Eighth Annual Conference
European Association of Environmental and Resource Economists
Tilburg University
The Netherlands
June 26-28, 1997

"INFORMATION STRATEGIES FOR POLLUTION CONTROL"

BY

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ABSTRACT:

Information 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 common place in natural resource settings (forest certification programs, for example), they are less familiar in a pollution control context. Yet the number of applications is now growing in both OECD and developing countries. This talk will review what we know and don't know about the use of information strategies to control pollution.

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

INTRODUCTION

THE DEMAND FOR INFORMATION 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) In response to these deficiencies in the second phase the use of market-based approaches such as tradable permits, emission charges, deposit-refunds and performance bonds have become much more common. (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 general these approaches have added flexibility and improved cost-effectiveness to the control of pollution.

Even the addition of market-based approaches, however, has not, however, fully solved the problems. In the industrialized countries the system remains over burdened by the shear number of substances to be controlled. Neither staffs nor budgets are adequate for the task of regulating all of the potentially harmful substances which are emitted by firms and households.

In many of the developing countries the regulatory infrastructure is insufficiently developed and/or subject to corruption. In either case it is incapable of adequately handling the burden of designing, implementing, monitoring and enforcing an effective pollution control system.

Phase three in the evolution of pollution control policy involves investment in the provision of information. This increasing role for information strategies seems to emanate not only from the increasing perceived need for more regulatory tools (as described above), but also from the falling cost of information collection, aggregation and dissemination. Rising benefits and falling costs imply that however inefficient their use may have been perceived to be in the past, changed circumstances merit another look.

The information 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. Information 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 control despite limited budgets and staffs. But how real is this promise?

THE CONCEPTUAL FOUNDATION FOR INFORMATION STRATEGIES

The starting point for thinking about information approaches to pollution control is the Coase Theorem. (Coase 1960) In that 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 precipitated by better information therefore can be motivated by victims experiencing both use and nonuse damages.

In the past the Coasian insight has been dismissed as a foundation for policy[1] 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 the 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 these approaches may have been misplaced.

OVERVIEW

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

Generally these right-to-know policies are justified on ethical grounds. In this paper we explore quite a different justification--whether providing greater information might 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 information 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.

Following a review of the conceptual foundations for information strategies the paper will consider how the policy setting influences the type of information strategy employed. Examples of innovative information strategies (U. S., Latin America, Indonesia, etc.) 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 author's sense of what we have learned and where further research would be particularly helpful.

THE CONTEXT

Tailoring information strategies to the situation requires an understanding of the various types of situations 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

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

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 information strategies is understanding the economic incentives which face the parties which are involved in the 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?

The next step involves isolating the role of information in this process. In the absence of government intervention will the efficient amount of information be generated? Or will the amount of information supplied normally be inefficient large or small? Will it normally be made available to the party who should take the control?

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

One setting in which the need for pollution control arises is within the household. 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 gas[2] and lead paint[3].

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 possible risk of radon or lead. 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.

How about the 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 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

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[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 US EPA has also estimates 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.

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. It would be expected that an informed buyer would reduce the offer price by an amount which reflects the cost of controlling the radon or lead. Linking the selling price to the pollution situation 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 US 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 and lead-based paint hazards before purchasing or renting.[4]

With respect to the provision of information the government has publicly provided one type of information, leaving the provision of the other type to the market. Specifically the government has conducted the basic research to discover appropriate risk thresholds for lead and radon[5] and has widely disseminated this information. It has also made sure that low costs test kits are available. It is now up to the market to supply the test kits at a reasonable price and up to the 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 efficient outcomes. The homeowner would not generally be free to balance the benefits and costs of remediation.

The Product Setting

Consider now a situation in which the pollution is inflicted by a producer on consumers of that product. Examples might include fruit 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 when 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 an externality. Consumers who are aware of products which are exposing them to an environmental risk will either not purchase the risky product (if, for example, an acceptable substitute which poses no environmental risk is available) or will purchase the product only if the price is lowered to reflect either the damage caused or the costs of preventing or mitigating the damage. In any of these cases the producer has an incentive to be concerned about the pollution and to balance the potential loss of sales against the costs of eliminating or mitigating the problem.

