionable environmental risk are raised from the community, a process must be established to verify and validate the claims. Lodging a complaint does not assure its validity. The organization that receives the complaint may be the regulatory authority, a court, or perhaps a special commission that is responsible for judging the claims. Its function is to determine whether the party bringing the claim has met the required burden of proof.

DISSEMINATING THE INFORMATION

For a disclosure strategy to work, the necessary information must reach the pollutees in a usable form. This step may be automatically satisfied by information provided by the

¹² This may be one area where criminal penalties are justified. See Segerson and Tietenberg (1992)

community itself, but it is not sufficient for information produced by the government or the polluter.

Transparency is the key to assuring the availability of useful information.¹³ In practice this means that the information must be in a form which can be used by the community, and the community must have access to it.¹⁴

Information disclosure can either be voluntary or mandatory. In a well-known voluntary system, organic farmers identify themselves as "green producers," subject to certification procedures. Since disclosure is voluntary, conventional farms have no obligation to list the types and amounts of the pesticides used. On the other hand most community-right-to-know approaches (such as the Toxic Release Inventory described below) require all firms to provide emission information.¹⁵

For complaints against public officials, private enforcers will have the necessary information only if the relevant decision processes are open to public scrutiny. For example, community leaders may wish to assure that environmental impact assessments filed by developers comply with procedural requirements and are truthful. Timely access to the assessments is especially important, since nearly-completed projects are difficult to enjoin.¹⁶

Monitoring of polluters is a prerequisite for initiating complaints against them. In most cases polluters themselves report their emissions to the authorities. Transparency is assured when the mandated periodic reports are also accessible to the public. When publicly available, they can be used by private enforcers as the basis for raising noncompliance claims.¹⁷

ACTING ON THE INFORMATION

Once the information is generated about an environmental risk, the next step is to define what can be done with it. The options range from letting the information generate its own pressure through preexisting channels to establishing new channels for pressure to be applied.

Existing channels can be used in many different ways.

¹³ In the United States the Center for Environmental Information and Statistics became operational and open to the public early in 1998. The Center provides easy access for the public to EPA's massive environmental information resources through computers and other means.

¹⁴ The Sector Facility Indexing Project (SFIP) initiated by the USEPA is a community-right-to-know and data integration pilot project that provides environmental performance data for facilities within five industrial sectors: automobile assembly, petroleum refining, pulp mills, iron and steel and primary nonferrous metal production (aluminum, copper, lead and zinc). The ultimate goal of the SFIP is to publish information regarding each profiled facility, and provide a publicly accessible database of current information which will allow for customized data searches. (62 Federal Register 19573).

¹⁵ The mandatory versus voluntary dimension is becoming an important issue in a US proposal to provide pollution information on electric utilities as part of the deregulation process. This proposal would provide consumers with information on the emissions profiles of each of the utilities from which they would be able to secure power, thereby enabling them to choose on environmental as well as economic grounds. An unresolved issue is whether it would be sufficient to let the green utilities identify themselves, or to require all utilities to disclose their emissions profiles.

¹⁶ In practice, unfortunately, timely access may be the exception rather than the rule in many countries. In commenting on the Mexican system Alanis-Ortega (1995, p. 9) states: "While government bodies may let you consult a document, obtaining a copy is generally more difficult. Not all offices have copy machines and most often it is prohibited to take a document out of the government office to make copies. Another limiting factor is that many government offices in Mexico do not have an organized document system, a place to store their documents that is readily available to the public or to the staff, to manage and organize such information. At times documents are not even available to the very government officials that are legally responsible for the information."

¹⁷ For an analysis of the consequences of various rules for making regulatory information available to private enforcers, see Che and Earnhart (1997)

- In the product market consumers may choose less environmentally harmful products when effective information makes the choices clear. In addition to the obvious case where consumers may be directly harmed by the product (such as pesticides), this channel can be used by consumers who chose green products such as chlorine-free paper, even if they are not directly harmed by the pollution. Product market effects are enhanced when large buyers (large chains or the government, for example) decide to include environmental considerations in their purchasing decisions.
- In the capital market owners of shares of common stock in polluting firms may decide to invest in companies with a “greener” record, either for moral reasons or because they believe that environmentally benign firms will ultimately face fewer clean up costs and will therefore be more competitive. Some evidence suggests that green firms may have higher rates of return.¹⁸ The ability of investors to make these choices has been facilitated by the rise of green mutual funds, which screen firms using well-defined environmental performance criteria. In the Netherlands, the government subsidizes green funds by exempting their income from taxation.
- In the labor market environmentally responsible employers may find it easier to hire employees, and to retain employee loyalty. This could be because employees perceive that such employers are likely to be more financially stable over the long run, or because they have a moral preference for supporting green activities with their labor.
- In the legislature, when existing regulation seems inadequate, the information may build community support for additional legislation.¹⁹
- In the judicial system parties directly harmed by the pollution may seek redress through a variety of channels.
 - Victims can recover compensatory damages by suing polluters (these are called "tort law" actions).
 - Judicial “oversight” actions can be brought against public enforcement authorities which are not fulfilling their statutory responsibilities.²⁰ The results of these judicial actions can also be made available to the public.
 - Citizens can use the information to assert their legal right to a clean environment. Following the United Nations Conference on the Human Environment at Stockholm in 1972, many countries incorporated environmental considerations in their constitutions. These constitutional principles generally hold that: the State and all its citizens are responsible for environmental protection; all humans have the right to a healthy environment; the State and all citizens must foster development that is environmentally appropriate. Some constitutions, like those of Colombia, Ecuador and Chile, establish the right of people to live in an unpolluted environment. As a result of these constitutional provisions, the right to a clean and safe environment has become a fundamental right for each individual, enforceable through judicial action.

¹⁸ A study conducted by Richard Clough of Duke University indicated that portfolios invested in “environmentally responsible” companies generally return one to three percentage points more annually than the holdings of “irresponsible” companies. (Investor’s Business Daily, 5/27/97)

¹⁹ Hamilton (1997), for example, found that U.S. legislators were more likely to vote for disclosure strategies when they had a large number of Superfund sites in their district.

