DOE/CE/40762T-HS

October 1991

Work Performed Under Contract No. DE-AC01-87CE40762

Prepared for:

U.S. Department of Energy
Assistant Secretary, of Conservation and Renewable Energy
Office of Industrial Technologies
Industrial Waste Reduction Program
Washington, D.C.

By

Energetics, Incorporated
Columbia, Maryland

DISCLAIMER

DOE/CE--40762T-H3

DE92 003608

Federal Legislative and Regulatory Incentives and Disincentives For Industrial Waste Reduction

October 1991

Work Performed Under Contract No. DE-AC01-87CE4-762

Prepared for:

U.S. Department of Energy
Assistant Secretary, of Conservation and Renewable Energy
Office of Industrial Technologies
Industrial Waste Reduction Program
1000 Independence Avenue, SW
Washington, D.C. 20585

Prepared by:
Richard Cordes and Joseph Nixon
Energetics, Incorporated
7164 Gateway Drive
Columbia, Maryland 21046

PREFACE

The U.S. Department of Energy (DOE) recently initiated the **Industrial Waste Reduction Program** (IWRP), which seeks to work with industry in developing and commercializing waste reduction technologies and practices that will reduce industrial energy use. The Program consists of five fundamental elements:

- Industrial Waste Characterization
- Opportunity Assessments
- Technology R&D
- Technology and Information Transfer
- Institutional Analysis

The purpose of the last program element, Institutional Analysis, is to identify, examine, and understand the many factors that affect industrial investment in waste reduction technology. This understanding will help DOE and others to effectively strengthen incentives and remove or diminish existing barriers to industrial implementation of waste reduction technologies.

This report, undertaken as part of the Institutional Analysis program element, focuses on federal legislation and regulations that stimulate or hinder waste reduction activities. In addition, it identifies options that the federal government could implement to foster available and emerging waste reduction activities, either by increasing incentives or by removing disincentives. Subsequent IWRP efforts will draw on the information assembled in this document to promote industrial waste reduction.

The authors wish to thank the members of the organizations listed in Appendix A, who directed us to appropriate resources, clarified confusing issues, and increased our understanding of the material. We also thank Bruce Cranford, of DOE's Office of Industrial Technologies for his direction and his comments, and Don Walter, of the Office of Industrial Technologies, for his contributions to this document.

EXECUTIVE SUMMARY

The Office of Industrial Technologies (OIT) within the U.S. Department of Energy has recently initiated the **Industrial Waste Reduction Program**, which is designed to reduce industrial energy use and pollution by reducing the amount of waste materials generated. The Program's primary focus is to develop and commercialize waste reduction technologies and practices in conjunction with industrial partners. OIT recognizes that adoption of these technologies is often inhibited by an assortment of institutional barriers that are unrelated to technical or economic performance. Therefore, as part of its technology development effort, OIT is examining selected barriers to industrial waste reduction to help identify and remove impediments to wider technology implementation.

This report examines the incentives and disincentives to industrial waste reduction that are provided in an assortment of legislation and regulations. The intent is to shed light on how our environmental laws affect industry's implementation of waste reduction, what particular problems exist with current legislation/regulations, and what general options are available for correcting any deficiencies. While the analysis does not recommend specific remedies, it does provide a basis for informed discussion and ultimate policy formulation.

Our study was confined strictly to federal legislation and regulations. During the course of the study, which was conducted between March and May 1991, we examined 16 pieces of existing legislation and their attendant regulations plus 22 pieces of proposed legislation. In addition, the authors consulted representatives from industry and from the government agencies administering or sponsoring the legislation to gain their perspectives on the effects the legislation is having and may be expected to have on industrial waste reduction.

The Resource Conservation and Recovery Act (RCRA) is by far the most comprehensive and dominant piece of legislation affecting solid waste disposal. This is because RCRA, which governs the management of both nonhazardous and hazardous wastes, places the most restrictive requirements on industry. Other important pieces of legislation that exert a direct influence on waste reduction *per se* include the Clean Air Act and the Pollution Prevention Act.

Our study found that existing legislation and their attendant regulations provide industry with many incentives for engaging in waste reduction. Numerous instances were found where waste reduction was encouraged over other waste management options for near-, mid-, and long-term applications. We also found cases where the law created disincentives to waste reduction, either directly or indirectly. While the *number* of disincentives are noticeably fewer than the incentives, this does not mean the disincentives are insignificant. Lawmakers, policy makers, and manufacturers have often noted that the disincentives created by some legislation and regulations are so substantial as to outweigh the collective effect of the incentives.

This study makes no conclusions regarding the ultimate effect of waste-related legislation and regulation on corporate decisionmaking. Instead, the focus of our analysis is to **determine what**

incentives and disincentives the law provides for regardless of ultimate impact. This limitation was necessary given our time constraints and the inherent complexity of corporate decisionmaking on waste management issues. Among the difficulties in judging how the law ultimately acts as an incentive or disincentive are:

- *Regulation* -- Regulations interpret law. A regulation that expresses an acceptable solution may inhibit other activities.

- *Enforcement* -- The best intentions of lawmakers may be in vain if enforcement is sporadic or nonexistent.

- *Dual incentives* -- The same laws and regulations offering incentives for waste reduction also provide incentives for waste treatment and disposal.

- *"Compared to what?"* -- A law or regulation that reduces waste generation (say in 20% of all cases) and results in waste treatment and disposal (say in 80% of all cases), may not be viewed as providing an incentive for waste reduction vis-a-vis waste disposal, even though waste reduction has occurred.

- *Application* -- Since waste reduction is often incorporated into process modifications and operating and maintenance procedures, the initial incentive for reduction may be easily forgotten, even though such actions may provide continuing benefits.

- *Ancillary factors* -- Waste management decisions must consider a variety of factors including costs, liability, capital availability, information, and other factors in addition to regulatory requirements. Disentangling the effect of just the regulatory element is both difficult and suspect at best.

Paradoxically, most of the regulations that create short-term barriers to waste reduction are likely to promote waste reduction in the long term. Two acts that may be placed in this category are RCRA and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The majority of the short-term barriers embedded in these two acts involve the scarcity of industrial funds for waste reduction research as a result of the escalating costs of waste disposal (due to stricter regulation).

In addition, the authors found that RCRA and the Safe Drinking Water Act contain mid-term disincentives to waste reduction. These may be summarized as follows:

- RCRA's definition of solid waste to include hazardous waste is seen to discourage industry from pursuing some in-process recycling because of the public's perception of such materials.

- A similar problem arises in RCRA's "used oil" regulation, the final form of which is still under consideration.

- RCRA's rules for the burning of hazardous waste for materials recovery is also seen to inadvertently bar some resource recovery, even if steps are taken to reduce environmental risks.

- The Safe Drinking Water Act lists use of granular activated carbon as a feasible water treatment method, yet this technique will assuredly boost the volume of wastes generated.

The primary forces driving current waste reduction efforts in industry appear to be the liability of generators for the wastes they produce, public pressure by an informed citizenry, and the costs associated with the handling of wastes. The actions available to the federal government to effect greater reductions in industrial waste generation fall into the following three categories:

Legislative Actions, which may include:

- Tax Incentives
- Tax Disincentives
- Deposit/Refund Systems
- Marketable Permits
- Information Disclosure
- "Environmentally Safe" Product Labelling
- Mandatory Waste Reduction Audits and Facility Plans
- Mandatory Performance Standards
- Mandatory Percentage Reduction in Waste Generation

Regulatory Actions, which may include:

- Expansion of RCRA Subtitle C Umbrella
- Flexibility to Handle Multi-Media Problems
- Banning of Certain Chemicals or Products

Non-Legislative Actions, which may include:

- Change Procurement Standards
- Modify Specifications
- Increase Awareness in Federal Sector

The selection of specific federal actions must be carefully considered individually as well as in conjunction with other proposed and existing measures. One of the biggest problems is the lack of good information on waste reduction activities. A closely related difficulty is the necessity to collect data through a multi-media program, so that cross-media transfers of wastes do not

distort the data. In addition, the interests of various federal agencies, industry, public interest groups, and Congress may converge or diverge on specific methods of accomplishing waste reduction; a cohesive policy is needed to guide federal actions. Finally, federal actions in themselves may be restricted by the leadership roles that some state governments have already assumed in waste reduction activities.

CONTENTS

OVERVIEW OF INSTITUTIONAL BARRIERS

Industrial wastes are the undesirable byproducts generated during the production of useful goods and services. These wastes are not only a potential threat to our environment and health, they often represent production inefficiencies. While some wastes are unavoidable, minimizing industrial wastes is a worthwhile national and corporate goal.

As a nation, we place a relatively high value on a clean environment and have taken steps to protect it. National environmental policy has evolved over the past twenty years, resulting in numerous statutes and regulations that seek to limit the introduction of pollutants into our air, water, and land. While the goal of nearly all of these laws is to protect human health and the environment, the focus has often been on controlling the amount of pollutants coming out of the end of the pipe, going up the stack, or being buried in the ground. Although this approach has helped to protect our environment, it has also imposed large costs -- as much as $80 billion annually -- on the businesses, consumers, and taxpayers who pay for pollution control. These laws have not necessarily reduced the *generation* of wastes, though they may have *controlled* pollution.

This report examines current and proposed legislation and regulations to determine what incentives or disincentives they provide for industrial waste reduction. The incentives and disincentives are characterized according to their likely impact in the near-, mid-, and long-term. Possible federal actions to promote industrial waste reduction are considered; they may encourage waste reduction by increasing incentives or by removing or reducing impediments that stand in the way of waste reduction activities. Ultimately, the information in this report can be used to propose legislative or regulatory reforms that further encourage industrial waste reduction or to provide alternatives to a regulatory approach.

Waste reduction is an appropriate means for improving environmental quality beyond that achieved under the traditional "command and control" strategies characteristic of many past and current environmental regulations. By reducing waste production, more raw material becomes product, and treatment and disposal activities are reduced. It is also the most economic approach to pollution control in a wide variety of situations. In the long-term, waste reduction can both lower consumers' cost of goods and minimize the environmental impacts of industrial production.

Many parties have observed these benefits, and now support the primacy of waste reduction as the preferred environmental management technique. Among them is the U.S. Environmental Protection Agency, the major environmental authority in the nation, which is integrating pollution prevention (waste reduction) into its regulatory framework.

While the economic benefits of waste reduction vary among specific industrial applications, its overall advantage over conventional pollution control has been widely demonstrated. Hundreds of firms have implemented waste reduction measures and have reported significant cost savings. Therefore, it has been disturbing to policymakers that waste reduction as a means to prevent

WASTE REDUCTION DEFINED

Waste reduction encompasses in-plant practices that reduce, avoid, or eliminate the generation of industrial wastes during the design, manufacture, use and discard of the product flow. Wastes include all forms of undesirable products, including solid materials, air emissions, and water discharges. Separate waste-management activities, such as off-site waste recycling or treatment of wastes after they are generated, are not considered waste reduction. Also, an action that merely concentrates the wastes to reduce volume or dilutes them to reduce the degree of hazard is not considered waste reduction. This definition is meant to be consistent with the goal of preventing the generation of wastes at their source rather than controlling, treating, or managing wastes after their generation.*

Waste reduction requires a clear understanding of industrial wastes included in the definition. For the purposes of this report, industrial wastes are not limited to the RCRA definition of solid waste, which excludes certain wastes under 40 CFR 261.4. Neither radioactive wastes nor municipal wastes are considered industrial wastes, except as described below.

On-site recycling of industrial by-products is usually considered waste reduction, while off-site and post-consumer recycling are not. However, legislation encouraging post-consumer recycling, analyzed in this report, may act as an incentive to industrial waste reduction, since it could reduce industrial wastes as a result of switching from virgin material feedstocks to recycled feedstocks.

* This paragraph adopted from *Serious Reduction of Hazardous Waste,* OTA 1986.

pollution is not more widespread. Studies conducted by the Office of Technology Assessment[1] and the Environmental Protection Agency[2] identified a number of barriers to waste reduction that are unrelated to the technical performance or cost advantage of various measures. The general conclusion of these studies is that significant waste reduction can be achieved in industry without advancements in technology or improvements in cost performance. By overcoming the non-technical *institutional* barriers, industry could reduce some wastes by as much as 50% in just a few years.

Among the institutional barriers identified in various studies, the lack of good technical and cost information was prominent. More broadly, the lack of understanding of the characteristics of various waste streams within industrial complexes is compounded by the lack of knowledge of waste reduction opportunities and techniques, allowing valuable waste reduction opportunities to be missed. Particular informational problems identified in the OTA study include lack of good waste stream data, lack of worker information programs, and ineffective or nonexistent auditing procedures. Other barriers to industrial waste reduction, not addressed in this report, include

- poor economic health or the lack of available resources;
- domestic or international competitive pressures;
- a corporate philosophy that discourages innovation or the adoption of waste reduction practices; or
- other impediments.

Regulatory and legislative requirements, the subject of this analysis, is another barrier that was identified by OTA. They noted that the need for immediate regulatory compliance resulting from a pollution *control* approach makes it difficult for firms to invest in more substantial pollution *prevention* measures. In addition, the various statutes sometimes work at cross-purposes and can be confusing.

Other barriers to waste reduction are generally of two types: financial/market and behavioral. Financial and market factors affect the company-specific economics of waste reduction, even if the overall cost effectiveness is proven. For example, waste reduction measures that require capital investments must compete against other capital needs. Resources needed for new production equipment, R&D, and other capital improvements will often take priority. Ironically, capital needed for pollution control equipment is often viewed as a fixed cost that acts to shrink the pool of available capital. Other company-specific economics are affected by the degree of competition within their industry segment, the cost of capital to the firm, the size of the firm, and general macroeconomic conditions.

Behavioral factors are often company- or industry-specific. They include a firm's propensity to innovate, corporate philosophy, liability concerns, and other non-financial factors. While it is inappropriate to develop federal policies to address individual company needs, understanding common behavioral problems can lead to effective government solutions.

Legislation and regulations have a somewhat unique role in that they can be used to help overcome barriers to waste reduction but could potentially become barriers themselves. In examining regulatory deficiencies and searching for new regulatory solutions, the need to place waste reduction in a comprehensive framework will become increasingly important.

This report first introduces the laws that govern the management of waste, recounting the intended effect of each piece of legislation. The incentives and disincentives to industrial waste reduction caused by these laws and the regulations that flow from them are then presented. A short analysis of some issues affecting regulatory reform are pointed out. The current legislative efforts which may affect industrial waste reduction are highlighted, followed by a series of summaries of other possible federal actions.

SUMMARY OF LEGISLATION AND REGULATIONS AFFECTING INDUSTRIAL WASTE REDUCTION

Industry's waste reduction activities are influenced by economics, public image, competition, liability issues, and legislation and regulations. The direct influence of legislation and regulations appears to be a small factor in encouraging firms to implement waste reduction.[3] However, legislation and regulations have raised the cost of managing wastes, increased public access to industrial information, and made companies responsible for their wastes even after they have been transferred to a treatment, storage or disposal facility. Laws and regulations are significant driving forces in promoting waste reduction, largely due to their secondary effects.

Most of the legislation that affects waste reduction gives power to the Environmental Protection Agency to regulate industry, though some tax laws and occupational standards also affect industry decisions in this area.

Environmental Laws Affecting Waste Reduction

The U.S. Congress has enacted several pieces of environmental legislation that influence industry's decisions about waste reduction. Overviews of these laws are given in Table 1.

Several laws were designed to control releases or discharges to a specific medium. The Clean Air Act targets emissions into the air, the Clean Water Act addresses discharges into streams and lakes, and the Resource Conservation and Recovery Act is directed primarily at the wastes destined for land-based disposal. The authority to develop regulations under each of these laws and to enforce them has been delegated to separate offices within the Environmental Protection Agency (EPA). These offices normally act independently of one another.

Other laws were enacted to protect the public from specific dangers (i.e., the Safe Drinking Water Act for unsafe drinking water, the Toxic Substances Control Act for toxic chemicals, the Federal Insecticide, Fungicide, and Rodenticide Act for pesticides).

With the authority granted by Congress under these laws, EPA promulgates regulations with which individuals and industries must comply and enforces their compliance. The regulations generally address wastes after their generation.[4] Few laws are directed specifically at waste reduction.

This section of the report provides summaries of each Act and a description of the regulations impacting waste reduction which flow from them.

Table 1. Overview of Environmental Laws*

Law	Purpose/Scope
Resource Conservation and Recovery Act of 1976 (RCRA)/Hazardous and Solid Waste Amendments of 1984 (HSWA)	Creates a framework for the proper management of nonhazardous solid wastes, hazardous wastes, underground storage tanks, and medical wastes.
Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)	Provides federal authority to respond directly to releases of hazardous substances that may endanger public health or the environment; institutes a tax to pay for such actions.
Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA)	Establishes requirements for federal, state and local governments and industry regarding emergency planning and community right-to-know reporting on hazardous and toxic chemicals; increases the public's knowledge and access to information on the presence of hazardous chemicals in their community and on releases of these chemicals into the environment.
Clean Air Act of 1977 (CAA)	Sets criteria for the control and reduction of hazardous air pollutants in order to protect and enhance the quality of the nation's air resources.
Clean Water Act of 1963 (CWA)	Restores and maintains the chemical, physical and biological integrity of the nation's waters.
Pollution Prevention Act of 1990	Establishes preventing pollution at the source as the preferred environmental management technique.
Safe Drinking Water Act of 1974 (SDWA)	Sets criteria to protect the public's drinking water systems.
Toxic Substance Control Act of 1976 (TSCA)	Regulates chemicals substances and mixtures manufactured, processed and distributed in the U.S. which present an unreasonable risk of injury to human health and the environment.
Federal Insecticide, Fungicide and Rodenticide Act of 1975 (FIFRA)	Regulates the use and trade of pesticides manufactured, processed and distributed in the U.S.

* The laws are presented in approximate order of significant impact.

Resource Conservation and Recovery Act/Hazardous and Solid Waste Amendments

The Resource Conservation and Recovery Act may be considered the Act designed to protect the ground; it governs the disposal of most land-based wastes. This Act developed through several amendments to the Solid Waste Disposal Act (SWDA) of 1965. The SWDA was the first federal law that required environmentally sound methods for disposal of household, municipal, commercial and industrial wastes. Congress amended the law in 1970 by passing the Resource Recovery Act. As the complexity and breadth of the waste management problem grew, the federal government saw a clear need for a more comprehensive program geared toward preventing significant future contamination problems. To address these needs, Congress amended the law again in 1976 by enacting the Resource Conservation and Recovery Act (RCRA). RCRA laid out the basic framework for regulating waste generators, waste transporters, and waste management facilities. In response to the public's increased knowledge about the health and environmental impacts of waste disposal, and its strongly voiced concerns that existing waste disposal methods were not safe, Congress revised RCRA, first in 1980 and again in 1984. Its present form is shown in Table 2. Subtitles C, D, I, and J lay out the framework for the four programs that make up RCRA: the hazardous waste management program; the solid waste program; the underground storage tank program; and the medical waste tracking program, respectively.

Table 2. RCRA Subtitles

Subtitle	Subject
A	General Provisions
B	Authorities of the Administrator of the EPA
C	Hazardous Waste Management
D	Solid Waste
E	Duties of the Secretary of Commerce
F	Federal Responsibilities
G	Miscellaneous Provisions
H	Research, Development, Demonstration and Information
I	Underground Storage Tanks
J	Medical Waste

The 1984 amendments, referred to as the Hazardous and Solid Waste Amendments (HSWA), expanded the scope of RCRA's industrial waste reduction initiatives by putting in place five provisions which are directly tied to hazardous waste minimization. These provisions are:

- RCRA § 1003(b)
- RCRA § 3002(b)
- RCRA § 3002(a)(6)
- RCRA § 3005(h)
- RCRA § 8002(r)

Section 1003(b). Section 1003(b) of RCRA Subtitle A, as amended by HSWA, established as a national policy that the generation of hazardous waste is to be reduced or eliminated as expeditiously as possible, wherever feasible. Furthermore, this Section also states that waste that is nevertheless generated should be treated, stored, or disposed of so as to minimize the present and future threat to human health and the environment.

