**FINAL DRAFT: July 1999**

# ASSESSMENT OF THE POTENTIAL COSTS, BENEFITS, & OTHER IMPACTS OF THE HAZARDOUS WASTE COMBUSTION MACT STANDARDS: FINAL RULE


Economics, Methods, and Risk Analysis Division
Office of Solid Waste
U.S. Environmental Protection Agency
401 M Street, SW
Washington, DC 20460

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This report contains portions of the economic impact analysis report that are related to the industry profile.

## OVERVIEW OF COMBUSTION PRACTICES AND MARKETS — CHAPTER 2

This chapter presents an overview of the hazardous waste combustion industry to provide a context for assessing the costs and economic impacts of the rule. Various aspects of the combustion industry, from economic and technological issues to combustion facility relationships, can have a significant impact on the effects of the MACT standards. In this chapter, we first describe the types of facilities that combust hazardous waste and characterize the current market structure. We then discuss the quantity and characteristics of combusted hazardous wastes, and the industries that generate these wastes. Following this, we present an overview of waste burning services and the factors that underlie the demand for these services. We then describe the current regulatory framework and the types of pollution control devices currently in place at combustion facilities. Finally, we explore the current market and financial performance of the various combustion industry sectors.

### COMBUSTION MARKET OVERVIEW

Three key segments constitute the hazardous waste combustion industry: hazardous waste generators, fuel blenders and other intermediaries (e.g. waste brokers), and commercial combustion facilities.[1] We illustrate the market structure and waste flows in Exhibit 2-1. As shown in the exhibit, some hazardous waste generators manage their wastes on-site and some send their wastes directly to commercial combustion facilities such as commercial incinerators and less often directly to waste-burning kilns.[2] Other generators manage their wastes through waste brokers or fuel blenders, who subsequently send the wastes to commercial combustion facilities.

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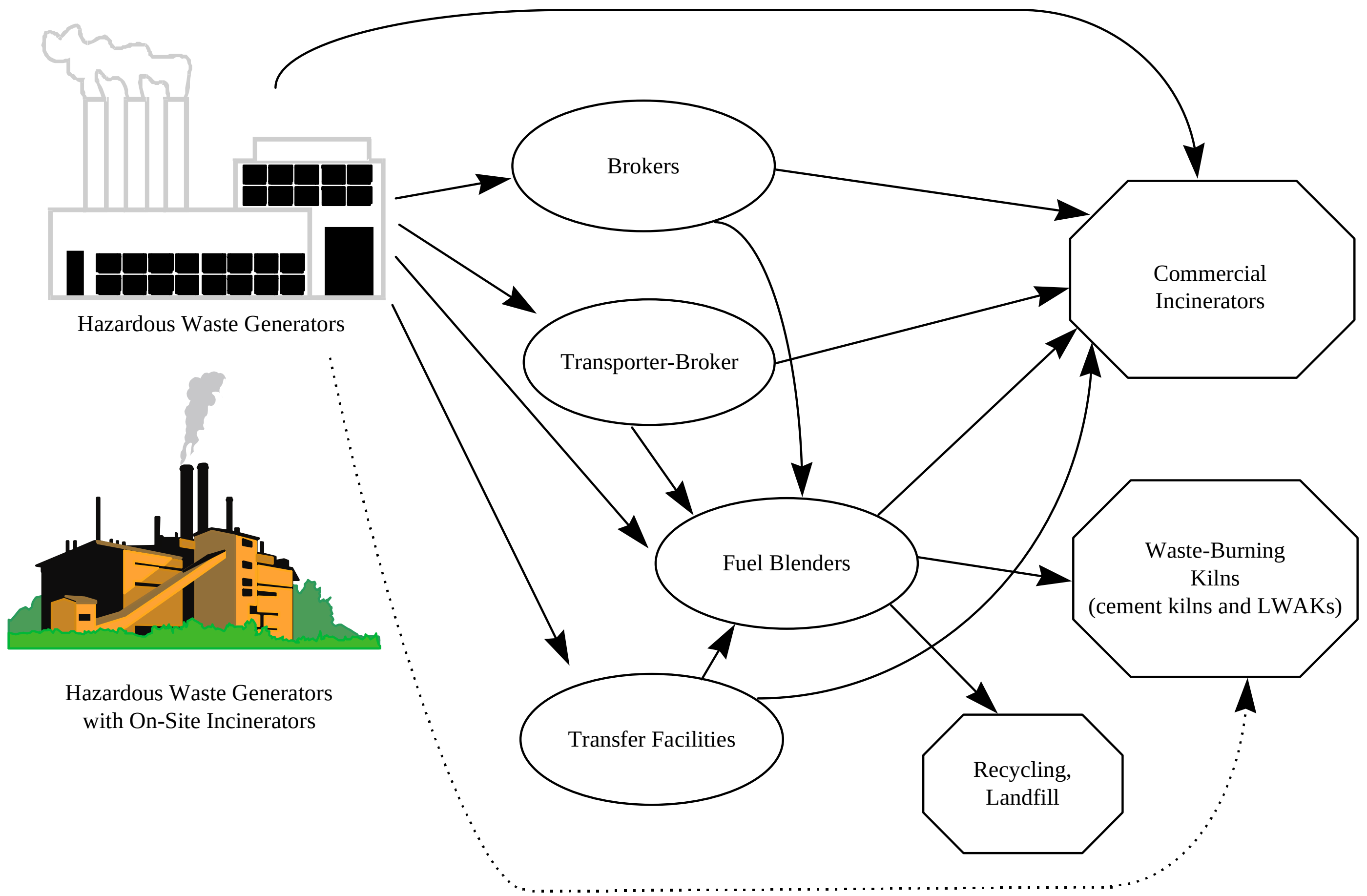
[1] Some generators also burn their hazardous wastes on-site in boilers. Because this rulemaking does not regulate on-site hazardous waste boilers and the boilers do not significantly affect market dynamics, we do not discuss them in the *Assessment*.

[2] The commercial/non-commercial division is not always clear-cut; a few generating facilities with on-site incinerators do accept some waste commercially even though most of the waste burned originates on-site.

## Exhibit 2-1

## HAZARDOUS WASTE COMBUSTION MARKET STRUCTURE




Note: The dotted line indicates that few generators send wastes directly to kilns; most generators send wastes to some type of intermediary who in turn, send the wastes to kilns.

## Types of Combustion Facilities

Hazardous waste is combusted at three main types of facilities: commercial incinerators, on-site incinerators, and waste-burning kilns. In addition, the MACT standards also apply to mobile incinerators, which are used to treat soils and other contaminated media at Superfund sites.[3] These combustion units are called mobile incinerators because they are transported to hazardous waste sites as complete units or as parts which are later re-assembled. Because only a few mobile incinerators are currently operational, the incremental costs and resulting economic impacts of regulating mobile incinerators are expected to be small relative to the total national costs of the rule.[4] For this reason, this *Assessment* does not include mobile incinerators in the cost, economic impact, and benefit analyses.

Incinerators generally burn wastes to destroy toxic characteristics, although some also recover a portion of the energy contained in the wastes.[5] Commercial incineration facilities manage a wide variety of waste streams generated across a range of industries. On-site incinerators tend to manage waste streams with more uniform characteristics generated by certain product lines. Commercial incinerators, therefore, tend to be larger in size and are generally designed as rotary-kilns, which can manage solid wastes as well as liquid wastes. On-site incinerators may be designed as liquid-injection incinerators, which handle liquids and pumpable solids, or as rotary kilns, depending on the wastes generated and burned at these facilities.

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[3] Technically, mobile and transportable incinerators differ in that firms can move a mobile incinerator as a single unit but must disassemble, transport, and reassemble a transportable incinerator. The MACT standards, however, consider both types of incinerators as mobile incinerators.

[4] Using EPA's BRS database, the RCRA Corrective Action Information Database (RCAID), and the Resource Conservation and Recovery Information System (RCRIS), between six and 12 mobile incinerators are currently operational in the United States. (Gwen Fairweather et al, ICF Incorporated, "Memorandum: QRT #1, WAB-30, EPA Contract 68-W6-0061," prepared for Lyn Luben, U.S. EPA, June 12, 1998).

[5] Energy recovery is possible at incinerators if they burn the cleaner liquid solvent streams to fuel their afterburners. (Phil Retallick, Rollins Environmental Services, personal communication, September 13, 1994.)

In contrast, cement kilns and lightweight aggregate kilns (LWAKs) burn hazardous wastes to generate heat and/or power for manufacturing purposes. While kilns traditionally burned conventional fuels like coal and oil, the high energy requirements of manufacturing cement and lightweight aggregate motivated many firms to modify their kilns to burn hazardous wastes as well.[6] Using hazardous waste as fuel provides two primary benefits to kilns: reduced energy requirements and additional revenues from tipping fees paid by generators or fuel blenders to kilns for managing the hazardous waste. Cement kilns and lightweight aggregate kilns can also incorporate a portion of the residual ash from combustion (of both hazardous and non-hazardous fuels) in their products, slightly reducing raw material requirements.

**Number of Combustion Facilities**

One hundred seventy two facilities are currently permitted to burn hazardous waste in the United States.[7] As shown in Exhibit 2-2, on-site incinerators comprise the greatest percentage of combustion facilities, with 129 on-site incinerators.[8] The commercial sector includes a relatively small number of facilities, with only 20 commercial incineration facilities, 18 cement kiln facilities, and five lightweight aggregate kiln facilities.

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[6] However, due to limitations on the quantities of hazardous waste that facilities can burn without affecting product quality, conventional fuels still provide the majority of the energy needed to produce cement. (Portland Cement Association. June 1994. *U.S. Cement Industry Fact Sheet Twelfth Edition*, 17.)

[7] Using additional information, we updated the 1997 list of combustion facilities to establish this universe of 172 combustion facilities.

[8] As previously discussed, between six to twelve mobile incinerators are currently in operation, but we do not include them in our analysis because they represent a small portion of the total incinerators currently burning hazardous waste.

**Exhibit 2-2**

**UNIVERSE OF REGULATED ENTITIES**

| **Type of Combustion Device** | **Estimated Number of Systems** | **Number of Facilities** | **Average Waste Burning Systems/Facility** |
|---|---|---|---|
| Cement kilns | 33 | 18 | 1.83 |
| Lightweight aggregate kilns | 10 | 5 | 2.00 |
| Commercial incinerators | 26 | 20 | 1.30 |
| On-site incinerators | 163 | 129 | 1.24 |
| **Total** | **232** | **172** | **1.35** |

**Notes:**
(1) The analysis includes facilities that are currently burning hazardous waste, as well as facilities that are no longer burning but have not commenced formal closure procedures.
(2) We do not include mobile incinerators in this analysis.

**Sources:**
(1) U.S. EPA, PSPD, List of Permitted Hazardous Waste Combustion Facilities, February 1996.
(2) Update of OSW Hazardous Waste Combustion Database (Revised Technical Standards for Hazardous Waste Combustion Facilities, NODA, January 7, 1997 (62 FR 960.)

As shown in Exhibit 2-3, at a given location, a facility may have more than one combustion system. In general, a combustion system has one combustion unit connected to a single stack. However, some systems have multiple units connected to a shared single stack. Because most systems comprise only one unit and because this distinction is not critical to the analysis and presentation of the *Assessment*, we use the terms "system" and "unit" interchangeably.