Will the market supply the proper amount of information about the risk to assure that

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[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 the requirements have been met.

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

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] Consumers normally do not have an incentive to derive the information since their individual gains are so small (even when societal gains are large) in comparison to the costs of the testing program which would be necessary to uncover the cases where a problem existed.[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 the product. A common case, however, arises when the environmental risk exceed the benefits of the product for some consumers, but not for others. One obvious answer here is for the market to provide products posing various levels of environmental risks, leaving the market to sort out the market share going to each type of product. As long as the products are produced by several producers the competitive process will normally supply the requisite information by means of labeling. 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.

The governments also have a role in assuring that provided information is reliable. While producers of energy-efficient appliances, for example, have an incentive to communicate the efficiency of their products, less efficient competitors have an incentive to make the same (but in this case incorrect) claim if they can get away with it. Here the government may have a role in standardizing the information provided and sanctioning those who disclose deceitful information.

A different sort of information need arises when the pollution arises from the use of the product. For example, pesticides are clearly toxic by design, not default. As long as the use of pesticides makes sense, banning them simply because they are toxic is not practical. The key to government policy in this case is recognizing that how the pesticides are applied can influence the likelihood and severity of damage caused. In response government policy typically mandates labels which explain in detail "proper" (damage minimizing) application procedures. Application of especially risky pesticides may be limited to licensed applicators who are required to undergo special training.[8]

Information strategies in the consumption setting share with those in the household setting the characteristic that they provide an alternative to traditional regulation. In some cases information 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 the others are controlled by requiring precautionary labels or licensed applicators).

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[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 would 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.

[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 have also been closed. Two men face charges of spraying commercial pesticides without a license. (GREENWIRE, 11/18/96)

The Occupational Setting

Whereas the consumption setting involves one relationship where pollutees can put pressure on polluters to control their pollution, the employment setting provides quite a different opportunity. Occupational environmental risks are jointly controlled by employees and employers. While employers typically control the overall production process, which includes decisions about the toxicity of the substances employees may have to work with, employees control the amount of precaution they exercise in working with those substances.

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 employee. To the extent he/she bears both the cost of taking precaution and the expected damage from the environmental risk the employee will attempt to take all cost-justified precautions to reduce risk and to seek wage increases to compensate for the remaining risk.[9]

The employer faces a choice of how much to invest in risk reduction. Since fully informed employees will demand compensation for any remaining environmental risk, the employer must balance the cost of increased wages with the cost of reducing the risk which gives rise to those increased wages. Though the wage mechanism the employer is induced to balance the cost of risk reduction with the benefits to the worker, a balancing which is compatible with an efficient outcome.

All of this, however, depends on the existence of workers who are fully informed about the nature of the environmental risks they face. 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 the information about the risk since their 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 becomes possible. In this case the collective benefits may be sufficient to justify the collective costs.[10]

How about employers? In general if employers do not pay the damages suffered by employees they do not have an incentive to assure that employees are fully informed about the occupational risks they. Fully informed workers are likely to demand higher wages; workers who are ignorant of the risks they face are not.

What role does this suggest for the government? It suggests a limited, but growing one. Since unionization seems to be a key in producing fully informed workers, the fact that unionization is on the decline in the U. S. implies a growing need for other sources of information.

In the U. S. the original thrust of government policy (in 1970) was strictly regulatory. The government promulgated thousands of very detailed standards, which in many cases prescribed the specific action to be undertaken by the employer. Empirical analysis performed up to the mid-1970s clearly indicated that this approach was ineffective. (Viscusi 1992, pp. 181-205) In response to that lack of success major reforms were proposed during

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

[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 the preponderance of wage premia for risk are found for unionized workers. See Viscusi (1983).

the Carter and Reagan administrations. The evidence on that period is more mixed. While some statistically significant effects of OSHA on worker safety were derived from this period, these effects were neither dramatic in terms of the 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" was introduced. This policy established uniform hazard communication requirements for manufacturers. 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 to incorporate information strategies involves situations where the polluter and pollutee have no obvious contractual relationship. Whereas information strategies could build upon the purchase relationship for consumption-related pollution, and the wage relationship for employment-related pollution, no such behavioral linkage exists in this final category.

