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the Generation of Hazardous Industrial Wastes
Environmental Studies Board
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COMMITTEE ON INSTITUTIONAL CONSIDERATIONS IN REDUCING THE GENERATION OF HAZARDOUS INDUSTRIAL WASTES

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PREFACE

This is a digest of the report of the Committee on Institutional Considerations in Reducing the Generation of Hazardous Industrial Wastes. The committee was organized in September 1983 under the auspices of the Environmental Studies Board of the National Research Council with financial support from the Andrew W. Mellon Foundation and National Academy of Sciences Endowment Funds. The digest was prepared by National Research Council staff and reviewed by the committee.

The purpose of the report is to facilitate public discussion and to provide a foundation upon which improved public policies for hazardous waste management might be built. Although prepared prior to the final reauthorization of the Resource Conservation and Recovery Act by the 98th session of Congress, the report analyzes actions that would accomplish the reduction in generation called for in the reauthorization.

The digest is intended to provide widespread, immediate, free dissemination of the core of the committee's deliberations to policy makers in all sectors, industrial leaders, and others who are concerned with means to reduce the generation of hazardous industrial waste. The full committee report, Reducing Hazardous Waste Generation: An Evaluation and Call for Action, priced at $4.95 list, is available from the National Academy Press at 2101 Constitution Avenue, Washington, DC 20418.

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INTRODUCTION

Managing hazardous industrial waste has become an important national issue. Almost daily, the news media call attention to the potential threat to public health or the environment from such waste. Places like Love Canal, Times Beach, and Stringfellow Pits have entered common discourse and become symbolic references to a deep public concern.

As the nation focuses attention on protecting the health and welfare of its citizens from existing hazardous waste sites, it is also important to emphasize the need for prudent management of future hazardous industrial waste. A modern industrial economy produces and uses chemicals of all kinds--some of which may be hazardous--and it must be expected that a growing economy will continue to produce and use chemicals. Managing hazardous materials to avoid adverse effects on health and the environment is a complex problem. One important strategy is to prevent the problem whenever practical by reducing the amount of hazardous waste generated as a byproduct of industrial operations. It is precisely that strategy--prevention as contrasted to clean-up--that is the subject of the report summarized in this digest.

The report focuses on nontechnical, institutional factors that affect the generation of hazardous waste. Nontechnical factors include, for example, access (or lack of it) to information on how to reduce the generation of hazardous waste, access (or lack of it) to funds for capital investment in new equipment, the predictability (or lack of it) of government regulation, and economic goals that determine the actions of industrial companies.

There are also numerous technical means for reducing the quantities of hazardous industrial waste generated. Such means typically involve using different raw materials, modifying production processes, or redesigning products. The number of industrial processes generating hazardous waste is large, and technical approaches to reducing waste generation are many and varied. Some firms in the United States have sophisticated waste reduction programs and have been successful in carrying them out. In some cases, the firms have realized substantial cost savings as a result of their waste reduction efforts. The term "waste reduction," as used in the report, refers not only to in-plant process modifications that reduce the volume or degree of hazard

of the hazardous waste generated, but also to the reuse or recycling of hazardous materials.

For its purposes, the report uses the definition of "hazardous industrial wastes" contained in the Resource Conservation and Recovery Act of 1976 (RCRA). Under that federal law, certain wastes are defined as hazardous because they may (a) cause or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness; or (b) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed. This definition, however, cannot always be applied in a straightforward manner. The federal government, the state governments, industrial firms, and others often differ as to which wastes should be considered hazardous under the definition found in federal law.

The differences in defining the term "hazardous industrial waste" and the subsequent inconsistent treatment of data on hazardous waste generation make it difficult to obtain reliable data on waste reduction. Accurate data are needed on the quantity of industrial hazardous waste generated and its degree of hazard to provide a focus for efforts to reduce its generation.

The lack of data, as well as the absence of an extensive peer-reviewed literature on waste reduction, constrained the committee's work. Therefore, many of the observations in the report are based on presentations to the committee and on discussions at a workshop organized by the committee in May 1984. In formulating its conclusions, the committee also relied on the collective experience of its members.

GENERAL PRINCIPLES

As a result of its deliberations, the committee arrived at the following general principles that should govern efforts to reduce the generation of hazardous waste.