²⁰ In January, 1997 France's largest water distribution company, Lyonnaise des Eaux, filed an "unprecedented" lawsuit against the French government for failure to meet European Union directives regulating permissible nitrate levels in one of the country's rivers. Lyonnaise had been fined after Brittany residents sued the firm for supplying water that contained high nitrate concentrations. The company seeks \$900,000 in compensation for damage to its reputation and for the cost of maintaining a special water-treatment plant to meet the standards (Andrew Jack, FINANCIAL TIMES, 1/24/97).

- The public can be given certain enforcement powers to act on the disclosure directly. Private enforcement actions differ from more conventional liability actions because their initiators are not seeking compensation for pollution-related damages. Rather, the private enforcers are seeking to bring a noncomplying polluter into compliance, or to prevent pollution which is perceived as violating individual rights to a clean environment. Private enforcement actions can either be direct, (“citizen suits” in which private enforcers bring claims before the judiciary on their own behalf) or indirect (“complaint actions,” in which enforcers are only allowed to file complaints with a designated legal authority).²¹

SELECTED FUNCTIONING PROGRAMS

Practical application of these principles can be illustrated by reference to some representative programs.

THE TOXIC RELEASE INVENTORY PROGRAM

The Toxic Release Inventory (TRI) was enacted by the U.S. Congress in January, 1986 as a part of the Environmental Protection and Community Right to Know Act (EPCRA). It is designed to provide information to the public on releases of toxic substances into the environment. Most of the substances involved are not themselves subject to release standards.

TRI states that firms which *use* 10,000 pounds or more of a listed chemical in a given calendar year, or firms which *import, process or manufacture* 25,000 pounds or more of a listed chemical must file a report on each of the chemicals in existence within the plant if they also have ten or more full time employees.

Reporting of emissions or use of listed chemicals is accomplished annually. The reports include such information as the name of the company, name of the parent company if it exists, toxic release and frequency of release, as well as the medium in which the chemical is released.²² The information is available to the public. Firms must also separately report emissions to their state and local authorities as well as fire and emergency officials. Whether the data supplied by these reports meets the reliability standard described above is not clear.

According to these reports has TRI reduced toxic emissions into the environment? Apparently it has. According to official EPA data, total releases are down by a bit over 44% since the program’s inception (Table 1). However, this does not necessarily imply that toxic risk has also declined by 44%. TRI discloses emissions, but does not provide complementary evidence on risk. Since risk factors for different toxics can differ by orders of magnitude, this is an important limitation of the program.

²¹ Private enforcement mechanisms are currently used in both the United States and Europe to enforce environmental standards, as well as in Latin America. (Tietenberg 1996b) In the U.S. some fourteen statutes authorize citizen suits, and some thousands of claims have been initiated. (Naysnerski and Tietenberg 1992) According to Sand (1991), in Europe the number of public and private environmental complaints filed rose from about 10 in 1982 to 460 in 1989. More than half of these have been filed by private individuals or organizations .

²² Polluters must report the scientific as well as the common name for the chemical being addressed by that form, and provide a risk rating. The ratings are: Immediate (acute) health hazard, delayed (chronic) health hazard, fire hazard, sudden release of pressure hazard, and reactive hazard. (40 C.F.R. § 370.2).

Table 1. TRI Releases. 1988-1994

	1988	1992	1993	1994	1988-1994	Change
	<u>Number</u>	<u>Number</u>	<u>Number</u>	<u>Number</u>	<u>Number</u>	<u>Percent</u>
Total Facilities	21,046	22,593	21,938	21,336	+ 290	1.38
Total Forms	66,571	70,238	68,567	66,777	+ 206	0.31
	<u>Pounds</u>	<u>Pounds</u>	<u>Pounds</u>	<u>Pounds</u>	<u>Pounds</u>	<u>Percent</u>
Total Air Emissions	2,252,904,433	1,560,000,713	1,385,442,978	1,340,980,491	-911,923,942	-40.48
Surface Water	176,726,741	195,589,595	203,003,168	47,011,773	-129,714,968	-73.40
Underground Injection	625,967,221	366,495,726	294,846,947	306,651,731	-319,315,490	-51.01
On-site Land Releases	480,451,877	327,557,956	274,062,285	282,267,922	-198,183,955	-41.25
Total Releases	3,536,050,272	2,449,643,990	2,157,355,378	1,976,911,917	-1,559,138,355	-44.09

Source: The 1994 TRI Data Release report (EPA publication 745-R-96-002) available on-line at <http://www.epa.gov/opptintr/tri/ttintro.htm>

THE 33/50 PROGRAM

To complement and reinforce the TRI Program, the EPA initiated the 33/50 Program in February, 1991. This program set national goals of 33 percent reduction in 17 priority toxic chemicals by 1992, and 50 percent reduction by 1995. The reductions were to be achieved voluntarily by program participants,²³ and compliance with the guidelines was to be measured using the TRI reports. The program emphasizes pollution prevention rather than end-of-pipe control.

The initial invitation list, which contained the names of 555 companies with substantial chemical releases, was subsequently expanded to 5000. Some 1,300 corporations ultimately signed up to participate in the 33/50 Program. Participants collectively reduced their emissions by more than 50 percent, a total of 757 million pounds of pollutants, by 1994 -- a year ahead of schedule.

PROPOSITION 65

Proposition 65 was established in the state of California by popular vote in November of 1986, after the inception of the Toxic Release Inventory by the EPA. Prop 65 requires companies producing, using, or transporting one or more of 480 listed chemicals to notify those who are potentially impacted. Chemicals are listed as carcinogenic or causing reproductive harm. When their use or potential exposure levels exceed unacceptable risk thresholds established by a group of approved scientists, the impacted people must be notified. The risk threshold is uniquely determined for each chemical and depends upon its intrinsic potency or the potency of a released mixture.

Notification (by means of warning labels) must be placed on all products that will cause adverse health effects when used for a prolonged period of time. Notification must also be

²³ Aside from good publicity, there seems to be little evidence of any other *quid pro quo* for participation. For example, participants apparently did not face diminished enforcement pressure as a result of their participation. See Arora and Cason (1996)

made by a company whose toxic emissions to air, ground or water exceed levels deemed safe for prolonged exposure.²⁴

The third form of notification involves workers in the plant emitting the toxins. Workers must be warned of the potential danger if toxic chemicals defined by Prop 65 are used in manufacturing a product or created as a by-product of manufacturing.