In addition to the public good characteristics of information provision which plague the other types of pollution problems, in this case another source of market failure arises. To the extent that the failure to provide the requisite information increases the amount of pollution, the damage caused is another form of externality. Kennedy, LaPlante, et. al. (1994) It represents the purest case of externality. Examples would involve ambient air and water pollution.

In this case the pollutees still have some incentive to take action to reduce the environmental risk to which they are exposed, but the action has to be indirect. This case raises some fundamental problems about how the information would be generated, distributed and used.

INFORMATION 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 information approach is discovering the extent and magnitude of environmental risks. Environmental risks will normally be detected only after some investment in information is made. Who should make that investment? What incentives do they face?

The degree of environmental risk faced by a community is determined a somewhat complex causation process. How much of the substances are emitted, the degree of exposure to the substances, and the sensitivity of the population to this exposure are all highly relevant considerations.

Full information about those risks requires knowledge about all of the links in that process, but notice that the types of information involved are quite different. Some of the information is general--it applies to the population at large--while other information is specific to the polluter. General risk information might include, for example, dose--response relationships

[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. They contain information on the characteristics of the substance, proper handling procedures and emergency and first aid procedures.

for substances and how these relationships can be used to define a socially acceptable level of risk. This information is useful for all citizens who may be exposed to the chemicals.

Polluters themselves are an obvious source of the firm-specific components of the risk. They have the best access to information about the substances they are using, the processes which rely upon those substances and the exposure of third parties to those substances, but they normally do not have the proper incentives to detect or to reveal these risks in the absence of the threat of liability or some other outside force..

The government may be in the best position to identify the general elements of the risk. These elements are of interest to the largest number of citizens. Collecting this information once by a central body eliminated the duplication of effort which would result if every firm had to derive this information independently on its own.

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

ASSURING RELIABLE INFORMATION

Information has both an quantity and quality dimension. Effective risk communication assumes not only that the requisite information is forthcoming, but also that it is reliable. Inaccurate or partial information could be worse than no information at all to the extent that it promotes a false sense of security or it promotes 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 making the penalties for falsifying information appropriately large.[12] The ISO 14000 process, a set of voluntary environmental management standards crafted by the International Standards Organization, represents one international way 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 claim. Lodging a complaint does not assure its validity. The organization which receives the complaint may be the control authority, a court, or perhaps a special commission set up for the specific purpose of dealing with these claims. Its function is to determine whether the claim is valid by establishing whether the private enforcer has met the required burden of proof.

DISSEMINATING THE INFORMATION

For this strategy to work the necessary information must reach the pollutees in a usable form. This step may even be automatically satisfied by information raised by the community itself, but for information produced by the government or the polluter it is not.

Transparency is the key to assuring the availability of useful information.[13] In practice this

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

[13] In the United States the Center for Environmental Information and Statistics will become operational and open to the public on Jan. 1, 1998. When open, the Center will provide easy access for the public to EPA's massive environmental information resources through computers and other means.

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. With respect to the products from organic farms, for example, the tradition has been to let those farms providing the "green" product identify themselves, subject to certification procedures. No requirements are placed on conventional farms to list the pesticides used and the amounts. This is a voluntary system. 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]

With respect to complaints against public officials, the necessary information will only be available to private enforcers if the relevant decision processes are sufficiently open to public scrutiny. For example, community leaders may wish to assure that environmental impact assessments filed by developers in preparation with project construction comply with procedural requirements and are truthful. Timely access to the assessments is especially important to prevent the process from proceeding too far before its consequences become clear. Nearly completed projects are more difficult to enjoin. In practice timely access may be the exception rather than the rule.[16]

With respect to complaints against polluters, at least some degree of monitoring the activities of the polluter is a prerequisite for a claim to be initiated. In most cases this monitoring is done by the regulated entity itself. Transparency is assured when the mandated periodic reports submitted to the public enforcer 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.