The number of systems per facility ranges from one to four. On average, cement kilns and lightweight aggregate kilns have more waste burning combustion systems per facility than do incinerators. On-site facilities have the lowest average number of systems per facility.

## On-Site Versus Commercial Combustion

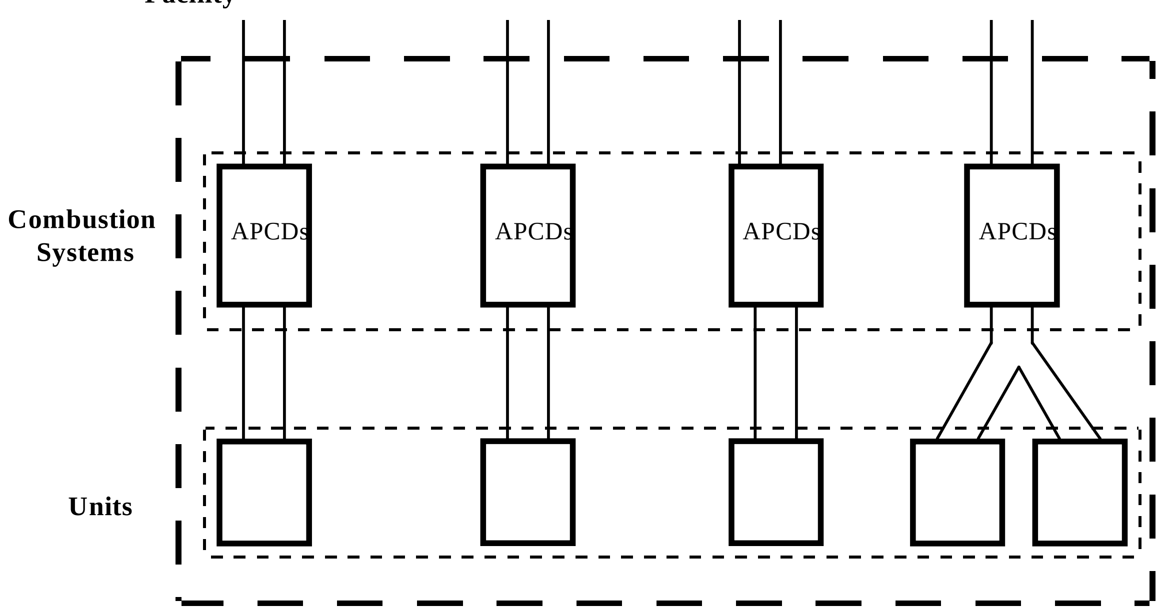
Companies that generate large quantities of hazardous waste typically choose to combust the waste themselves. These non-commercial facilities are usually located at the generator's production site, and are referred to throughout this report as "on-site" incinerators. Generators choose to burn their wastes on-site rather than sending wastes off-site for several reasons:

- The costs of on-site combustion are often less than the costs of managing wastes at commercial facilities, especially for large quantity generators.
- Generators remain somewhat insulated from price fluctuations in the commercial sector.
- Generators of specialized wastes may not be able to send their wastes off-site because commercial incinerators will not accept certain wastes (e.g., explosives) or because transportation is too risky or difficult (e.g., gaseous wastes).
- Finally, generators limit liability risks by controlling the entire treatment process. For many firms, cradle-to-grave internal waste management is a corporate policy.

For facilities that generate small to medium quantities of waste and do not already have an incinerator, paying a commercial facility to burn the waste is usually less costly than constructing and maintaining an on-site incinerator.

**Exhibit 2-3**

**COMBUSTION FACILITY STRUCTURE**



## Fuel Blenders and Other Intermediaries

Hazardous waste combustion intermediaries include waste brokers and fuel blenders. Waste brokers arrange the movement of wastes from the generator to the combustion facility without additional processing. In contrast, fuel blenders collect waste from a number of generators and process it to meet the requirements of their customers in the commercial combustion market, primarily cement kilns.[9] As of March 1997, 92 active fuel blenders were in operation, compared to 58 in 1996, 73 in 1993, and 74 in 1994.[10] Many of these fuel blenders are vertically integrated with kilns, and may be located on-site or adjacent to the cement facility.[11] The National Association of Chemical Recyclers (NACR) estimates that 55 percent of the waste received by its membership is recycled (often at solvent recovery facilities), while kilns use 45 percent as fuel.[12]

Fuel blenders mix wastes used as fuels to meet customer requirements for energy content, viscosity, and acceptable concentrations of hazardous constituents. A consistent energy content is important for both kilns and incinerators. For kilns, the waste fuels replace conventional fuels in a production process with specific energy requirements. For incinerators, a variable thermal loading can reduce efficiency and potentially damage the combustion unit. Viscosity affects the ability to pump wastes into the combustion chamber in a uniform manner. Criteria for hazardous constituent concentrations are important both for controlling emissions and for protecting the stability of the production process and the quality of the product (in the case of cement kilns and LWAKs). Fuel blenders have continually worked to improve their blending abilities, and have had a large impact on hazardous waste combustion markets. We discuss activity of fuel blenders in more detail below.

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[9] See Daphne McMurrer, Bob Black, and Tom Walker, Industrial Economics, Inc., "Memorandum: The Processing and Use of Waste Fuels," prepared for Lisa Harris, Office of Solid Waste, U.S. EPA, December 13, 1994.

[10] These figures were derived from the U.S. EPA, 1993 Biennial Reporting System (BRS); the U.S. EPA, 1995 Biennial Reporting System (BRS); and Allen White and David Miller, Tellus Institute, "Economic Analysis of Waste Minimization Alternatives to Hazardous Waste Combustion," prepared for U.S. EPA, July 24, 1997.

[11] In a CKRC survey of 21 cement companies, 17 facilities reported having fuel blending done on-site or adjacent to the facility. Cement Kiln Recycling Coalition. Fall 1994. "CKRC Cement Facility Questions on Hazardous Waste Fuel Blending and Burning."

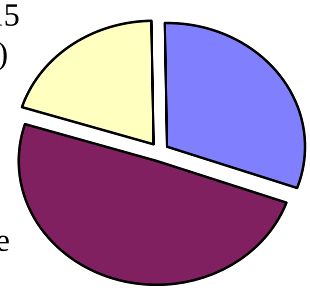
[12] Chris Goebel, National Association of Chemical Recyclers, personal communication, May 20, 1997.

## CHARACTERISTICS OF COMBUSTED WASTE

Waste quantities burned at combustion facilities are a function of industrial activities in generating industries (e.g., chemicals, pharmaceuticals), regulatory requirements, remedial activity, and available waste management substitutes. In 1995 combustion facilities burned about three million tons of hazardous waste annually. As shown in Exhibit 2-4, on-site incinerators burned about 49 percent of the total combusted wastes. Commercial kilns burned approximately 31 percent, and commercial incinerators burned the remainder.[13]

**Exhibit 2-4**

**WASTE QUANTITIES MANAGED BY COMBUSTION SYSTEMS (Tons)**




Total Demand: 3,282,995

Source: EPA Biennial Reporting System.

**Notes:**

1) We adjusted the on-site/captive incinerator tons data to account for a data entry error involving the Dow facility in Plaquemine, L.A. While available 1995 BRS data indicate that the facility combusted 2,099,059 tons of waste, the facility actually combusted 22,639 tons.
2) This analysis excludes wastes burned at mobile incinerators.

[13] U.S. EPA. 1995. Biennial Reporting System (BRS).

In general, hazardous waste used for fuel in cement kilns and LWAKs differs from the waste burned at commercial facilities. Waste burned in kilns tends to be liquid, high-Btu waste (e.g., solvents and organic liquids) that is most suitable for use as fuels. This type of waste is easy to pump, burns cleanly, and results in a relatively small amount of solid residue. Under the Boiler and Industrial Furnace (BIF) rule,[14] the waste burned for energy recovery must have a minimum heat value of 5,000 Btu/lb. In practice, the blended waste burned by cement kilns has an average heat value of 12,000 Btu/lb.[15]

Wastes burned in incinerators include streams that kilns cannot accept, such as highly contaminated solids with low heating value. In addition, incinerators also burn liquid wastes and solids with low levels of contaminants. Unlike kilns, incinerators burn waste that typically has a low heat value; the average is only 6,700 Btu/lb.[16] Incinerators often supplement wastes with conventional fuels to ensure temperatures high enough to destroy organic toxics.

Increasingly, improvements in blending technologies and storage units are allowing kilns to handle more solids and other wastes that have historically been sent to commercial incinerators.[17] Fuel blenders can mix solids and other wastes together with high Btu liquid wastes to create a slurry suitable for use as fuel. According to industry representatives, in 1997 hazardous wastes used as fuel typically contained between 20-25 percent suspended solids.[18] Blending also ensures that contaminants, such as metals and chlorine, do not exceed allowable levels in fuels sent to combustion units.

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[14] The final rule was published on February 21, 1991 (56 FR 7134).

[15] The 1994 weighted average heat value of fuels supplied to kilns by fuel blenders in the National Association of Chemical Recyclers (NACR) was 12,073 Btu/lb., with a minimum value of 8,800 Btu/lb. and a maximum of 14,000 Btu/lb. See NACR, *NACR Waste Processing Survey*, August 1994, question 1. Values vary by type of waste; see Appendix B for heat content values assumed in the EPA economic impact model.

[16] Average heat content of waste at medium and large commercial rotary kiln incinerators from Energy and Environmental Research Corporation combustion database.

[17] Technology improvements in storage units include improved dispersion tanker with agitators and storage tanks with pulverizers. These technologies keep the solids mixed with the liquids and ensure that the slurry is pumpable.

[18] Personal communication with fuel blender, May 29, 1997.

## MAJOR SOURCES OF COMBUSTED HAZARDOUS WASTES

Most of the waste managed by combustion comes from a relatively narrow set of industries as shown in Exhibit 2-5. The entire chemical industry in 1995 generated 74 percent of combusted waste.[19] Within this sector, the organic chemicals subsector was the largest source of waste sent to combustion, providing about 32 percent of all combusted waste. The pesticide and agricultural chemical industry generated 12 percent of the total. No other single sector generated more than 10 percent of the total.

## MARKET AND REGULATORY FORCES INFLUENCING COMBUSTION INDUSTRY

Regulatory requirements, liability concerns, and economics affect the demand for combustion services. Regulatory forces influence the demand for combustion by mandating certain hazardous waste treatment standards and by establishing technical requirements for the combustion systems. Liability concerns of waste generators affect combustion demand because combustion, by destroying organic wastes, greatly reduces the risk of future environmental problems.[20] Finally, if alternative management options are more expensive, hazardous waste generators will likely choose to combust their wastes to increase their overall profitability. However, this industry is not a fluid market and changes in waste management practices often present logistical and regulatory challenges. For example, a firm that wants to burn its own wastes faces many barriers, mostly regulatory, and typically require very long lead times.

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[19] We exclude industries with SICs corresponding to refuse systems from our analysis because they are likely to be fuel blenders.

[20] Note that some, albeit much reduced, liability exposure remains in the form of residual incinerator ash that must be disposed of in a hazardous waste landfill. With some cement kilns and LWAKs, even this problem is minimal because much of the combustion residuals are integrated into the product.