Only companies with ten or more full time workers are required to notify endangered people of exposure. Non-profit organizations like hospitals, recycling plants, and government organizations, which account for over 65 percent of California's pollution, are not required to comply with Prop 65.

Under the Proposition, private citizens, other industry members and environmental groups can sue companies that fail to notify people of exposure in an appropriate fashion. Plaintiffs who make a successful legal claim get to keep a substantial portion of the settlement; this encourages private enforcement of the law and reduces government monitoring. Industry members also have a strong incentive to monitor each other, so that one company does not cheat and look greener than its rivals.

EPA AUDIT POLICY

What incentives can the government provide for encouraging the discovery of private environmental information? One possibility is to apply weaker sanctions to firms reporting environmental problems before they are detected by the regulators. On December 22, 1995, USEPA implemented an ambitious new policy which reduces, but does not waive, fines for non-compliant companies which audit themselves and promptly disclose and correct their own violations. (60 Fed. Reg. 66706) USEPA believes that such audits should be made public. About 100 companies had taken advantage of the EPA program by February of 1997. (GREENWIRE 2/18/97).

As of 1997, twenty-four states had passed similar measures and 16 states were actively considering them. (GREENWIRE 8/14/97). Achieving the right balance between sticks and carrots has not been easy. For example, some states have carried positive incentives beyond EPA's "comfort zone" by granting immunity from prosecution rather than reduced fines to firms which disclose and correct their own violations.²⁵

Despite these problems, data provided by the EPA show that the Audit Policy is having some effect on corporate behavior. One hundred and five companies have disclosed violations at more than 350 facilities under the policy. EPA already has settled matters with 40 companies and 48 facilities, waiving all penalties in most cases. In some cases even criminal penalties have been waived.²⁶

²⁴ In practice, notification on labels has sometimes been so small as to attract little attention from the consumer. Notification of community-type risks has frequently been via the classified advertisement sections of the newspapers, which few people read. An increasing body of research suggests that the form of the risk communication matters. See Magat and Viscusi (1992)

²⁵ In one, for example, the EPA ruled that Idaho must revise its "controversial" environmental audit law to ensure it does not interfere with the state's authority to enforce air pollution regulations. The Idaho Audit Act grants immunity from civil and criminal penalties to companies that disclose and correct environmental problems during self-audits. (LEWISTON MORNING TRIBUNE, 12/4 as cited in GREENWIRE, 12/4/97)

²⁶ For example, in one such case, on February 7, 1996, the United States Department of Justice announced that Chiquita Brand International was not prosecuted due to its voluntary disclosure that its subsidiary, John Morrell and Company, had illegally dumped slaughterhouse waste into the Big Sioux River in Sioux Falls, South Dakota for years, and had deliberately submitted false discharge monitoring reports to conceal its crimes. John Morrell and Company and several of Morrell's corporate officials now stand convicted of conspiracy and various Clean Water Act felonies. However, the government has declined to prosecute Chiquita, citing the parent company's voluntary disclosure and cooperation as the prime factors. (<http://es.inel.gov/oeca/epapolguid.html> (March 21, 1997))

PRIVATE ENFORCEMENT ACTIONS

Increasingly, provisions for better environmental information also give citizens the right to submit environmental complaints to administrative or judicial boards.²⁷ In Latin America and the Caribbean, for example, complaints are frequently triggered by perceived violations of regulatory procedures or citizens' environmental rights, not by failure to comply with specific legal discharge standards. In the U.S. and Europe, actions are more commonly related to the latter.²⁸

Administrative actions may result in the imposition of civil penalties, the creation of compliance orders, or both. Successful negotiations between control authorities and violators typically produce consent decrees, which create compliance schedules and/or provide for the collection of civil penalties. Civil penalties may be imposed to eliminate the economic benefit from non-compliance. Sometimes citizens who initiate actions even receive monetary rewards, though that is currently the exception rather than the rule.²⁹

At the next level, private enforcers may be empowered to do more than raise complaints.³⁰ Citizens empowered as private "attorney generals" are authorized to initiate civil proceedings against any polluter violating the terms of its pollution permit. In the U.S. these proceedings may be initiated by any "person," defined as an "individual, corporation, partnership, association, state, municipality, political subdivision of a state and any agency department or instrumentality of the U.S. or any officer, agent or employee thereof."³¹

Under several U.S. statutes, citizens may sue for appropriate civil penalties as well as an injunction against pollution. Civil penalties are calculated to remove any "significant economic benefits" from noncompliance with federal environmental statutes.

With only a few exceptions, under the American Rule each party in a court case must bear its own litigation expenses. The "private attorney general" approach, created during the 1970's, extends the common benefit approach by allowing reimbursement for actions performed in the general public interest. Otherwise, the courts have ruled, few people would have an incentive to protect the public good. Congress has affirmed this approach by including attorney fee reimbursement procedures in the citizen suit provisions of the environmental statutes (Jordan 1987).

Citizen groups are only reimbursed for successful or partially successful claims. When an action is proved to be harassing or frivolous, attorney fee awards can also be made to the defendants. That is apparently a rare occurrence.

²⁷ This section draws upon Tietenberg (1996)

²⁸ Complaint processes have also been established in both China and India. In India, for example, an "environmental audit" procedure has been developed for the 500 megawatt Dahanu Thermal Power project. The authorities in charge of the project distribute summaries of the results of environmental monitoring to the local community. Community groups can then check emissions against legal standards and seek redress through the courts as necessary. (World Bank 1992)

²⁹ On Feb. 7, 1997 EPA approved monetary awards to 20 citizens who helped the Agency take successful enforcement actions under the Clean Air Act (CAA). These were the first monetary awards given under the CAA, which authorizes EPA to make awards of up to \$10,000 after an enforcement action is concluded for reporting violations or assisting the Agency in enforcement proceedings. The Agency awarded the \$10,000 maximum to a citizen who helped EPA conclude a major asbestos enforcement case. The citizen learned that children were playing with bags of a powdery substance in an abandoned industrial building and, suspecting that the material was asbestos, warned the children, contacted the local air pollution control agency, and provided other information about the large quantity of asbestos improperly stored there.