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[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 would allow for customized data searches. Detailed information about the specific topics is contained in the April 22, edition of the Federal Register (Page 19573, Volume 62, Number 77).

[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 attempt to 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 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)

Existing channels can be used in many different ways.

- 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 also be used by consumers who chose to buy "green" products even if they are not directly harmed by the pollution (such as those who pay more for chlorine-free paper). Product market effects are enhanced when disproportionately large buyers (large chains or the government, for example) decide to take environmental considerations into account.

- In the capital market owners of shares of common stock in polluting firms may decide to invest in companies with a more "green" record either for moral reasons or because they believe that ultimately environmentally benign firms will face fewer clean up costs and therefore will be more competitive. Some evidence suggests that "green" firms may have higher rates of return.[18] The ability of green investors to make these choices has been facilitated by the rise of several "green" mutual funds where the investment advisors carefully screen the firms using well-defined criteria.

- In the labor market environmentally responsible employers may find it easier to hire employees, and to retain employee loyalty. These situations could either result because employees perceive that environmentally responsible employers are likely to be more financially stable over the long run or because they have a moral preference for the types of activities they support with their labor.

- In the judicial system parties directly harmed by the pollution can recover compensatory damages by suing polluters (called "tort law" actions). In addition judicial "oversight" actions can be brought against public enforcement authorities which are not fulfilling their statutory responsibilities.[19] Furthermore the results of these judicial actions can also be made available to the public.

- In the legislature when existing legislation seems inadequate, the information may build community support for additional legislation.

It is also possible to establish new channels through which pressure may be brought.

- Following the United Nations Conference on the Human Environment at Stockholm in 1972, many countries incorporated environmental considerations in their constitutions. These constitutional principles were in general related to the following basic ideas: 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 Colombia, Ecuador and Chile, contain 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.

- The public can be given certain enforcement powers. Private enforcement actions differ

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

[19] 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).

from more conventional liability actions in that in private enforcement the initiator of the action is not seeking compensation for pollution-related damages. Rather the private enforcer is 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, where the private enforcer is empowered to bring claims before the judiciary on its own behalf (called "citizen suits") or indirect, where the enforcer is only allowed to file complaints with a designated legal authority (called "complaint actions".)[20]

SELECTED FUNCTIONING PROGRAMS

THE TOXIC RELEASE INVENTORY PROGRAM

The Toxic Release Inventory (TRI) was enacted by the US 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 who *use* 10,000 pounds or more of a listed chemical in a given calendar year, or firms who *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.[21] Firms must also report emissions to their state and local authorities as well as fire and emergency officials.

The information is available to the public.

Has it resulted in reduces releases of toxic emissions into the environment? Apparently it has. According to official EPA data total releases are down by a bit over 44%. (Table 1).

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[20] Private enforcement mechanisms are currently being actively 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 .

[21] Polluters must also report the scientific as well as the common name for the chemical being addressed by that form and give the amount a rating. The ratings go as follows; Immediate (acute) health hazard, delayed (chronic) health hazard, fire hazard, sudden release of pressure hazard, and reactive hazard. The category under which a chemical and it's level of emission fall is designated by section 312; 40 C.F.R. sect. 370.2.

THE 30/50 PROGRAM

To complement and reinforce the TRI Program the EPA initiated the 33/50 Program in

Table 1. TRI Releases. 1988-1994

	1988	1992	1993	1994	1988-1994 Change	
	Number	Number	Number	Number	Number	Percent
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
	Pounds	Pounds	Pounds	Pounds	Pounds	Percent
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

February, 1991. This program set national goals of 33 percent reduction in 17 priority toxic chemicals by 1992 and 50 percent reduction by 1995. These reductions were to be achieved voluntarily by program participants.[22] 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 explained 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 the 480 listed chemicals to notify those who are potentially impacted by the substance. Substances are listed as carcinogen or causing reproductive harm, and when the use or potential exposure levels of these chemicals exceed what has been determined by a group of approved state scientists as an unacceptable risk threshold the impacted people or person 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.