**Exhibit 2-5**

**INDUSTRIAL SECTORS GENERATING COMBUSTED WASTE, 1995**

| | SIC Code | Corresponding NAIC Codes | Volume (tons) | % of Volume |
|---|---|---|---|---|
| Industrial Organic Chemicals, N.E.C. | 2869 | 32511, 325188, 325193, 32512, 325199 | 853,216 | 31.82 |
| Pesticides and Agricultural Chemicals, N.E.C. | 2879 | 32532 | 321,869 | 12.00 |
| Business Services, N.E.C. | 7389 | 51224, 51229, 541199, 81299, 54137, 54141, 54142, 54134, 54149, 54189, 54193, 54135, 54199, 71141, 561421, 561422, 561439, 561431, 561491, 56191, 56179, 561599, 56192, 561591, 52232, 561499, 56199 | 245,241 | 9.15 |
| Organic Fibers, noncellulosic | 2824 | 325222 | 190,209 | 7.09 |
| Medicinal Chemicals and Botanical Products | 2833 | 325411 | 157,520 | 5.87 |
| Pharmaceutical Preparations | 2834 | 325412 | 105,881 | 3.95 |
| Plastics Materials and Resins | 2821 | 325211 | 93,043 | 3.47 |
| Petroleum Refining | 2911 | 32411 | 92,023 | 3.43 |
| Industrial Inorganic Chemicals, N.E.C. | 2819 | 325998, 331311, 325131, 325188 | 64,826 | 2.42 |
| Unknown | | | 61,487 | 2.29 |
| Nonclassifiable Establishments | 9999 | | 46,108 | 1.72 |
| Services, N.E.C. | 8999 | 71151, 51221, 54169, 51223, 541612, 514199, 54162 | 30,585 | 1.14 |
| Paints, Varnishes, Lacquers, Enamels | 2851 | 32551 | 29,837 | 1.11 |
| Cyclic Organic Crudes and Intermediates, and Organic Dyes and Pigments | 2865 | 32511, 325132, 325192 | 29,667 | 1.11 |

**Exhibit 2-5 (cont.)**

**INDUSTRIAL SECTORS GENERATING COMBUSTED WASTE, 1995**

| | SIC Code | Corresponding NAIC Codes | Volume (tons) | % of Volume |
|---|---|---|---|---|
| Air, Water, and Solid Waste Management | 9511 | 92411 | 28,033 | 1.05 |
| Photographic Equipment and Supplies | 3861 | 333315, 325992 | 27,356 | 1.02 |
| Scrap and Waste Materials | 5093 | 42193 | 18,768 | 0.70 |
| Synthetic Rubber (Vulcanizable Elastomers) | 2822 | 325212 | 17,025 | 0.63 |
| Special Warehousing and Storage, N.E.C. | 4226 | 49312, 49311, 49319 | 14,914 | 0.56 |
| Primary Aluminum | 3334 | 331312 | 12,648 | 0.47 |
| Chemicals and Chemical Preparations, N.E.C. | 2899 | 32551, 311942, 325199, 325998 | 10,303 | 0.38 |
| Sanitary Services, N.E.C. | 4959 | 48819, 56291, 56171, 562998 | 10,089 | 0.38 |
| Alkalies and Chlorine | 2812 | 325181 | 9,567 | 0.36 |
| Local and Suburban Transit | 4111 | 485111, 485112, 485113, 485119, 485999 | 9,471 | 0.35 |
| Chemicals and Allied Products, N.E.C. | 5169 | 42269 | 7,337 | 0.27 |
| All Other SIC Codes | | | 201,826 | 7.53 |
| Total: | | | 2,681,509 | 100.00 |

**Notes:**

1) We exclude refuse systems (SIC code 4953) from the analysis because they are likely to be fuel blenders; our intent was to characterize the original sources of hazardous waste.

2) We adjusted the tons data to account for a data entry error involving the Dow facility in Plaquemine, LA. While the state-reported data used in the 1995 BRS indicate that the facility combusted 2,099,059 tons of waste, the facility actually combusted 22,639 tons.

3) The total tons listed does not equal the total in Exhibit 2-4 because only the 1995 BRS GM forms contained SIC codes, yet the GM forms do not capture data from small quantity generators. (To obtain the information in Exhibit 2-4 we were able to use the 1995 BRS WR forms, which list the wastes received from small and large quantity generators.) In addition, reporting errors on the part of generators and data entry errors on the part of EPA affect the accuracy of the tons combusted.

Source: 1995 BRS data.

## Regulatory Requirements Encouraging Combustion

While industry began incinerating some of their hazardous wastes as early as the late 1950s, the current market for hazardous waste combustion emerged largely from EPA regulation of hazardous waste disposal. Two major regulatory forces directly encouraging combustion are the land disposal restrictions under the Hazardous and Solid Waste Amendments (HSWA) of 1984 and the "Records of Decision (RODs)" documenting clean-up agreements for Superfund sites.[21]

EPA's Land Disposal Restrictions (LDRs) prohibit hazardous waste generators from sending untreated wastes directly to landfills and mandate alternative waste treatments, known as Best Demonstrated Available Technologies (BDATs). Many of these standards are based on the performance of combustion technology.

The Records of Decision establish the cleanup plan for contaminated sites under the Comprehensive Environmental Reclamation, Compensation, and Liability Act (CERCLA). Since contaminated soil at Superfund sites is subject to the LDRs, incineration is sometimes a technology chosen during remediation. Between 1982 and 1991, incineration was the single source control remedy selected most often (in 28 percent of the RODs issued).[22] In more recent years, however, use of incineration as the cleanup method at Superfund sites has been declining. Through fiscal year 1995, EPA chose incineration as the cleanup method in only 6 percent (43 times) of the RODs issued.[23]

The percentage of source control RODs stipulating *mobile* incinerators as the management technology started at about 6 percent in 1986 and increased to about 11 percent in 1987. In recent years, however, the use of mobile incinerators to treat hazardous waste at Superfund sites has also declined. Since Superfund cleanups create the majority of the demand for mobile thermal treatment units, the demand for mobile incinerators has decreased significantly. In 1994 and 1995, for example, treatment remedies at Superfund sites declined as containment-only remedies increased; in addition, *within* the category of treatment remedies selected by EPA, mobile incinerators' share decreased steadily. By 1995 mobile incinerators constituted only 4 percent of the treatment technologies selected by EPA.[24]

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[21] Robert Graff and Thomas Walker, Industrial Economics, Inc., "Factors that Require, Encourage, or Promote Combustion of Hazardous Waste," memorandum to Walter Walsh, Office of Policy Analysis, U.S. EPA, November 11, 1993, 12.

[22] Graff and Walker, op. cit., p. 10.

[23] US General Accounting Office. 1997. *Superfund: EPA Could Further Ensure the Safe Operation of On-Site Incinerators.*

[24] US EPA, Solid Waste and Emergency Response, Technology Innovation Office. 1997. "Clean Up the Nation's Waste Sites: Markets and Technology Trends: 1996 Edition."

Other pending EPA rules could also affect the combustion industry. For example, the Hazardous Waste Identification Rule (HWIR) could potentially reduce the quantity of waste sent to combustion facilities as some treated hazardous wastes could exit the RCRA Subtitle C regulatory system. The HWIR media rule would have a similar effect on the combustion industry because the rule gives generators of clean-up wastes greater flexibility in managing their wastes on-site.[25]

## Liability Concerns

Remediation regulations also affect generators' hazardous waste management policies by increasing firms' liability. For example, CERCLA created a liability system in which a generator that ships waste to a licensed disposal site can be liable for up to the entire cost to clean the site if environmental damages occur. With such large potential costs, generators found combustion's ability to destroy the wastes, rather than simply dispose of them, extremely attractive.

Fears of product liability exposure through the courts have also increased demand for combustion. In addition, many manufacturers want to be certain that off-specification products (e.g., pharmaceuticals) are destroyed so they do not illegally enter the market. The Hazardous Waste Treatment Council estimated that 15 to 30 percent of waste handled by destructive incineration is not classified as hazardous by any agency.[26]

## Economic Forces Encouraging Combustion

Economic forces can encourage combustion over alternative treatment in various ways. For example, combustion can treat a wide variety of waste streams and may be cheaper than segregating and managing streams with different methods.[27]

[25] "Redefining Hazardous Waste." 1996. *Environmental Business Journal*, 5.

[26] However, this non-hazardous waste helps combustion units cover their fixed costs of operation, an important attribute during periods of excess combustion capacity. (Graff and Walker, op. cit, pp. 15-16.)

[27] For larger waste streams, however, waste segregation can often lead to large cost savings because it allows facilities to handle less toxic fractions less expensively.

## CURRENT REGULATORY FRAMEWORK

A number of regulations govern emissions from combustion units and the processes by which residuals must be managed. Because different sets of regulations apply to different segments of the combustion market, they influence the relative costs across different combustion sectors. Below, we discuss the regulatory framework separately for waste-burning kilns and hazardous waste incinerators (both commercial and on-site units). We then explain the regulations that govern ash disposal from combustion facilities. Finally, we explain how the regulations may affect the nature of competition across sectors of the combustion market.

### Regulations Governing Hazardous Waste-Burning Kilns

Currently, emissions from hazardous waste-burning kilns are regulated under the 1991 Boiler and Industrial Furnace Rule.[28] This rule establishes destruction and removal efficiency requirements (DREs) for dioxin-listed wastes and other organic hazardous wastes. In addition, the rule establishes emission limits for toxic metals, hydrogen chloride, chlorine, and particulate matter. The rule also controls products of incomplete combustion (PICs) by limiting flue gas concentrations of carbon monoxide and hydrocarbons. In addition, the rule establishes Part B RCRA permit requirements to ensure that kilns are operating within the specifications of the rule. Although several waste-burning kilns have applied for final Part B RCRA permits, as of mid-1997 only one of these facilities has actually obtained a final permit. Hazardous waste-burning kilns that do not have RCRA permits operate under "interim status," which requires compliance with the substantive emission controls for metals, chlorine, particulates, and carbon monoxide (and, where applicable, HC and dioxins and furans).

The BIF rule conditionally exempts from regulation kilns that burn small quantities of hazardous waste fuel. This exemption is known as the "small quantity burner exemption." The small quantity burner exemption is a risk-based exemption mentioned in the statute. The exemption is provided only to hazardous waste fuels generated on-site and is conditioned on a number of requirements, including a one-time notification and recordkeeeping.

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[28] Emissions from cement kilns that do *not* burn waste will be regulated under the Portland Cement MACT (proposed March 13, 1998). Cost estimates in the *Assessment* are incremental to the current baseline and do not account for the proposed Portland Cement MACT (see Chapter 4).

## Regulations Governing Hazardous Waste Incinerators

Title 40 in the *Code of Federal Regulations,* Parts 264 and 265, regulate hazardous waste incinerators.[29] This rule establishes performance standards for dioxins and other organic pollutants, particulate matter, and hydrogen chloride. In general, standards for these pollutants are more stringent than those set for kilns. However, the existing regulations for incinerators do not directly control either toxic metal emissions or products of incomplete combustion (PICs).