Section 3002(b). Section 3002(b) of RCRA Subtitle C, as amended by HSWA, requires generators to certify on their hazardous waste manifests that they have a program in place to reduce the volume or quantity and toxicity of waste to the degree determined by the generator to be economically practicable, and that the proposed method of treatment, storage, or disposal is that practicable method available to the generator which minimizes the present and future threat to human health and the environment.[5]

Section 3002(a)(6). Section 3002(a)(6) of RCRA Subtitle C, as amended by HSWA, requires generators to describe, in their biennial reports, the efforts undertaken during the year to reduce the volume and toxicity of waste generated and document actual reduction achieved in comparison to previous years.[6]

Section 3005(h). Section 3005(h) of RCRA Subtitle C, as amended by HSWA, requires that hazardous waste treatment, storage, or disposal facility permitees certify, no less often than annually, that the generator of the hazardous waste has a program in place to reduce the volume or quantity and toxicity of the waste to the degree determined by the generator to be economically practicable, and that the proposed method of treatment, storage, or disposal is that practicable method currently available to the generator which minimizes the present and future threat to human health and the environment.[7]

Section 8002(r). Section 8002(r) of RCRA Subtitle H, as amended by HSWA, requires the EPA Administrator to evaluate specifically the feasibility and desirability of (1) establishing standards of performance or taking other additional actions under RCRA to require generators of hazardous waste to reduce the volume or quantity and toxicity of the hazardous waste they generate, and (2) establishing, with respect to hazardous waste, required management practices or other requirements to ensure such waste are managed in ways that minimize present and future risks to human health and the environment.

In addition to the provisions mentioned above, Subtitle C of RCRA also contains many other provisions which indirectly provide incentives or disincentives for industrial waste reduction. For further discussion of these provisions refer to the "Analysis of Regulatory and Legislative Impacts" section of this report.

Comprehensive Environmental Response, Compensation, and Liability Act

Congress enacted the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly known as Superfund, in 1980. This law created a tax on the chemical and petroleum industries and provided a broad federal authority, delegated to the EPA, to respond directly to releases or threatened releases of hazardous substances that may endanger public health or welfare or the environment. Over 5 years, $1.6 billion were collected and the tax went to a Trust Fund for cleaning up abandoned or uncontrolled hazardous waste sites. On October 17, 1986, the Superfund Amendments and Reauthorization Act (SARA) was signed into law.

SARA increases the Trust Fund to $8.5 billion over 5 years and strengthens EPA's authority to conduct cleanup and enforcement activities.

Under the Superfund program, EPA can:

- Pay for the cleanup of hazardous waste sites when those responsible for such sites cannot be found or are unwilling or unable to clean up a site.
- Take legal action to force those responsible for hazardous waste sites that threaten public health or the environment to clean up those sites or pay back the federal government for the costs of cleanup.

The law authorizes two kinds of response actions:

- Short-term *removals* where actions may be taken to address releases or threats of threats of releases requiring prompt response.
- Longer-term *remedial responses* that permanently and significantly reduce the dangers associated with releases or threats of releases of hazardous substances that are serious but not immediately life threatening. They can be conducted only at sites on EPA's National Priorities List.

Remedial and removal responses include, but are not limited to:

- Destroying, detoxifying, or immobilizing the hazardous substances on the site through incineration or other treatment technologies.
- Containing the substances on-site so that they can safely remain there and present no further threat.
- Removing the materials from the site to an EPA-approved, licensed hazardous waste facility for treatment, containment, or destruction.
- Identifying and restoring contaminated ground water, halting further spread of the contaminants, or in some circumstances providing an alternate source of drinking water.[8]

Emergency Planning and Community Right-to-Know Act

The Emergency Planning and Community Right-to-Know Act (EPCRA), also known as Title III of the Superfund Amendments and Reauthorization Act, plays an important pollution prevention role by enforcing accountability among industries and by equipping EPA to develop pollution prevention strategy. Congress promulgated EPCRA in an effort to increase the public's awareness of the chemicals present at the industrial facilities in their communities as well as to make available information about the quantities and types of chemicals that are being released to the air, water, and land.

EPCRA provides for two basic needs: the need for communities to prepare for the possibility of chemical accidents that may affect persons outside the bounds of industrial facilities; and the

need for communities to have access to information about the chemical use inside facilities to provide citizens with the opportunity to exercise a moderating control over chemical safety and handling. Section 313, the Toxics Release Inventory (TRI), is one of the Sections of EPCRA that addresses this second issue. It also makes a significant contribution to pollution prevention.

Section 313 requires all manufacturers (businesses within Standard Industrial Classification, or SIC, codes 20-39) that have 10 or more employees to complete a Toxics Release Inventory Form (the Form R) for each toxic chemical that they manufacture or process in a quantity equal to or greater than 25,000 pounds per year, or that they otherwise use in a quantity equal to or greater than 10,000 pounds per year. (The list of toxic chemicals is defined by regulation.) The Form R reports on the how these chemicals were used; the maximum amount of each chemical that was on site at one time during the previous calendar year; the chemical releases to air, water, and land; the quantities of chemicals transferred off-site as waste; the locations of waste disposal; details about chemical waste treatment; and optional information on waste minimization. About 70,000 manufacturers report this information to EPA each year.

TRI does not provide EPA a recourse for facilities that refuse to reduce emissions or waste production, but it brings waste activities out into the open. The TRI information gives the public and public interest groups the facts that they need to pressure industries into reducing waste and emissions. The TRI reports can also be used as a publicity spotlight for companies that have initiated innovative and effective pollution prevention techniques. In both instances, the increased public awareness of emissions and waste production generally results in increased pollution prevention efforts.

In the Pollution Prevention Act of 1990, Congress strengthened the pollution prevention potential of Form R by expanding the pollution prevention information section of the form and by making this section mandatory, beginning with reports for calendar year 1991 (Forms R submitted by July 1, 1992). Historically, less than 10% of the reporting facilities have completed the *optional* version of this section. The following information will need to be reported on the pollution prevention section of Form R:

- The amounts of toxic chemicals entering the waste stream before recycling, treatment, or disposal and the percentage change from previous year;
- The amounts of toxic chemicals recycled, percentage change from previous year, and the recycling process used;
- Estimates of amounts that will be reported for the next two years;
- Specific source reduction practices used by the facility;
- Any techniques used to identify source reduction opportunities;
- The ratio of production in the reporting year to production in the preceding year; and
- The amounts of toxic chemicals released because of accidents or other one-time events.

The Form R information is useful for tracking pollution prevention efforts, reductions in emissions of toxic chemicals, and the production wastes containing toxic chemicals. EPA

established a database of Form R information on the National Library of Medicine's TOXNET database network. The database allows easy access to the TRI information and facilitates analysis of pollution prevention methods being used by industry.

The TRI information has certain limitations. Only a select number of chemicals are reported to TRI; many wastes, especially non-toxic wastes, are omitted. In addition, only manufacturers are required to submit Form R, so there is a large universe of facilities (e.g., power production facilities) that are not covered by TRI. Tracking waste minimization efforts through TRI is therefore limited to manufacturing industries that make or use the chemicals on the TRI list.

Clean Air Act

A primary goal of the Clean Air Act (CAA) is "to encourage or otherwise promote reasonable federal, state, and local governmental actions, consistent with the provisions [of the Clean Air Act], for pollution prevention".[9] The Act defines air pollution prevention as "the reduction or elimination, through any measures, of the amount of pollutants produced or created at the source". The Act also encourages pollution control at its source as another legitimate means of enhancing the quality of our air resources.

The CAA consists of eleven Titles that address ways the United States must control and reduce the emission of pollutants into the air. The subject of each Title is listed in Table 3. Title I requires EPA to establish a national research and development (R&D) program for the prevention and control of air pollution.[10] The program must include a basic engineering research and technology program to develop, evaluate, and demonstrate non-regulatory strategies and technologies for air pollution prevention.[11]

Table 3. Clean Air Act Titles

Title	Subject
I	Provisions for Attainment and Maintenance of National Ambient Air Quality Standards
II	Provisions Relating to Mobile Sources
III	Air Toxics
IV	Acid Deposition Control
V	Permits
VI	Stratospheric Ozone and Global Climate Protection
VII	Provisions Relating to Enforcement
VIII	Miscellaneous Provisions
IX	Clean Air Research
X	Disadvantaged Business Concerns
XI	Clean Air Employment Transition Assistance

Title I also contains the CAA nonattainment provisions. States are required to submit to EPA within three years after the issuance of any National Ambient Air Quality Standard (NAAQS) for any air pollutant, a plan which provides for implementation, maintenance, and enforcement of the standard. The plan may require "periodic reports on the nature and amounts of emissions and emissions-related data from [emissions] sources". The

accountability afforded by this requirement will pressure polluters to reduce their waste by decreasing emissions.

Title II of the CAA establishes tighter pollution standards to reduce tailpipe emissions of hydrocarbons, carbon monoxide, and nitrogen oxide, and to control evaporative emissions from gasoline vehicles under summer high-ozone conditions.

Under Title III of the CAA, EPA is required to promulgate emissions standards for air toxics that achieve the maximum degree of emissions reduction deemed achievable by EPA. The measures to implement the standards may include, but are not limited to, process changes or material substitutions; enclosures; measures to collect, capture, or treat process, storage, stack or fugitive emissions; design equipment, work practice or operational requirements; or any combination of such measures. These changes will result in waste reduction. Title III of the CAA also contains an accidental release section that requires a number of measures including the establishment of a Chemical Safety and Hazard Investigation Board and promulgation of reasonable regulations and appropriate guidance to provide for the prevention and detection of accidental releases of chemicals. Preventing accidental releases will decrease the amount of pollution that enters the environment and the quantity of waste produced as a result of these releases.

Title IV addresses the control of acid deposition resulting from sulfur dioxide and nitrogen oxide emissions (acid rain). Its aim is to reduce the annual SO_2 emissions by 10 million tons from 1980 levels and, in combination with other provisions of the CAA, to reduce the emissions of NO_X by 2 million tons from 1980 levels. EPA will use a market-based system of emissions allowances designed to encourage industries to meet the required reductions through energy conservation, renewable and clean alternative technologies, and pollution prevention. Although the allowance system supports a multi-media pollution prevention strategy, it is still likely that utilities will also turn to scrubber technology and other pollution control methods to supplement pollution prevention methods as a way to meet the required reductions in SO_2 and NO_X emissions. These pollution control methods remove pollutants from the air but they also tend to produce solid waste as well.

Title V of the CAA authorizes states to issue federally enforceable operating permits. The permits are to be designed to clarify which requirements apply to the permitted stationary source and to facilitate enforcement of the requirements. A permitting fee system based on the quantity of pollution emitted (an annual fee of $25/ton is suggested) is included in the CAA to fund state air programs.

Title VI requires EPA to publish two lists of ozone-depleting chemicals (Class I and Class II). Industries must report their production, imports, and exports of these chemicals to EPA quarterly. The CAA also prohibits actions, such as venting ozone-depleting chemicals during the servicing or disposal of refrigeration equipment, that might cause these chemicals to be released to the atmosphere. The rest of the Title contains a ban on nonessential products (e.g., CFC-containing party streamers) within two years, labeling requirements, safe alternatives strategy, and

requirements for the General Services Administration and the Department of Defense to promulgate regulations requiring maximum substitution of safe alternatives for ozone-depleting chemicals.

Title VII contains the enforcement provisions of the CAA. It gives EPA authority to issue administrative penalty orders of up to $200,000 and field citations of up to $5000 for lesser offenses. The Title also enhances civil judicial penalties and upgrades criminal penalties for knowing violations from misdemeanors to felonies. In order to strengthen accountability, sources must certify their compliance, and EPA has the authority to issue administrative subpoenas for compliance data.

The other Titles of the CAA (VIII through XI) do not have a substantial, direct impact on waste reduction. Title VIII contains miscellaneous provisions about outer continental shelf air pollution, grants for air pollution planning and control programs, analysis of costs and benefits, and visibility impairment studies. Title IX provides for clean air research on air pollution monitoring, health effects, pollution prevention and emissions control, clean alternative fuels, and other topics. Title X requires that EPA make not less than 10 percent of total federal funds for any EPA-funded CAA research to disadvantaged businesses. Title XI provides assistance to employees who may lose their employment due to effects of implementation of the CAA.

Clean Water Act

The Clean Water Act (CWA), outlines the regulation of water and wastewater discharges into the waters of the United States. The facilities subject to control under CWA include those that discharge directly to navigable or surface waters, those that discharge to publicly owned treatment plants (indirect discharge), those involved in dredge or fill activities, and possibly those that use or store oil, oil products, or polychlorinated biphenyls (PCBs). A facility may be subject to control under one or more of these major provisions:

- § 402: National Pollutant Discharge Elimination System
- § 307: Pretreatment Standards for Indirect Discharges
- § 404: Dredge or Fill Activities
- § 311: Spill Prevention Control and Countermeasures

National Pollutant Discharge Elimination System. Facilities with point sources that discharge directly to navigable or surface waters are required to obtain a National Pollution Discharge Elimination System (NPDES) permit. Most states presently have the authority to administer permits within their state. These permits may be referred to as SPDES (state PDES) instead of PDES permit or the first letter can represent the state's name (e.g., WPDES for Wisconsin PDES). These state permits are usually based on the state regulations which are as stringent as the federal regulations.

The NPDES permit will include effluent discharge limitations for the various direct discharges at the facility. Self-monitoring is required to determine if these effluent limitations are being achieved. Monitoring frequency and methods are included for each regulated pollutant.

Pretreatment Standards. Pretreatment standards apply to those facilities which discharge to a publicly owned treatment works (POTW). This is referred to as indirect discharge. The discharge must meet National Pretreatment Standards (Prohibited Discharges), Local Pretreatment Standards if they have been developed, and Categorical Pretreatment Standards if the facility is one or more of the industries listed in 40 CFR 403. These National Pretreatment Standards prohibit discharges which have one or more of the following five general characteristics: Ph below 5.0, temperature above 40°C, certain solid or viscous material, oxygen-demanding pollutants with interference potential, and fire- or explosion-creating pollutants.

Dredge or Fill. For a facility to be subject to Section 404 of the Clean Water Act, it must discharge dredged or fill material, be involved in a dredging operation, or be constructing a fill area or impoundment in U.S. waters. A Department of the Army or an individual or regional permit is required for this type of activity. Activities exempt from permit requirements include certain farming activities and certain maintenance and construction.

Spill Prevention Control and Countermeasures. A Spill Prevention Control and Countermeasures (SPCC) plan is required for facilities which are non-transportation facilities engaged in storing, transferring, distributing or consuming oil and/or oil products. For the plan to be required, the facility must be located in an area where it could possibly discharge into navigable waters. The purpose of the SPCC plan is to aid in spill prevention, detection, containment, and control. When spills do occur, they are to be reported to the regional EPA administrator and to the state water pollution control agency.

Pollution Prevention Act

The United States produces millions of tons of pollution annually and spends billions of dollars each year controlling this pollution. There are significant opportunities for industry to reduce or prevent this pollution at the source through cost-effective changes in production, operation, and raw materials use. Unfortunately this reduction in pollution is not realized because of a historic lack of attention to source reduction in the existing regulations and industrial resource allocation. The emphasis has been on treatment and disposal of pollution rather than on reducing pollution at the source, before it is produced.

The Pollution Prevention Act of 1990 attempted to correct this situation by requiring the EPA to establish a multi-media source reduction program. Congress made it clear that "source reduction" must reduce the amount of pollution prior to recycling, treatment, or disposal. Source reduction may include equipment or technology modifications, process or procedure modifications, reformulations or redesign of products, substitution of raw materials, and improvements in housekeeping, maintenance, training, or inventory control.

According to this Act, EPA's pollution prevention program must be based on the policy that pollution should be prevented or reduced at the source whenever feasible; pollution that cannot be prevented should be recycled in an environmentally safe manner; pollution that cannot be prevented or recycled should be treated in an environmentally safe manner; and disposal or other release into the environment should be employed only as a last resort and should be conducted in an environmentally safe manner. The program involves collecting and disseminating information, providing financial assistance to states, and promoting a multi-media approach to source reduction within EPA, among other agencies, and within industry.

EPA has established a Pollution Prevention Office to administer the program. The office is independent of EPA's single-medium program offices, but has the authority to review and advise these offices on their activities to promote a multi-media approach to source reduction. This office is responsible for developing pollution prevention policy, coordinating source reduction activities within EPA and among other federal agencies, and promoting research and development on techniques and processes that have broad pollution prevention applicability. It identifies, where appropriate, measurable national goals, the tasks necessary to achieve the goals, dates at which the principal tasks are to be accomplished, required resources, organizational responsibilities, and the means by which progress in meeting the goals will be measured.

The Pollution Prevention Office is also responsible for the dissemination of pollution prevention information. As part of this effort, a Source Reduction Clearinghouse to foster the exchange of information regarding source reduction techniques with industry was created. In addition, the office ensures public access to information collected under federal environmental statutes. The office has established an advisory panel of technical experts to advise EPA on ways to improve collection and dissemination of data.

This office also promotes the use of pollution prevention information, by establishing and operating a source reduction training program; by making recommendations to Congress to eliminate barriers to source reduction; by identifying opportunities to use federal procurement to encourage source reduction; by developing, testing, and disseminating model source reduction auditing procedures; and by establishing an annual awards program to recognize outstanding or innovative source reduction programs.

Under the Act, EPA is authorized to encourage businesses to use source reduction techniques by providing matching grants to states with pollution prevention programs. The state programs will make specific technical assistance available to businesses, targeting businesses for which lack of information is an impediment to source reduction. The programs will also provide training through local engineering schools or any other appropriate means. Among those EPA has teamed with in this effort are the Department of Commerce and the Department of Energy.

As noted in the discussion of the Emergency Planning and Community Right-to-Know Act (EPCRA), the Pollution Prevention Act also expands national source reduction and recycling data

collection by increasing the pollution prevention reporting requirements of the Toxics Release Inventory Form (Form R).

The Pollution Prevention Act readjusts the focus of EPA and the nation away from simply dealing with the pollution they produce and toward preventing the production of pollution at its source. The Act provides tools and establishes accountability for EPA and industry to progress in accordance with the national policy that pollution should be prevented or reduced at the source whenever feasible and that disposal should only be employed when prevention, recycling, or treatment is unfeasible. The Act requires EPA to produce biennial pollution prevention reports that include an assessment of the effectiveness of the clearinghouse and grant program and an evaluation of the pollution prevention data collected under federal environmental statutes. This will measure the effectiveness of the Act.

Safe Drinking Water Act

The Safe Drinking Water Act (SDWA), enacted December 16, 1974, has the overall intent of protecting the water consumed by the public. To accomplish this, the Act has been divided into two broad classes, primary drinking water standards, which pertain to public water systems, and the Underground Injection Control Program, which protects present or future sources of drinking water.

Drinking Water Standards. Drinking Water Standards are regulated according to 40 CFR 141. The regulations require that the operators of public water systems meet minimum water quality standards. A public water system is defined as a system that provides water for human consumption for at least 15 service connections or serves 25 individuals during at least 60 days out of the year. This is further subdivided into community and non-community systems. A community water system is one that serves at least 15 connections used by year-round residents or regularly serves at least 25 year-round residents; non-community water system is defined as a public system that is not a community water system. Maximum contaminant levels (MCLs) vary depending on whether a system is classified as a community or non-community system. Reporting, monitoring, and public notification requirements also vary for the two classifications.

MCLs for primary drinking water standards are divided into six groups as follows:

- Inorganic chemicals
- Organic chemicals
- Turbidity
- Microbiological contents
- Natural radioactivity
- Man-made radionuclides

For each contaminant, 40 CFR 141 specifies analytical methods, sampling frequency, sampling location, reporting, public notification, and record keeping.

Underground Injection Control. SDWA also establishes the Underground Injection Control (UIC) Program to protect groundwater form injection of contaminated or polluted water that would reduce the quality of the underground water source. The UIC program is regulated under 40 CFR 144 through 147. A well injection is defined as the subsurface emplacement of fluids through a bored, drilled, or driven shaft, or through a dug well, where the depth of the dug well is greater than the largest surface dimension. The regulations divide injection wells into the following five classes of regulatory treatment.

- Class I wells are those that inject hazardous, industrial and/or municipal wastes beneath the lowermost aquifer and within a quarter mile of the well bore.
- Class II wells are used with oil and gas production, enhanced recovery of oil or natural gas, or storage of liquid hydrocarbons.
- Class III wells are used for extractive mining.
- Class IV wells dispose of hazardous and radioactive wastes.
- Class V wells include all other injection wells not included in Classes I through IV.

Wells regulated as Class I and IV, used for the injection of hazardous wastes, are also regulated under the RCRA requirements for notification and interim status.