1. No single approach to encouraging waste reduction will be most effective in all circumstances. The effectiveness depends on variables, such as the type and size of the industry or plant and the amount of waste reduction that has already been achieved. The dynamic character of waste reduction programs provides a

framework to explore the potential effectiveness of public policy alternatives.

Reductions in the generation of hazardous industrial wastes can be expected to occur through a series of loosely defined and overlapping phases. Initially, firms consider changing their current waste management practices in order to exploit technically simple, low-cost waste reduction opportunities. Firms then undertake increasingly sophisticated, more costly technologies to achieve further waste reduction. Finally, firms begin to confront the political, economic, and technical limits to waste reduction activities. Different public policies are appropriate at different stages of an industry's waste reduction effort.

2. It is desirable to reduce the generation of hazardous waste. Regulatory standards, however, should be based on overall health and environmental considerations and not made more stringent than necessary solely to encourage waste reduction. If properly developed and applied, standards will be a strong impetus to undertaking waste reduction efforts.

3. The costs of alternative methods of waste disposal should reflect the social costs of protecting public health and the environment. The incentive for industrial firms to pursue opportunities for reducing waste generation will be inadequate if the disposal option remains priced below the true costs.

4. Regulation will continue to play a crucial and central role in the overall waste management effort, but future waste reduction is more likely to be fostered by nonregulatory methods, such as information dissemination programs and economic incentives.

FACTORS AFFECTING REDUCTION OF HAZARDOUS WASTE GENERATION

As a result of increased public awareness and concern, generators of hazardous industrial waste now have a number of incentives for reducing generation of such wastes, including the following:

- **increasing costs of disposal;**
- **prospects of incurring substantial financial liability for remedial (clean-up) activities, even where the generator may not have been directly responsible for improper disposal;**

- the risk of third-party liability; and
- the unpredictability of adverse public reaction or opposition.

On the other hand a number of factors need to be overcome to enhance the reduction of hazardous wastes that are generated. These factors and potential steps to overcome them are discussed below.

Costs of Land Disposal

Hazardous waste management in the past had been skewed in favor of using land disposal--especially landfills--largely because costs of land disposal were low. But there was insufficient appreciation of the risks of this type of disposal to human health and the environment. The low cost of land disposal, therefore, did not adequately reflect the long-term costs to society of cleaning up disposal sites, the potential effects on human health, or the degradation of environmental resources, such as groundwater.

More recently, costs of land disposal have begun to rise. It is also becoming evident that the liability of generators for cleaning up existing disposal sites may be very large. Consequently, many generators of waste are becoming aware of the high, potential, longer-term costs associated with land disposal and have begun to reexamine their dependence on this method. The increase in costs will encourage and make economic a wide range of waste reduction actions.

Attitudes Toward Unfamiliar Methods

Reduction in generation of hazardous waste may be impeded because of a tendency in industry to select proven production technologies rather than alternatives that may generate less waste. Once a manufacturing process is operating, there may be even greater reluctance to make major modifications that could affect reliability.

The responsibility for increased attention to waste reduction should extend throughout a corporation or a manufacturing facility from top management to the production line. Successful waste reduction depends on the day-to-day cooperation of production employees, who

often are in the best position to identify some kinds of waste reduction opportunities. Education of engineers on the desirability of waste reduction can also be valuable.

Availability of Information

Reducing the generation of hazardous waste gives a company a competitive advantage if waste management costs are a significant fraction of production costs. Thus many firms are reluctant to release information about their waste reduction practices because doing so may help competitors. Such reluctance can prevent other firms from considering similar changes in their own waste management practices, particularly simple, low-cost measures that could be used to reduce the overall generation of waste. Small companies that often lack the resources to explore waste reduction opportunities on their own can be particularly affected.

Problems posed by confidentiality of information are not likely to be alleviated through stricter agreements or other arrangements. However, governments, trade associations, universities and other institutions can disseminate generic information on how waste can be reduced.

NONREGULATORY ISSUES

Public policies that directly control the output of industrial processes are often effective. Thus, direct regulatory control of hazardous waste can be appropriate for dealing with it once it is generated. In contrast, public policies that directly control industrial processes through regulation are inherently quite complex and often impractical. The sheer number of industrial processes in use throughout the country makes it extremely difficult to design or administer a program that requires specific changes in industrial activities, as does waste reduction. Thus public policy approaches other than direct regulation of production processes are generally preferable for encouraging industry to undertake waste reduction activities.