Unlike RCRA combustion units, incinerators used for CERCLA cleanups must comply with the *substantive* requirements of the RCRA and Title VI CAA regulations (e.g., emission levels) but not with the *administrative* requirements (e.g., reporting).[30] In fact, CERCLA units do not require Title V permits to operate; they must simply meet applicable, relevant, and appropriate requirements (ARARs).[31]

## Ash Disposal

Ash from hazardous waste incinerators is also considered a hazardous waste. Facilities must dispose of the material in a permitted hazardous waste landfill at a cost of $74 to $147 per ton.[32] By comparison, ash from cement kilns or LWAKs is often integrated into their products. Even when ash cannot be used in their products, the kilns can sell the ash or deposit it on-site as a non-hazardous material at a cost of slightly over $3 per ton.[33] This ash from kilns can be treated as non-hazardous because it is exempt under RCRA Subtitle C, as discussed in Section 3001(b)(3)(A), the so-called Bevill Amendment.

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[29] 40 CFR 264.343 (1997)

[30] Robin Anderson, U.S. EPA, OSWER, personal communication, May 21, 1998.

[31] Andrew Opalko, U.S. EPA, personal communication, May 8, 1998.

[32] Mohsen Zadeh, Energy and Environmental Research Corporation, personal communication, March 11, 1997.

[33] U.S. EPA, 1993. *Report to Congress on Cement Kiln Dust*, 9-10.

EPA regulatory initiatives are likely to change this balance within a few years. Future regulation of cement kiln dust (CKD), the ash from cement production, will likely increase the cost of managing residuals at kilns that combust hazardous wastes.[34] The impact of this change on hazardous waste markets is unclear. To the extent that waste-burning and non-waste burning kilns face the same CKD management costs, it is likely that cement markets rather than waste-burning markets will change as a result.

## Effect of Regulatory Differences on Market Competition

Differences in the requirements for fully permitted facilities can create economic advantages for one sector over another. In addition, interim status under the BIF rule can create temporary benefits for BIFs that disappear once a unit is fully permitted. In reality, these temporary benefits can sometimes last many years.[35] Representatives from each industry claim that their facility type is more stringently regulated than the other, and thus subject to higher costs. In addition to differences in the disposal requirements for combustion residuals, already discussed above, industry representatives claim that waste-burning kilns have lax standards for metal emissions relative to commercial incinerators. These representatives also argue that the destruction and removal efficiency (DRE) verification does not need to occur for BIFs until a full permit is issued.

Conversely, the cement kiln industry asserts that incinerators have an advantage under current regulations. For example, Subpart O regulations do not require extensive feed rate analysis on a continuous basis and do not establish metal-specific emission limits.[36]

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[34] In January 1995 EPA published a regulatory determination which stated that additional control of the cement kiln dust from hazardous waste-burning kilns and non-hazardous waste burning kilns is warranted. In the regulatory determination EPA agreed to develop additional regulations under RCRA Subtitle C and, if necessary, the Clean Air Act. Currently, RCRA does not regulate cement kiln dust, which the 1980 Bevill amendment excluded from regulation pending EPA study.

[35] As of June 1995, for example, all waste burning cement kilns were operating under interim status. (Karen Randolph, U.S. EPA, personal communication, June 13, 1995.)

[36] The incinerator regulations do not require metal emissions standards, but limit particulate matter emissions. Since low particulate matter emissions do not necessarily correspond with low toxic metals emissions, opponents view the controls as inadequate. (Bureau of National Affairs. 1995. “Cement Industry ‘Enforceable Agreement’ Would Replace Agency’s Plan for Kiln Dust.” *Environmental Reporter*, 1645).

The validity of these claims is difficult to gauge. Baseline emissions (described in Chapter 1) suggest that BIFs have higher average emissions of mercury and semi-volatile metals than do incinerators. Incinerators emit more low volatility metals. However, these data cannot be used to compare emissions per ton of waste burned across sectors. Nor do they provide insights into the cost savings to any sector attributable to higher emissions. The MACT will alleviate some of these cost advantages because the standards are likely to ensure that human health and the environment are protected equally across combustion sectors and on a nationwide basis.

## COMBUSTION MARKET PERFORMANCE

### Historical Performance

Throughout much of the 1980s, hazardous waste combustors enjoyed a strong competitive position. In spite of their high capital costs, incinerators were extremely profitable. EPA regulations requiring combustion greatly expanded the waste tonnage requiring treatment. Federal permitting rules, as well as powerful local opposition to incinerator siting, constrained the entry of new combustion units. As a result, combustion prices rose steadily, reaching nearly $640/ton for clean high-Btu liquids and $1,680/ton for sludges and solids in 1987.[37] Profits were equally high. For example, after-tax profits earned by Rollins Environmental Services, a firm operating primarily in the incineration sector, peaked at 16.4 percent that year.[38] The high profits induced many firms to enter the permitting and siting process for new combustion units, despite the inevitable delays in obtaining the required operating permits.

Hazardous waste combustion markets have changed significantly since the 1980s. In the early 1990s, the industry entered a period of substantial overcapacity, resulting in fierce competition, declining prices, poor financial performance, numerous new project cancellations, and some facility closures. Within the past few years, several additional combustion facilities have closed; many of those that remain open have combined with other combustion facilities and then further consolidated their operations.[39]

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[37] Midpoint values from industry survey data presented in ICF Incorporated, *1990 Survey of Selected Firms in the Hazardous Waste Management Industry*, prepared for the U.S. Environmental Protection Agency, Office of Policy Analysis, July 1992, 2-5.

[38] Wayne Nef. June 24, 1994. "Rollins Environmental Services." *Value Line*, 352.

[39] EPA's List of Permitted Hazardous Waste Combustion facilities indicates that some commercial facilities have retracted pending permits and others have exited the market. (See: Shaye Hokinson, Alice Yates, Alexi Lownie, and Doug Koplow, "Core Combustion Data Update," memorandum prepared by Industrial Economics, Incorporated for U.S. EPA, 23 August 1996.

The demand for combustion at mobile incinerators has also decreased in the 1990s. Two factors are largely responsible for the decline: the high cost of incineration and the public and governmental opposition to high-temperature incinerators, due to potential human health risks.[40] As a result, several mobile incinerators have ceased operating or have merged with other companies. In addition, some of these firms have moved a portion or all of their processes overseas.[41]

## Overcapacity and Effects on Poor Market Performance

Despite the recent consolidation activity in the combustion industry, overcapacity remains. According to surveys of the combustion industry, capacity utilization estimates have decreased significantly from 1980 levels, which were in the 80 percent range. By 1995, the capacity utilization rates dropped to rates of around 50 percent. As shown in Exhibit 2-6, commercial incinerators have the lowest capacity utilization, at an average of 42 percent.[42]

Although EPA-promulgated land disposal restrictions (LDRs) increased waste quantities managed across combustion sectors, these increased quantities were insufficient to offset the following factors:

- **New Combustion Supply**. Most of the new combustion supply came on-line in the 1980s. The new supply came both from new and expanded combustion units. In recent years, however, companies have canceled many projects with the price declines of the past few years. The closing of certain facilities, however, has prompted others to expand so that they can attract the new waste streams in the market. In addition, the elimination of waste processing bottlenecks (e.g., waste storage capacity) has also expanded the capacity of some facilities already in operation. New combustion capacity is also expected to come on-line in the near future; the Louisiana Department of Environmental Quality is issuing a permit that will allow an additional 550,000 tons per year of capacity at a GTX incinerator.

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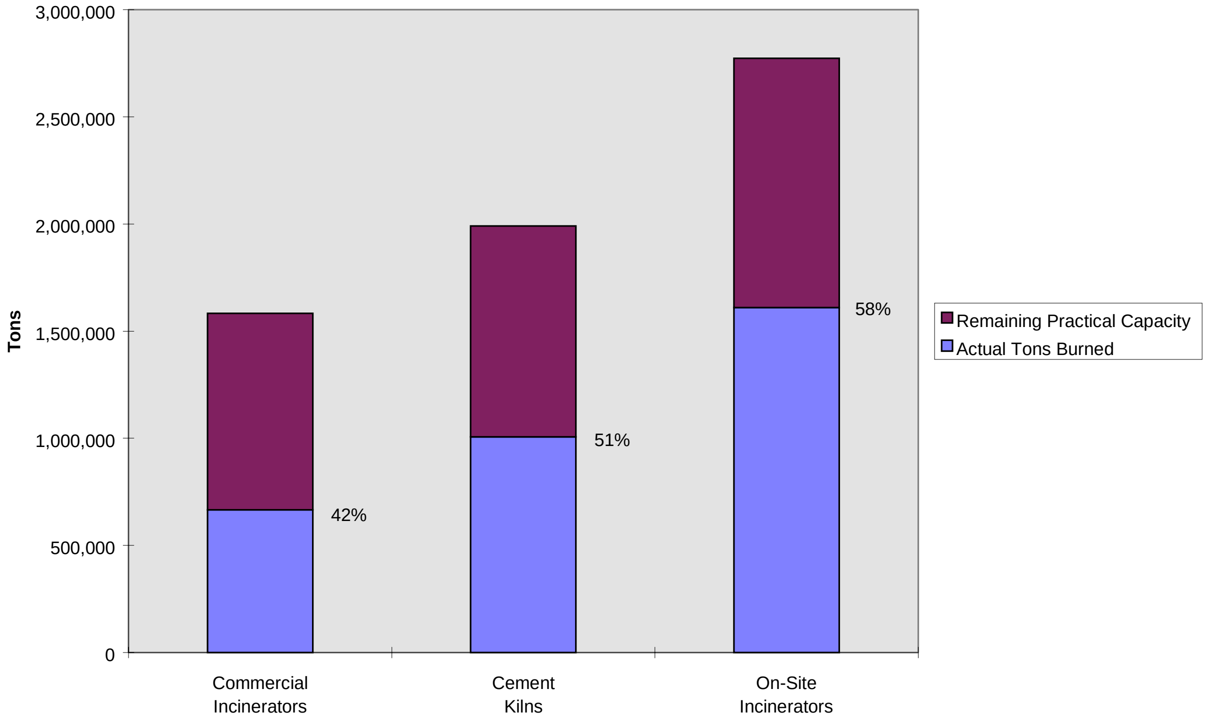
[40] US EPA, Solid Waste and Emergency Response, Technology Innovation Office. April 1997. "Clean Up the Nation's Waste Sites: Markets and Technology Trends: 1996 Edition"; Gwen Fairweather, Steven Brown, and Michael Berg, ICF, "Memorandum: QRT #1, WA B-30, EPA Contract 68-W6-0061," prepared for Lyn Luben, OSW/EPA, and Kevin Brady, IEc, June 13, 1998.

[41] Gwen Fairweather, Steven Brown, and Michael Berg, ICF, "Memorandum: QRT #1, WA B-30, EPA Contract 68-W6-0061," prepared for Lyn Luben, OSW/EPA, and Kevin Brady, IEc, June 13, 1998.

[42] Actual tons figures are from 1995 BRS; capacity estimates are converted from trial burn feed rate data and assume operating rates of 8,000 hours per year.

**Exhibit 2-6**
**AVERAGE CAPACITY UTILIZATION AT HAZARDOUS WASTE-BURNING FACILITIES**




Source: 1995 BRS; "HW Feed Data Update" (Electronic communication from EER), July 14, 1998.