Toxic Substance Control Act

The Toxic Substances Control Act (TSCA) became effective January 1, 1977. This legislation was enacted to reduce the unreasonable risk of injury to human health and the environment from harmful chemicals and to provide needed health and safety information on chemical substances and mixtures. TSCA gave EPA broad authority to prevent harmful new chemicals from entering the market and to take control action against hazardous chemicals already in the environment.

TSCA primarily applies to manufacturers, distributors, processors, and importers of chemicals. When there is a reasonable basis to conclude that the manufacture, processing, distribution in commerce, or the use or disposal of a chemical substance or mixture presents an unreasonable risk of injury to human health or the environment, EPA is empowered to apply controls to the chemical. These controls include:

- testing chemicals;
- premanufacture notification;
- significant new use notification;
- control of imminent hazards; and
- recordkeeping and reporting.

Testing of Chemicals. TSCA gives EPA authority to require manufacturers or processors of certain existing chemicals (i.e., those already being distributed in commerce) to test the health and environmental effects of those chemicals. EPA exercises this authority only when it can make certain statutory findings about the substance and when industry fails to develop the needed

data on its own. These required statutory findings are: (1) that insufficient data are available to permit a reasonable risk assessment; (2) that testing is necessary to provide such data; (3) that a chemical may present an unreasonable risk of injury to human health or the environment; or (4) that the chemical is produced in substantial quantities resulting in significant human exposure or environmental release.

Premanufacture Notification. TSCA requires manufacturers or importers of new chemicals to provide EPA with a 90-day advance notification of their intent to manufacture or import a new chemical, except for those chemical categories specifically excluded by TSCA. Any chemical that is not listed on the inventory of existing chemicals, published by EPA, is considered "new" for purposes of the premanufacture notice requirement.

Significant New Use Notification. Under TSCA, EPA may designate a use of a chemical as a significant new use, based on consideration of several factors, including the anticipated extent and type of exposure to human health and the environment. Anyone who intends to manufacture, import, or process a chemical for such significant new use (even if the chemical is on the inventory and/or went through premanufacture notification review) must notify EPA 90 days before manufacturing, importing, or processing the substance for that use.

Control of Imminent Hazards. TSCA gives EPA the authority to prohibit or limit the manufacture, import, processing, distribution in commerce, use, or disposal of a chemical when these activities are found to pose an unreasonable risk of injury to human health or the environment. A number of control options are available, ranging from total prohibition to labeling. For example, TSCA has the authority to regulate the disposal stage of a chemical's life cycle on a chemical-by-chemical basis -- that is, once a particular chemical is determined to pose an unreasonable risk to human health and the environment (e.g., PCBs).

Recordkeeping and Reporting. TSCA requires any person who manufactures, processes, or distributes in commerce any chemical substance or mixture to keep records of significant adverse reactions to human health or the environment that allegedly were caused by the chemical. Records concerning health effects on employees must be kept for 30 years; other records must be retained for 5 years. In addition, if the chemical industry has information indicating that a chemical presents a substantial risk of injury to human health and the environment, EPA must be notified.

Federal Insecticide, Fungicide and Rodenticide Act

Originally enacted in 1947, the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) provides for the regulation of pesticides in the United States. Before they may be sold or distributed, all pesticides must be registered by EPA. FIFRA sets a risk/benefit standard for pesticide registration: pesticides must perform their intended function when used in accordance with labeling directions without posing an unreasonable risk of damage to human health or the environment. When making registration decisions, EPA is required by law to consider the

economic, social, and environmental costs and benefits of pesticide use. Pesticide registrants are responsible for providing all test data necessary to satisfy EPA's registration requirements. Under FIFRA, EPA is authorized to cancel the registration of an existing pesticide if new test data show that unreasonable adverse effects on human health or the environment are possible.

With the enactment of the FIFRA amendments of 1988, EPA's authority has been strengthened in several areas. The amendments require an accelerated timetable for the submission of reregistration data by registrants of pesticides. EPA must also review and deny or approve pesticide reregistrations according to very specific deadlines. Reregistration is required to ensure that all previously registered pesticides meet current scientific and regulatory standards. The collection of fees has also been provided for in the amendments to aid in the reregistration process.

Under the FIFRA amendments of 1988, EPA is no longer required to accept upon request suspended and canceled pesticides and dispose of them at government expense.

The amendments of 1988 also expanded EPA's ability to regulate the transportation, storage and disposal (TSD) of pesticides, including the establishment of labeling requirements for the TSD of the pesticide and its container.

To reduce problems associated with the disposal of pesticide containers, EPA has been required to conduct a study analyzing options to provide incentives for, or to require, the return, refill, and/or reuse of used pesticide containers. EPA will also examine the development and use of pesticide formulations that facilitate the removal of residues from containers and the use of bulk storage facilities to reduce the number of containers used and ultimately discarded. This study is expected to be released in early May, 1991. EPA must also promulgate regulations for the design of pesticide containers.

Other Laws Affecting Waste Reduction

In addition to the major pieces of environmental legislation discussed above, Congress enacted a number of laws that also affect waste reduction activities. Typically, the authority for promulgating regulations and enforcing these laws has been given to federal departments other than EPA. An overview of these laws is given in Table 4.

Hazardous Materials Transportation Act

The Hazardous Materials Transportation Act of 1975 (HMTA) was enacted "to protect the Nation adequately against the risks to life and property which are inherent in the transportation of hazardous materials in commerce."[12] Under this Act, the Secretary of Transportation designates quantities and forms of materials that pose an unreasonable risk to health and safety or property

Table 4. Overview of Non-Environmental Laws

Law	Purpose/Scope
Hazardous Materials Transportation Act of 1975 (HMTA)	Provides for the safe transport of hazardous materials.
Occupational Safety and Health Act of 1980 (OSHA)	Guards the safety and health of workers.
Omnibus Trade and Competitiveness Act of 1988	Fosters better and increased technology transfer between industry and the federal government. Also stimulates federal/industry research and development.
Tax Reform Act of 1986	Provides a tax credit for increasing research and development activity.
Revenue Reconciliation Act of 1990	Places a tax on the production or importation of ozone-depleting chemicals.
Revenue Act of 1926	Provides a depletion allowance for mining and for oil and gas drilling.
Federal Non-Nuclear Energy Research and Development Act of 1974	Requires the federal government to undertake basic and applied research and development projects.

as *hazardous materials.* These materials are then subject to DOT regulations governing the transportation and handling of hazardous materials.

Lists of hazardous materials are found in 49 CFR Part 172, and the manner in which they are to be packaged are given in other sections of 49 CFR.[13] Hazardous material transportation regulations are covered in 49 CFR Part 397.

The regulations increase the cost of handling and transporting materials. Depending upon the material to be transported, they may include requirements for the number of personnel; the minimum level of training needed; the frequency of inspection; equipment needed for detection, warning, and control of the risks of the materials; specifications regarding the use of equipment and facilities used in the handling and transportation of hazardous materials; and a system of monitoring safety assurance procedures.

Occupational Safety and Health Act

The Occupational Safety and Health Act of 1970 (OSHA) was designed to increase the safety of workers. The Secretary of Labor is expected to recognize the dangers that exist in workplaces and establish regulations that govern the conditions in which people work.

Hazardous materials, including many wastes, present dangers to workers. The OSHA Standards pertaining to hazardous materials are listed at 29 CFR 1910.120. In addition, 29 CFR 1990.101 identifies, classifies and regulates potential occupational carcinogens, which are often present in waste streams.

The OSHA standards regulate the ways in which the dangers are to be mitigated. Employers are required to provide proper training and equipment for workers. As the risks to employees increase, the cost to the employer rises.

Omnibus Trade and Competitiveness Act

One goal of the Omnibus Trade and Competitiveness Act of 1988 is to help U.S. industry remain competitive in an international market. It encourages the development and spread of technology, often with the support of the federal government. Some actions called for under this Act help the development of new technologies and the transfer of information, including the following:

- Regional Centers for the Transfer of Manufacturing Technology. Here, technologies developed by the National Institute of Standards and Technology (NIST) are demonstrated. (NIST is part of the Department of Commerce.) Small- and medium-sized businesses are most likely to benefit from these outlets.

- Technology Extension Services. NIST may provide technical assistance to state technology extension programs, encouraging the flow of technical information.

- Non-Energy Inventions Program. Aid in financing the development of technologies will be given to projects deemed to have potential.

- The Advanced Technology Program. The Advanced Technology Program (ATP) was established to aid in solving the generic problems of concern to large segments of an industry. The ATP is to encourage companies to form joint R&D ventures.

Congress has passed a number of Acts designed to stimulate industrial research and development and the transfer of technology from the federal government to private industry. In addition to the Omnibus Trade and Competitiveness Act of 1988, these include the Stevenson-Wydler Technology Innovation Act of 1980, the Federal Technology Transfer Act of 1986, and the National Competitiveness Technology Transfer Act of 1989. As a group, these Acts increase industrial access to federal research, both by inviting private industry to be a partner in R&D activities and by supporting the dissemination of technology to a wider audience.

As knowledge of new technologies becomes more widespread, those technologies are more likely to be used. When industry decides to address problems like waste reduction, the presence of research and development programs and technology transfer outlets in the federal government becomes an incentive to implementing these technologies.

Tax Reform Act of 1986

Among the provisions of this wide-ranging Act are incentives for individuals or companies to increase the amount of research and development activity they are doing. Specifically, a taxpayer may claim a 20% tax credit for qualified annual research and experimental expenditures in excess of those the taxpayer invested in research and experimentation during a base period. Special provisions apply to contracted work, universities, and some other items.

This credit has been in effect, in some form, since 1981. However, though a permanent credit has been frequently proposed, the projected loss of national revenue due to this tax credit has so far prevented it from becoming permanent.

Revenue Reconciliation Act of 1990

A tax on the production, manufacture, or import of ozone-depleting chemicals (ODCs) was included in the Omnibus Budget Reconciliation Act of 1989 and the Revenue Reconciliation Act of 1990. It has been recognized internationally that these chemicals present a danger to the atmosphere, leading the U.S. Congress to impose a tax on ODCs to deter their use and provide an incentive to produce environmentally safe alternative. The amount of the tax is based on the amount of chemical produced and the severity of the threat the chemical presents. The tax is raised annually, indicating an effort by the federal government to phase-out these chemicals. Recycled ODCs are specifically exempted from this tax.

Revenue Act of 1926

The Revenue Act of 1926 allows a percentage of the value of the oil and gas recovered by oil and gas producers to be deducted from their gross income. This has been extended to most minerals. Under 26 USC 611 *et seq*, individuals and firms engaged in drilling and mining for oil, gas, and minerals are granted this "depletion allowance" for a percentage of the value of the material they recover. The allowance ranges between 5% and 22%. For instance, a company that mines iron ore is entitled to exclude form its income 15% of the value of the ore mined. This allows drilling and mining companies to recover some of the loss associated with reducing the amount of material remaining in the well or the mine. In contrast, individuals who recover "previously used" oil and minerals (i.e., recyclers) do not receive this allowance.

Federal Non-Nuclear Energy Research and Development Act

The Federal Non-Nuclear Energy Research and Development Act requires the federal government to undertake basic and applied research and development for non-nuclear energy. Under 42 USC 5904, Congress requires that "energy conservation, including ... energy waste reductions, be a primary consideration in the design and implementation of the Federal non-nuclear energy program ....") One DOE effort conducted under this Act is the Industrial Waste Reduction Program, which seeks to cut energy consumption by reducing industrial waste.

THE IMPACTS OF REGULATIONS AND LEGISLATION ON INDUSTRIAL WASTE REDUCTION

The federal statutes and regulations identified in the preceding chapter affect industrial waste reduction practices in a variety of ways. While some provisions tend to encourage waste reduction activities, others provisions may discourage them. The provisions also vary in their effects on different types of waste, in the directness of their effects, and in the effects they produce in different time frames.

Most of the incentives identified encourage industry to reduce production of *hazardous* solid wastes. Similarly, many existing legislation and regulations limit air emissions and water discharges. There are few inducements for industry, however, to reduce the generation of *nonhazardous* solid wastes.

The Resource Conservation and Recovery Act (RCRA) contains many waste reduction incentives, although many of these act indirectly. They raise the cost of treating, storing, and disposing of hazardous waste, causing industry to consider other methods of handling its waste, as well as the option of waste reduction.

Scope of Impact Analysis

The legislative and regulatory incentives and disincentives that this report discusses can be divided into three groups. As discussed before, they can directly foster or inhibit a firm's implementation of waste reduction activity, its awareness of waste-reducing technologies, or its attempts to research and develop processes that generate less waste.

- The largest number of incentives and disincentives affect waste reduction efforts directly. Examples of these policies include the RCRA permitting stipulations, which are required for facilities choosing to recycle some of their hazardous waste on-site. Such policies directly limit waste reduction activity.

- Some laws and regulations advance or obstruct the use of waste reduction technologies. For example, federal procurement of recycled goods promotes the implementation of available technologies.

- Still other policies stimulate or frustrate waste reduction research and development. An illustration of this is the tax credit provided to firms that increase their annual research and development expenditures.

Incentives Encouraging Waste Reduction

Firms perform waste reduction procedures for diverse reasons, but most companies will implement steps that will save them money quickly. Most of the laws and regulations that provide incentives increase the cost of handling waste.

Short-Term Incentives

Most of the legislative and regulatory waste reduction incentives provided to industrial firms are short-term. (A summary of short-term incentives appears in Table 5.) For purposes of this report, short-term incentives are defined as legislative and regulatory requirements that encourage industrial waste reduction now (i.e., this year). Typically, these laws and regulations work by levying a financial or public relations cost on firms that generate waste, thus providing companies a definite incentive to engage in waste reduction activities.

The laws under which short-term incentives were identified in this study are the Resource Conservation and Recovery Act; the Comprehensive Environmental Response, Compensation, and Liability Act; the Pollution Prevention Act; the Clean Air Act; the Clean Water Act; the Toxic Substances Control Act; the Occupational Safety and Health Act; the Hazardous Materials Transportation Act; and the Revenue Reconciliation Act. The other laws discussed in this report, under which no short-term incentives were identified, are the Safe Drinking Water Act; the Federal Insecticide, Fungicide, and Rodenticide Act; the Omnibus Trade and Competitiveness Act; the Tax Reform Act of 1986; the Revenue Act of 1926; and the Federal Non-Nuclear Energy Research and Development Act.

The specific short-term incentives that were identified in the different pieces of legislation and the regulations derived from them are discussed below.

Resource Conservation and Recovery Act. The summary of RCRA (see the Summary of Legislation and Regulations Affecting Waste Reduction) cites five provisions of the law that create incentives for industrial waste reduction. These provision where added by Congress under the Hazardous and Solid Waste Amendments (HSWA) of 1984 and provide the base authorities for RCRA waste minimization programs. Specifically, the waste minimization provisions added by HSWA are sections: 1003(b); 3002(b); 3002(a)(6); 3005(h); and 8002(r). (For an explanation of these provisions, see the Summary of Legislation and Regulations Affecting Waste Reduction.)

In addition to the statutory provisions mentioned above, Subtitle C of RCRA also provides other regulatory provisions that provide incentives for industrial waste reduction. A discussion of these regulatory incentives, which are considered to be short-term incentives, is provided below.

Exclusion to the toxicity characteristic. The recently promulgated toxicity characteristic is one of several characteristics used to identify hazardous waste. Applying the toxicity characteristic to used chlorofluorocarbon (CFC) refrigerants (one of the more than 30 organic constituents

Table 5. Short-Term Incentives for Industrial Waste Reduction

Incentive	Law	Effect
Exclusion to the Toxicity Characteristic	RCRA	Minimizes chlorofluorocarbon (CFC) venting and encourages CFC recycling.
Generator Manifest Certification	RCRA	Requires generator to put in place some type of waste minimization program.
Generator Biennial Report Certification	RCRA	Requires generator to put in place some type of waste minimization program.
Permit Conditions	RCRA	Requires generator to put in place some type of waste minimization program.
Liability Insurance Requirements	RCRA	Generator and facility owners and operators reduce liability by reducing waste.
Small Quantity Generator Rules	RCRA	Entices "borderline" generators to reduce wastes in order to be subject to less rigorous regulations.
Land Disposal Restriction	RCRA	Increases the cost of waste management.
TSDF Organic Emission Standards	RCRA	Encourages TSD facilities to control organic emissions from process vents.
Federal Procurement Guidelines	RCRA	Encourages procurement of recovered materials.
CERCLA Financial Liability	CERCLA	Generators reduce future liability by reducing waste.
National Ambient Air Quality Standards	CAA	Promote cutting emissions of six hazardous air pollutants.
New Source Performance Standards	CAA	New plants must conform to strict emission requirements ("... the best technological system of continuous emission reduction...").
Administrative Enforcement Authority	CAA	The threat of higher penalties (from EPA) for violations prompts firms to comply with Clean Air Act requirements.
Effluent Limitation Guidelines and Standards	CWA	Industrial firms must control discharges of pollutants from point sources.
Waste Minimization Certification	CWA	Requires a plan for industrial firms to diminish the volume and toxicity of their hazardous discharges.
Pollution Prevention Act	Pollution Prevention Act	Expands reporting requirements established under SARA §313; will help determine if meaningful waste reduction has been achieved.

Table 5. Short-Term Incentives for Industrial Waste Reduction (continued)

Incentive	Law	Effect
Significant New Use Notification	TSCA	Makes firms legally responsible to EPA for voluntary waste minimization commitment.
Handling and Transportation Requirements	HMTA	Safety requirements raise costs of transporting wastes.
Handling Requirements	OSHA	Safety requirements raise costs of handling wastes.
Environmental Taxes	Revenue Reconcil-iation Act	Taxes on ozone-depleting chemicals (ODCs) will cut production and waste.

covered by the toxicity characteristic) would possibly promote continued or increased CFC venting in order to avoid hazardous waste regulations. As a result, there would be an increase in the levels of ozone-depleting chemicals in the stratosphere. Therefore, to minimize CFC venting and to encourage recycling, EPA changed the rules to provide an exemption for "[u]sed chlorofluorocarbon refrigerants from totally enclosed heat transfer equipment ..., *provided the refrigerant is reclaimed for further use.*"[14]

Generator manifest certification. Under the Subtitle C program, the Uniform Hazardous Waste Manifest is used to track hazardous waste from the point of generation to the point of ultimate treatment, storage, or disposal. To encourage generators to consider and implement hazardous waste reduction activities, EPA requires each generator to certify on each manifest that he or she has in place a program to reduce the volume and toxicity of the waste to the degree economically practicable, as determined by the generator, and the treatment, storage, or disposal method chosen by the generator minimizes the risk to human health and the environment insofar as currently practicable.[15]

Generator biennial report certification. In addition to filing the Uniform Hazardous Waste Manifest, generators who transport hazardous waste off-site must submit a biennial report to EPA.[16] The report details the generator's hazardous waste management activities during the previous calendar year. Generators must include descriptions of the efforts taken to reduce the volume and toxicity of waste generated and the changes in volume and toxicity that were actually achieved as compared with levels achieved in previous years.[17]

Although the intent of the generator manifest and biennial report certifications was to encourage industrial waste reduction, these mechanisms do not require particular waste reduction activities, nor do they authorize EPA to impose mandatory requirements. While all generators are required to adopt waste minimization programs, the nature of the criteria for certification (that a program

exists) and the determination of compliance with those criteria are to be made solely by the generator. The generator is authorized to determine what degree of waste reduction is "economically practicable," and is left free to choose whether to reduce waste generation or whether to rely more heavily on waste treatment.[18]

Permit conditions. The RCRA permit program requires generators who treat, store, or dispose of hazardous waste on-site to submit an annual statement on their waste minimization program. Specifically, these generators must certify that they have a waste reduction program in place. The program must reduce the volume or quantity and toxicity of the waste to the extent they determine to be economically practicable, and that the proposed method of treatment, storage, or disposal is that method currently available, which minimizes the present and future threat to human health and the environment.