³⁰ This section is based on Naysnerski and Tietenberg (1992)

³¹ 42 U.S.C. 7602(e).

INDONESIA'S PUBLIC DISCLOSURE PROGRAM³²

Indonesia's regulatory structure for controlling pollution is weak due to budget constraints, staffing deficiencies and corruption in the judicial system. Faced with a growing industrial sector in the mid-1990's, Indonesia's National Pollution Control Agency (BAPEDAL) decided to initiate a program called PROPER (Program for Pollution Control, Evaluation and Rating), which would rate and publicly disclose the environmental performance of Indonesian factories.

Indonesia has chosen a single-index approach to the provision of information. Under this approach BAPEDAL compiles raw pollution information and aggregates it into a single, easy-to-interpret color rating for environmental performance:

- A black rating is assigned to factories that have made no attempt to control pollution and are causing serious damage.
- A red rating is assigned to factories which have some pollution control, but which fall short of compliance with national regulatory standards.
- A blue rating is assigned to factories that are in compliance with national regulatory standards.
- A green rating is assigned to factories whose emissions control and environmental management procedures significantly exceed those needed for compliance.
- A gold is reserved for world-class performers, those which rank among the cleanest plants of that type anywhere in the world.

In the pilot phase of PROPER, 187 plants were rated. When the program was officially launched in June 1995, only the names of the five Green plants were publicly announced. The 121 plants rated as Red or Black were privately notified, and given until December 1995 to improve their performance. Full disclosure was implemented on December 29; the pilot-phase results are displayed in Table 2.

Table 2. Indonesia Disclosure Program

Number of Firms in Each Classification Category, Various Dates

<u>Color</u>	<u>June 1995</u>	<u>December 1995</u>	<u>September 1996</u>
Gold	0	0	0
Green	5	4	5
Blue	61	72	94
Red	115	108	87
Black	6	3	1

Source: Data provided by the World Bank

These data suggest that PROPER's short-term impact in the below average category has been substantial. Before full disclosure in December, half the Black plants made successful efforts to upgrade their status, along with a substantial number of Red plants. By September 1996,

³² This section is based upon Afsah, LaPlante and Wheeler (1996). This paper is available on the web at http://www.worldbank.org/nipr/work_paper/1672/index.htm.

only one plant remained Black, and Red plants had fallen by 24%. No short-term impact is observable in the overcompliance range, but this is not surprising. Attaining Green or Gold status will require longer-term investments, while rapid installation of basic abatement equipment can be sufficient to promote escape from a Black rating.

Has PROPER been expensive? A very conservative estimate is provided by the program's first 18 months of operation. This estimate is overly conservative for two reasons. First, most of the expenses were devoted to reorganization and upgrading of BAPEDAL's monitoring, data processing and technical analysis capabilities – all costs which would have been incurred for implementation of any effective pollution control program, whether command-and-control or market-based. Appropriately imputed costs for PROPER would actually be at the margin determined by applications of the ratings methodology to existing data and public dissemination of the results. Obviously, these would be far lower than the full costs of agency upgrading. Second, during the first eighteen months, all parties were high on the learning curve and technical assistance was provided by expensive foreign consultants. Since then, the PROPER team has operated independently of foreign assistance.

The conservative cost estimate is indeed sobering -- because it is so small. For the first 187 plants, fully-accounted administrative costs of about \$100,000 were sufficient to reduce BOD emissions by approximately 40%. The implied cost is about \$535/plant for 18 months: about \$360/year, or \$1/day. Other benefits have included a sharp improvement in BAPEDAL's general performance, as the new information-handling standards have taken hold, and a much higher level of credibility with industry, NGO's, and the general public. Recalling that the previous regime was almost totally ineffective, it is difficult to avoid the conclusion that PROPER has been very successful in improving environmental performance at very low public cost.

As PROPER becomes better known, the concept is spreading. The Philippines' Department of Environment and Natural Resources (DENR) has begun a public disclosure program called EcoWatch which is similar to Indonesia's PROPER. The program started in 1997, when President Ramos publicly introduced EcoWatch along with the leaders of around 20 Philippines Business Associations. The Associations signed an agreement with DENR to support EcoWatch by providing information for program development and encouraging participation by members. (Manila Bulletin, April, 1997 as cited in <http://www.worldbank.org/NIPR/comrole.htm/ecowatch>.) In June, 1998, President Ramos initiated public disclosure by publicly congratulating the recipients of the first Blue awards. After the recent change in administration, the new government has reaffirmed its support for EcoWatch and announced its intention to expand the program.

Mexico and Colombia are also beginning similar programs. The Mexican program, called PEPI (Public Environmental Performance Index) will use pollution reports generated by the new national environmental licensing program. Colombia plans to use data generated by its new water pollution charge program to rate and publicly disclose the environmental performance of polluters.

GREEN ELECTRICITY PRICING³³

As of 1997 some 13 electric utilities in the United States had adopted some form of green pricing. Under a green pricing scheme the customer is asked to pay a premium of up to 15% of the normal bill.³⁴ In return the utility uses renewable energy sources according to a set formula.

Surveys consistently reveal that from 56% to 80% of respondents indicate a willingness to pay more for environmentally friendly energy sources. Green pricing attempts to tap this

³³ This section is based upon Moscovitz (1993) and Lamarre (1997).

³⁴ Despite the fact that in Detroit Edison's Solar Currents plan customers pay an average of 14% more, the program has quickly become oversubscribed. Some 70 customers are currently on a waiting list.

willingness to pay as a means of financing renewable energy sources which are not quite cost-effective. (The cost-effective sources would presumably be added to the mix even without green pricing.)

Green pricing provides an example of a voluntary information disclosure strategy. Utilities prepared to offer green options to consumers can advertise that fact, but other utilities are under no obligation to follow suit.

EMPIRICAL ANALYSIS

The literature on economic analysis of disclosure strategies is rather young, but it does contain some useful, if partial, information.

DOYLE (1990)

In the early stages of this study, a review of the literature on risk communication and self-protective behavior found that traditional information and awareness programs (such as advertising campaigns and public service announcements) were likely to fail when they are targeted at the general population.