- **Increased Solids-Burning Capability in Kilns**. Fuel blenders have improved their ability to suspend solids in liquid wastes. One fuel blender, for example, estimates that suspended solids comprise 20 to 25 percent of the facility's hazardous waste-derived fuel.[43] Suspending solids in liquid waste has greatly expanded the effective solids burning capacity among kilns that could previously only burn liquids and has driven down prices in this formerly high-profit segment. This practice has also improved the financial performance of fuel blenders. As discussed in the April/May 1995 issue of *Hazardous Materials Management*, "To improve margins, fuel blenders have recently increased the solid content of the mixtures they send to the kilns."

[43] Fuel blender, personal communication, May 29, 1997.

- **Waste Minimization Efforts**. Industry efforts to minimize hazardous waste generation have reduced the quantity of wastes requiring treatment.

- **Substitution of Alternative Technologies in Remediation Market**. On-site units are likely to handle much of the future combustion demand for remedial wastes. In addition, new alternative technologies, such as thermal desorbers, have further weakened demand.

## Structural Advantages for Waste-Burning Kilns

Kilns possess two major structural advantages in the combustion of hazardous wastes that will remain regardless of federal regulatory actions. First, they are able to recover the energy content of the wastes in their production process. Second, they can use existing production capital equipment to combust hazardous wastes.

- **Energy Recovery.** Waste-burning kilns can use the heating value of hazardous waste fuels to offset purchases of virgin fuels that would otherwise be necessary to achieve required heating temperatures to a much greater extent than can incinerators.[44] A commercial incinerator uses process heat to break down and destroy hazardous organic wastes, while a cement kiln uses the heat both to break down wastes and to manufacture cement, a saleable end product.

- **Shared Capital.** Even in the absence of energy recovery advantages, cement kilns still enjoy an advantage based on their ability to produce a saleable product. A commercial incinerator must purchase all of its capital equipment to combust hazardous wastes and control emissions from the process. In contrast, a cement kiln purchases capital equipment to manufacture cement, and this equipment can also destroy hazardous wastes. While there are some incremental capital purchases required for a kiln to burn hazardous wastes, these are small relative to the overall cost of an incineration unit.

[44] Incinerators can use some cleaner solvent streams to fuel their afterburners. However, while some broader energy recovery is done at European incinerators, it is unlikely to be done in the United States. When the heat recovery process runs hot gas through a heat exchanger, the temperature of the gas flow drops, increasing the likelihood that chlorine PICs can re-form dioxins. This increases the dioxin emissions from the stack. (Retallick, op. cit.)

The result is that the incremental cost of burning a ton of hazardous waste in a kiln is lower than the cost of burning it in an incinerator.

## Market Performance Across Combustion Sectors

While the hazardous waste combustion sector overall has experienced declining prices, such a decline has affected commercial incinerators more than kilns until recently.[45] In the commercial incineration sector, industry representatives report that average prices for liquid organics fell by about 10 percent and solid prices declined by almost 20 percent between 1991 and 1993. From 1994 to 1996, prices began to level off, although for some waste categories, such as cleaner liquid streams, prices declined slightly. Prices in the cement kiln sector remained mostly stable from 1991 to 1993, as measured by the prices that fuel blenders paid to cement kilns. However, the prices have declined slightly in 1994 through 1996. Kilns continued to accept wastes at lower prices than incinerators. This is due, in part, to the kilns' lower costs and in part to the higher heat content of the waste streams they receive.

## Financial Performance and Profitability

Financial performance indicators help contrast the condition of incinerators and cement kilns but are subject to two caveats. First, financial data for Rollins Environmental Services, which has recently merged with Laidlaw Environmental Services, Inc., serves as a proxy for the entire commercial incinerator sector because data on other firms include substantial non-incinerator assets and because Rollins was a large portion of the industry. Performance of incinerators owned by other firms may be somewhat different from Rollins, though we have no reason to believe that these differences are large. Second, cement markets heavily influence financial performance for cement kilns. Nonetheless, the baseline costs of hazardous waste combustion in the kilns (detailed in Appendix B) suggest strong returns on waste burning.

[45] As demand for mobile incineration diminishes and firms introduce new remediation technologies, prices for mobile incineration have also declined.

Examining financial returns for Rollins Environmental Services provides some insights into the economics of the incineration segment of the market because Rollins derived nearly 80 percent of revenues from incineration. The firm's net profit margin peaked at 16.4 percent in 1987, and remained quite high until 1992. The net profit margin dropped to 5.6 percent in 1993, and the firm lost money in 1994, 1995, and 1996.[46]

Cement industry profits, which are presently stronger than in the commercial incineration segment, have followed an upward trend over the past few years. Net profit margins were 2.8 percent in 1993, 5.7 percent in 1994, and 8.1 percent in 1995. Net profits continued to increase to 9.5 percent in 1996 and 10.4 percent in 1997.[47]

The return-on-equity ratio (ROE) measures the financial returns to investors in a firm or industry. As these returns fall, it becomes more difficult for firms to raise new funds in capital markets. Rollins' ROE between 1985 and 1988 was above 20 percent, a better performance than the environmental services sector overall. With the increase in incineration overcapacity, Rollins' ROE declined steadily to only 5.6 percent in 1993 and turned negative in 1994.

Average returns to shareholders in the cement industry dropped from 8.6 percent in 1990 to only 0.1 percent in 1991 as a result of the recession. The ROE had recovered to 6.8 percent in 1993, and 10.3 percent in 1994.[48] By 1997 the ROE was 16.9 percent.[49] This implies that the cement industry may be able to raise investment capital more readily than the commercial incineration sector over the next few years.

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[46] Wayne Nef. March 24, 1995. "Rollins Environmental Services." *Value Line*, 350; SEC's Edgar Database - Internet Address: www.sec.gov/archives/edgar/data.

[47] Thomas Mulle. January 20, 1995. "Cement and Aggregates." *Value Line*, 891; Christopher Coyle. April 17, 1998. "Cement and Aggregates." *Value Line*, 894.

[48] Mulle, op. cit., p. 891; Christopher M. Coyle. April 17, 1998. "Cement and Aggregates." *Value Line*, 894.

[49] Christopher M. Coyle. April 17, 1998. "Cement and Aggregates." *Value Line*, 894.

## DEFINING THE REGULATORY BASELINE — CHAPTER 3

This chapter provides the necessary information for specifying the regulatory "baseline," which describes the world absent the hazardous waste combustion MACT standards. Specifying the baseline is necessary for accurately estimating incremental MACT compliance costs and risk-reduction benefits, as well as for evaluating economic and distributional effects of the MACT standards (e.g., market exits, employment shifts). According to the Office of Management and Budget, "the baseline should be the best assessment of the way the world would look absent the proposed regulation. That assessment may consider a wide range of factors, including the likely evolution of the market, likely changes in exogenous factors affecting benefits and costs, likely changes in regulations promulgated by the agency or other government entities, and the likely degree of compliance by regulated entities with other regulations."[1] While Chapter 2 provides a general description of the market, regulations, and other exogenous factors (i.e., energy price fluctuations), this chapter summarizes conclusions from Chapter 2 critical for the baseline specification. We organize this chapter into two main sections -- a baseline profitability analysis and a discussion of emissions and pollution control practices. Each section describes the assumptions and data sources for the baseline elements identified below.

The "Baseline Economic Assumptions" section presents our assumptions about key characteristics of hazardous waste combustion markets in the absence of the MACT rule. This includes characterization of the following elements:

- **Hazardous Waste Combustion Prices —** the price that combustion facilities charge for their services affects the facilities' ability to cover operating costs and any additional costs imposed by the MACT standards. This section describes our assumptions about the anticipated evolution of combustion prices and the prices we use in the economic impact analysis.

[1] Office of Management and Budget (OMB). 1996. *Economic Analysis of Federal Regulations Under Executive Order 12866*, p. 9.

- **Quantities of Combusted Hazardous Wastes —** like prices, changes in hazardous waste quantities managed by combustion affect the degree to which combustion facilities cover operating costs. Due to the high fixed costs of certain types of hazardous waste combustion, waste quantities are especially important to a firm's profitability. This section describes our source for hazardous waste quantity estimates and how market changes will affect quantities combusted over time.

- **Energy Savings —** for waste-burning kilns, the decision to burn also depends on savings from avoided energy purchases. This section includes information on the conventional fuel mix at kilns and fuel prices.

- **Transportation Costs —** for on-site incinerators, avoided costs also include shipping costs. This section describes our data assumptions for transportation costs.

- **Baseline Costs of Waste-Burning —** we require baseline cost estimates to assess baseline profitability and to identify marginal facilities that may exit the market even in the absence of the MACT standards. This section summarizes the approach and results from the baseline cost analysis.

- **Future Capacity —** after developing data assumptions for the revenue and cost components above, we then project longer term capacity trends in light of current profitability.

The "Emissions and Pollution Control Practices" section establishes baseline emission profiles and current pollution control practices in the industry. We describe the following baseline elements in this section:

- **Baseline Emissions —** we characterize baseline emissions so that emission reduction projections and subsequent human health and ecological benefit estimates are incremental to the baseline.

- **Pollution Control Practices —** we define baseline pollution control practices to assess the type of engineering retrofits and other pollution control measures needed at specific combustion facilities. Characterizing this baseline element ensures that compliance cost estimates are incremental to the baseline (i.e., we do not assign pollution control costs if a facility currently employs this particular control).

## BASELINE ECONOMIC ASSUMPTIONS

We evaluate baseline economics of hazardous waste combustion facilities to assess whether facilities will continue waste burning, even in the absence of the increased costs associated with the MACT standards. This information is then used to assess other economic impacts, such as employment shifts and waste quantities diverted, on an incremental basis. As described in Chapter 2, current overcapacity in the combustion market has resulted in poor financial performance across the combustion industry (e.g., declining and even negative operating profits). By identifying the combustion facilities that are non-viable in the baseline, we can avoid attributing the market exit of these facilities to the MACT standards. Given market performance, we do not expect any significant activity in terms of new entry to the market.

We assess baseline profitability of each modeled system by determining whether a combustion system is burning enough waste to adequately cover the costs of operation and realize a reasonable return on capital.[2] Operating profits are calculated as follows:

*Operating Profits = Waste Burning Revenues - Waste Burning Costs*

Where:

*Waste Burning Revenues = Combustion revenues + Avoided energy costs (for cement kilns and LWAKs) + Avoided transportation costs (for on-site incinerators)*

*Waste Burning Costs = Baseline costs of hazardous waste burning*

Operating profits are calculated before tax and deductions for plant and corporate overhead. After-tax profits would be lower. We describe each of the baseline revenue and cost components in more detail below.

As shown in the equations above, we require a number of data inputs to calculate baseline revenues and costs for each modeled combustion system. We describe our assumptions for each of the revenue and cost components below, in light of the current and future expected activity in the combustion market.

[2] Because baseline costs of burning also include a capital recovery factor, at breakeven, facilities also realize a reasonable return on capital.