Liability insurance requirements. Owners or operators of treatment storage and disposal facilities (TSDFs) are required to demonstrate financial responsibility for bodily injury and property damage to third parties caused by sudden and nonsudden accidental occurrences arising from the operation of the facility.[19] Traditionally, these owners and operators purchased liability insurance to cover any potential hazardous waste management liabilities. For many generators and owners or operators of TSDFs, liability insurance is no longer available, or is available only at extremely high costs. Increases in insurance costs or the inability to obtain insurance result in higher treatment and disposal costs or the loss of available treatment or disposal capacity. This provides a strong incentive to industry to reduce the quantity of hazardous waste to be disposed of through the application of source reduction and on-site recycling techniques.[20]

Small-quantity generator rules. Under the RCRA regulations, there are reduced requirements for small-quantity generators (SQGs) and conditionally exempt small-quantity generators. For example, if a generator falls into one of these generator categories, it may be able to store waste on-site without a permit for longer than 90 days, or, in the case of a conditionally exempt small quantity generator, indefinitely. Since a large quantity generator wishing to store hazardous waste on-site for longer than 90 days is required to go through the costly and time consuming process of obtaining a storage permit, the SQG rules provide a strong incentive for generators to keep hazardous waste volumes low.

Land disposal restrictions. Under RCRA, EPA is using a variety of converging techniques to promote hazardous waste minimization. By far the most effective of these techniques is the institution of the land disposal prohibitions,[21] which ban the disposal of certain types of waste in land disposal units (landfills, surface impoundments, and waste piles) without pre-treatment. With the full implementation of the land disposal prohibitions, the cost of disposal of most types of hazardous waste via land disposal units has increased and is likely to continue to increase. Many waste generators have responded to this cost pressure by implementing waste minimization programs.[22]

Organic air emissions standards for treatment, storage, or disposal facilities. While regulatory incentives to reduce emissions are primarily found under the Clean Air Act, some RCRA regulations serve as incentives to reduce industrial emissions. EPA established standards limiting organic emissions from process vents associated with distillation, fractionation, thin-film evaporation, solvent extraction, and air or stream stripping operations.[23] The standards apply to hazardous waste containing organic chemicals with total concentrations of 100 parts per million by weight or greater. To meet these standards, owners or operators are required to: (1) reduce total organic emissions from all affected process vents at the facility to below 1.4 kg/h (3 lb/h) and 2.8 Mg/yr (3.1 ton/yr), or (2) install and operate a control device(s) that reduces total organic emissions from all affected process vents at the facility by 95 percent by weight.

Federal procurement guidelines. Under RCRA, EPA must establish guidelines for the federal procurement of products containing recovered materials.[24] Each procuring agency must ensure that any procured items, covered under these guidelines, are composed of the highest percentage of recovered materials possible. Also, contracting officers must require that vendors (1) certify that the percentage of recovered materials to be used in the performance of the contract will be at least the amount required by applicable specifications or other contractual requirements, and (2) estimate the percentage of total material used in the performance of the contract that is recovered materials. These guidelines will help to encourage the substitution of recovered material for virgin raw materials as industrial feedstocks.

In addition to the requirements for product procurement, procuring agencies must also, to the maximum extent practicable, manage or arrange for the procurement of solid waste management services in a manner which maximizes energy and resource recovery.

Comprehensive Environmental Response, Compensation, and Liability Act. CERCLA provides a powerful incentive for waste reduction in the form of potential future liability. Generators using off-site treatment, storage, or disposal face financial liability under CERCLA for two reasons: (1) there is a potential for mismanagement of wastes by facility operators, and (2) there is the possibility of improper design of the disposal facility itself. Even careful evaluation of facility management cannot reduce the risk to zero. A generator risks incurring liability when the treatment, storage, or disposal facility owner or operator cannot or will not pay for remedial or corrective actions made necessary by migration of wastes. In these situations, the generator can be held liable for absolute, strict, joint, and several liability. In addition, the imminent and substantial endangerment provisions of CERCLA state, "A generator can be held financially liable for the entire cleanup cost or restoration of a facility."[25] When less waste is generated, it reduces the generator's potential liability for future disposal, and thus is an incentive for both source reduction and on-site recycling.[26]

Clean Air Act. The Clean Air Act provisions enacted before 1990 (particularly the Clean Air Act of 1977) provide the majority of the short-term incentives for waste reduction.

National Ambient Air Quality Standards (NAAQS). The Clean Air Act mandated the adoption of industrial pollution control and prevention standards. In response to this mandate, EPA set industrial air emission standards for total suspended particulates, sulfur dioxides, carbon monoxide, nitrogen dioxides, ozone, and lead. Standards for these six hazardous air pollutants and standards for numerous new sources have also been developed under this legislation, providing a regulatory incentive to reduce those industrial emissions.

New Source Performance Standards. One of the incentives provided under the Clean Air Act is the establishment of New Source Performance Standards. They are "... based on the application of the best technological system of continuous emissions reductions ...."[27] The technological system is defined by the statute in two ways. The first is a technological process for production or operation by any source which is inherently low-polluting or nonpolluting" (i.e., waste reduction approach). The second includes a pollution control approach or the treatment of fuels.[28]

Administrative Enforcement Authority. Title VII of the Clean Air Act Amendments of 1990 contains a broad array of authorities to make the law more readily enforceable, thus providing a greater incentive for compliance and industrial waste reduction. This Title makes more administrative enforcement procedures available to the EPA, thus enabling the agency to respond more quickly to violations. The EPA will be able to issue administrative enforcement penalty orders and will also be able to issue administrative orders with compliance schedules of up to 12 months. Additionally, EPA has the authority to establish a field citation program for minor violations. These citations may be issued during an on-site inspection.[29]

Clean Water Act. Wastes discharged from point sources to navigable or surface waters are governed by the Clean Water Act. This law provides two short-term incentives.

Effluent Limitation Guidelines and Standards. Under the Clean Water Act, effluent limitation guidelines and standards are issued as an incentive to control discharges of pollutants from industrial facilities (or point sources). Some of these guidelines and standards specify chemical use minimization or substitution and water use reduction.[30]

Waste Minimization Certification. In addition to the effluent limitations, the Clean Water Act contains a provision similar to RCRA's waste minimization certification as an incentive to industrial waste reduction. Industrial users of publicly owned treatment works (POTW) must certify that they have a program in place to reduce the volume and toxicity of hazardous waste generated to the degree they have determined to be economically practical.[31] Other than this certification requirement, there is no other requirement in the pretreatment regulations that an industrial user actually have a waste minimization program.

Pollution Prevention Act. The new Pollution Prevention Act substantially expanded reporting requirement under the Emergency Planning and Community Right-to-Know Act's Section 313 Form R. Section 313 requires manufacturing facilities with more than ten employees to report

annually on toxic emissions to all environmental media during the previous calendar year. The reporting requirement applies if such facilities manufacture, import, process, or otherwise use any one or more three hundred or so listed chemicals.[32]

The Form R currently has about 60 data fields. The revisions mandated by the Pollution Prevention Act will increase the number of data fields in the Form R to approximately 113.[33] These changes, detailed in the Emergency Planning and Community Right-to-Know Act section of the Summary of Legislation and Regulations Affecting Waste Reduction, were mandated to address what Congress believed to be an excessive amount of flexibility in reporting under the existing Form R. In the future, companies subject to the Section 313 reporting requirements will be required to report in precise detail what they are doing to achieve waste reduction. These changes will make it easier for third parties reviewing this publicly available information to ascertain whether meaningful waste reduction has been achieved.[34]

For example, under the revised Form R, interested parties will be able to look at historic production levels and generated waste quantities. If a company appears to have achieved substantial waste reduction in 1990, that fact will be confirmed or refuted, depending upon whether production levels were comparable to the preceding year or substantially lower (thus accounting for the perceived waste reduction).

Toxic Substances Control Act. Under TSCA, EPA is authorized to determine that a use of a chemical substance is a "significant new use." Once EPA determines a use to be a significant new use, persons must submit a significant new use notice to EPA at least 90 days before they manufacture, import, or process the substance for that use.

As an incentive for industrial waste reduction, a binding optional information section has been added to the significant new use notice form. This new section has been added for submitters to report on comparative risks, pollution prevention, and recycling practices planned by the submitter regarding activities surrounding the manufacturing, processing, use, and disposal of the new chemical substances. In order to effectively implement risk management options, EPA can exercise its authority to make certain statements regarding the reported optional information legally binding and enforceable.[35] As a result, the submitter may have a legal obligation to stick to his or her planned waste reduction activities.

Hazardous Materials Transportation Act. Hazardous materials, including many wastes, present threats to those who transport them and to the public at large. To reduce the risk associated with the transport of these materials, the Department of Transportation has set up guidelines delineating the training required and the preventive measures needed for various categories of materials. These guidelines raise the cost of transporting such materials. Reducing the amount of waste that needs to be transported is one method of reducing this cost.

Occupational Safety and Health Act. The goal of this Act is to protect workers from dangers in the workplace. To safeguard those who handle wastes (especially hazardous wastes), the

Department of Labor requires these workers to undergo proper training, to wear protective clothing, and to follow specified procedures. Each of these requirements demands an investment of time and money from the employer. Cutting or eliminating wastes can reduce the level of this required investment.

Revenue Reconciliation Act. This Act imposed a tax on CFCs and other ozone-depleting chemicals, which increases annually, raises their cost to the consumer which should reduce the amount consumed and therefore produced.[36] Decreased production levels will lead to reductions in the amount of waste by-products produced as well.

Mid-Term Incentives

For purposes of this report, mid-term incentives are defined as legislative and regulatory requirements that are not currently encouraging waste reduction, but will encourage industrial waste reduction during the next five years. Some of these policies phase in requirements in this period, while others stimulate technology transfer and implementation.

For many of the pieces of legislation and regulations discussed in this report, no mid-term incentives for industrial waste reduction were identified. Specifically, no mid-term incentives were identified under the Resource Conservation and Recovery Act, the Comprehensive Environmental Response, Compensation and Liability Act, the Emergency Planning and Community Right-to-Know Act, the Clean Water Act, the Safe Drinking Water Act, the Occupational Safety and Health Act, the Revenue Act of 1926, the Revenue Reconciliation Act, the Tax Reform Act of 1986, the Hazardous Materials Transportation Act, and the Federal Non-Nuclear Energy Research and Development Act.

Mid-term incentives were identified under the Clean Air Act, the Pollution Prevention Act, the Toxic Substances Control Act, the Federal Insecticide, Fungicide and Rodenticide Act, and the Omnibus Trade and Competitiveness Act. In addition, the Industrial Toxics Project (ITP) was identified as an incentive to waste reduction. A discussion of the laws providing mid-term incentives and the ITP is provided below. An overview of mid-term incentives is found in Table 6.

Clean Air Act. The Clean Air Act Amendments of 1990 outline many regulatory activities that will serve as mid-term incentives to reduce industrial emissions. A discussion of the key titles relating to the reduction of industrial emissions is provided below.

The Air Toxics provisions of the new Clean Air Act Amendments require a reduction in the emission rates of 189 toxic air pollutants. Within one year after enactment of the Amendments, EPA must publish a list of source categories that emit certain levels of these pollutants. The list of source categories must include: 1) major sources emitting 10 tons/year of any one, or 25 tons/year of any combination of those pollutants; and 2) area sources (smaller sources, such as dry cleaners).[37]

Table 6. Mid-Term Incentives for Industrial Waste Reduction

Incentive	Law	Effect
Phased-In Requirements	CAA	Firms must meet new, more restrictive air emission standards.
Source Reduction Clearinghouse	Pollution Prevention Act	Makes source reduction information more readily available.
Grants to States	Pollution Prevention Act	Provide a vital influence to the promotion and use of source reduction techniques by relevant industries.
EPA Reports	Pollution Prevention Act	Provide descriptions of the different actions being conducted by industries that promote source reduction.
Bans on Chemical Substance or Mixtures	TSCA	Eliminates feedstocks responsible for certain waste streams.
Pesticide Container Research	FIFRA	Study on pesticide containers provides information on how to prevent pesticide wastes.
Technology Transfer	Omnibus Trade and Competi-tiveness Act	Technology transfer programs spread knowledge of technologies to industry.
33/50 Program (Industrial Toxics Program)	None	Voluntary program gives industry a chance to exhibit waste reduction successes. Addresses 17 toxic chemicals, targets 50% reduction by 1995.

EPA must then issue "Maximum Achievable Control Technology" (MACT) standards for each listed source category according to a prescribed schedule. These standards will be based on the best demonstrated control technology or practice within the regulated industry. Companies are encouraged to voluntarily reduce their emissions. By meeting certain conditions, they can receive a six year extension to the MACT requirements.

Because a source's pollution control obligations may be scattered throughout numerous hard-to-find provisions of state and federal regulations, and because the source may not be required to submit periodic compliance reports to EPA or the states, Title V of the new Clean Air Act Amendments introduces an operating permits program that will clarify a source's pollution control requirements and make them more enforceable. This permit program will ensure that all of a source's obligations with respect to its pollutants will be contained in one permit document, and that the source will file periodic reports identifying the extent to which it has complied with those obligations. These two requirements will greatly enhance the ability of federal and state agencies to evaluate the air quality situation.[38]

Title VI of the Clean Air Act Amendments provides an incentive for industrial waste reduction by building on the market-based structure and requirements currently contained in EPA's regulations to phase out the production of substances that deplete the ozone layer. The law requires a complete phase-out of CFCs and halons with interim reductions and some related changes to the existing Montreal Protocol, revised in June 1990.[39]

EPA must also ensure that Class I chemicals are phased out on a schedule similar to that specified in the Montreal Protocol (CFCs, halons, and carbon tetrachloride by 2000; methyl chloroform by 2002) but with more stringent interim reductions. Class II chemicals (hydrochlorofluorocarbons, or HCFCs) are to be phased out by 2030.[40]

The Amendments also require EPA to publish a list of safe and unsafe substitutes for Class I and II chemicals and ban the use of unsafe substitutes.[41] Nonessential products releasing Class I chemicals will be banned within 2 years of enactment of the Clean Air Amendments. In 1994 a ban will go into effect for aerosols and noninsulating foams using Class II chemicals, with exemptions for flammability and safety. Regulations for this purpose will be required within one year of enactment, to become effective two years afterwards.[42]

Though banning the use (and therefore, the production) of certain chemicals will certainly eliminate any wastes generated in their production, it is impossible to predict if the wastes generated during the manufacture of the replacements will be more or less harmful than those eliminated.

Pollution Prevention Act. In addition to making changes to the Section 313 Form R, the Pollution Prevention Act created a Pollution Prevention Office within EPA to implement strategies promoting source reduction. EPA must also (1) establish standard methods for measuring source reduction, (2) review regulations to determine their effect on source reduction, (3) coordinate source reduction strategies among various federal agencies, (4) assure public access to data collected under federal environmental laws, and (5) establish a clearinghouse to disseminate information regarding source reduction technologies.[43]

Source reduction clearinghouse. The Act establishes a "source reduction clearinghouse" to compile certain information regarding pollution prevention. Specifically, the clearinghouse must include a database with information on management, technical, and operational approaches to source reduction. EPA is directed under the Act to use a clearinghouse to serve as a center for source reduction technology transfer; conduct outreach and educational programs in the states to further the adoption of source reduction technologies; and to collect and compile information reported by states receiving grants under the new act on the operation and success of the state source reduction programs.[44]

Grants to states. Under the Act, EPA must make matching grants to states for programs that promote the use of source reduction techniques by industry. In determining whether to issue a grant, EPA must consider, among other criteria, whether the proposed state program (1) makes

specific technical assistance available to businesses seeking information about source reduction opportunities; (2) targets businesses for which the lack of information is an impediment to source reduction; and (3) provides training to encourage source reduction techniques.[45]

EPA reports. Under the Act, EPA must provide Congress with a report within eighteen months after the enactment of the law and biennially thereafter. The initial report must describe the actions taken to promote source reduction and the results of these actions. Specifically, the report must include an assessment of the effectiveness of the clearinghouse and grant program established under the Act.[46]

Biennial reports submitted thereafter must contain certain categories of information, as follows:

- an analysis of the data collected under SARA, Section 313, Form R, on an "industry-by-industry basis" for not less than five Standard Industrial Classification (SIC) codes or other categories, as EPA deems appropriate. The analysis must include an evaluation of trends in source reduction by industry, firm size, production, or other useful means. Each subsequent report must cover five SIC codes or categories that were not covered in a prior report until all SIC codes or other categories have been covered;

- an analysis of the usefulness and validity of the data collected under Form R for measuring trends, source reduction, and the adoption of source reduction by industry;

- identification of regulatory and non-regulatory barriers to source reduction and of the opportunities for using existing regulatory programs and incentives and disincentives to promote and assist source reduction;

- identification of industries and pollutants that require priority assistance in multi-media source reduction;

- recommendations as to incentives needed to encourage investment in research and development in source reduction;

- identification of opportunities and development of priorities for research and development in source reduction methods and techniques;

- an evaluation of the cost and technical feasibility of industry source reduction opportunities and current activities, and identification of any industries for which there are significant barriers to source reduction, with an analysis of the basis for this identification;

- an evaluation of methods of coordinating, streamlining, and improving public access to data collected under federal environmental statutes; and

- an evaluation of data gaps and data duplication with respect to data collected under federal environmental statutes.[47]

Toxic Substances Control Act. Under TSCA, EPA is granted the authority to ban or otherwise restrict the manufacture, processing, or distribution of a chemical substance or mixture "that presents, or will present an unreasonable risk of injury to human health or the environment."[48] This authority could apply to the feedstocks that are responsible for particular waste streams, as well as at the waste streams themselves. In promulgating such regulations, EPA assesses the degree of health risk and the extent of human exposure, the benefits of the substance, the availability of alternatives for beneficial uses, and the economic consequences of the regulatory action.[49]

In principle, EPA could use this authority to specify overall waste limitations or concentrations for manufacturers generating certain types of wastes. One example of this is the ban on manufacture for most uses of chlorofluorocarbons for aerosol propellants. A similar type of authority has been invoked in a nonfederal context by California's South Coast Air Quality Management District to ban any emission of certain air toxics.[50]

Federal Insecticide, Fungicide, and Rodenticide Act. EPA was instructed to study ways to reduce the problems associated with the disposal of pesticide containers (and therefore waste pesticides) under the 1988 amendment to FIFRA. These studies will give pesticide manufacturers important information on how to prevent pesticide waste and may encourage them to investigate methods to reduce wastes. For example, if containers must be reused and refilled, then the manufacturer will be responsible for handling the wastes returned with the container. If these materials are recovered and reused, a potentially hazardous waste stream will be eliminated.

Omnibus Trade and Competitiveness Act. The technology transfer programs set up by the Omnibus Trade and Competitiveness Act and other pieces of legislation offer industry access to the technical knowledge developed by the federal government. This acts as a mid-term incentive to firms that may be seeking methods to cut their waste generation. Firms that might not otherwise have access to the information become more likely to invest in waste reduction technologies and conduct waste reduction activities.

Other Programs. The 33/50 Program (the Industrial Toxics Project) is a voluntary pollution prevention initiative that builds squarely on EPA's pollution prevention policies and programs. It aims, through voluntary pollution prevention activities, to reduce releases and off-site transfers of a targeted set of 17 chemicals from an aggregate of 1.4 billion pounds in 1988 to 700 million pounds by 1995, a 50% overall reduction.[51]

The principal goals EPA has set for the 17 selected chemicals are an interim one-third reduction in 1992, and a one-half reduction by 1995. The Toxics Release Inventory will be used to track these reductions, using 1988 data as a baseline.[52]

The second, and equally significant, goal of the program is to achieve these reductions primarily through pollution prevention practices and to encourage industry in further developing its pollution prevention activities.[53]

Long-Term Incentives

For purposes of this report, long-term incentives are defined as legislative and regulatory requirements which will not encourage waste reduction now or within the next five years, but will encourage industrial waste reduction after the next five years.

Most of the pieces of legislation and regulations discussed in this report lack long-term incentives. Specifically, no long-term incentives were identified under the Resource Conservation and Recovery Act; the Comprehensive Environmental Response, Compensation and Liability Act; the Emergency Planning and Community Right-to-Know Act; the Clean Water Act; the Safe Drinking Water Act; the Toxic Substances Control Act; the Federal Insecticide, Fungicide, and Rodenticide Act; the Occupational Safety and Health Act; the Revenue Act of 1926; or the Hazardous Materials Transportation Act. Long-term incentives for industrial waste reduction were identified under the Clean Air Act, the Pollution Prevention Act, the Omnibus Trade and Competitiveness Act, the Tax Reform Act of 1986, and the Federal Non-Nuclear Energy Research and Development Act. (See Table 7 for an overview of the incentives.) A discussion of these laws and their long-term incentives is provided below.