The committee believes that, currently, dissemination of information on waste reduction is vital to further waste reduction efforts by industry. In the future, as industries and firms need to use more sophisticated waste

reduction methods, research and development and assistance in meeting capital costs will be required.

Dissemination of Information on Waste Reduction

The greatest current need is for industrial firms to take advantage of the many existing opportunities for hazardous waste reduction. Often, there are few financial obstacles to taking advantage of these techniques. Procedures are available to firms for reviewing their current practices in light of opportunities for reducing their generation of hazardous waste. Some of the opportunities may involve minor changes in manufacturing processes or work practices. Others involve no more than simple, good housekeeping practices. Ways are needed to encourage wider dissemination of information about these opportunities.

Although the committee could not predict how much waste reduction might occur as a result of effective programs of information exchange, the programs are likely to have significant effects, particularly by aiding smaller firms that would otherwise not be able to obtain such information. The programs could take a variety of forms:

- educational programs for generators, engineers, and plant operators that could be organized by specific industries;
- dissemination of information through conferences, workshops, technical literature, and other methods;
- enlistment of state agencies, university-based groups, trade associations, and other institutions to work with local industry in implementing waste reduction practices; and
- innovative approaches--such as competitions, in which industries would submit explanations or demonstrations of how they achieved waste reduction through the use of new methods--with the understanding that the new methods are to become public knowledge.

Several states, including North Carolina, New York, and Georgia, have already initiated such programs.

Research and Development

As more reduction in waste generation occurs, new techniques to accomplish greater reduction may have to be developed. The importance of research and development will increase as more of the country's industrial firms implement available techniques and see the need to undertake even further reduction. Research and development has a long lead time. A well-developed, ongoing research program on waste reduction methods will allow an orderly transition to future waste reduction efforts as more industries exhaust available methodologies and face the need to develop new ones.

As increasingly sophisticated and costly waste reduction technologies are implemented, the trade-offs between protection of public health and the environment and costs must be made. The technologic, economic, and political limits of waste reduction need to be defined through a program of risk assessment and delineation of risk management approaches. Efforts should begin now because such a program may require a long lead time.

Assistance in Meeting Capital Costs

In some cases, waste reduction initiatives may pay for themselves, because the implementation of such processes can result in greater production efficiency and lower operating and disposal costs. After industrial firms have exploited the initial low-cost opportunities for reducing hazardous waste generation, however, the capital costs of the equipment needed to make further reductions may become a significant constraint.

Thus policy approaches that reduce the capital costs of equipment necessary for waste reduction may become important in the future as incentives are needed to implement more sophisticated and higher-cost technologies. Approaches to alleviating capital constraints could include:

- low-interest or no-interest government loans with liberal repayment plans, both for the capital costs of new equipment and for environmental audits to determine the best ways of reducing waste generation;

- government guarantees of repayment of loans extended to industrial firms by private investors for waste reduction purposes;
- tax reductions, exemptions, or credits for implementing waste reduction initiatives;
- government actions to encourage smaller firms to pool their resources in implementing a joint waste reduction strategy or constructing joint resource recovery facilities; and
- direct government subsidies to firms actively working on new methods of reducing hazardous waste.

REGULATORY ISSUES

While nonregulatory approaches are generally preferable for fostering waste reduction, four attributes of the regulatory program appear to be critically important in industrial decisions pertaining to the generation of hazardous wastes:

1. The definition of hazardous waste. Would change in the definition result in greater reductions?
2. The predictability of the program. Is the future of the program sufficiently predictable to encourage decisions leading to reductions in waste generation?
3. The stringency of regulatory standards. Are the standards appropriate incentives for reducing waste generation?
4. The degree of success in implementing the current regulatory program. Has implementation encouraged waste reduction activities?

Definition of Hazardous Waste

The current definition of hazardous waste may inhibit progress toward waste reduction in two ways. First, it excludes both certain types and certain sources of waste. Second, many wastes that are covered by the definition are treated in a uniform manner, whether the waste is recycled, reused, treated, or disposed of. Manufacturers therefore may have less incentive to develop recycling and reuse techniques than society desires.