## Hazardous Waste Combustion Prices

The combination of decreasing demand and overcapacity in the hazardous waste market has contributed first to declining prices, then to fairly constant, low prices, which we assume will approximate the hazardous waste combustion prices at the end of the 1990s. In the *Assessment* we specify prices for seven waste categories, reflecting differences in waste form (liquid, sludge, or solid), as well as other waste characteristics, such as contaminant concentrations (e.g., metals, mercury), heat content, and water content. Pricing data are shown in Exhibit 3-1 and represent average market prices.[3]

**Exhibit 3-1**

**WASTE PRICES FOR FINAL ECONOMIC IMPACT MODEL**
**(price per ton in 1996 dollars)**

| Liquids | | | Sludges | | Solids | |
|---|---|---|---|---|---|---|
| **Comparable Fuels** | **With Suspended Solids** | **Highly Contaminated** | **Less Contaminated** | **Highly Contaminated** | **Less Contaminated** | **Highly Contaminated** |
| $20 (Baseline)<br>$0 (post-MACT) | $70 | $301 | $320 | $630 | $683 | $1,281 |

Notes:
1. We base the prices on information obtained from industry representatives in 1997. We use the GDP implicit price deflator to convert these values to 1996 dollars.
2. Contaminants evaluated include halogen, mercury, lead, cadmium, and water. (Lauren Fusfeld, Alice Yates, Tom Walker, Industrial Economics, Inc., November 17, 1997. "Preliminary Findings from NHWCS Database to Inform Distribution of Waste Types Across Combustion Systems," Memorandum prepared for Lyn Luben, U.S. EPA.)
3. We expect that combustion facilities will not charge a tipping fee for comparable fuels, and thus the price drops to $0 post-MACT.
4. CKRC, the hazardous waste burning cement kiln industry group, reported revenue estimates for wastes burned by cement kilns of about $67 per ton (cement kilns generally burn liquids with lower-contaminant levels than commercial incinerators). This difference may be a result of pricing arrangements between cement kilns and fuel blenders. EPA conducted a sensitivity analysis to assess the impact of this pricing difference and found that market exit estimates did not change. (For more information, see: "Evaluation and Use of Data Submitted by the Cement Kiln Recycling Coalition," 30 June 1999 (Docket Number F-97-CS4A-FFFFF).

[3] We incorporate price changes associated with the comparable fuel exclusion to project prices post-MACT. The comparable fuel exclusion is one component of the "Fast-Track" rulemaking that allows a conditional exclusion from RCRA Subtitle C for wastes that are similar to conventional fossil fuels (verified by testing and analysis). We expect that combustion facilities will not charge a tipping fee for comparable fuels, and thus the price drops to $0 post-MACT.

The price estimates we use in this document represent the prices received by combustion facilities, and not intermediaries (e.g., we use tipping fees paid to cement kilns, and not to fuel blenders).[4]

With the exception of a few on-site facilities handling specialized wastes, we apply the prices in Exhibit 3-1 to estimate waste-burning revenues. However, for those few facilities known to burn specialized waste such as explosives and low-Btu aqueous wastes, we adjust prices upward to reflect the actual market prices for these waste types.[5]

## Hazardous Waste Quantities

The total quantity of waste combusted for destruction and energy recovery has varied slightly over the 1990s, as shown in Exhibit 3-2. In total, combustion facilities managed about three million tons in 1995.[6] From 1991 to 1993, the quantity of waste combusted increased approximately 1 percent; from 1993 to 1995, combusted waste quantities increased by 9 percent. From 1991 to 1993, the greatest increase occurred in the on-site incinerator sector. From 1993 to 1995, the greatest increase in tonnage combusted occurred in the commercial incineration sector. In more recent years, the growth rate of combusted hazardous waste quantities has slowly decreased in both the commercial incineration and on-site incineration sectors. In fact, industry representatives note that the absolute quantities of waste combusted by commercial energy recovery facilities decreased in 1995 and 1996. As discussed in Chapter 2, several factors contributed to the diminished growth rate of demand for hazardous waste in the 1990s. These include waste minimization, source reduction, and the substitution of alternative remediation treatment technologies, such as thermal desorbers.[7]

[4] This practice is consistent with public comments. For example, one industry trade group, CKRC, points out, "the revenues that accrue to the cement kilns are far more relevant to assessing the impact of the proposed MACT rule than are revenues received by the fuels managers," (Susel and Sessions 1997, 10).

[5] We adjust prices for two of the 34 private on-site incinerators and one of the 15 commercial incinerators in the economic model.

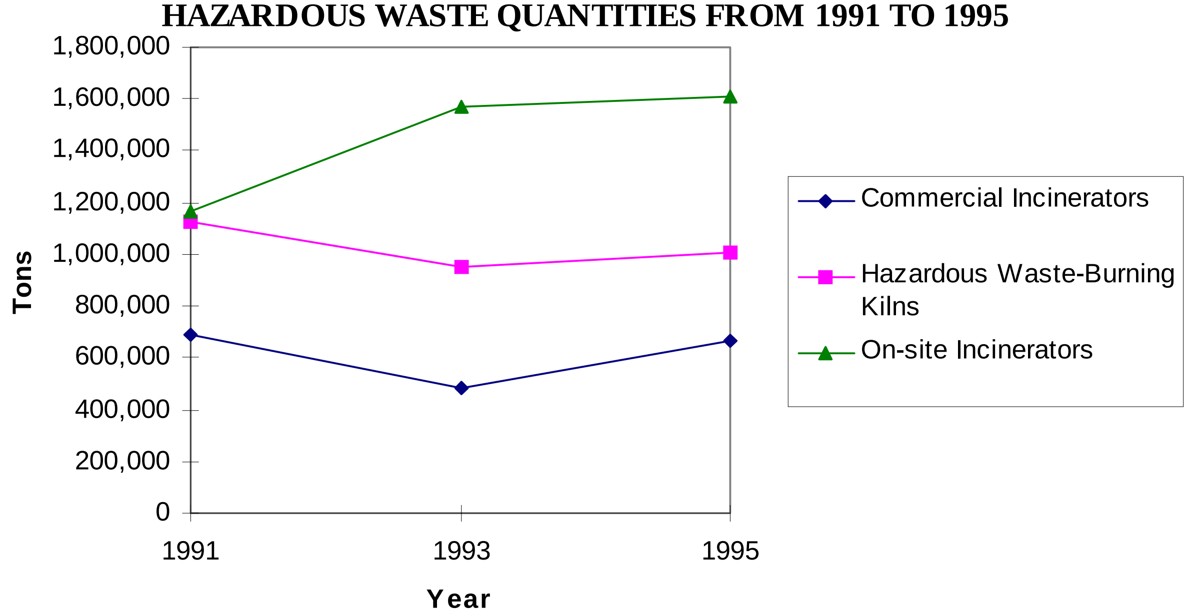
[6] Note that our waste analysis does not include wastes handled by mobile incinerators.

[7] Maureen M. Cromling. December 1996. "A Year of Challenges and Achievements." *Environmental Business Journal*, 11; "Redefining Hazardous Waste." June 1996. *Environmental Business Journal*, 5; "Commercial Hazardous Waste Management Facilities: 1997 Survey of North America." March/April 1997. *Hazardous Waste Consultant*, 4.2, 4.6.

As indicated in Exhibit 3-2, our primary data source for hazardous waste quantities managed at combustion facilities is EPA's Biennial Reporting System, a national system that collects data on the generation and management of hazardous waste. The BRS captures data on two groups of RCRA-regulated hazardous waste handlers: non-household Large Quantity Generators and Treatment, Storage, and Disposal facilities (TSDs). These facilities must submit a report every other year detailing the quantities and composition of the waste, along with the management method used for handling the waste. BRS data exist for odd-numbered years; 1995 is the latest year for which final BRS data are currently available.[8] Thus, while prices are from 1997, because we do not expect any significant changes in total hazardous waste quantities combusted from 1995 to 1997, this difference in years should not bias the results.

**Exhibit 3-2**

**HAZARDOUS WASTE QUANTITIES FROM 1991 TO 1995**




Sources: 1991, 1993, and 1995 Biennial Reporting Systems.

Note: The analysis does not include wastes managed at mobile incinerators.

We use facility-specific tons burned data from the 1995 BRS in the economic assessment model. To match the waste streams with the available pricing data, we group wastes by BRS form code (i.e., wastes are categorized as liquids, solids, or sludges) for each facility and then further characterize the wastes using sector averages from EPA's National Hazardous Waste Constituent

[8] The U.S. EPA, 1997, Biennial Reporting System (BRS) data are expected in late 1998 or early 1999.

Survey (NHWCS) which provides more detailed constituent concentration data. For facilities for which there was no form code information, we use sector averages to distribute the waste across the seven waste categories. For facilities that have more than one combustion system, we evenly distribute waste quantities across systems.

While total waste quantities combusted have not changed significantly over the past several years, for particular facilities, tons burned may vary significantly from year to year. This may make certain facilities appear non-profitable in the baseline or post-MACT, where in fact, these facilities are willing to operate at a loss for a single year, with the expectation that in the following year they will more than regain their losses. Year-to-year variability may also make certain facilities appear more economic if the quantities from 1995 are high-volume due to special circumstances. On the whole, these factors should cancel out each other, such that the economic impact results presented in Chapter 5 are not biased either upward or downward, particularly given the relatively constant level of overall demand for combustion services.

Because the demand for hazardous waste combustion has leveled off over the past few years and we do not foresee any significant changes in the factors contributing to decreased demand, using facility-specific information from 1995 should be adequate for the purposes of this analysis. It is important to note, however, that economic impact results are sensitive to the tons burned assumptions. The economic analysis would need to be revisited if waste generation or management behavior change markedly.

## Energy Savings

In addition to the revenues facilities earn from combustion fees, we estimate the savings to cement and lightweight aggregate kilns from avoided energy purchases. To calculate energy savings, we first convert the waste quantities burned into an energy equivalent (in million Btus per pound).[9] We compare the energy content of the waste fuels to the energy content of conventional fuels displaced by waste burning. Then we calculate the quantity of conventional fuel the cement kilns would have to buy if they were unable to obtain hazardous waste. We assume that conventional fuel for cement kilns is 91.1 percent coal and 8.9 percent natural gas.[10]

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[9] We used the average Btu/lb estimates used in the baseline cost models. These models assumed 13,111 Btu/lb for liquids burned by cement kilns and 10,767 Btu/lb for liquids burned by lightweight aggregate kilns. For sludges and solids burned by both types of kilns, we used an average heat content of 9,733 Btu/lb. *See Appendix B for more information.*

[10] Portland Cement Association, Economic Research Department. 1996. *U.S. Cement Industry Fact Sheet: 14th Edition, Table 24: Fossil Fuel Mix*, 17.

**Avoided Transportation Costs**

We also account for transportation costs in the avoided costs of on-site incinerators. Assuming an average distance of 200 miles, the cost of transporting liquid waste to a commercial incinerator was estimated to be $53/ton in 1996 dollars. The cost of transporting sludges and solids was estimated to be $50/ton in 1996 dollars.[11]

**Baseline Waste-Burning Costs**

To evaluate baseline profitability we also need estimates of the baseline costs of combustion for each modeled facility. Baseline costs suggest important differences across combustion segments that significantly influence competitiveness. The results of the baseline cost analysis provide a core input to the combustion cost model. Below, we summarize how these baseline costs are estimated. A more detailed description of the approach, as well as detailed results, can be found in Appendix B.