- To test this hypothesis for radon, the study sent a mail survey to 920 households that had purchased radon test kits as part of an intensive information and awareness campaign in the Washington, D.C. area. Over 100,000 test kits were purchased as a result of the campaign. Although about 33,000 homes in this area exceeded the EPA action level for radon by a factor of five or more (had a radon reading of 20 picocuries per liter or higher), the survey results indicated that only 1.2% of this group had taken convincing remedial action as a result of the campaign. In addition, only about a third of the homes in this 1.2% group conducted a post-mitigation retest to confirm that mitigation had been effective.
- In contrast, a separate telephone survey of 303 home buyers in Boulder County, Colorado found that over 40% of recently purchased homes were tested for radon gas at the time of home sale, and that this testing was often motivated by information provided by the realtor. Even though no intensive information and awareness campaign has been conducted in Colorado, and no state laws currently apply to radon, 54% of tested homes in the sample that had radon levels above the EPA action level underwent mitigation (with 87% of those completing follow-up testing) as part of the home sale transaction.

The authors attribute this difference to powerful economic incentives which apply at the point of home sale. Such targeted information appears to elicit much more action than information directed at the general population.³⁵

MAGAT AND VISCUSI (1992)

This was among the first studies which examined the potential role of hazard warnings. Through a series of carefully defined experiments, the authors attempted to estimate not only the value of hazard warnings, but also how their structure might influence their effectiveness. Their results suggest several conclusions:

- Consumers did react to warning labels, and their reactions implied significant perceived benefits.
- Information overload is a potentially serious problem. Because of cognitive limitations, the marginal cost of complete information will generally exceed the marginal benefit of providing it. As information increases, marginal benefits may even become negative because confusion increases.

³⁵ This study was subsequently published in concise form as Fisher, et. al. (1991)

- Making information available to consumers is insufficient to guarantee that they will respond. The information must be organized for efficient processing. Label design matters.³⁶

ARORA AND CASON (1996)

Using an econometric model, the authors assess the factors which influence a firm's decision to participate in EPA's 33/50 Program. Their study draws the following conclusions:

- The largest firms with the greatest toxic releases are the most likely to participate in this voluntary program.
- There is no evidence that firms free ride on emission reductions prior to the program's initiation, or that they participate to divert attention from poor compliance with mandatory regulations.
- Firms in industries which are closer to final consumers (proxied by normalized advertising expenditures) are more likely to participate in the program.

NAYSNERSKI AND TIETENBERG (1992)

The information used in this analysis included data on 1205 citizen actions: plaintiffs, defendants, filing dates for notices and/or complaints, penalties, and statutes involved in the claim. The analysis examined the effects of various incentives on the types of claims filed. The following conclusions emerged from this study:

- Disclosure plays a key role in determining the effectiveness of private enforcement, since the disclosed information is the basis for bringing the actions. The effectiveness of citizen suits has been greatly affected by the magnitude of the burden of proof environmental groups are forced to bear. Proof of violation is relatively easy to establish under the Clean Water Act because regulated firms are required to file publicly available Discharge Monitoring Reports. Lacking the government's power to conduct on-site inspections, citizen groups are heavily dependant on these self-monitoring reports.
- The effectiveness of the citizen suit process is affected to a large degree by the incentives offered private enforcers in the program. In particular, allowing private enforcers to extract penalties which are earmarked for environmental improvement, and to be reimbursed for legal expenses, increases the attractiveness of the process for private enforcers.
- For one class of polluters, public facilities, citizen suits seem a distinctly superior form of enforcement.
- Since citizen suits are typically based on proving noncompliance with specific effluent/emission standards, determining that citizen suits have led to greater compliance does not necessarily indicate that they have led to greater cost effectiveness. Complete compliance is not necessarily cost-effective if the effluent/emission standards are not themselves cost-effective.
- Since the evidence suggests that private enforcers respond to specific incentives, a bias will be created if the incentives are not applied uniformly to the various pollutants. Those programs which reward private enforcers will be preferred, whether or not they address the most serious problems.

³⁶ The US EPA is in the "early" stages of considering whether to require "talking labels" on products like pesticides and herbicides. Under a proposal being circulated among interested parties, computer chips like those found in toys and greeting cards would play brief warnings when activated by a button. (Mike Wagner, Newhouse/S.F. EXAMINER, 12/31/96 as cited in GREENWIRE, 12/31/96).

This study suggests that coupling disclosure with private enforcement can be effective, but efficiency depends on program design.

MUOGHALU, ROBISON AND GLASCOCK (1990)

This study examined the capital market impacts of hazardous waste mismanagement lawsuit filings and settlements for the 1977-1986 period. The sample contained 128 initial lawsuits against firms and 74 case settlements which were announced in the print media (generally the Wall Street Journal).

- Though significant results were obtained for the day of the announcement, no significant results were obtained for the two control periods: from 2 to 5 days prior to and 1 to 5 days after the announcement.
- The results indicate that stockholders suffered, on average, a statistically significant loss in market value of 1.2% at the filing of the lawsuit, but no significant abnormal returns at the disposition of the suit.

LAPLANTE AND LANOIE (1994)

This study examines the capital market effects on Canadian firms of some 47 announcements of environmental events, including environmental regulation violations (12), initiation of legal action (9), settlement of suits (13), and investments in emissions control (13) during the period 1982-1991. Their findings:

- Announcements of incidents and the filing of lawsuits did not trigger any significant abnormal stock market returns.
- Announcements of suit settlements which resulted in fines resulted in a decline in value of about 2%.
- Announcements of investments in emissions control equipment resulted in an abnormal loss on the day of the announcement of about 1.2%.

These results contrasted with those for American firms in Muoghalu, Robison and Glascock (1990), who found that the American stock market reacted to the initiation of a law suit. The authors attribute the difference to less credible enforcement of environmental regulations in Canada; Canadian investors as seen as influenced only by the outcome.

BADRINATH AND BOLSTER (1996)

This article examines stock market reactions to 730 EPA judicial actions for a sample of publicly traded firms from 1972-1991.

- The market value of the average affected firm dropped 0.43% during the week of settlement.
- While high relative fines appear to have affected stock market prices, the analysis uncovered no consistent relationship between the magnitude of relative fines and prices.
- The estimated market penalty was larger for more recent actions and for repeat offenders.