Clean Air Act. In addition to mid-term incentives, the Clean Air Act Amendments also provide long-term incentives for industrial emissions reduction. Title IV of the Amendments addresses the control of pollutants associated with acid rain. The goal of Title IV of the Clean Air Act Amendments, which addresses the pollutants associated with acid rain, is to reduce sulfur dioxide (SO_2) emissions by 10 million tons and to reduce nitrogen oxides (NO_X) emissions by approximately 2 million tons, relative to 1980 levels. To achieve this, EPA will allocate allowances in two phases permitting utilities to emit one ton of sulfur dioxide. The first phase, effective January 1, 1995, requires 110 powerplants to reduce their emissions to a level equivalent to the product of their average 1985-1987 fuel use times an emissions rate of 2.5 pounds of SO_2/mmBtu. Plants that use certain control technologies to meet their Phase I reduction requirements may receive a two-year extension of compliance until 1997.[54] The second phase, which will become effective January 1, 2000, will require approximately 2000 utilities to reduce their emissions to a level equivalent to the product of their average 1985-1987 fuel use times an emissions rate of 1.2 pounds of SO_2/mmBtu. In both phases, affected sources will be required to install systems that continuously monitor emissions in order to track progress and assure compliance.[55]

Utilities will be allowed to trade allowances within their systems and/or buy or sell allowances to and from other affected sources. Each source must have sufficient allowances to cover its annual emissions. If not, the source is subject to a $2,000/ton excess emissions fee and is

Table 7. Long-Term Incentives for Industrial Waste Reduction

Disincentive	Law	Effect
Phased-In Emission Restrictions	CAA	Emission limits become effective between 1997 and 2000.
Increased Reporting Requirements	Pollution Prevention Act	Increases public access to information, stimulating citizen enforcement. Holds industry to stricter standards.
Federal/Industry Cost-Shared Research and Development	Omnibus Trade and Competi-tiveness Act	Encourages long-term research and development activities through burden-sharing.
Research and Development Tax Credits	Tax Reform Act	Provides a tax credit for increasing investment in research and development of processes and products that reduce waste.
Federal Research and Development	Federal Non-Nuclear Energy Research and Development Act	Research conducted by or sponsored by the federal government speeds the development of waste reduction technologies, hastening the implementation of waste reduction strategies.

required to offset the excess emissions in the following year.[56] It is hoped that this will encourage utilities to reduce their emissions below regulated levels to generate allowances to sell.

Nationwide, plants that emit SO_2 at a rate below 1.2 lbs/mmBtu will be able to increase emissions by 20% between a baseline year and 2000. Bonus allowances will be distributed to accommodate growth by units in states with a statewide average below 0.8 lbs/mmBtu. Plants experiencing increases in their utilization in the last five years also receive bonus allowances. 50,000 bonus allowances per year are allocated to plants in 10 midwestern states that make reductions in Phase I. Plants that repower with a qualifying clean coal technology may receive a four-year extension of the compliance date for Phase II emissions limitations.[57]

The Amendments also include specific requirements for reducing nitrogen oxide emissions.[58]

Pollution Prevention Act. The Pollution Prevention Act has several far-reaching implications. First, the increased emphasis on and expanded utility of Section 313 Form R will continue to inspire EPA-initiated enforcement activity and the initiation of citizen suits. According to EPA sources, in 1991 the Agency expects to double the number of enforcement actions brought under the Emergency Planning and Community Right-to-Know Act in 1990. With this increased federal enforcement activity, the number of citizen suits is likely to rise also accordingly.[59]

Second, the law will hasten the need for business to treat the notion of source reduction and pollution prevention with greater respect. Historically, the waste minimization certification required under the Hazardous and Solid Waste Amendments of 1984 (i.e., generator certifications on manifest and on biennial or annual reports) has not been thought to be meaningful. For example, to the best of our knowledge, no enforcement action has ever been brought against a person for improperly certifying that a company has in place a waste minimization program.[60]

The expanded Form R will change that. Because businesses subject to Section 313 will be required to report in greater detail their production ratios and the amount of waste entering the waste stream prior to recycle, treatment, or disposal, it will be that much more difficult to finesse responding to questions about the levels of toxic reductions actually realized at the source.[61]

Third, the Act will provide even more hard data for community groups to use in questioning companies about their efforts to reduce or eliminate the emission of toxics into the environment.[62]

Finally, the reports to Congress required under the Act could be an effective catalyst for identifying further improvements to Form R. The biennial reports specifically require an analysis of the utility of Form R data. This analysis will likely identify deficiencies in the form and EPA will be required to address those deficiencies.[63]

In addition, the biennial reports require an analysis of all data submitted on an industry-by-industry basis. Although this analysis will take time, no industry group's pollution prevention activities will escape intense scrutiny under this review.[64]

Omnibus Trade and Competitiveness Act. In addition to the technology transfer programs, federal legislation has also provided funds for federal industry cost-shared R&D. This long-term incentive offers the prospect of solving long-term waste generation problems that most companies would be reluctant to undertake by themselves because of both the cost and the uncertain outcome.

Tax Reform Act of 1986. The tax credit provided to companies that increase their investment in research and development activities stimulates R&D in many areas, including waste reduction. Because the results of the R&D cannot be known for some time, the tax credit is a long-term incentive.

Federal Non-Nuclear Energy Research and Development Act. Under this legislative mandate, the Department of Energy is required to conduct research and development for non-nuclear energy, including projects that promote energy conservation. New waste reduction technologies are being developed under DOE's Industrial Waste Reduction Program. However, tangible results from these R&D projects are probably several years away, making this a long-term incentive.

Disincentives Inhibiting Waste Reduction

While there are individual laws that hinder industry's waste reduction efforts, many of the disincentives arise from the same legislation and regulations that provide the incentives for waste reduction. The most prominent piece of legislation of this type is the Resource Conservation and Recovery Act.

Short-Term Disincentives

Most of the legislative and regulatory disincentives to industrial waste reduction were identified as being either short-term or mid-term. This section discusses the short-term disincentives. For purposes of this report, short-term disincentives are defined as legislative and regulatory requirements that are discouraging industrial waste reduction now (i.e., this year). The laws under which short-term disincentives were identified include the Resource Conservation and Recovery Act and the Revenue Act of 1926. (A summary of these disincentives is shown in Table 8.)

There were no short-term disincentives to industrial waste reduction identified under the Comprehensive Environmental Response, Compensation, and Liability Act; the Emergency Planning and Community Right-to Know Act; the Clean Air Act; the Clean Water Act; the Pollution Prevention Act; the Safe Drinking Water Act; the Toxic Substances Control Act; the Federal Insecticide, Fungicide, and Rodenticide Act; the Occupational Safety and Health Act; the Omnibus Trade and Competitiveness Act; the Tax Reform Act of 1986; the Revenue Reconciliation Act; the Hazardous Materials Trade Act; and the Federal Non-Nuclear Energy Research and Development Act.

The specific short-term disincentives that were identified under RCRA, the Revenue Act of 1926, and the regulations that are derived from them, are discussed below.

Resource Conservation and Recovery Act. While RCRA provides many of the incentives for waste reduction, it is also responsible for some of the barriers. Most of the regulations causing the short-term barriers discussed here are also effective in promoting waste reduction.

Land disposal restrictions (LDRs). Although the increasing cost of treatment and disposal, resulting from the LDRs, has been an incentive for waste reduction, the program also provides some disincentives that need to be addressed. These disincentives are

- the reduction in funds available for waste minimization investigations[65] due to increased waste management costs;
- treatment standards expressed as specific technologies, theoretically eliminating the possibility of using a reuse, recycle, or reclamation process, even if that process produces a residue with a lower associated risk than the technology standard;[66] and

Table 8. Short-Term Disincentives for Industrial Waste Reduction

Disincentive	Law	Effect
Land Disposal Restrictions	RCRA	Increases management costs, eliminates possibility of using a reuse, recycle, or reclamation process due to the treatment standards expressed, and diverts certain waste streams to incinerators in response to statutory compliance deadlines.
Derived-from Rule	RCRA	Discourages hazardous wastes from being legitimately reused or recycled.
RCRA 90 Day Storage Limit	RCRA	Time limit may serve as a disincentive to recycle/reuse.
RCRA Permitting Process	RCRA	Corrective action provisions may cause facility owners and operators to treat, store, dispose or recycle their waste off-site.
Permits for Boilers and Industrial Furnaces	RCRA	Will encourage incineration and discourage burning for energy recovery.
Depletion Allowances for the Mining Industry	Revenue Act of 1926	Depletion allowances for the mining (and oil and gas) industry subsidize virgin material consumption relative to using recycled (or other) feedstocks.

- the statutory compliance deadlines (hard hammer deadlines), which have encouraged diversion of certain streams to incinerators rather than reuse or recycling of these streams.[67]

Derived-from rule. The RCRA regulatory process specifically contains a provision commonly referred to as the "derived-from rule."[68] This provision designates as hazardous waste "... any solid waste generated from the treatment, storage, or disposal ... of a hazardous waste." The net effect of the requirement is to designate any waste produced through the treatment of a hazardous waste (unless the material is delisted) as a hazardous waste. The practical realities of a delisting petition under RCRA are two fold. First, such petitions are extremely expensive in terms of the amount of technical and legal effort required to engage in that process, and second, they are extremely time intensive, often taking years to obtain, if at all. The net effect of requiring a delisting petition in this instance is that hazardous waste that might otherwise be legitimately reused or recycled are not, due to the regulatory cost imposed in complying with the system or otherwise engaging in the delisting process. A change in the derived-from rule to eliminate the regulatory presumption that the materials are hazardous would encourage legitimate reuse/recycle technologies.[69]

RCRA 90 day storage limit. Under RCRA, large quantity generators are allowed to store hazardous waste for a maximum of 90 days without a permit. However, the practical realities

of recycle and reuse technologies often dictate that materials be stored until the amount sufficient for the cost-effective processing in a batch operation is accumulated. Being confined to the 90-day storage limit sometimes serves as a disincentive to recycling and reuse.[70]

RCRA permitting process. Under the RCRA regulations a permit is required for the treatment, storage, or disposal of hazardous waste. Currently, the permitting process creates a disincentive because seeking such a permit for a beneficial waste minimization project may hold the generator "hostage" to potentially severe corrective action requirements. Under these circumstances, waste generators may be encouraged to dispose of a hazardous waste off-site rather than minimize the hazardous waste on-site.[71]

Permits for boilers and industrial furnaces. The recently promulgated standards for burning hazardous waste for energy recovery in boilers and industrial furnaces may serve as a disincentive to waste reduction. Waste generators who currently burn their hazardous waste on-site in boilers and industrial furnaces may cease doing so. Instead, they may send their waste to off-site incinerators and avoid subjecting their facilities to corrective action requirements and the Part B permit process. This would be counterproductive since burning such waste in boilers and industrial furnaces for energy conversion is a legitimate reuse of the material.[72]

Revenue Act of 1926. The consumption of virgin materials is encouraged by granting the mining and the oil and gas industries tax exemptions on the amount of minerals they produce.[73] This depletion allowance is granted because of the limited resource base in a mine or a well, and the difficulty in depreciating the cost of the mine or the well.[74] However, this tax discount cuts the cost of purchasing virgin feedstocks relative to the cost of recycled feedstocks.

The depletion allowance cuts the cost of oil and gas feedstocks relative to other potential feedstocks, which may include those from biological sources.

Mid-Term Disincentives

For purposes of this report, mid-term disincentives are defined as legislative and regulatory requirements that do not currently discourage waste reduction, but may discourage industrial waste reduction during the next five years.

For many of the pieces of legislation and regulations discussed in this report, no mid-term disincentives for industrial waste reduction were identified. Specifically, no mid-term disincentives were identified under the Comprehensive Environmental Response, Compensation and Liability Act; the Emergency Planning and Community Right-to-Know Act; the Pollution Prevention Act; the Clean Air Act; the Clean Water Act; the Toxic Substances Control Act; the Federal Insecticide, Fungicide, and Rodenticide Act; the Occupational Safety and Health Act; the Omnibus Trade and Competitiveness Act; the Tax Reform Act of 1986; the Revenue Act of 1926; the Revenue Reconciliation Act; the Hazardous Materials Transportation Act; and the Federal Non-Nuclear Energy Research and Development Act.

Mid-term disincentives were identified under the Resource Conservation and Recovery Act and the Safe Drinking Water Act. A discussion of these laws and their mid-term disincentives is provided below. A summary of these disincentives is given in Table 9.

Resource Conservation and Recovery Act. The mid-term disincentives presented by RCRA discourage firms from engaging in recycling or other recovery activities. RCRA may divert these waste streams to treatment, storage, and disposal (TSD) facilities.

Definition of "solid waste." To be hazardous wastes under RCRA, materials must fulfill two criteria. First, they must be solid wastes (as defined by RCRA). Second, they must be **characteristic** or **listed** wastes (also as defined by RCRA). Materials not meeting both of these criteria are **not** hazardous wastes.

Many materials used in on- or off-site recycle and reuse operations are now considered hazardous wastes, as they fulfill both of these criteria. Because these materials are considered "hazardous" by definition, they acquire the public stigma associated with such a characterization. The public has been trained to view "hazardous waste" as an imminent threat to public health and the environment, regardless of the placement of all appropriate safeguards. Industries that are sensitive to public reaction will steer away from using legitimately recycled or reused material in their industrial processes by this NIMBY ("Not In My Back Yard") response. In short, designation of a material as a "solid waste" (and a "hazardous waste") has severe market repercussions on the financial viability of reuse and recycle technologies.[75] (The company presenting this scenario believes that recycling and reuse reduces the danger presented by these materials and should therefore be encouraged. It argues further that the wastes should be exempted or excluded from the definition of solid waste, thereby avoiding their designation as hazardous, and the stigma bestowed on such materials by the public at large.)

Table 9. Mid-Term Disincentives for Industrial Waste Reduction

Disincentive	Law	Effect
Definition of "Solid Waste"	RCRA	The stigma associated with the terms "solid waste" and "hazardous waste" severely diminishes the financial viability of those engaged in the reuse and recycle of certain materials.
Regulating Used Oil	RCRA	Will discourage used oil recycling.
Burning Hazardous Waste for Materials Recovery	RCRA	Manufacturers will choose to dispose of their wastes rather than recovering valuable components.
Drinking Water Standards	SDWA	Regulation of granulated activated carbon will increase the volume of waste generated.

Regulation of used oil. Section 1008 of the RCRA statute states that "used oil is a valuable source of increasingly scarce energy and materials." In 1985, EPA proposed to regulate used oils, including automotive and industrial oils, as hazardous wastes under RCRA. The proposal elicited a public outcry that alerted policy makers to the broad and counterproductive impacts of this listing. For example, the scrap metal industry would become handlers of hazardous wastes from used vehicles, commercial buildings with dirty oil from air conditioners could fall into the RCRA net, and materials used to absorb spilled oils would become hazardous wastes. In the petroleum industry, the proposed rule would curtail environmentally sound recycling practices, such as upstream insertion of used oils into crude oil pipelines for recovery of the valuable hydrocarbons, and, downstream, the acceptance at service stations of "do-it-yourselfers'" used oil.[76] The final decision to list used oil as a hazardous waste is still being considered by EPA.

Burning hazardous waste for materials recovery. A secondary material that contains a fuel component and that is combusted in an on- or off-site process is considered by RCRA to be a waste being "burned for fuel" and is subject to regulation as a hazardous waste. This rule overrides other considerations, such as the presence of valuable chemical constituents (not necessarily the toxic constituent), even though it may be more desirable to recover these non-toxic constituents in a high-temperature process than it would be to recover the fuel content of the material. The fact that an energy-bearing constituent is burned in the process or that a toxic constituent is destroyed in the process should not prevent the recovery of the valuable constituent if it can be shown that environmental risks are reduced. The processing of spent potlining (an aluminum industry secondary material) in a mineral wool cupola is an example of such a situation. This situation truly represents resource recovery, yet is prevented today by RCRA's "burning for energy recovery" rules.[77]

Safe Drinking Water Act. Under the Safe Drinking Water Act, using granular activated carbon (GAC) is listed as "feasible." This listing was apparently made without regard for the ultimate environmental impacts of GAC disposal. Certainly, the use of GAC in water treatment implies the potential for tons of solid waste requiring disposal in addition to the wastes that currently exist. In fact, tighter drinking water standards are likely to boost the volume of wastes generated.[78]

Long-Term Disincentives

For the purposes of this report, long-term disincentives are defined as legislative and regulatory requirements that will not discourage waste reduction now or within the next five years, but will discourage industrial waste reduction thereafter. Based on the available information, no specific legislative or regulatory long-term disincentives to industrial waste reduction were identified.

On the other hand, if the existing laws and regulations are looked at in more general terms, there are some common long-term disincentives that exist. These would include:

- The lack of authority or enabling legislation that would enable the government to provide stronger legislative and regulatory incentives for industrial waste reduction. Currently, there are very few provisions that specifically address waste reduction, and the ones that do are somewhat passive. For example, under the manifest and biennial report waste minimization certification requirements, the generator alone decides what degree of waste reduction is economically practicable. As a result, generators may not seriously consider reducing their waste unless the requirements are made more stringent.

- The existing single-media programs with industrial waste reduction provisions do not effectively reduce waste. Rather, firms are allowed to simply shift the waste from one media to another. For example, wastewater treatment plants and air pollution control devices produce a sludge, which can be a hazardous waste that may or may not be regulated under RCRA. In other words, while the waste is removed from the air and water, it may ultimately end up in or on the land. Comparable activities may generate air or water wastes while reducing wastes to other media.

- The low priority of waste reduction research and development. According to a 1986 OTA estimate, much less than 50 percent of EPA's funding for waste minimization R&D applied to waste reduction.[79] This reduces industry's ability to reduce wastes over the long term, because waste reduction technologies will be limited due to the lack of R&D funding.

Industry-Specific Impacts

The chemical, petroleum refining, primary metals, and pulp and paper industries are among the largest generators of waste. The wastes they produce may have different properties (e.g., hazardous or nonhazardous) and the manner in which the wastes are handled may differ. A particular law or regulation may affect some industries more severely than others.

Chemical Industry

The chemical industry releases the most toxic chemical wastes in the nation (as measured by the Toxics Release Inventory[80]), generates the largest amount of hazardous solid waste, and is a major contributor to other waste areas. The waste streams of the chemical industry are diverse, as many different products are produced by this sector. The products range from fertilizers and pesticides to pharmaceuticals to paints and lacquers. Each part of the chemical industry creates a product which generates a specific waste stream.

Since the chemical industry is perhaps the one industry most affected by the various environmental laws, most of the impacts of this legislation and the regulations on the chemical industry are covered in the general discussion of incentives and disincentives. However, the tax on ozone-depleting chemicals is specific to this industry. Only chemical manufacturers (and importers) pay the tax. And the burden of reporting toxic chemical releases (the Toxics Release

Inventory) currently falls more heavily on chemical manufacturers than on others. Because of this, some firms resist additional reporting requirements.[81]

Petroleum Refining Industry

The petroleum industry is characterized by stiff competition. This industry attempts to exploit each element of the crude oil extracted from the ground, separating the oil into many valuable products, like gasoline for consumer use and feedstocks for the chemical industry. Because many of their products are used by the chemical industry, the two industries share some concerns regarding waste reduction. But they also have special concerns as well.

Almost all of the wastes produced by the petroleum industry are generated from processing activities such as desulfurization, water treatment, tank cleaning, and spent catalyst disposal.[82] The ability of the industry to reduce these wastes depends on improving technology and on the manner in which EPA will regulate these wastes.

One problem area is the benzene NESHAP (National Emission Standard for Hazardous Air Pollutants) rule for refiners.[83,84] This rule requires that changes be made in the way wastewater is treated. The wastewater is now treated in tanks, producing sludges that will probably be considered TCLP (Toxic Characteristic Leaching Procedure) wastes. The effect of the rule is to change a liquid waste to a solid waste, generating a larger amount of waste in the process.

Another issue of particular interest is the possible listing of used oil as a hazardous solid waste.[85] Designating this material as hazardous waste would hinder efforts to recycle it, as it must be handled according to EPA's guidelines for hazardous waste. Clearly, this would discourage recycling of used oil, and limit the use of used oil as an alternative to virgin oil feedstocks.

Similar arguments can be made for other substances used by refineries, such as catalysts and solvents.

Metals Industry

The metals industry is largely dependent on ores for its raw materials. Producing the desired minerals from ore often requires many steps, as the material to be extracted must be concentrated to be recovered. But as the main stream is concentrated, minerals are lost to waste streams.