[22] Aside from good publicity there seems to be little evidence of any other quid pro quo for participation. Apparently participants, for example, faced no diminished enforcement pressure from their participation. See Arora and Cason (1996)

Notification (by means of warning labels) must be placed on all products which will cause adverse health effects when used for a prolonged period of time. Notification must also be made in the case of a company exposing a surrounding community to toxins released to the air ground or water system above what is deemed a safe level after prolonged exposure.[23]

The third group which must be notified of exposure is the workers in the plant emitting the toxins. If the use of certain chemicals used in manufacturing a product, created as a by-product of production, or the chemical is the product are unhealthy as defined by Prop 65 then workers must be warned of the potential danger.

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

Under the Proposition, private citizens, other industry members and environmental groups can sue companies who 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 serves to encourage private enforcement of the law and reduce government monitoring. Other industry members also have a strong incentive to monitor themselves so that one company does not cheat and come out looking greener than their rivals.

EPA AUDIT POLICY

What incentives can the government provide for encouraging the disclosure of private environmental information? One possibility is to suggest that firms reporting environmental problems before they are detected by regulatory authorities might face lower sanctions.

On December 22, 1995, USEPA issued an ambitious new policy to provide incentives for companies that audit or otherwise voluntarily discover violations, where the companies promptly disclose and correct such violations. (60 Fed. Reg. 66706) As of 1997 twenty-four states had passed environmental-auditing laws, while 16 states were still considering such legislation. (GREENWIRE 8/14/97)

The EPA's policy encourages self-audits, but fines are reduced, not waived, and USEPA believes that audits should be made public. About 100 companies had taken advantage of the EPA program by February of 1997. (GREENWIRE 2/18/97)

Data provided by the Agency 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.[24]

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

[24] 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, but the government 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))

Achieving a balance between the desire to encourage firms to disclose private information and the desire to punish wrongdoing has not been easy. Some of the states have carried this policy beyond EPA's "comfort zone", granting immunity from prosecution rather than reduced fines.[25]

COMPLAINT ACTIONS[26]

One increasing common form by which citizens follow up on the availability of greater information gives citizens the right to bring an environmental complaint to some kind of administrative or judicial board. In Latin America and the Caribbean, for example, frequently the complaint is triggered by a perceived violation of some procedural requirement or of some fundamental right to a clean environment which is not related to specific legal discharge standards. In the U. S. and European contexts the action is more likely to be related to a violation of a specific discharge standard.[27]

Administrative actions may result in the imposition of a civil penalty, the creation of a compliance order, or both. Successful negotiation between the control authority and the violator typically produces a consent decree, which creates compliance schedules and/or provides for the collection of civil penalties. Civil penalties may be imposed to assure that violators receive no economic benefit by failing to comply with environmental standards.

In either case the pressure brought to bear on the polluter is a function of the sanctions or penalties that can be imposed. The differences among these various types of penalties are based on the process by which they are imposed and the culpability of the offense. Punishment and removal of the economic benefit can also be pursued simultaneously, since damage awards may include exemplary or punitive damages. Whenever penalties may be triggered by a valid finding of noncompliance, they may be imposed even in the absence of any actual environmental harm. Penalties may take many forms including fines, clean up costs, compensation to injured parties, punitive damages and imprisonment. Sometimes the citizens who brought the action will even receive monetary rewards, though that is currently the exception rather than the rule.[28]

CITIZEN SUITS[29]

The next possible step beyond a complaint process involves giving private enforcers power to

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[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] This section draws upon Tietenberg (1996)

[27] 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)

[28] 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.