The authors note that, while these results reflect an environment which does not promote public information about enforcement actions, they do suggest substantial social benefits from providing more systematic information.

HAMILTON (1995)

This event study uses data on 436 publicly traded companies to ascertain whether stock prices were affected by the announcement of emissions information by the Toxic Release Inventory.

The results are complemented by a study of media coverage of TRI announcements in 1989.³⁷

- Holding emissions constant, news stories about firms were negatively related to the dispersion of their pollution across facilities, and to the amount of public information about their pollution patterns prior to TRI disclosure.
- Most of the publicly traded firms in the sample did not receive any coverage of their TRI releases in the print sources traced by the study.
- For those companies which reported TRI data to the EPA, the average abnormal return on the day the information was made public was negative and statistically significant.
- These effects were smaller for firms where investors had previous information about pollution patterns (such as companies with exposure at Superfund sites).

This study suggests that disclosure does have stock market impacts, but the magnitude of the impacts depends on the treatment of the disclosure by the press and how much knowledge investors already have.

KONAR AND COHEN (1997)

Comparing the 40 firms with the largest abnormal reductions in stock prices to a control group of otherwise similar firms, this analysis finds:

- The top 40 firms were among the top 1/3 of polluting firms (per dollar revenue) in their industries, but did not necessarily have the largest emissions.
- The top 40 firms subsequently reduced their emissions more than other firms in the industry (including those firms with the largest TRI-reported emissions/\$revenue prior to the TRI disclosure).
- The top 40 firms made more significant attempts to improve their environmental performance by reducing the number and severity of oil and chemical spills.
- The top 40 firms had a lower likelihood of large fines from the government in subsequent years.

This study suggests that stock market effects are ultimately translated into real environmental improvements.

KHANNA ET. AL. (1997)

This study also examines stock market and waste management responses to TRI disclosure, but in this case the sample period is 1990-1994 and the focus is on the chemical industry.

- Chemical firms incur statistically significant losses in market value during the one-day period following the disclosure of the Toxic Release Inventory.
- These losses have a significant negative impact on subsequent on-site releases and a significant positive impact on wastes transferred off-site for recycling and treatment, but their impact on total toxic wastes generated by the firms is negligible.

The key aspect of this study was its deeper analysis of the changes in environmental behavior which followed the capital market effects of disclosure. TRI disclosure promoted a reduction in on-site releases and off-site recycling, but it did not encourage pollution prevention.

³⁷ This information was compiled from the Nexis database and the Wall Street Journal index for 1989.

KHANNA AND DAMON (1997)

This paper examines the motivations for participating in the voluntary 33/50 Program and its implications for toxic releases. It demonstrates that benefits due to potentially avoided costs of liabilities and compliance provide strong incentives for participation.

- After controlling for sample selection bias and the impact of other firm-specific characteristics, the paper shows that program participation led to a statistically significant decline in toxic releases over the period 1991-93.
- Participation also had a statistically significant negative impact on the short run profits of firms, but it had a positive and statistically significant affect on market value, indicating that investors expected costs of participating to be more than offset by lower future environmental liabilities.

DASGUPTA AND WHEELER (1996)

This study examines environmental complaints lodged in China by citizens over the 1987-1993 period to discover the factors that seem to explain the number of complaints. The results indicate:

- The incidence of complaints does mirror abatement benefits and the intensity of exposure for visible pollutants, although this is not true for less-visible pollutants with similar risk.
- Regions with higher education levels tend to initiate many more complaints, all other things being equal. This implies that a reliance on complaints alone would result in inappropriately low allocation of inspection resources to less-educated, relatively 'silent' regions.

This study raises the possibility that complaint processes may be biased against poorer and less educated communities. It reflects the findings of several studies which suggest that richer, better educated communities in developing countries control pollution more effectively, through formal regulation or informal pressure.³⁸

DASGUPTA, LAPLANTE AND MAMINGI (1997)

This event study for developing countries parallels earlier studies for the U.S. and Canada. It focuses on stock market reactions to environmental news in Argentina, Chile, Mexico, and the Philippines. None of these countries has a strong record of enforcing environmental regulations. However, the study finds that:

- Stock values rise when good environmental performance is publicly recognized by the government.
- Stock values fall in response to publicized citizens' complaints about polluters.
- Environmental news seems to induce greater much greater valuation changes in these emerging markets than in North American stock markets.

DASGUPTA, HETTIGE AND WHEELER (1998)

³⁸ See for example Pargal and Wheeler (1996), Pargal, Hettige, Singh and Wheeler (1997), Pargal, Hettige, Huq and Wheeler (1997), Hettige, Huq, Pargal and Wheeler (1996), and Hartman, Huq and Wheeler (1997).

This survey-based econometric analysis controls for many determinants of environmental performance in Mexican factories, including differences between firms which are publicly-traded and privately-held.

- Other things equal, the results indicate significantly better performance for plants owned by publicly-traded firms.
- Furthermore the results suggest that environmental performance is improved by exposure to public scrutiny in developing countries, as well as industrial economies.

SUMMARY AND CONCLUSIONS

The information that we have in hand at this point is too sketchy to allow us to draw firm conclusions. It is possible, however, to generate some hypotheses which are consistent with the available evidence. If and when these hypotheses are upheld by other studies, they could form a basis for both understanding information approaches and for enhancing their effectiveness.