The objective of the baseline cost analysis is to estimate the total costs (variable and fixed) of burning a ton of hazardous waste in combustion units of different types. In the case of incinerators, this baseline cost is simply the variable and fixed costs of the facility (prior to new pollution control requirements), since incineration is the sole function of the facility. For cement kilns and LWAKs, the decision is whether to burn hazardous waste or some other fuel. In this case, we need to know the incremental costs introduced by the decision to burn hazardous waste rather than conventional fuel; this is the cost that would be avoided if the facility chose to burn conventional fuel. These incremental costs might include permitting costs, the cost of insurance, and the cost of special hazardous waste handling procedures and equipment. Because the same kiln is required for cement production regardless of hazardous waste combustion activities, no kiln capital costs are included in the baseline cost estimates for cement kilns.

The baseline cost analysis involved three key tasks:

- Identification and classification of combustion cost components;
- Quantification of combustion cost components; and
- Development of annualized baseline combustion cost estimates for each combustion system in the cost model.

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[11] DPRA, Incorporated, September 1994, "Estimating Costs for the Economic Benefit of RCRA Non Compliance," Prepared for U.S. EPA, Office of Regulatory Enforcement. 5-4. Data were inflated to 1996 prices using the GDP implicit price deflator.

EPA first identified the key elements of baseline costs for kilns and incinerators. For cement kilns, key cost components include waste storage, waste sampling and analysis, and waste-specific labor. For incinerators, key components include the cost of the combustion system and air pollution control device (APCD) units already installed, labor, and incinerator ash disposal. Both cement kilns and incinerators incur permitting costs. These costs are also included in the baseline costs.

We then classified the baseline cost components into three categories: fixed annual capital; fixed operating and maintenance costs (O&M); and variable costs. Fixed annual capital costs refer to expenditures lasting multiple years. This includes capital equipment and operating permits. Costs have been annualized using a 10 percent interest rate to convert the total capital cost to a series of equal annual payments over the estimated life of the capital.[12] Fixed O&M costs include items such as annual machine repairs. These costs recur every year, but do not vary significantly in proportion to the quantity of hazardous waste burned. Variable costs include items such as supplemental fuel and some labor costs that increase in proportion to the amount of waste burned. Annual variable costs are derived by multiplying variable costs per ton of waste burned by the number of tons burned.

After identifying the key cost components to include in the baseline analysis, engineering cost models were developed separately for incinerators and kilns to estimate baseline costs for each combustion system.[13] The engineering cost models use combustion system-specific parameters such as the size and type of the unit (e.g., wet vs. dry, rotary vs. liquid injection) to calculate costs for each combustion system. The cost components for each system were divided into fixed and variable costs of hazardous waste combusted. We separated annual capital recovery figures from the other annual fixed costs because annual fixed O&M costs would cease if a unit stopped combusting hazardous waste, while capital costs apply to equipment already purchased and therefore could not be recovered.[14] We relied on a number of sources, including trade journals, discussions with

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[12] A 10 percent real rate of return was used to calculate a capital recovery factor (CRF) using the following equation:

$$CRF = \frac{i\,(1+i)^n}{(1+i)^n - 1}, \text{where } i = 10\% \text{ and } n = 10, 15, \text{or } 20 \text{ years}.$$

The 10 percent annualization factor matches the rate of return recommendation for private investment in the OAQPS Control Cost Manual, January 1990.

[13] Energy and Environmental Research Corporation, *Revised Estimation of Baseline Costs for Hazardous Waste Combustors for Final MACT Rule*, Prepared for Industrial Economics, Inc. and US EPA, Office of Solid Waste Management Division, August 20, 1998.

[14] The distinction between fixed O&M and fixed capital is important in our calculation of short-run breakeven quantities. While fixed capital is sunk and need not be recovered for a unit to continue burning waste, fixed O&M is a recurring cost and must be recovered through revenues.

facilities, and engineering judgment, to quantify the baseline cost components. The sources for each component along with more detailed information about the baseline cost methodology are provided in Appendix B.

Based on the judgment of engineering experts, the baseline cost estimates assume continuous operation for every combustion sector, except on-site incinerators. We assume on-site incinerators operate in batch mode because they are generally small, combust relatively small quantities of hazardous waste, and would consume a great deal of energy if they were to be operated continuously.[15] On-site incinerators are also assumed to burn only hazardous wastes. To the extent that non-hazardous wastes are also burned, the fixed costs per ton of hazardous waste burned would decline. (This issue, along with other factors affecting the economics of on-site burning is discussed further in Chapter 2.)

Baseline combustion costs for the different combustion sectors are summarized in Exhibit 3-3. As shown, baseline costs for incinerators differ dramatically from those for kilns. We expect this difference because baseline costs for kilns do not include capital costs. Baseline costs vary most widely across on-site incinerators. This is a product of the different types and sizes of on-site incinerators. Across all sectors, larger systems have a lower fixed costs per ton of capacity. These economies of scale illustrate the importance of capacity utilization; a large facility can have extremely high costs per ton of waste actually burned if much of its combustion capacity is not being utilized.

## Future Capacity

We project future capacity in the combustion industry by assessing the baseline profitability of each system in the model. We first determine if the combustion system is covering its short-term costs (which include both fixed and variable operating and maintenance costs). We then assess longer term future capacity by evaluating profitability over the capital replacement cycle. We use future capacity projections so that costs and economic impacts are incremental to the baseline. In other words, if a facility is not currently covering its long-term costs, we do not attribute market exit to the MACT rule because we expect that over the longer term, this facility will exit the market even in the absence of the MACT standards. To reflect the uncertainty of the data assumptions, we also estimate costs and economic impacts assuming constant capacity.

[15] This assumption leads to lower annual O&M costs, reducing the cost per ton combusted.

**Exhibit 3-3**

**ANNUAL BASELINE COSTS FOR EXISTING COMBUSTION SYSTEMS**

| Sector | Average Tons Per System | Average Capital (Annualized) Costs | Average Fixed O&M Costs | Average Variable O&M Costs | Total Costs (Capital Costs + O&M) | Median Total Cost Per Ton |
|---|---|---|---|---|---|---|
| Cement Kilns | 26,567<br>(11,526 - 96,012) | $389,075<br>($262,828 - $601,529) | $503,959<br>(409,690 - 677,138) | $832,076<br>(338,773 - 2,728,03) | $1,725,110<br>($1,152,352 -$3,696,451) | $67<br>($35 - $121) |
| LWAKs | 331,397<br>(102,248 - 675,620) | $242,574<br>($189,363 - $314,260) | $461,803<br>($410,004 - $565,880) | $184,473<br>($126,491 - $246,312) | $888,849<br>($766,155 - $1,073,878) | $4<br>($1 - $10) |
| Commercial Incinerators | 25,034<br>(206 - 96,080) | $1,669,073<br>($437,841 - $3,141,895) | $1,306,425<br>($864,210 -$1,874,319) | $2,606,140<br>($77,533 - $7,403,559) | $5,581,639<br>($1,379,584 - $11,587,124) | $278<br>($76 - $6,697) |
| Private Incinerators | 16,703<br>(0 - 113,217) | $678,926<br>($191,292 - $1,780,392) | $320,416<br>($110,771 - $812,304) | $1,572,833<br>($21 - $13,078,031) | $2,568,183<br>($421,287 - $14,294,148) | $303<br>($23 - $1,381,339) |

Notes:

1. Baseline costs not included for government incinerators because we assume these systems remain operational regardless of cost. While this assumption may overstate costs and understate closures post-MACT, EPA believes this is a reasonable assumption because in general these systems burn specialized wastes.
2. Cost averages appear at the top of each cell, except the "Total Cost per Ton" column which presents the median values. Minimum and maximum values appear in parentheses.

In the short term, most combustion systems are adequately covering their baseline waste-burning costs. Exhibit 3-4 shows the results of the short-term profitability analysis. Every cement kiln and LWAK in the model is currently burning enough waste to cover its operating and maintenance costs. Most incinerators, both commercial and on-site units, are also meeting their short-term costs. As shown in the exhibit, with the exception of one on-site incinerator, the systems not covering their short term costs are burning waste quantities significantly below the median tons burned in that sector. This result is due to the fact that the quantity of wastes burned at a facility is the most important determinant of whether a combustion system is profitable.

In the long term, over the capital replacement cycle, the total number of systems that are not covering their baseline waste-burning costs increases by a factor of five. We assess baseline profitability over the longer term by determining whether a combustion system is burning enough waste to cover the costs of operation and capital replacement and to realize a reasonable return on capital.[16] Exhibit 3-5 summarizes our results. In comparison with the short term results, one additional commercial incinerator and 40 additional on-site incinerators cannot cover waste-burning costs over the longer term capital replacement cycle. We expect these facilities will exit the combustion market over the longer term because there is no incentive for these facilities to invest in new equipment if growth for combustion services remains stagnant (i.e., we expect these facilities will leave the market regardless of the MACT standards).

Based on the profitability analysis, we expect some additional consolidation in the commercial incinerator sector and no changes in future capacity of the kiln sectors. We expect a significant number of on-site incinerators will discontinue burning over the capital replacement cycle, as they find it less expensive to ship wastes off-site to a commercial incinerator or to other waste management alternatives. Future capacity over the longer term in the on-site sector is expected to decrease by approximately 35 percent.

The profitability analysis also provides us with insights regarding the economic performance across combustion sectors. In general, kilns have lower operating profits per ton on an absolute dollar basis than commercial incinerators, reflecting the fact that they burn lower-priced liquid wastes. However, the kilns' lower baseline costs of waste burning keep all kilns operating within healthy profit margins. As noted earlier, on-site incinerators appear to be the worst performers and have many unprofitable systems.

[16] Because baseline costs of burning also include a capital recovery factor, at breakeven, facilities also realize a reasonable return on capital.

**Exhibit 3-4**

**SYSTEMS THAT APPEAR NON-VIABLE IN THE SHORT TERM BASELINE**

| Site ID | Hazardous Waste Quantity Burned (Tons) | Breakeven Quantity (Tons) |
|---|---|---|
| **Commercial Incinerators** | | |
| 324 | 206 | 4,601 |
| 359 | 2,234 | 5,017 |
| **Total Number of Non-Viable Commercial Incinerator Systems: 2 systems ( 10%)** | | |
| **Private On-Site Incinerators** | | |
| 708 | 6,492 | 13,886 |
| 711 | 205 | 3,189 |
| 504 | 0 | 1,943 |
| 904 | 0 | 436 |
| 340 | 44 | 526 |
| 342 | 211 | 629 |
| 229 | 860 | 1,748 |
| 725 | 269 | - |
| **Total Number of Non-Viable Private On-Site Incinerator Systems: 8 systems ( 15%)** | | |

Notes:
1. All cement kilns and LWAKs in the model appear viable in the short run baseline.
2. The source of the hazardous waste quantities data is the 1995 BRS.
3. We do not include government incinerators in this analysis because we assume that they will continue burning wastes post-MACT and will not affect future capacity projections.
4. The average and median tons per system for commercial incinerators are 25,034 and 17,092 tons, respectively. The average and median tons per system are 16,703 and 5,746 tons, respectively, for on-site incinerators.
5. Number in parenthesis represents the percent of systems non-viable in the short term baseline.
6. Where there is no breakeven quantity reported, the variable costs are significant enough to prevent the facility from being profitable.