[29] This section is based on Naysnerski and Tietenberg (1992)

do more than simply raise complaints. When empowered by statutes as private attorney generals, citizens are authorized to initiate civil proceedings against any private or public polluter violating the terms of its pollution permit. In the U. S. these proceedings may be initiated by "any person". A "person" is 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."[30]

Under several U. S. statutes, citizens may sue for appropriate civil penalties as well as an injunction. The amount of penalty can vary between $10,000 and $25,000 per day, per violation. Continued violation under can lead to penalties of up to $75,000 per day, per violation. The civil penalties assessed in citizen suits are calculated to remove any "significant economic benefits" which resulted from noncompliance with federal environmental statutes. When determining the magnitude of the penalty, the agency considers such aspects as: the amount and types of costs a defendant has delayed paying through noncompliance, the savings gained by failing to operate and to monitor the proper pollution control equipment, the advantage gained over competitors who have installed the required pollution control equipment, the amount and toxicity of the pollution, the length of time the violation continued, and the sensitivity of the environment affected.

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" theory, created during the 1970's, extended the common benefit theory by allowing reimbursement for actions performed in the general public interest. Otherwise, the court ruled, few people would have an incentive to protect the public good. Congress followed and affirmed the private attorney general theory when they included 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 action against defendants is proved to be harassing or frivolous, attorney fee awards can also be made to them. That is apparently a rare occurrence.

INDONESIA'S PUBLIC DISCLOSURE PROGRAM[31]

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

Indonesia has chosen a single-index approach to the provision of information. Under this approach the authority compiles the various raw pollution information and aggregates it into a single (hopefully easy-to-interpret) index.

Under the Indonesia scheme each polluter is assigned a color rating based on BAPEDAL's evaluation of its environmental performance .

- A black rating is assigned to factories which 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 local standards.
- A blue rating is assigned to factories which are in compliance with national regulatory standards.

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[30] 42 U.S.C. 7602(e).

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

- A green rating is assigned to factories whose emissions control and environmental management procedures significantly exceed those needed for local 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. Number of Firms in Each Classification Category, Various Dates

Color	June 1995	December 1995	September 1996
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 site: http://www.NIPR.org/proppres/sld036.htm.

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. 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.

The concept is spreading. The Philippines' Department of Environment and Natural Resources (DENR) is introducing a public disclosure program called EcoWatch modeled on Indonesia's PROPER program. EcoWatch will soon have its first disclosure of factory performance ratings. The program started on a high note last year 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.NIPR.org/comrole.htm# ecowatch.)

GREEN ELECTRICITY PRICING[32]

As of 1997 some 13 electric utilities (Table 3) 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 to15% of the normal bill.[33] In return the utility acquires renewable energy sources according to a set formula.

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[32] This section is based upon Moscovitz (1993) and Lamarre (1997).

[33]Despite the fact that in Detroit Edison's Solar Currents plan customers pay an average of 14% more the program quickly became oversubscribed. Some 70 customers are currently on a waiting list. (1997).

TABLE 3 GREEN PRICING IN THE US

Sponsor and Program	Year Launched	Renewable Type	Renewable Capacity	Market Segment	Number of Participants	Funding Mechanism	Monthly Customer Cost
City of Austin Electric Utility: Solar Explorer	1997	PV	219 kW	Residential and Business	NA	Fixed payment	$7
Detroit Edison: SolarCurrents	1995	PV	28.4 kW	Residential	195 Residential*	Fee per 100 W (minus electricity credit)	$9.89 (avg.)
Florida Energy Extension Service and Gulf Power: Solar for Schools	1996	Solar Thermal and PV	100 W PV (for lights)	Residential	513	Fixed payment	$1.75
Fort Collins (Colorado) Light & Power: Wind Power Pilot Program	1996	Wind	750 kW	Residential and business	NA	Fee per kWh (residen-ial):fee per 1000-kWh block (business)	$10 residential (est.)
Gainesville Regional Solar Project	1993	PV	10 kW	Residential and business	657	Contribution	$3.27 (avg.)
Hawaiian Electric Co.: and subsidiaries Sun Sun Power for Schools	1996	PV	8-16kW	Residential and (min.)Business	NA	Contribution	NA
Northern States Power: EnergyWise Solar Advantagefor Homes	1995	PV	34 kW	Residential	17*	Fixed payment (minus electricity credit)	$36 (est.)
Portland General Electric: Renewable Energy Supply	1996	Wind	NA	Large commercial and industrial	NA	Fee per kWh	NA
Public Service of Colorado: Renewable Energy Trust	1993	PV	13 kW	Residential	14,000	Contribution	$1.77 (avg.)
Sacramento Municipal Utility District:: PV Pioneers	1993	PV	1200 kW	Residential	350*	Fixed payment	$4
Traverse City (Michigan) Light & Power: Green Rate	1994-	Wind	600 kW	Residential and business	145 residential 20 business	Fee per kWh	$7.58 residential $27 business (avg.)
Wisconsin Electric Power: Energy for Tomorrow	1996	Hydro and biomass	5 MW	Residential and business	NA	Fee per kWh	$3, $6, or $12, depending on option chosen
Wisconsin Public Service: SolarWise for Schools	1995	PV	36 kW	Residential	2600	Contribution	$1.64 (avg.)