The mineral industry considers waste streams that contain unrecovered minerals in much the same way as they view the raw ores -- as materials to be processed. But EPA classifies these sludges and dusts generated from pollution control methods as "solid waste," placing them within EPA's regulatory purview. On- or off-site reclamation of these materials may be subject "... to

RCRA Subtitle C regulation if the reclaimed sludges or by-products are listed 'hazardous waste' ...."[86,87] The regulations make reclaiming the minerals more costly.

Furthermore, the "mixture" and "derived-from" rules may cause the reclamation process residuals to be regulated as hazardous waste regardless of the characteristics of the residuals.[88] This increases disposal costs. Industry would like EPA to drop these rules in regard to secondary materials intended for recycling or processing.[89]

The metals industry asserts that its recycling activities are in the spirit of the Resource Conservation and *Recovery* Act, and that their activities should be supported by EPA. In addition, the metals industry generally believes that recycling needs to be considered a major part of a waste minimization strategy, and that EPA should take steps to promote it.[90,91,92]

Pulp and Paper Industry

Much of the solid waste produced in the pulp and paper industry is not covered under RCRA Subtitle C. It is considered nonhazardous waste (Subtitle D), with fewer restrictions on its treatment, storage, or disposal. Since most of the wastes are less regulated than those in other industries, the pulp and paper industry has fewer incentives to reduce waste.

Because of the nature of the materials they work with, however, some members of the pulp and paper industry are interested in promoting burning for energy and incineration as desirable waste management options.[93]

ISSUES AFFECTING REGULATORY REFORM

The regulations issued by EPA over the past twenty years have the cleaned the air, clarified lakes and streams, provided safer handling of solid wastes, and increased corporate awareness of the dangers of uncontrolled releases (especially the releases of toxic or hazardous wastes). The regulations have levied much of the cost of producing these environmental benefits on industry. Now, as the general approach toward pollution moves toward prevention and away from end-of-pipe control, regulations impose other burdens on industry, presenting obstacles that must be overcome to reduce waste. The preceding section discusses these regulatory barriers.

Change is needed. However, reform of the regulatory structure itself faces some obstacles. This section addresses four major areas of concern: measurement techniques and compliance, cross-media problems, national policy objectives, and state and federal roles.

One of the first difficulties to be addressed is the lack of good information about the problem. No one knows how much waste is generated; no one knows how much waste reduction activity is ongoing or what kind of gains have been made. While it is acknowledge that waste is a large problem, the lack of information limits the federal government's ability to attack the areas of greatest need.

Many of the collected data are gathered in support of single-media programs, instead of being accumulated in a single, multi-media effort. Cross-media transfers may suggest a significant reduction in the amount of wastes generated in one medium, although only the method of managing the waste or the medium of disposal has been changed.

Another potential problem is the lack of a cohesive national policy on waste reduction. Different elements have divergent interests, reflecting different constituencies. While the consideration of several viewpoints can be beneficial, it can also lead to confrontations.

The federal government must also acknowledge that its role is limited. In particular, many of the responsibilities involving waste have been delegated to the states. A few states have been much more active than the federal government in promoting waste reduction. Some federal actions may be seen as infringing on the authority of the states.

Measurement Techniques and Compliance

Great progress has been made in industrial waste reduction and will continue to be the trend in the future. However, measuring progress in waste reduction has proved to be a challenging task. Federal agencies and the states have found it difficult to assess and compare waste generation and waste minimization efforts among facilities and production processes from different manufacturing sectors, and often among facilities within the same sector.

According to a 1986 OTA report, there are several practical reasons why perfect waste reduction information can never be assembled by the government. Those reasons, as identified by the OTA report, are:

- "Not all industrial operations lend themselves to measurement of waste on a production output basis because units of production or output are often easy to establish."

- "The amount of data theoretically needed to assess waste reduction is staggering. Collecting process-level mass balance data on every single hazardous substance from every plant in the country is impossible."

- "Many companies consider detailed data on their processes to be proprietary. Companies may fear that, if made public, this information could be useful to their competitors and may therefore strongly resist reporting each year."

- "Even if industry had the resources to collect and report this kind of data, government has not yet demonstrated its ability to efficiently and effectively manage the data on waste that it currently requires from industry. A data deluge of this magnitude would be overwhelming."[94]

In addition to describing the constraints mentioned above, the OTA report also provided criteria by which data collection methods need to be changed. Without revising the data collection methods to meet these criteria, a complete and reliable measurement of industrial waste reduction can not be provided. The criteria the OTA report suggests data collection methods meet are:

"Waste Reduction Data Must Be Correlated to Production"

"Because waste generation varies directly with capacity utilization (everything else remaining the same), it is important to know whether waste amounts are rising and falling because more or less product is being manufactured or because waste reduction measures are being implemented. *Waste generation figures not correlated to production can mask waste reduction successes as well as failures.* A company may be implementing waste reduction as its business is growing. Waste volumes may appear to be going up while waste per unit production, the true measure of waste reduction, is actually going down. Thus, it may be to the advantage of companies to measure waste generation on a per unit product basis."[95]

"Waste Reduction Information Must Be Substance Specific"

"This is the only way to overcome the volume measurement problem and the media shifting problem. When waste streams are complex mixtures of hazardous and nonhazardous substances, volume measurements do not give the amount of hazardous substance in the waste, much less the amount of any given hazardous substance. One might hope to gather this information by intensively monitoring waste streams for their hazardous constituents, however such a procedure

would assume that all releases were known. Fugitive air emissions, leaks, and spills can contain substantial amounts of hazardous materials, and would almost certainly not be accounted for in such a system."[96]

"Waste Reduction Data Must Be Process-Specific"

"Conducting mass balance calculations at the plant level with a high degree of sensitivity and accuracy would be extraordinarily difficult. Processes, reactions and transformations are usually so complex that good data can not be collected except at the smallest production level - the process or unit operation. It might be possible in some cases to conduct a very rough mass balance on a hazardous substance at the plant level by figuring the difference between input and production output, and assuming the rest is waste, without trying to tract that waste. Doing this over time, one might get a rough sense of the amount of waste reduction, but uncertainties in this calculation are almost always large and may not reveal much about small amounts of highly hazardous waste. *Moreover a plant level mass balance would not normally provide any guide for waste reduction action because it tells little about where the substance appears as waste in the plant operations.*"[97]

"Waste Reduction Data Must be Collected Periodically"

"Without time series data on waste generation, waste reduction cannot be calculated. Government information collection efforts about wastes, in particular, are frequently one-time events or a series of event which cannot be compared."[98]

Considering the limitations (i.e., the practical constraints and the needed revisions to waste generation data collection methods), the following measurements techniques to industrial waste reduction were identified.

- "Determine the total amount of waste generated per unit of production. This is the only way to compensate for the production, volume and multimedia limitations of existing data. Waste generation is directly dependent on the production rate."[99]

- "Determine the effect on the organization's cash flow. Waste reduction efforts should pay for themselves through reduced management cost and reduced raw materials costs."[100]

- "Determine the quantities of waste generated before and after waste project implementation. The difference represents the percentage reduction in waste quantity."[101]

Cross-Media Transfers

As stated earlier, one difficulty with data collection is that wastes can migrate across media boundaries; for instance, gases may be condensed to form liquids or absorbed in solids. Though the liquid or solid is then a waste, it is no longer recorded as a waste gas. The waste may be lost in the accounting mechanism.

This problem is also exhibited in how the wastes are regulated. The current environmental legislative and regulatory framework focuses primarily on single media programs. For example, the Clean Air Act addresses air pollution problems, while the Clean Water Act addresses water pollution problems. Other pieces of legislation are directed at other problems. Some of the contaminants regulated under these programs, particularly toxics, present problems in more than one medium. As pointed out by OTA, "pollutants are released into the environment as solids, liquids, or gases and do not follow paths set forth by statute. Once released, their physical or chemical forms can change, and they can be transported some distances from their source by air or by water. The effect of environmental regulations and their implementation is often to shift pollutants among media -- in some cases out of the realm of regulatory control. For example: wastewater treatment plants and air pollution control devices produce a sludge which can be a hazardous waste and may or may not be regulated under RCRA; tall smokestacks required under clean air regulations to disperse emissions long distances are now suspected of being a source of acid rain; and surface impoundments (settling ponds), for which RCRA sets operating standards, are a source of volatile organic compound (VOC) air emissions."[102]

To further illustrate how this problem is affecting industrial waste reduction in the petroleum refining industry, the following example is provided.

> "Under the Clean Air Act, the benzene NESHAP rule is intended to control benzene emissions into the atmosphere from the handling of benzene-containing wastes. One company's strategy was pollution prevention that involved eliminating sources of benzene, and where that was not possible, collecting the benzene-containing streams separately in a closed system, steam stripping out the benzene, and discharging the purified water into the wastewater sewer system. The current definition of 'point of waste generation' which has no connection to the RCRA definition of point of waste generation will result in a situation that will ultimately create the need for greater solid waste disposal and greater worker exposure hazards. The devices used to strip the benzene are considered, by EPA, to be waste treatment devices, meaning that the water *entering* the strippers must comply with the benzene concentration limits. Hence, there is no incentive to keep benzene out of the sewers, thus requiring the installation of charcoal canisters that will result in the need for greater hazardous waste disposal -- estimated at 45,000 pounds per day at one refinery. Aside from the disposal concern, coordination between the benzene NESHAP rule, the RCRA Toxicity Characteristic rule and other RCRA requirements, as well as Clean Water Act

requirements would have provided for greater incentives for implementing pollution prevention measures."[103]

While combining the responsibility for the management of all forms of a release in one multi-media program is desirable, the abandonment of the existing single-media framework is unlikely to occur any time soon. A short-term response to the problem of cross-media transfers is to promote cooperative efforts among the existing programs, encouraging them to work together to limit the most damaging form of pollution, rather than having each program insist that industry meet the standards set up for its media alone.

National Policy Objectives

While waste reduction has gained support within the federal government, in the private sector, and with the public, each constituency has its own goal in promoting waste reduction. Five of the major participants in the waste reduction discussion are the Department of Energy, the Environmental Protection Agency, industry, public-interest groups, and Congress. Each group has a role to play in developing and promoting waste reduction as a national goal.

Department of Energy

Several programs within the Department of Energy (DOE) include activities related to waste reduction. The goal of the Industrial Waste Reduction Program in DOE's Office of Conservation and Renewable Energy (CE) is to improve the energy efficiency of industrial processes through cost-effective waste reduction in the industrial sector. Processes that generate waste often make inefficient use of their raw materials. These feedstocks have an intrinsic worth, based on their potential to be used as fuel or to create new materials. In addition, when wastes are generated, energy is squandered. The inherent energy of the feedstock is lost; the energy added to the feedstock is dissipated; and energy is expended to handle, treat, store and dispose of the waste. Using this analysis, reducing the generation of any waste to the extent feasible is important.

The Office of Defense Programs (DP) and the Office of Environmental Restoration and Waste Management (EM) are responsible for the clean-up of DOE's facilities. They conduct DOE's operations in a safe and environmentally sound manner, which includes pursuing waste reduction.[104] Their efforts follow a hierarchy of environmental protection practices. First, eliminate or minimize the generation of waste through source reduction. Second, recycle those potential waste materials that cannot be eliminated or minimized. Third, treat all waste that is nevertheless generated to reduce volume, toxicity, or mobility prior to storage or disposal. This hierarchy applies to hazardous, nonhazardous solid, radioactive, and radioactive mixed waste.

In handling its own wastes, DOE defines waste reduction as the reduction of the total amount of waste that is generated and disposed of by DOE operations through waste minimization and treatment activities.[105]

Environmental Protection Agency

Congress granted EPA most of the authority to address threats to the environment. This gives the EPA the greatest effect of any federal agency on waste issues.

EPA's mandate is to protect human health and the environment. This directive may be at odds with a policy of waste reduction, especially in cases where the discharge is effectively neutralized and therefore poses no threat to the environment. An example of this is the general lack of incentives to reduce the solid wastes classified as nonhazardous under the Resource Conservation and Recovery Act.

EPA is also currently assessing its activities. It now intends to first address those problems which present the greatest risk. EPA hopes to use its limited funds to make the environment as safe as possible. Based on this approach, current waste reduction activities may be cut in the future unless the hazard presented by the waste stream is considered severe.

Industry

The industrial community was reducing its waste before anyone else was interested. Many waste reduction activities are good business sense; when a waste stream is generated, feedstocks are being squandered.

Though it knows that waste reduction can be cost-effective, industry will contest most government efforts to mandate industrial waste reduction.[106] It prefers voluntary waste reduction programs, under which it is able to consider its own priorities first.

Public-Interest Groups

Industry's view is not shared by public-interest groups, who continue to urge industry to pursue waste reduction more actively. Most of these environmental groups are concerned about the same issues as the EPA; they want to know how the wastes affect their health, their local community, and the general environment. Because these groups believe that many wastes are harmful, they want industry to cut the generation of wastes, especially toxic and hazardous wastes, significantly and quickly.

U.S. Congress

The Congress are elected to represent the diverse views and interests of U.S. citizens. Some members of Congress would like to impose mandatory waste reduction requirements on industry, while others seek to remove the regulatory impediments to free enterprise. Public-interest groups appear to have significant influence on Congress on waste issues, as illustrated by the passage of the Clean Air Act Amendments of 1990. However, this bill also included many measures agreed on by both industry and environmental groups. When it enacts laws, promulgates

regulations, or undertakes other activities, the federal government must try to balance the interests of industry against the risks presented to the public at large.

State and Federal Roles

According to a 1986 OTA report on waste reduction, "environmental programs have most often been designed at and mandated from the federal level; but in the case of waste reduction, states have assumed a leadership role." Many state governments have encouraged industrial waste reduction by establishing various programs and/or funding mechanisms. These programs and funding mechanisms fall under six categories.

Regulatory Programs

The authority to implement many of the nations federal environmental programs has been delegated to the states. Examples include the RCRA hazardous management program and the National Pollution Discharge Elimination System program of the Clean Water Act. All states authorized to implement federal programs must ensure that their programs are no less stringent than the federal program. Some states adopt the federal regulations directly as the state programs with little or no modification; while others chose to make the adopted programs more stringent. In most cases the more stringent controls serve as regulatory incentives to reduce industrial waste.[107]

State Incentives

There are several methods implemented by states to stimulate waste reduction activities. These include fee and taxation incentives, loan and bond assistance, grant programs, information programs, and award programs.

Fee and Taxation Incentives. Many states currently offer several fee and tax incentives that may encourage preferred waste management alternatives. These financial incentives include:

- Assessment of permit fees for the operation, treatment, storage, or disposal of hazardous waste;
- Assessment of fees or taxes on the volume of hazardous waste generated or disposed (waste-end taxes); and
- Assessment of taxes on raw materials used in processes that generate hazardous waste (feedstock taxes).

In some states, additional incentives are provided by allowing exemptions and reductions from these assessments, as well as reductions and credits on sales, income, or property taxes for using more desirable waste management methods.[108]

Loan and Bond Assistance. Credit assistance through some form of subsidy from the state (e.g., direct state loans, subsidized interest for private loans, or bond financing) can promote source reduction and recycling when used to purchase waste reduction equipment or to build and operate recycling facilities.[109]

Grant Programs. State grants are a direct method for investigating new and existing technologies. They may be awarded to hazardous waste generators, processing facilities, and other public and private organizations to support industrial waste reduction efforts, including research and development activities and/or demonstration of recycling and source reduction technology.[110]

Information Programs (Information Transfer, Technical Assistance, and Waste Exchanges). "An information transfer program works through such vehicles as studies, conferences, workshops, telephone hotlines, clearinghouses, and training programs. These mechanisms help industry and the general public alike by: (1) recommending source reduction, recycling, and other treatment and disposal alternatives; (2) providing regulatory assistance; (3) studying hazardous waste issues; and (4) performing technical and economic feasibility studies.[111]

Awards Programs. These are low-cost strategies that are used to recognize and honor individuals, companies, and institutions that have demonstrated outstanding achievement in industrial waste reduction.[112]

PROPOSED LEGISLATION AND ITS IMPACTS

A number of bills that could influence industry's waste reduction activities have been introduced for consideration in the 102nd Session of Congress. These bills are listed in Tables 10 and 11.

Bills introduced into the House of Representatives (H.R.) have been referred to the Energy and Commerce Committee, while bills introduced into the Senate (S.) have been referred to the Environment and Public Works Committee.

Bills Introduced in the U.S. House of Representatives

If passed, these House bills would give states the right to close their borders to incoming waste; require firms to dispose of their hazardous waste on-site; stimulate industrial water conservation; support recycling and the development of a recycling infrastructure; and extend the tax credit for increased research and development expenditures.

H.R. 173, H.R. 607 and H.R. 724.

These bills would allow states to restrict the hazardous wastes entering from out-of-state, or allow them to levy fees on this waste. Before gaining this authority, states would be required to have a twenty-year plan of managing their own waste. Some bills have provisions requiring the states to include source reduction and recycling activities in these plans.

Two incentives are provided by these bills. If states are required to include source reduction and recycling activities in their plans, they must provide some encouragement to the industrial generators of the waste. (This could be in the form of grants, technology transfer, or legislative mandates.)

These bills provide an indirect incentive for waste reduction, especially for industries in a state without the capacity to manage its own solid waste. If wastes generated in that state are banned from entering other states, the cost of waste management would become prohibitively expensive, causing industry to seek alternatives, one of which is waste reduction.

H.R. 510.

This bill requires hazardous waste generators to treat or dispose of their wastes at the site on which it was generated. This is a clear incentive for hazardous waste generators to cut their waste generation, as setting up and running a treatment or disposal program would be a costly endeavor.

Table 10. Bills Introduced in the 102nd Congress (House of Representatives)

Bill No.	Sponsor	Title
House Energy and Commerce Committee		
H.R. 173	Olin (D-VA)	Solid Waste Transportation Act
H.R. 510	Kolter (D-PA)	On-Site Treatment and Disposal of Hazardous Waste, Requirement
H.R. 607	Erdreich (D-AL)	Solid Waste Disposal Act, Amendment
H.R. 724	Erdreich (D-AL)	Hazardous and Solid Waste Management Act of 1991
H.R. 844	Atkins (D-MA)	Municipal and Industrial Water Conservation Act of 1991
H.R. 871	Torres (D-CA)	Tire Recycling Incentives Act
H.R. 872	Torres (D-CA)	Oil Recycling Incentives Act
H.R. 873	Torres (D-CA)	Newsprint Recycling Incentives Act
H.R. 1201	Porter (R-IL)	Recycled Paper Procurement Act of 1991
H.R. 1301	Dingell (D-MI)	National Energy Strategy Act; Arctic Coastal Plain Competitive Oil and Gas Leasing Act; Naval Petroleum Reserve Leasing Act; Oil Pipeline Regulatory Reform Act; Power Marketing Administration Timely Payment Act

H.R. 844.

This bill calls for municipal and industrial water conservation through increased water efficiency, recycling, and reducing water losses. EPA is to set up an Office of Water Conservation, which will promote reduction in water use through education and technology transfer, and by conducting research on beneficial technologies. EPA will also provide technical assistance to businesses and institutions, to support their efforts in using water more efficiently. To industries interested in cutting their water use and waste, this will be an incentive.

H.R. 871, H.R. 872, and H.R. 873.

These bills to amend the Solid Waste Disposal Act propose measures to encourage the recycling of scrap tires, used lubricating oil, and newsprint. In addition to cutting municipal waste, the recycling of these materials can reduce industrial waste generation at two levels. First, these materials have already been refined from virgin materials, so the initial steps of extracting oil or cutting timber need not be repeated. The wastes avoided in this manner are significant. In addition, the reprocessing of already refined material (the recycled goods) usually produces less waste at the manufacturing level.