OVERALL EFFECTIVENESS

- Disclosure strategies can be effective in motivating environmental improvement. However, the form of disclosure seems to be critical. Disclosure of overall performance seems to encourage pollution abatement, while focusing only on some pollutants may simply result in substitution toward undisclosed forms of pollution.
- When information disclosure is coupled with voluntary compliance programs, the evidence suggests that the largest firms with the greatest emissions are the most likely to participate; no evidence suggests that firms free ride on emission reductions prior to the program's initiation, or that they participate to divert attention from poor compliance with mandatory regulation. In other words voluntary compliance programs can result in real, not merely reported, environmental improvement.
- For one class of polluters, public facilities, combining disclosure with the empowerment of private enforcers has apparently been more effective than traditional public enforcement.
- Public announcements do seem to affect stock market valuations of firms, but these effects seem lower for known polluters. The different results for Canada and the U.S. suggest that the enforcement culture may determine whether it is the initiation of the action or the final settlement that affects value. In the new stock markets of Latin America and Asia, public announcements have strong effects on firms' valuation despite the weakness of formal regulation.
- Large declines in stock market value seem to motivate firms to improve their environmental performance.
- The green pricing information suggests that at least some consumers are willing to pay higher prices for products with lower environmental impact, even when the consumers are not directly affected by the pollution.
- Public disclosure has significantly reduced pollution in a variety of settings (e.g., TRI in the U.S.; PROPER in Indonesia). In the case of PROPER, at least, abatement has been induced at very low public cost. However, the evidence on the *cost-effectiveness* of these programs remains sparse. Promotion of compliance with inappropriate regulatory standards is not generally cost-effective, of course. On the other hand, public disclosure can facilitate a diversity of local solutions to pollution problems which no formal

regulatory system (market-based or otherwise) could encompass. New measurement strategies may be necessary for rigorous cost-effectiveness analysis in this context.

THE DETERMINANTS OF EFFECTIVE STRATEGIES

- The quality and quantity of information conveyed can have a large impact on the effectiveness of the program. However, too much information can produce cognitive overload and lower the effectiveness of disclosure. The form in which information is conveyed seems to matter a great deal.
- The U.S. experience with provision of radon information to homeowners suggests that targeting strategy can have a strong impact on program effectiveness.
- Incentives created by complementary aspects of disclosure programs can also be important. Private enforcers, for example, seem to respond to incentives such as earmarking penalties for environmental improvement and the reimbursement of legal costs. Also important is the burden of proof environmental groups are forced to bear in bringing claims against polluters. Properly designed disclosure strategies can lower this burden of proof significantly.

BIASES IN DISCLOSURE STRATEGIES

- Firms in industries which are closer to final consumers (proxied by normalized advertising expenditures) are more likely to participate in voluntary compliance programs that are accompanied by disclosure.
- Complaint processes seem to reflect damages for visible pollutants, but not for less visible pollutants.
- Complaints processes seem to work quite well in areas with relatively high income and education levels, but they work less well in poorer areas with lower education levels.
- Although citizen suits have apparently led to greater compliance, greater compliance does not necessarily guarantee greater cost effectiveness. Complete compliance is not necessarily cost-effective if the effluent standards are not themselves cost-effective.
- Since the evidence suggests that private enforcers respond to specific incentives, their actions against polluters will be biased toward high-incentive problems, whether or not these are the most serious for public welfare.

REMAINING QUESTIONS

The current level of evidence provides no guidance on whether disclosure strategies are producing efficient outcomes or not. The fact that they are effective does not necessarily mean that they are efficient. Reaching that conclusion requires much better information than we currently have on both the marginal benefits and marginal costs of information provision strategies. We currently do not have enough information to begin to assess where the next investments in information provision should be made. Important questions for future research include:

- Do these investments in the provision of information yield rates of return that compare favorably with other pollution control policy investments or not? First-round results from PROPER suggest an excellent rate of return, but more work is necessary.
- Which types of information provision yield the highest rates of return?
- What form should the disclosure take? Under what circumstances might highly aggregated and structured information (as in the Indonesia program) be preferred to the provision of more raw data (as with the Toxics Release Inventory)? When might the provision of raw data be preferred?

- How cost-effective are various channels of information provision (e.g. newspaper articles, internet,)?
- Are there diminishing returns to the provision of information as the number of substances and circumstances covered by disclosure increases? Does the public become saturated?
- Does the effectiveness of disclosure diminish over time as it becomes a more common form of regulation?
- What are the distributional implications of information strategies?

REFERENCES

- Alanis-Ortega, Gustavo (1995). "Private Enforcement of Environmental Regulations: El Tamarindo in Jalisco, México: A Case Study" a draft report to the Inter-American Development Bank, Washington, DC (September).
- Afsah, S. and B. Laplante (1996a). "Program-Based Pollution Control Management: The Indonesia Prokasih Program," World Bank, Policy Research Dept. Working Paper No. 1602, May.
- Afsah, S., B. LaPlante, and D. Wheeler (1996b). "Controlling Industrial Pollution: A New Paradigm." World Bank, Policy Research Dept. Working Paper No. 1672.
- Arbeláez, T., S. Dasgupta, B. Laplante and D. Wheeler (1998). "Colombia's Pollution Charge System: Implementation, Impact and Implications: Research Proposal," World Bank, Development Research Group, April.
- Arora, S. and T. N. Cason (1996). "Why do firms volunteer to exceed environmental regulations? Understanding participation in EPA's 33/50 program." Land Economics 72(4): 413-432.
- Badrinath, S. G. and P. J. Bolster (1996). "The Role of Market Forces in EPA Enforcement Activity." Journal of Regulatory Economics 10(2): 165-81.
- Che, Y.-K. and D. Earnhart (1997). "Optimal Use of Litigation: Should Regulatory Information Be Withheld to Deter Frivolous Suits?" Rand Journal of Economics 28: 120-134.
- Coase, R. (1960). "The Problem of Social Cost." The Journal of Law and Economics 3(October): 1-44.
- Dasgupta, S. and D. Wheeler (1996). Citizen Complaints as Environmental Indicators. Washington, DC, World Bank.
- Dasgupta, S., B. Laplante and N. Mamingi (1997). Pollution and Capital Markets in Developing Countries. Washington, DC, World Bank
- Dasgupta, S., H. Hettige and D. Wheeler (1998). What Improves Environmental Performance? Evidence from Mexican Industry. Washington, DC, World Bank.
- Deweese, D. (1992). Tort Law and the Deterrence of Environmental Pollution. Innovation in Environmental Policy. T. H. Tietenberg. Cheltenham, UK, Edward Elgar: 139-164.
- Doyle, J. K., Gary H. McClelland, William D. Schulze, Paul A. Locke, Steven R. Elliott, Glenn W. Russell Andrew Moyad (1990). An Evaluation Of Strategies For Promoting Effective Radon Mitigation. Washington, U.S. Environmental Protection Agency.
- Fisher, A., G. H. McClelland, et al. (1991). "Communicating the Risk from Radon." Journal of the Air & Waste Management Association 41(11): 1440-1445.
- Hahn, R. W. (1989). "Economic Prescriptions for Environmental Problems: How the Patient Followed the Doctor's Orders." The Journal of Economic Perspectives 3(2): 95-114.
- Hamilton, J. T. (1995). "Pollution as News: Media and Stock market Reactions to the Toxics Release Data." Journal of Environmental Economics and Management 28(1): 98-113.
- Hamilton, J. T. (1997). "Taxes, Torts, and the Toxics Release Inventory: Congressional Voting on Instruments to Control Pollution" Economic Inquiry 35(4):745-762.