Source: Ed Holt & Associates, Harpswell, Maine as cited in [Lamarre, 1997, 8]

Notes:
*Participation limited by project size.

Surveys consistently reveal that from 56% to 80% of respondents to polls indicate a willingness to pay more for environmentally friendly energy sources. Green pricing attempts to tap this 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 willing to pay a price premium can advertise that fact, but utilities which are not prepared to offer that option do not have to.

EMPIRICAL ANALYSIS

The literature on economic analysis of information 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 motivating 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 the radon context this 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 this 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 indicate 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 currently no state laws are in effect concerning radon, 54% of tested homes in their 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 believe that these results suggest that a radon information and awareness program targeted at the point of home sale, when the transaction context provides a strong economic incentive to repair any problems a home might have, could be highly effective in comparison to information targeted at the general population.[34]

MAGAT AND VISCUSI (1992)

One of the first studies was conducted to examine the potential role of hazard warnings. Though a series of carefully defined experiments the authors attempted to discern not only the value of hazard warnings, but also how the structure of the warning might influence its effectiveness. The authors suggest several conclusions from their work.

- Consumers did react to warning labels and their reactions implied benefit levels to the individual which implied that warning labels were valuable.

- Information overload is a potentially serious problem. Due to cognitive limitations in processing information more information is not always better. This suggests that complete information will

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

rarely be efficient, not only because of the marginal cost of providing additional information, but also because the marginal benefits of additional information apparently decline after some point and may even become negative.

- Making information available to consumers is insufficient to guarantee that they will respond to it. The information must be organized in such a manner as to be able to be processed efficiently. Label design matters.[35]

ARORA AND CASON (1996)

Using an econometric model this study attempts to isolate the factors which influence a firm's decision to participate in EPAs 30/50 Program. the study draws the following conclusions:

- The largest firms with the greatest toxic releases were the most likely to participate in this voluntary program.

- The authors found no evidence that firms either free ride on emission reductions prior to the program's initiation or that they participate to divert attention away from poor compliance with mandatory regulation.

- Firms in industries with more contact with final consumers (proxied by normalized advertising expenditures) were more likely to participate in the program.

NAYSNERSKI AND TIETENBERG (1992)

The data used in this analysis included 1205 citizen actions. The data base included information regarding 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.

- 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 private enforcement 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, if the incentives are not applied uniformly to the various pollution problems a bias will be created. Those problems which treat private enforcers favorably will be preferred whether or not they represent the most serious problems.

MUOGHALU, ROBISON AND GLASCOCK (1990)

This study examines 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).

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[35] 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 Magner, Newhouse/S.F. EXAMINER, 12/31/96 as cited in GREENWIRE, 12/31/96).

- Though significant results were obtained for the day of the announcement, no significant results were obtained for intervals from 2 to 5 days prior to or 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) covering the 1982-1991 period.

- Announcements of incidents and 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%.