With respect to the first of these problems, the committee suggests that the existing exclusions and

exemptions be evaluated and that a specific program for removing or amending them be developed where appropriate. The examination should determine the reason for the exemption and the extent to which the generation of waste could be reduced by altering it.

With respect to the second problem, the committee recommends that the definition of hazardous waste be modified to include the degree of hazard, and that the U.S. Environmental Protection Agency consider using its "delisting" process to encourage activities that reduce the amount of hazardous waste that must be placed in the environment.

Predictability of the Program

The degree to which the regulatory system is implemented in a predictable fashion will have a major effect on how much hazardous waste is generated. A failure to carry out regulation predictably and consistently will have an adverse effect, because industrial firms are less likely to make definite plans for waste reduction in the face of uncertainty.

In a fundamental sense, predictability depends on the existence of political consensus among government, industry, and the public. Such consensus may not be reached soon, but the committee believes that certain steps toward resolving the problem can be taken now. A system of waste classification based on degree of hazard would indicate which materials are to be given the most attention. More effort should be devoted to educational programs that would help to achieve consensus.

In the near term, steps could be initiated to move toward greater program predictability. Government could develop a priority plan for implementation of RCRA. A comprehensive review could be undertaken to find and eliminate inconsistencies and loopholes in the regulations. A program plan could be developed detailing how RCRA will be implemented in those states that do not qualify for delegation.

Stringency of Regulatory Standards

The committee concluded that regulatory standards should be made as stringent as necessary to achieve goals protective of public health and the environment. But

restraints unwarranted in the light of perceived threats should be avoided. In particular, the following actions may be appropriate to protect public health and at the same time encourage waste reduction:

- placing restrictions on which materials can be deposited in landfills;
- rapidly closing old and inadequate landfills; and
- strengthening requirements for long-term care of landfills.

Degree of Success in Implementing the Program

The initial implementation of RCRA was not as vigorous as might have been expected, but recently the situation appears to have improved. The committee, however, wishes to emphasize that the current trend toward stronger implementation of the program must continue if reduction efforts are to be maximized. Adequate resources must be allocated to ensure that implementation is successful.

IMPROVING THE CLIMATE FOR COMMERCIAL RECYCLING AND REUSE

According to the EPA, only a small portion of the hazardous waste generated in 1981 was recycled. Nonetheless, recycling appears to be an increasingly attractive option to waste generators, and the number of generators recycling hazardous waste appears to be increasing.

Several existing recycling programs make effective and economical use of hazardous waste. The best-known example is the recycling of solvents, both on and off the sites of commercial facilities. Other waste streams have not been recycled as successfully because of various technological, legal, and economic factors.

Approaches that could encourage the development of additional recycling and reuse facilities include:

- steps to increase procurement of recycled materials, either by the federal government, state governments, or industry; further study is necessary to determine which materials might be good candidates for procurement;

- revisions of federal and state regulations that would treat recycling plants more like ordinary chemical processing plants; with tighter enforcement and financial assurance requirements, recyclers could be regulated with greater flexibility while protecting public health and the environment;
- greater educational efforts to demonstrate to the public that properly managed recycling can mean less danger from hazardous waste rather than more; and
- financial assistance to waste exchanges to enable them to play a more active role in arranging for the recycling and reuse of materials.

CONCLUSIONS

1. Most waste reduction efforts in U.S. industry are still in their early stages. Many opportunities exist for reducing the generation of hazardous waste. Efforts should begin now to encourage industries to take advantage of these opportunities.

2. At the current stage of development of industrial waste management programs across the nation, substantial progress in reducing the amount of hazardous waste generated can be achieved by employing relatively simple methods that entail modest capital expense. Such methods emphasize engineering or plant specific circumstances. The amount of waste generation that can be avoided is, unfortunately, not known, because of difficulties in obtaining reliable data.

3. The current trend toward increasing costs of land disposal for hazardous wastes--through greater liability for generators and site operators as well as through restrictions on this use of land--is an extremely important impetus to implementing waste reduction programs. To encourage reduction in the amount of waste generated in the future, this trend bringing the cost of land disposal to the level of its true costs to society should continue.

4. An important impediment to implementing low-cost waste reduction practices is lack of access to information about them. Developing means to exchange and disseminate information about successful waste reduction projects is an essential first step toward reducing future waste generation.