Table 11. Bills Introduced in the 102nd Congress (Senate)

Bill No.	Sponsor	Title
Senate Environment and Public Works Committee		
S. 153	Coats (R-IN)	State Regulation of Certain Solid Waste, Authorization
S. 174	Specter (R-PA)	Solid Waste Disposal Act Amendments Act of 1989
S. 201	Gore (D-TN)	World Environment Policy Act of 1991; CO2 Offsets Policy Enabling Act of 1991; National Recyclable Commodities Act of 1991; National Recyclable Commodities Financing Act of 1991; Conservation Data Act
S. 241	Warner (R-VA)	States Solid Waste Regulatory Authority Act
S. 396	Wirth (D-CO)	Tire Recycling Incentives Act
S. 397	Heinz (R-PA)	Solid Waste Disposal Act, Amendment
S. 399	Heinz (R-PA)	Oil Recycling Incentives Act
S. 570	Johnston (D-LA)	National Energy Strategy Act; Arctic Coastal Plain Competitive Oil and Gas Leasing Act; Naval Petroleum Reserve Leasing Act; Oil Pipeline Regulatory Reform Act; Power Marketing Administration Timely Payment Act
S. 592	Shelby (D-AL)	Hazardous and Solid Waste Management Act of 1991
S. 742	Wirth (D-CO)	National Energy Efficiency and Development Act of 1991; Used Oil Energy Production Act of 1991; Tire Recycling Incentives Act; Electric Vehicle Technology Development and Demonstration Act of 1991; Replacement Fuels and Alternative Fuels Act of 1991
S. 761	Lieberman (D-CT)	Hazardous Pollution Prevention Planning Act of 1991

These bills introduced by Representative Torres would require tire manufacturers, oil producers, and newsprint producers to recycle a percentage of the materials they produce (EPA will set this quantity), or to purchase "recycling credits" from permitted recycling facilities in lieu of or in addition to recycling the materials internally.

Under H.R. 871, tire manufacturers must increase their recycling activity or stimulate growth among those involved in scrap tire recycling. This bill provides them an incentive to alter their feedstock capability and accept post-consumer tires.

In H.R. 872, EPA is prohibited from listing used oil (or affiliated materials, like oil filters and oily rags) as a hazardous waste. Commercial generators of waste oil are required to send their waste oil to a permitted waste oil recycling or disposal facility.

Because of H.R. 872, petroleum refiners and other lubricating oil suppliers would be greatly encouraged to recycle scrap tires and used oil under these bill. At least three incentives can be identified. The absence of used oil from the hazardous waste list removes a potential barrier, as it eases permitting regulations which often restrict recycling activity. Requiring commercial generators to ship their oil to authorized recycling or disposal facilities should provide sufficient quantities of oil to support recycling facilities, and the recycling percentage requirement also stimulates the creation of oil recycling facilities. The recycling of used oil to produce new oil reduces the amount of waste generated in the extraction of raw materials and during the production of oil from these virgin materials.

If H.R. 873 becomes law, newsprint producers will have an incentive to change their processes to accept old newsprint as a feedstocks. The production of newsprint from recovered paper generates less waste than production of newsprint from virgin materials, so this is a waste reduction incentive.

H.R. 1201.

This bill provides an incentive for paper manufacturers to create more recycled paper by strengthening the standards for federal procurement of recycled paper and stipulating that these standards apply to Congress itself. It defines certain grades of paper, each with a given recycled paper content, and gives a cost offset up to 15% to those papers having the greatest amount of post-consumer material.

By providing a substantial market for papers with high recycled fiber content, this bill stimulates the production of these papers. This, in turn, reduces the amount of municipal waste landfilled or incinerated. In addition, the post-consumer paper substitutes for a virgin raw material as a feedstock in paper production, cutting the amount of solid waste, air emissions, and water discharges typically generated in the production of paper from virgin feedstocks.

H.R. 1301.

This bill embodies President Bush's proposals to implement the National Energy Strategy. An extension of the research tax credit is included in this bill, making permanent the benefits of annual increases in research outlays.

Bills Introduced in the U.S. Senate

Most of the bills proposed in the Senate are similar to bills in the House. Notable exceptions are Senator Gore's CO_2 Offsets Policy Enabling Act of 1991 (S. 201) and Senator Lieberman's Hazardous Pollution Prevention Planning Act of 1991 (S. 761).

S. 153, S. 174, S. 241, and S. 592.

The provisions contained in these bills are similar to those contained in three House bills: H.R. 173, H.R. 607 and H.R. 724. They create waste reduction incentives by giving states the right to prevent wastes from entering their disposal facilities. Most also have provisions for states to promote industrial source reduction as part of their planning activities.

S. 201.

The *CO_2 Offsets Policy Enabling Act of 1991*, which seeks to reduce carbon dioxide emissions because of their function as a greenhouse gas, is just one provision of this bill. New major CO_2 sources will require a permit obtained under this Act. The permit will indicate that the amount of CO_2 to be generated by the CO_2 source is offset by at least an equal number of CO_2 credits. These credits can be accumulated by activities such as reduction in current CO_2 production, energy conservation, cogeneration, or switching to less carbon intensive fuels.

Since failure to comply with the permit results in a fine, firms building plants that meet the definition of major source (emissions of more than 100,000 tons of CO_2 per year) have an incentive to design processes that reduce their production of this specific waste gas.

S. 396.

This is the companion bill to H.R. 871. It would stimulate the recycling and reuse of used tires.

S. 397.

This is the companion bill to H.R. 873. It sets up a system of "credits" to promote newspaper recycling.

S. 399.

This is the companion bill to H.R. 872. It proposes to support the creation of an infrastructure to recycle used oil.

S. 570.

This is the companion bill to H.R. 1301, the President's National Energy Strategy bill.

S. 742.

This bill contains provisions (the Tire Recycling Incentives Act and the Used Oil Energy Production Act of 1991) for tire recycling incentives such as those described in H.R. 871 (S. 396) and for recycling used oil as described in H.R. 872 (S. 399).

S. 761.

This bill attempts to encourage reductions in toxic pollution by mandating that companies consider the benefits of source reduction activities.

Those who now submit a toxic chemical release form under section 313 of SARA will be required to prepare a Hazardous Pollution Prevention Plan, which is to be signed by the chief executive officer of the company, or a designated senior officer. The Plan will include evaluations of the processes in which toxic chemicals are generated, with analyses of methods to cut toxic releases, including technical descriptions, detailed cost estimates, and the expected payback periods. The Plan will include two- and five-year goals for reducing the generation of toxic chemicals.

The bill also sets up a demonstration program, which may include as many as fifty facilities. The EPA Administrator may, as part of this demonstration program, modify the terms of any permit or agreement. (This may provide regulatory flexibility for firms attempting to finance source reduction activities while being pressured to comply with specific emission standards.)

POLICY OPTIONS

The removal of regulatory and legislative impediments is the responsibility of the legislative and the executive branches of the U.S. government. Congress can repeal old laws or enact new legislation; the EPA and other members of the executive branch can rescind old regulations and release new regulations; and both the legislative and executive branches can encourage waste reduction through non-legislative, non-regulatory acts.

In addition to removing barriers, there may yet be a need to further stimulate waste reduction activity. In the recent past, the major forces driving waste reduction appear to have been the liability of generators for the wastes they produce, public knowledge of industry use of hazardous materials, and the cost involved in handling the wastes. Laws and regulations that use these methods are likely to be effective in encouraging further waste reduction efforts.

Economic incentives may also be effective in changing industrial practices. Throughout its history, industry has adopted practices that lower its costs and improve its efficiency. Some form of financial inducement, provided by the government, could encourage industrial waste reduction.

Table 12 lists some specific actions which the U.S. government may consider. These actions are also described below. Other countries have already taken some of these steps to cut waste generation.[113]

Legislative Actions

Congress has a number of available options that it can choose to implement. Some alternatives listed here are market-based; they work by encouraging industry to reduce their wastes. Other proposals are more prescriptive, as they mandate reducing waste generation to a set level. As a group, the market-based incentives are likely to be more effective in encouraging industry to cut its waste production.[114]

Waste Taxes

Taxes which reduce waste generation usually increase the cost of generating undesired materials. Among the taxes that have been proposed in different arenas are carbon taxes,[115] fees on VOCs,[116] and charges on TRI emissions.[117]

In its 1986 report, OTA suggested that to make waste-end taxes an effective means of promoting waste reduction, they could be combined with tax rebates or credits for waste reduction activities. With this strategy, however, difficulties could arise due to the differences in reduction potential among various industries.[118]

Table 12. Available Federal Actions

Recommendation	Effect
Legislative Actions	
Tax Incentives	Create economic stimulus for waste reduction efforts.
Tax Disincentives	Remove economic impediments to certain waste reduction activities.
Deposit/Refund Systems	Help set up structure for recovering and recycling solvents, containers, and other materials.
Marketable Permits	Reduce overall pollution while allowing industry to choose most effective methods for attaining pollution standards.
Information Disclosure	Give the public access to more information, increasing the pressure on industry to perform waste reduction activities.
Label "Environmentally-Safe" Products	Inform consumers of the environmental effects of marketed products, which may influence their purchasing habits.
Mandatory Waste Reduction Audits and Facility Plans	By mandating the investigation of waste reduction alternatives, the benefits to the company will become more obvious.
Mandatory Performance Standards	Companies will have to reduce their wastes or face the penalties.
Mandatory Percentage Reduction in Waste Generation	Companies will have to reduce their wastes or face the penalties.
Regulatory Actions	
Expansion of Subtitle C Authority	Include more wastes under Subtitle C umbrella, creating increased incentives for waste reduction of those wastes.
"Flexibility" to Handle Multi-Media Problems	Industry could receive time to implement multi-media waste reduction practices without risking single-media penalties.
Banning Certain Chemicals, Products and Management	Eliminates the waste streams associated with the production of these materials.
Other Federal Actions	
Change procurement standards	Increase the market for materials produced using more "environmentally-safe" means.
Modify specifications	Allow government contractors to pursue waste reduction activities without losing contracts.
Increase awareness	Reduce waste generation by federal employees and government contractors.

Tax Disincentives

The tax code provides a *depletion allowance* to individuals and companies involved in mineral exploration and recovery. Some recycling advocates claim that this places recycled materials at an economic disadvantage, and encourages waste generation.[119] They advocate repeal of the allowance to place materials recovery on an equal footing with mining.

Deposit/Refund Systems

Placing a deposit on materials such as chlorinated solvents discourages the loss of the material or reduces the use of the material. Providing a refund for the material increases the incentive to recover the material. Deposit/refund systems have been suggested for pesticide containers as well as for solvents.[120,121,122]

By discouraging the disposal and loss of these materials, less production is needed. Diminished levels of production typically result in the reduction of the wastes associated with production.

Marketable Permits

Marketable permits allow the firms that are able to reduce their emissions below the legally permitted value to gain a credit equal to the difference between the permitted level and their emission level. This credit can then be sold for whatever the market will bear. Proponents of this system suggest that this gives flexibility to the regulatory process, and allows firms to decide where and how to make the desired reductions.[123,124,125] (The Clean Air Act Amendments allow marketable permits for some emissions.)

Information Disclosure

The dissemination of the information gathered under Section 313 of the Emergency Planning and Community Right-to-Know Act (the Toxics Release Inventory) has allowed public groups to apply pressure to companies in their regions to limit or eliminate releases of the TRI chemicals. This pressure has prompted many firms to initiate programs in waste reduction. Broadening the scope of the information gathered and distributed to the public could increase industry's waste reduction efforts.

While the Pollution Prevention Act of 1990 expanded the reporting requirements originally mandated under the Emergency Planning and Community Right-to-Know Act, other steps to increase the scope of the Toxics Release Inventory could be taken. These steps could include: (1) expanding the number of chemicals on the TRI list; (2) expanding the reporting requirements to activities outside the manufacturing field to include agriculture, mining, and construction operations; and (3) making federal facilities report their TRI wastes.

Label "Environmentally-Safe" Products

This is another means of providing information to the public. Consumers interested in reducing the environmental consequences of their purchases often cannot make informed decisions, since they lack information about the impacts of individual products. Firms interested in capturing part of the "environmentally conscious" market will be sensitive to the practices they use in manufacturing their products, including the amount of waste they generate in production.[126] The labeling of environmentally harmful products, such as ozone-depleting chemicals, might serve to curb their use.[127]

Labeling allows consumers to use the information as one of the criteria they consider in purchasing, in addition to price and perceived quality. More costly production methods that reduce waste might be supported by consumers who are willing to pay more for products which have fewer detrimental effects on the environment.

Mandatory Waste Reduction Audits and Facility Plans

A law demanding that firms conduct waste reduction audits and fill out facility waste reduction plans would ensure that plant supervisors or owners would understand the effects of waste reduction activities on their firm. However, the cost of undertaking these required projects is likely to be a burden for at least some firms.[128] (Facility plans are proposed in S. 761.)

Mandatory Performance Standards

Another legislative possibility would give EPA the power to regulate process performance. In a manner similar to way that Best Demonstrated Available Technologies (BDAT) standards are now developed, EPA could develop Best Available Production Process (BAPP) standards. Manufacturers would be required to meet or surpass the standards set by this process standard.[129]

Implementation of a full-scale BAPP program would be dependent on the rate at which research could be conducted by EPA, and on the speed of the regulatory process.

Mandatory Percentage Reduction in Waste Generation

Congress could legislate that manufacturers cut their wastes by a certain percentage, based on an absolute basis or one relative to their production level. Some manufacturers doubt that this will actually promote waste reduction.[130] This approach also presents many difficulties, especially with certain industry members already conducting waste reduction efforts. They could be penalized for the efforts they have completed. Such a proposal may also ignore differences between industries, and between the hazards that different wastes present.[131]

Regulatory Actions

The EPA has been given the authority, through established Acts of Congress, to regulate industry in certain ways. Some regulatory actions that would promote waste reduction are listed below.

Expansion of Subtitle C

The high costs of handling the solid wastes that fall under the RCRA Subtitle C regulations are a major factor in encouraging waste reduction among many firms. However, EPA has chosen to exclude certain wastes governed under RCRA from Subtitle C. Firms generating these wastes have less incentive to cut their waste production.

Regulatory Concessions

EPA offices could provide regulatory concessions to companies that attempt to develop and implement waste reduction technologies to meet the EPA standards, rather than relying on off-the-shelf control equipment or technologies. The costs of maintaining compliance while conducting research and development in this area can strain or break a company's "pollution control" budget; companies may have to choose between compliance and their waste reduction efforts.

EPA could encourage firms to undertake waste reduction efforts by granting companies a limited deferment in meeting new standards if it could be assured that the gains made through the waste reduction technologies exceed the standard set by EPA. EPA could also allow other activities, such as extending the storage period for hazardous waste without a permit, if the need is confirmed. An important aspect of such a program is to insure that the regulatory flexibility results in an overall net improvement.[132]

Banning Certain Chemicals, Products and Management Practices

Banning products or practices can be an effective way to cut certain wastes. EPA currently has this power under TSCA and FIFRA, and it has been successful with certain pesticides (i.e., DDT). It is generally only done when it can be proven that the damage done by the product outweighs the benefits generated by the product. In addition, there is generally no assurance that the substitute that is developed is better than the banned product, or that the wastes generated during the manufacture of the replacements will be less harmful than the wastes formerly generated in the production of the banned substance.[133]

Other Actions

The federal government itself is a huge corporation. The policies it sets for itself can have a great influence over the way that its suppliers conduct their business.

Change Procurement Standards

The federal government can promote waste reduction through its procurement standards. Some have considered increasing the amount of recycled materials the government purchases, for example, by (1) implementing price preferences for recycled products, (2) placing set-asides for recycled products, or (3) allowing a petitioning procedure, whereby a manufacturer could petition federal agencies to purchase recycled material.[134] Each of these options would lead to an increase in government spending, at least in the short term.

Substituting post-consumer, or recycled, goods for virgin raw materials in the manufacture of a product usually saves energy and reduces the overall amount of waste generated.

Modify Specifications

Federal agencies can also take direct steps to cut waste by reviewing the standards they require their contractors to meet. For example, the Defense Department purchases billions of dollars of parts each year.[135] Most of these must conform to specifications detailing the process in which a part must be made. Reviewing these specifications and changing the process could reduce waste generation significantly. Changing a process specification to a performance standard might be able to save even more, as it allows a manufacturer to choose a process that performs as needed, but reduces the waste.

Increase Awareness

Heightening waste reduction awareness within federal laboratories and other federal facilities would also reduce waste. More suggestions on methods to cut waste would be brought up if source reduction and recycling were commonly discussed ideas. Projects run jointly with industry would gain from their development in an environment when waste reduction was stressed.

CONCLUSIONS

The legislation enacted by Congress to promote human health and preserve the environment and the regulations drawn from them play a substantial role in motivating industry to reduce waste. Typically, however, these laws (including RCRA, CERCLA, the Clean Air Act, and the Clean Water Act) promote waste reduction indirectly by limiting the options that industry previously favored. The restrictions imposed by these laws and regulations increase waste reduction activities much as they stimulate other actions deemed acceptable by regulators, such as waste treatment. Other laws, such as those enacted to protect workers or encourage research and development, play a relatively minor role in promoting industrial waste reduction.

However, many of the laws and regulations which provide a general incentive for waste reduction contain specific disincentives. For example, environmental laws tend to place increasing strict standard on pollutant releases, requiring industry to install the Best Demonstrated Available Technology. This demand drains resources that could otherwise be used to develop more efficient processes which generate fewer wastes.

Reform of this regulatory framework will be slow, as the environmental establishment has evolved over the last twenty years and become difficult to change. However, both Congress and the executive branch have opportunities to modify the existing framework. If waste reduction is to become the primary method of addressing waste, the federal government must help industry overcome these barriers.

APPENDIX A: ORGANIZATIONS CONTACTED

American Institute of Chemical Engineers, Center for Waste Reduction Technologies
American Iron and Steel Institute
American Paper Institute
American Petroleum Institute
Chemical Manufacturers Association
Department of Energy - Office of Conservation and Renewable Energy
Department of Energy - Office of Policy, Planning and Evaluation
Environmental Protection Agency - Office of Pollution Prevention
Environmental Protection Agency - Office of Solid Waste
Internal Revenue Service - Office of Passthroughs and Special Industries
National Association of Manufacturers
Procter and Gamble
3M
World Wildlife Fund

NOTES

1. OTA 1986.
2. EPA 1986a.
3. HWRIC 1990, p. 84.
4. HWRIC 1990, p. 16.
5. 40 CFR 262.20(a); 262 Appendix, Item 16.
6. 40 CFR 262.41 (a).
7. 40 CFR 264.75 (i).
8. EPA 1987a.
9. P.L. 101-549, § 101 (c).
10. P.L. 101-549, § 103 (a).
11. P.L. 101-549, § 103 (g).
12. P.L. 93-633, Title I, § 102.
13. 49 CFR Parts 173, 176, 177, 178, and 179; see also 46 CFR Part 30 for tank vessel construction.
14. 40 CFR 261.4. See also discussion at 56 FR 5910.
15. 40 CFR 262.
16. 40 CFR 262.
17. 40 CFR 262.41(a)(6 & 7).
18. LaCroix 1987.
19. 40 CFR 264/265.
20. EPA 1986a, p. 22.
21. 40 CFR 268.
22. AWWA 1990.
23. 55 FR 25454.
24. RCRA §6002.
25. CERCLA §106 and 107.
26. EPA 1986a, p. 21.
27. Clean Air Act §111.
28. OTA 1987.
29. EPA 1990a.
30. EPA 1986a.
31. 40 CFR 403.12(p)(4).
32. Lazkowski 1990.
33. Lazkowski 1990, p. 5.

34. Lazkowski 1990, p. 5.
35. EPA 1991d, p. 2.
36. 26 USC §§ 4681 and 4682.
37. EPA 1990b, p. 4.
38. EPA 1990b, p. 6.
39. EPA 1990b, p. 7.
40. EPA 1990b, p. 7.
41. EPA 1990b, p. 7.
42. EPA 1990b, p. 7.
43. Lazkowski 1990, p. 7.
44. Lazkowski 1990, p. 8.
45. Lazkowski 1990, p. 8.
46. Lazkowski 1990, p. 9.
47. Lazkowski 1990, pp. 9-11.
48. TSCA §6(a).
49. EPA 1986a.
50. EPA 1986a.
51. EPA 1991c, p. 1.
52. EPA 1991c, p. 1.
53. EPA 1991c, p. 1.
54. EPA 1990b, p. 5.
55. EPA 1990b, p. 5.
56. EPA 1990b, p. 5.
57. EPA 1990b, p. 6.
58. EPA 1990b, p. 6.
59. Lazkowski 1990, p. 11.
60. Lazkowski 1990, p. 12.
61. Lazkowski 1990, p. 12.
62. Lazkowski 1990, p. 12.
63. Lazkowski 1990, p. 12.
64. Lazkowski 1990, p. 13.
65. du Pont 1990, p. 3.
66. AIPP 1990, p. 8.
67. du Pont 1990, p. 3.
68. See 40 CFR 261.3(6)(2)(i).