- This contrasted with an earlier result involving American firms (Muoghalu, Robison and Glascock, 1990). That study found that the American stock market reacted to the announcement of the initiation of a law suit. The authors attribute the difference to the 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 affect 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 where no special attention is paid to providing public information about enforcement actions, they also appear to support the possibility of substantial social benefits from providing more systematic information.

HAMILTON (1995)

An event study is performed on 436 publicly traded companies to ascertain whether the announcement of the information compiled under the Toxic Release Inventory affected stock prices. This is complemented by a study of media coverage of this information complied by searching the Nexis database and the Wall Street Journal index for 1989.

- Holding emissions constant, the more dispersed its pollution across facilities and the more information available to the public about the company's pollution patterns prior to the TRI, the less likely journalists were to treat the firm's TRI releases as news.

- Most of the publicly traded firms in the sample did not receive any coverage of their TRI releases in the print sources traced by this 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).

KHANNA (1997)

This study also examines stock market and waste management responses to disclosure of the Toxic Release Inventory, 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 these firms is negligible.

KONAR AND COHEN (1997)

Comparing the 40 firms with the largest abnormal reductions in their stock prices to a control group of otherwise similar firms, this analysis examines differences in the behavior of firms in these two samples. In general they find:

- The top 40 firms were found to be among the top 1/3 of polluting firms (per dollar revenue) in their industries, but not necessarily the largest emitters in terms of overall emissions.

- The top 40 firms subsequently reduced their emissions more than other firms in the industry (including those firms with the largest TRI/$revenue prior to the disclosure of TRI levels).

- The top 40 firms made more significant attempts at improving their environmental performance by reducing the number and severity of oil and chemical spills.

- The top 40 firms had a lower likelihood of receiving higher fines from the government in subsequent years.

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, but not less visible , but potentially equally harmful, pollutants.

- 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.

SUMMARY AND CONCLUSIONS

The information that we have in hand a this point is too sketchy to allow us to draw firm conclusions. It is possible to use the available information, however, to generate some hypotheses which are consistent with the evidence we currently have before us. 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

- Information strategies can be effective in motivating environmental improvement, some evidence

raises the possibility that the improvement may involve diversion of pollutants rather than prevention.

- When information disclosure is coupled with voluntary compliance programs the evidence suggests that the largest firms with the greatest toxic releases were the most likely to participate and no evidence suggest that firms either free ride on emission reductions prior to the program's initiation or that they participate to divert attention away from poor compliance with mandatory regulation.

- For one class of polluters, public facilities, citizen suits are apparently a superior form of enforcement to traditional public enforcement.

- Public announcements do seem to affect stock market valuations of firms, but these effects will be lower for known polluters. The different results for Canada and the U. S. suggest that the enforcement culture may determine whether it is the announcement of the initiation of the action or the final settlement of the action which affects value.

- 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 which were produced with a lower negative impact on the environment even when the consumers may not be directly affected by that pollution.

THE DETERMINANTS OF EFFECTIVE STRATEGIES

- The quality and quantity of information conveyed can have a large affect of the effectiveness of the program. Due to the possibility of cognitive overload, more information does not always produce lower risk and the form in which information is conveyed can affect can matter a great deal.

- The experience with providing US homeowners with information about radon suggests that how the information is targeted may make a considerable difference in its 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. Their effectiveness has apparently also been affected by the magnitude of the burden of proof environmental groups are forced to bear in bringing claims against polluters.

BIASES IN INFORMATION STRATEGIES

- Firms in industries with more contact with final consumers (proxied by normalized advertising expenditures) were more likely to participate in the voluntary compliance programs which were 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 education levels, but they work less well in area with lower education levels.

- Although citizen suits have apparently led to greater compliance, that is not sufficient to demonstrate that they have led to 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, if the incentives are not applied uniformly to the various pollution problems a bias will be created. Those problems which treat private enforcers favorably will be preferred whether or not they represent the most serious problems.

REMAINING QUESTIONS

- The current level of evidence provides no guidance on whether information 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. Do these investments yield rates of return that compare favorably with other investments or not? Which types of information provision yield the highest rates of return?

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