Hartman, R., M. Huq and D. Wheeler (1997). Why Paper Mills Clean Up: Determinants of Pollution Abatement in Four Asian Countries, Washington, DC, World Bank.

Hettige, H., M. Huq, S. Pargal and D. Wheeler (1996). Determinants Of Pollution Abatement In Developing Countries: Evidence From South And Southeast Asia. World Development 24 (12), 1891-1904

Hettige, H., M. Singh, S. Pargal and D. Wheeler (1997). Formal and Informal Regulation of Industrial Pollution: Comparative Evidence from Indonesia and the United States. World Bank Economic Review (Fall).

Jordan, S. J. (1987). "Awarding Attorneys Fees to Environmental Plaintiffs Under a Private Attorney General Theory." Boston College Environmental Affairs Law Review 14: 287-311.

Kennedy, P. W., B. LaPlante, et al. (1994). "Pollution Policy: The Role for Publicly Provided Information." Journal of Environmental Economics and Management 26(1): 31-43.

Khanna, M. and L. Damon (1997). "EPA's Voluntary 33/50 Program: Impact on Toxic Releases and Economic performanc of Firms" Environmental and Resource Economics Working paper #8, Program in Environmental and Resource Economics, University of Illinois at Urbana-Champaign.

Khanna, M., W. R. H. Quimio, et al. (1997). Toxics Release Information: A Policy Tool for Environmental Protection. Urbana-Champaign, Department of Agricultural and Consumer Economics, University of Illinois.

Konar, S. and M. A. Cohen (1997). "Information as Regulation: The Effect of Community Right to Know Laws on Toxic Emissions." Journal of Environmental Economics and Management 32(1): 109-124.

Lamarre, L. (1997). "Utility Customers Go for the Green." EPRI Journal 22(2): 6-15.

LaPlante, B. and P. Lanoie (1994). "Market Response to Environmental Incidents in Canada." Southern Economic Journal 60: 657-72.

Lewis, T. (1996). "Protecting the Environment When Costs and Benefits are Privately Known." Rand Journal of Economics 27(4): 819-847.

Magat, W. A. and W. K. Viscusi (1992). Informational Approaches to Regulation. Cambridge, MA, The MIT Press.

Marcinowski, F. and S. Napolitano (1993). "Reducing the Risks from Radon." Air & Waste 43: 955-62.

Moscovitz, D. (1993). "Green Pricing: Why Not Customer Choice?" The Electricity Journal 6(8): 42-49.

Muoghalu, M. I., H. D. Robison, et al. (1990). "Hazardous Waste Lawsuits, Stockholder Returns and Deterrence." Southern Economic Journal 57: 357-370.

Naysnerski, W. and T. Tietenberg (1992). Private Enforcement. Innovation in Environmental Policy. T. H. Tietenberg, Cheltenham, UK, Edward Elgar: 109-136.

Naysnerski, W. and T. Tietenberg (1992). "Private Enforcement of Environmental Law." Land Economics 68(1): 28-48.

OECD (1989). Economic Instruments for Environmental Protection. Paris, Organization for Economic Cooperation and Development.

OECD (1994). Applying Economic Instruments to Environmental Policies in OECD and Dynamic Non-Member Countries. Paris, Organization for Economic Co-operation and Development.

OECD (1995). Environmental Taxes in OECD Countries. Paris, Organization for Economic Co-operation and Development.

Pargal, S. and D. Wheeler (1996). Informal Regulation Of Industrial Pollution In Developing Countries: Evidence From Indonesia. Journal of Political Economy 104(6): 1314+

Sand, P. H. (1991). International Cooperation: The Environmental Experience. Preserving the Global Environment: The Challenge of Shared Leadership. J. T. Mathews. New York, W. W. Norton & Co.: 236-279.

Segerson, K. and T. Tietenberg (1992). "The Structure of Penalties in Environmental Enforcement: An Economic Analysis." Journal of Environmental Economics and Management 23(2): 179-200.

Sinclair-Desgagné, B. and H. L. Gabel (1997). "Environmental Auditing in Management Systems in Public Policy." Journal of Environmental Economics and Management 33(3): 331-346.

Tietenberg, T. (1995). Design Lessons from Existing Air Pollution Control Systems: The United States. Property Rights in a Social and Ecological Context: Case Studies and Design Applications. S. Hanna and M. Munasinghe. Washington, DC, The World Bank.

Tietenberg, T. (1996). Private Enforcement of Environmental Regulations in Latin America and the Caribbean: An Effective Instrument for Environmental Management? Washington, Inter-American Development Bank.

Tietenberg, T. H. (1985). Emissions Trading: An Exercise in Reforming Pollution Policy. Washington, DC, Resources for the Future.

Tietenberg, T. H. (1990). "Using Economic Incentives to Maintain Our Environment." Challenge 33(2): 42-46.

Tietenberg, T. H. (1992). Environmental and Natural Resource Economics. New York, HarperCollins Publishing Co.

Vincent, J. (1993). "Reducing Effluent While Raising Affluence: Water Pollution Abatement in Malaysia," Harvard Institute for International Development, Spring.

Viscusi, W. K. (1983). Risk By Choice: Regulating Health and Safety in the Workplace. Cambridge, MA, Harvard University Press.

Viscusi, W. K. (1992). Fatal Tradeoffs: Public and Private Responsibilities for Risk. New York, Oxford University Press.

Wang, H. and D. Wheeler (1996). "Pricing Industrial Pollution In China: An Econometric Analysis of the Levy System," World Bank, Policy Research Dept. Working Paper No. 1644, September.

World Bank (1992). World Development Report 1992: Development and the Environment. Washington, Oxford University Press.