69. Kaiser 1990, p. 9.
70. Kaiser 1990, p. 9.
71. Air Products 1990, p. 1.
72. Air Products 1990, p. 2.
73. Young 1991, p. 31.
74. Harold Burghart, Internal Revenue Service, private communication.
75. Kaiser 1990, p. 8.
76. Amoco 1990, p. 2.
77. AIPP 1990, p. 7.
78. AWWA 1990, p. 4.
79. OTA 1986, p. 193.
80. EPA 1990f.
81. Kodak 1991.
82. ICF 1985, p. 124.
83. 55 FR 8292.
84. Pennzoil 1990.
85. Amoco 1990.
86. Phelps Dodge 1991, p. 3.
87. Kennecott 1991, p. 6.
88. Phelps Dodge 1991, p. 4.
89. Phelps Dodge 1991, p. 7.
90. Kaiser 1990, p. 7.
91. Kennecott 1991, p. 7.
92. Phelps Dodge 1991.
93. Union Camp 1990, p. 2.
94. OTA 1986, p. 127.
95. OTA 1986, p. 125.
96. OTA 1986, p. 125.
97. OTA 1986, p. 127.
98. OTA 1986, p. 127.
99. OTA 1986, p. 125.
100. EPA 1988b, p. 25.
101. EPA 1988b, p. 25.
102. OTA 1986, p.147.
103. Amoco 1990, p.6.

104. DOE 1990, p. 1.
105. DOE 1990, p. 1.
106. Teresa Pugh, National Association of Manufacturers, private communication.
107. EPA 1986b, p. 7-19.
108. EPA 1986b, p. 7-25.
109. EPA 1986b, p. 7-33.
110. EPA 1986b, p. 7-36.
111. EPA 1986b, p. 7-37.
112. EPA 1986b, p. 7-42.
113. EPA 1990g, p. 7.
114. OTA 1986, p. 55.
115. EPA 1991a, p. 3-4.
116. EPA 1991a, p. 5-5.
117. EPA 1991a, p. 5-30.
118. OTA 1986, p. 56.
119. EPA 1991a, p. 5-33.
120. EPA 1991a, pp. 4-10, 5-18.
121. Project 88, pp. 22, 70, 75.
122. Bergeson and Campbell, p. 85.
123. EPA 1991a, p. 4-10.
124. Project 88, pp. 21, 26, 32, 55.
125. Bergeson and Campbell, p. 85.
126. EPA 1991a, p. 5-22.
127. Project 88, p. 22.
128. HWRIC 1990, p. 133.
129. HWRIC 1990, p. 133.
130. OTA 1986, p. 55.
131. HWRIC 1990, p. 134.
132. OTA 1986, p. 65.
133. HWRIC 1990, p. 135.
134. EPA 1991a, pp. 5-38 to 5-40.
135. OTA 1986, p. 57.

GLOSSARY

ATP	Advanced Technology Program
BAPP	Best Available Production Process
BDAT	Best Demonstrated Available Technology
CAA	Clean Air Act
CE	DOE's Office of Conservation and Renewable Energy
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFC	Chlorofluorocarbon
CFR	Code of Federal Regulations
CWA	Clean Water Act
DOE	Department of Energy
DOT	Department of Transportation
DP	DOE's Office of Defense Programs
EIES	Electronic Information Exchange System
EM	DOE's Office of Environmental Restoration and Waste Management
EPA	Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FR	Federal Register
GAC	Granular Activated Carbon
HCFC	Hydro-Chlorofluorocarbon
HMTA	Hazardous Materials Transportation Act
HSWA	Hazardous and Solid Waste Amendments
ITP	Industrial Toxics Program (also referred to as the 33/50 Program)
IWRP	OIT's Industrial Waste Reduction Program
LDR	Land Disposal Restriction
MACT	Maximum Achievable Control Technology
MCL	Maximum Contaminant Levels
NAAQS	National Ambient Air Quality Standards
NESHAP	National Emission Standards for Hazardous Air Pollutants
NIMBY	"Not In My Backyard"
NIST	National Institute of Standards and Technology
NO_x	Nitrogen oxides

NPDES	National Pollution Discharge Elimination System
ODC	Ozone-Depleting Chemical
OIT	CE's Office of Industrial Technologies
OSHA	Occupational Safety and Health Act
PCB	Polychlorinated Biphenyl
POTW	Publicly Owned Treatment Works
PPIC	Pollution Prevention Information Clearinghouse
R&D	Research and Development
RCRA	Resource Conservation and Recovery Act
SARA	Superfund Amendments and Reauthorization Act
SDWA	Safe Drinking Water Act
SIC	Standard Industrial Classification
SO_2	Sulfur dioxide
SPCC	Spill Prevention Control and Countermeasures plan
SQG	Small Quantity Generator
SWDA	Solid Waste Disposal Act
TCLP	Toxic Characteristic Leaching Procedure
TRI	Toxics Release Inventory
TSCA	Toxic Substances Control Act
TSD	Treatment, Storage, and Disposal
TSDF	Treatment, Storage, and Disposal Facilities
UIC	Underground Injection Control
USC	United States Code
VOC	Volatile Organic Compounds

BIBLIOGRAPHY

AIPP 1990. Comments of American Institute of Pollution Prevention in response to the Notice on Waste Minimization Incentives (55 FR 40881). EPA Docket No. F-90-IGRP-FFFFF. December, 1990.

Air Products 1990. Comments of Air Products and Chemicals, Inc., in response to the Notice on Waste Minimization Incentives (55 FR 40881). EPA Docket No. F-90-IGRP-FFFFF. December 4, 1990.

Alcoa 1990. Comments of the Aluminum Company of America in response to the Notice on Waste Minimization Incentives (55 FR 40881). EPA Docket No. F-90-IGRP-FFFFF. December 3, 1990.

Aluminum Association 1991. Comments of The Aluminum Association in response to the Notice on Waste Minimization Incentives (55 FR 40881). EPA Docket No. F-90-IGRP-FFFFF. January 18, 1991.

Amoco 1990. Comments of the Amoco Corporation in response to the Notice on Waste Minimization Incentives (55 FR 40881). EPA Docket No. F-90-IGRP-FFFFF.

AWWA 1990. Comments of the American Water Works Association in response to the Notice on Waste Minimization Incentives (55 FR 40881). EPA Docket No. F-90-IGRP-FFFFF. November 27, 1990.

Bergeson, Lynn L., and Lisa M. Campbell. 1991. "Economic Incentives in U.S. Environmental Regulation." *Environmental Finance.* Spring 1991.

Bivins, Dana L., Bertram C. Frey, and Lars Johnson. 1988. "Anti-Backsliding Under the Clean Water Act Amendments of 1987." *Environment Reporter*, 0013-9211/88. Bureau of National Affairs, Inc.

BP 1991. Comments of the BP Oil Company in response to the Notice on Waste Minimization Incentives (55 FR 40881). EPA Docket No. F-90-IGRP-FFFFF. January 18, 1991.

Chevron 1991. Comments of the Chevron Corporation in response to the Notice on Waste Minimization Incentives (55 FR 40881). EPA Docket No. F-90-IGRP-FFFFF. January 10, 1991.

CMA 1990. Comments of the Chemical Manufacturers Association in response to the Notice on Waste Minimization Incentives (55 FR 40881). EPA Docket No. F-90-IGRP-FFFFF.

Cyanamid 1990. Comments of the American Cyanamid Company in response to the Notice on Waste Minimization Incentives (55 FR 40881). EPA Docket No. F-90-IGRP-FFFFF. November 30, 1990.

Cyprus 1991. Comments of Cyprus Copper Company in response to the Notice on Waste Minimization Incentives (55 FR 40881). EPA Docket No. F-90-IGRP-FFFFF. January 16, 1991.

DOE 1990. *Waste Reduction Policy Statement.* Unpublished. Memorandum, U.S. Department of Energy. Washington, D.C. June 27, 1990.

EPA 1991a. *Economic Incentives: Options for Environmental Protection.* 21P-2001. Office of Policy, Planning and Evaluation, U.S. Environmental Protection Agency. Washington, D.C.

EPA 1991b. *Implementation Strategy for the Clean Air Act Amendments of 1990.* Office of Air and Radiation, U.S. Environmental Protection Agency. Washington, D.C.

EPA 1991c. *The Industrial Toxics Project, The 33/50 Program: Forging an Alliance for Pollution Prevention.* EPA 560-1-91-003. U.S. Environmental Protection Agency. Washington, D.C.

EPA 1991d. *Instruction Manual for Premanufacture Notification of New Chemical Substances.* EPA-7710-25(I). Office of Toxic Substances, U.S. Environmental Protection Agency. Washington, D.C.

EPA 1990a. *Clean Air Act Amendments of 1990: Detailed Summary of Titles.* U.S. Environmental Protection Agency. Washington, D.C.

EPA 1990b. *The Clean Air Act Amendments of 1990: Summary Materials.* Office of Air and Radiation, U.S. Environmental Protection Agency. Washington, D.C.

EPA 1990c. *Environmental Investments: The Cost of a Clean Environment.* EPA-230-12-90-084. Office of Policy, Planning and Evaluation, U.S. Environmental Protection Agency. Washington, D.C.

EPA 1990d. *The Nation's Hazardous Waste Management Program at a Crossroads: The RCRA Implementation Study.* EPA/530-SW-90-069. Office of Solid Waste and Emergency Response, U.S. Environment Protection Agency. Washington, D.C.

EPA 1990e. *Pollution Prevention Research Plan: Report to Congress.* EPA/600/9-90/015. Office of Research and Development, U.S. Environment Protection Agency. Washington, D.C.

EPA 1990f. *Toxics in the Community: National and Local Perspectives.* EPA/560/4-90-017. Office of Pesticides and Toxic Substances, U.S. Environment Protection Agency. Washington, D.C.

EPA 1990g. *Waste Minimization: Environmental Quality with Economic Benefits.* EPA/530-SW-90-044. Office of Solid Waste and Emergency Response, U.S. Environment Protection Agency. Washington, D.C.

EPA 1989a. *Case Studies from the Minnesota Technical Assistance Program and the Hazardous Waste Reduction Program of Oregon: Metal Finishing.* Office of Environmental Engineering and Technology Demonstration and Office of Pollution Prevention, U.S. Environmental Protection Agency. Washington, D.C.

EPA 1989b. *Case Studies from the Pollution Prevention Information Clearinghouse (PPIC): Electroplating.* Office of Environmental Engineering and Technology Demonstration and Office of Pollution Prevention, U.S. Environmental Protection Agency. Washington, D.C.

EPA 1989c. *Case Studies from the Pollution Prevention Information Clearinghouse (PPIC): Solvent Recovery.* Office of Environmental Engineering and Technology Demonstration and Office of Pollution Prevention, U.S. Environmental Protection Agency. Washington, D.C.

EPA 1989d. *Pollution Prevention in Metal Manufacturing: Saving Money Through Pollution Prevention.* EPA/530-SW-89-056. Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency. Washington, D.C.

EPA 1989e. *PPIC: The Pollution Prevention Information Clearinghouse.* Office of Environmental Engineering and Technology Demonstration and Pollution Prevention Office, U.S. Environmental Protection Agency. Washington, D.C.

EPA 1989f. *U.S. EPA Pollution Prevention Information Clearinghouse (PPIC): Electronic Information Exchange System (EIES) -- User Guide, Version 1.1.* EPA/600-9-89/086. Office of Environmental Engineering and Technology Demonstration and Pollution Prevention Office, U.S. Environment Protection Agency. Washington, D.C.

EPA 1989g. *Waste Minimization in Metal Parts Cleaning.* EPA/530-SW-89-049. Office of Solid Waste and Emergency Response, U.S. Environment Protection Agency. Washington, D.C.

EPA 1988a. *Report to Congress: Solid Waste Disposal in the United States.* EPA/530-SW-88-011. Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency. Washington, D.C.

EPA 1988b. *Waste Management Opportunity Assessment Manual.* EPA/625/7-88/033. Hazardous Waste Engineering Research Laboratory, U.S. Environmental Protection Agency. Cincinnati, Ohio.

EPA 1987a. *Superfund.* WH/FS-87-001R. Office of Emergency and Remedial Response, U.S. Environmental Protection Agency. Washington, D.C.

EPA 1987b. *Waste Minimization.* EPA/530-SW-87-026. Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency. Washington, D.C.

EPA 1986a. *Report to Congress: Minimization of Hazardous Waste.* EPA/530-SW-86-033. Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency. Washington, D.C.

EPA 1986b. *Waste Minimization: Issues and Options.* EPA Contract No. 68-01-7053, Task No. 17. Prepared for the U.S. Environmental Protection Agency by Versar, Inc., and Jacobs Engineering Group. Washington, D.C.

EPA 1984. *The Toxic Substance Control Act.* EPA 560/1-83-002. Office of Toxic Substances, U.S. Environmental Protection Agency. Washington, D.C.

Garrett, Theodore L. 1987. "Examination of 1987 Amendments to Clean Water Act Shows Refinement of Existing Programs, Addition of New Ones." *Environment Reporter,* 0013-9211/87. Bureau of National Affairs, Inc.

GCMC 1990. Comments of Gulf Chemical and Metallurgical Corporation in response to the Notice on Waste Minimization Incentives (55 FR 40881). EPA Docket No. F-90-IGRP-FFFFF. December 4, 1990.

GPP 1991. *Proceedings of the Global Pollution Prevention - '91 Conference and Exhibition.* Edited by Lorraine R. Penn. Washington, D.C. April 3-5, 1991.

Hinds, Richard deC., and James W. Conrad, Jr. 1987. "Reporting Requirements for Chemicals Leaks and Spills." *Environment Reporter,* 0013-9211/87. Bureau of National Affairs, Inc.

Hogeland, Andrew. 1988. "EPA's Pretreatment Regulation Amendments: Forcing Enforcement." *Environment Reporter,* 0013-9211/88. Bureau of National Affairs, Inc.

Howard, Jeffrey H. and Linda B. Benfield. 1988. "CERCLA Liability for Hazardous Waste Generators: How Far Does Liability Extend?" *Environment Reporter,* 0013-9211/88. Bureau of National Affairs, Inc.

HWRA 1989. Hearing before the Subcommittee on Transportation and Hazardous Waste of the Committee on Energy and Commerce, House of Representatives, One Hundred First Congress, First Session, on H.R. 1457 (Hazardous Waste Reduction Act). Serial No. 101-35. U.S. Government Printing Office. Washington, D.C.

HWRIC 1990. *Industrial Waste Reduction: State Policy Options.* P.A. 85-1196. Illinois Department of Energy and Natural Resources, Hazardous Waste Research and Information Center. Chicago, Illinois.

ICF 1985. *Economic Incentives for the Reduction of Hazardous Waste: Appendices to Final Report.* Contract No. 84-84451. Prepared for the California Department of Health Services by ICF Consulting Associates, Incorporated.

Kaiser 1990. Comments of Kaiser Aluminum & Chemical Corporation in response to the Notice on Waste Minimization Incentives (55 FR 40881). EPA Docket No. F-90-IGRP-FFFFF. December 3, 1990.

Kennecott 1991. Comments of Kennecott Utah Copper in response to the Notice on Waste Minimization Incentives (55 FR 40881). EPA Docket No. F-90-IGRP-FFFFF. January 18, 1991.

Kodak 1991. Comments of Eastman Chemical Company in response to the Notice on Waste Minimization Incentives (55 FR 40881). EPA Docket No. F-90-IGRP-FFFFF. January 18, 1991.

Lazkowski, Stanley. 1990. *Pollution Prevention Act of 1990.* Memorandum to the Pollution Prevention Advisory Committee, U.S. Environmental Protection Agency. Washington, D.C.

LaCroix, Catherine James. 1987. "Waste Minimization: The Goal is Laudable, But the Meaning Debatable." *Environment Reporter*, 0013-9211/87. Bureau of National Affairs, Inc.

Macko, Carole L. 1990. "Pollution Prevention Act Sharpens Teeth of TRI Enforcement Program." *Special Analysis: A Supplement to BNA's Right-to-Know Planning Guide*, 0-87179-939-1/90. Bureau of National Affairs, Inc.

OTA 1987. *From Pollution to Prevention: A Progress Report on Waste Reduction.* OTA-ITE-347. Office of Technology Assessment, U.S. Congress. Washington, D.C.

OTA 1986. *Serious Reduction of Hazardous Waste for Pollution Prevention and Industrial Efficiency.* OTA-ITE-317. Office of Technology Assessment, U.S. Congress. Washington, D.C.

Pennzoil 1991. Comments of the Pennzoil Company in response to the Notice on Waste Minimization Incentives (55 FR 40881). EPA Docket No. F-90-IGRP-FFFFF. January 18, 1991.

Phelps Dodge 1991. Comments of the Phelps Dodge Corporation in response to the Notice on Waste Minimization Incentives (55 FR 40881). EPA Docket No. F-90-IGRP-FFFFF. January 17, 1991.

P.L. 91-596. *Occupational Safety and Health Act of 1970.* Public Law 91-596. December 29, 1970.

P.L. 93-577. *Federal Non-Nuclear Energy Research and Development Act of 1974.* Public Law 93-577. December 31, 1974.

P.L. 93-633. *Hazardous Materials Transportation Act of 1975.* Public Law 93-633. January 3, 1975.

P.L. 94-580. *Resource Conservation and Recovery Act.* Public Law 94-580.

P.L. 95-217. *Clean Water Act of 1977.* Public Law 95-217. December 28, 1977.

P.L. 96-510. *Comprehensive Environmental Response, Compensation, and Liability Act.* Public Law 96-510. December 11, 1980.

P.L. 98-616. *Hazardous and Solid Waste Amendments of 1984.* Public Law 98-616. November 8, 1984.

P.L. 99-499. *Superfund Amendments and Reauthorization Act.* Public Law 99-499. October 17. 1986.

P.L. 99-514. *Tax Reform Act of 1986.* Public Law 99-514. October 22, 1986.

P.L. 100-368. *Toxic Substances Control Act.* Public Law 100-368. July 18, 1988.

P.L. 100-418. *Omnibus Trade and Competitiveness Act of 1988.* Public Law 100-418. August 23, 1988.

P.L. 100-572. *Safe Drinking Water Act.* Public Law 100-572. October 31, 1988.

P.L. 101-549. *Clean Air Act Amendments of 1990.* Public Law 101-549. November 15, 1990.

P.L. 101-580. *Revenue Reconciliation Act of 1990.* Public Law 101-580. November 5, 1990.

P.L. 101-624. *Federal Insecticide, Fungicide, and Rodenticide Act.* Public Law 101-624. November 30, 1990.

Project 88. *Project 88: Harnessing Market Forces to Protect Our Environment.* A Public Policy Study sponsored by Senator Timothy E. Wirth (Colorado) and Senator John Heinz (Pennsylvania). December 1988.

Tufts 1986. *Foreign Practices in Hazardous Waste Minimization.* Center for Environmental Management, Tufts University. Medford, Massachusetts.

Union Camp 1990. Comments of the Union Camp Corporation in response to the Notice on Waste Minimization Incentives (55 FR 40881). EPA Docket No. F-90-IGRP-FFFFF. December 4, 1990.

Unocal 1991. Comments of the Unocal Corporation in response to the Notice on Waste Minimization Incentives (55 FR 40881). EPA Docket No. F-90-IGRP-FFFFF. January 17, 1991.

Wheeling 1990. Comments of the Wheeling-Pittsburgh Steel Corporation in response to the Notice on Waste Minimization Incentives (55 FR 40881). EPA Docket No. F-90-IGRP-FFFFF. December 3, 1990.

Wigglesworth, David. 1988. *Profiting from Waste Reduction in Your Small Business.* Alaska Health Project.

Young, John, E. 1991. *Discarding the Throwaway Society.* Worldwatch Paper 101. Worldwatch Institute. Washington, DC.

26 CFR. Internal Revenue, Code of Federal Regulations.

26 USC. Internal Revenue, United States Code.

29 CFR. Labor, Code of Federal Regulations.

29 USC. Labor, United States Code.

40 CFR. Protection of Environment, Code of Federal Regulations.

42 USC. The Public Health and Welfare, United States Code.

49 CFR. Transportation, Code of Federal Regulations.

49 USC. Transportation, United States Code.

55 FR. Federal Register, 1990.

56 FR. Federal Register, 1991.

END

DATE
FILMED
01/08/92