**Exhibit 3-5**

**LONG TERM BASELINE OPERATING PROFITS PER TON OF HAZARDOUS WASTE BURNED (Number of Systems Falling in Profit Range)**

| | **<$0** | **$0-$50** | **$51-$100** | **$101-$150** | **>$150** |
|---|---|---|---|---|---|
| **Cement Kilns** | 0 | 0 | 8 | 15 | 10 |
| **LWAKs** | 0 | 0 | 8 | 3 | 0 |
| **Commercial Incinerators** | 3 | 1 | 1 | 1 | 20 |
| **On-Site Incinerators** | 48 | 13 | 11 | 11 | 56 |

Notes:
1. Estimates taken from model exhibit "Baseline Operating Profits Per Ton of Hazardous Waste Burned."
2. Baseline operating profits = weighted average price per ton + weighted average energy savings per ton - total annual baseline costs per ton. Total annual baseline costs include fixed annual capital costs, fixed annual operating and maintenance costs, and annual variable costs.

This analysis is subject to numerous uncertainties. In particular, profitability calculations are sensitive to waste quantity data, which are not fully up-to-date and vary from year to year. The calculations are also sensitive to combustion prices. We rely on national average prices, and therefore may understate or overstate waste burning revenues. In addition, declining combustion profits over the past several years may reduce the ability of some kilns to cross subsidize marginal cement operations with hazardous waste revenues. EPA does not expect this to be a major issue because cement markets are extremely healthy now and because most kilns do not subsidize cement production with waste-burning profits.[17]

In the on-site incinerator sector, uncertainties may lead us to understate future capacity and overstate consolidation in the baseline. Four key factors may lead to overestimates of the number of incinerators likely to stop burning hazardous wastes in the baseline:

- Waste quantity burned data for on-site incinerators are three years old and are self-reported by combustion facilities. Inaccuracies could be substantial.

- Operators of some on-site incinerators may continue to operate units at a loss to avoid liabilities associated with off-site shipments.

[17] For a more detailed discussion on this issue, see the "Joint Impacts Analysis" for cement kilns in Chapter 5.

- Some on-site incinerators may spread the fixed costs of combustion over both hazardous and non-hazardous wastes burned at the incinerators, reducing the total costs of hazardous waste combustion.

- Finally, avoided costs of off-site treatment for on-site incinerators that burn specialized wastes are higher than our average commercial prices suggest. While we adjust avoided costs for two on-site incinerators that burn specialized waste streams, we may not account for all such on-site incinerators.[18]

To further evaluate the economics of waste burning at on-site combustion systems, we conducted interviews with plant managers and other staff at eight facilities with on-site incinerators.[19] In this research, we found that several factors contribute to firms' decisions to incinerate waste on-site, including economic issues, self-sufficiency goals, liability issues, specialized waste treatment, and non-hazardous waste combustion. Energy recovery, which we thought might be an important consideration for firms with on-site incinerators, does not appear to affect decisions regarding the continued operation of the incinerators in any significant manner. In addition, we found that technical and other physical limitations constrain waste consolidation at on-site facilities.

As shown in Exhibit 3-6, industry staff reported economic and liability issues as the main factors for burning waste on-site, rather than sending it to an off-site combustion facility such as a commercial incinerator or waste-burning kiln. With the exception of one on-site facility, all the facilities noted that the current costs of burning their hazardous wastes off-site exceed the costs of burning their wastes on-site. These economic issues should be adequately captured in the economic impacts model. Unlike economic concerns, we were not able to quantify liability issues for incorporation into the economic impact model. Avoiding liability risks associated with off-site disposal liability is often driven by corporate policy, regardless of costs. By managing wastes on-site, the facilities limit the risks posed by the transportation of dangerous materials and by the handling of these materials in commercial facilities that are not as familiar with the wastes.

[18] We might not have identified all such facilities in the model and/or the facilities included in the model may not be representative of all on-site facilities in the universe.

[19] A summary of our findings can be found in "Summary of On-Site Incinerator Analysis," Memorandum Prepared for Lyn Luben, U.S. EPA, Prepared by Lauren Fusfeld and Alice Yates, Industrial Economics, Incorporated, 20 February 1998.

**Exhibit 3-6**

**FACTORS INFLUENCING VIABILITY OF COMBUSTION**

| Company | Economic Issues | Liability | Specialized Wastes | Energy Recovery | Self-Sufficiency | Combustion of Non-Hazardous Wastes |
|---|---|---|---|---|---|---|
| American Cyanamid | ★ | ★ | ★ | | ★ | ● |
| Ashland Chemical | ★ | ● | ★ | | | ★ |
| Bayer | ★ | ● | | ● | | ● |
| Dupont | ★ | | | ● | ● | |
| Eastman Kodak | ★ | ★ | | ❍ | | |
| Novartis Pharmaceuticals | ❍ | ● | | ❍ | ★ | ● |
| Olin Chemicals | ● | ★ | ★ | ● | | ● |
| Vulcan | ★ | ❍ | | ● | | |

Note: ★ Factor is very important to facility.
● Factor is somewhat important to facility.
❍ Factor is not important to facility.
A blank cell indicates that the facility did not mention the factor.

## EMISSIONS AND POLLUTION CONTROL PRACTICES

This section establishes baseline emission profiles and current pollution control practices in the industry. We characterize baseline emissions so that emission reduction projections and subsequent human health and ecological benefit estimates are incremental to the baseline. We define baseline pollution control practices to assess the type of engineering retrofits and other pollution control measures needed at specific combustion facilities. Characterizing this baseline element ensures that compliance cost estimates are incremental to the baseline (i.e., we do not assign pollution control costs if a facility currently employs this particular control).

### Emissions

The risk assessment for the hazardous waste combustion MACT rule uses baseline emissions as the starting point for estimating the health and ecological benefits of the rule (see Exhibit 3-6 and Exhibit 3-7). These emissions are based on trial burn test and certification of compliance testing data, and are a product of the type of waste fed, pollution controls in place, and other operational conditions during the tests.[20] (See Chapter 1 for a graphical depiction of the emissions profiles across combustion sectors and pollutants.) The characteristics of waste fed during normal operations may differ significantly from that fed during trial burns. In particular, facilities often "spike" the waste feed at the trial burns with high levels of metals, chlorine, and mercury. During testing, facilities operate under worst-case conditions to give operators a wide allowable envelope of operating limits needed to burn a wide array of wastes.

This situation results in emission estimates that likely exceed "typical" emissions. Therefore, the risk reductions and benefit estimates in Chapter 6 are likely overestimates. We do not expect that cost estimates will be biased in the same way, however, because EPA expects that sources will likely operate under the same worst-case conditions for the HWC MACT performance tests as they did during trial burns (for incinerators) and certification of compliance testing (for kilns). Thus, if sources want to maintain operational flexibility, they will still need to implement additional pollution control measures, even if under *typical* operating conditions, they meet the MACT standards.

**Exhibit 3-7**

**BASELINE NATIONAL EMISSIONS FROM COMBUSTION SYSTEMS (AGGREGATE)**

| | Cement Kilns (pounds per year) | LWAKs (pounds per year) | Incinerators (pounds per year) |
|---|---|---|---|
| **CO** | 41,866,939 | 290,469 | 20,222,247 |
| **TCl** | 7,211,308 | 4,051,105 | 7,513,779 |
| **THC** | 5,543,943 | 32,882 | 643,141 |
| **PM** | 5,235,808 | 82,637 | 4,008,097 |
| **SVM** | 65,497 | 636 | 128,963 |
| **Hg** | 3,324 | 118 | 9,708 |
| **LVM** | 1,810 | 223 | 17,548 |
| **Dioxins/ Furans** | 0.029 | 0.005 | 0.055 |

Note: Incinerators include commercial facilities and facilities with on-site systems.
Source: Energy and Environmental Research Corporation, May 5, 1998.

[20] These emissions data are based on an updated and significantly expanded database of emissions and ancillary information. A detailed description of this update can be found in the January 7, 1997 Federal Register (62 FR 960).

**Exhibit 3-8**

**AVERAGE BASELINE NATIONAL EMISSIONS PER SYSTEM**

| | **Cement Kilns (pounds per year)** | **LWAKs (pounds per year)** | **Incinerators (pounds per year)** |
|---|---|---|---|
| **CO** | 1,268,695 | 29,047 | 108,722 |
| **TCl** | 218,524 | 405,110 | 40,397 |
| **THC** | 167,998 | 3,288 | 3,458 |
| **PM** | 158,661 | 8,264 | 21,549 |
| **SVM** | 1,985 | 64 | 693 |
| **Hg** | 101 | 12 | 52 |
| **LVM** | 55 | 22 | 94 |
| **Dioxins/ Furans** | 0.0009 | 0.0005 | 0.0003 |

Note: Incinerators include commercial facilities and facilities with on-site systems.
Source: Energy and Environmental Research Corporation, May 5, 1998.

## Air Pollution Control Practices

The baseline assumes the same pollution controls and operational conditions as during the trial burn or certification of compliance testing. Combustion facilities already control at least some of the emissions targeted by the MACT standards.[21] This baseline pollution control information is used in the compliance costing analysis of Chapter 3. We require information on baseline pollution controls so that we do not assign pollution control measures to facilities that already have this equipment installed. At the same time, baseline pollution control information is important because a facility may be able to implement a design or operational change to an existing control to meet the MACT standard at lower cost than installing a completely new air pollution control device.

Although nearly all facilities have installed some air pollution control devices, there are distinct differences in the types of controls installed by various types of combustion facilities. Exhibit 3-8 lists the APCDs that control pollutants, as well as the prevalence of those APCDs by facility type. The majority of cement kilns (79 percent) already have dry electrostatic precipitators, which control particulate matter. A significant number of commercial incinerators have quenches, which control flue gas temperature to reduce formation and emissions of dioxins and furans; low energy wet scrubbers, which control acid gas and chlorine; and fabric filters, which control particulate matter and metals. A significant number of private on-site incinerators also have quenches (76 percent) and low energy wet scrubbers (57 percent). For government incinerators, 88

[21] Mobile incinerators, which we exclude from the general baseline pollution control analysis, often use comprehensive APCD systems, including fabric filters and wet scrubbers (Bruce Springsteen, EER, personal communication, May 15, 1998).

**Exhibit 3-9**

**BASELINE APCDS BY COMBUSTION SECTOR**

| Control Device | Emissions Controlled | Number (Percentage) of Sample Systems Currently Using Device | | | | |
|---|---|---|---|---|---|---|
| | | Cement Kilns | Commercial Incinerators | Private On-Site Incinerators | Lightweight Aggregate Kilns | Government Incinerators |
| Fabric Filter | Particulate matter, metals | 21% | 54% | 12% | 100% | 42% |
| Dry Electrostatic Precipitators (ESPs) | Particulate matter | 79% | 4% | 1% | 0% | 0% |
| Wet Electrostatic Precipitators (ESPs) | Particulate matter | 0% | 12% | 7% | 0% | 0% |
| Ionizing Wet Scrubber | Acid gas and particulate matter | 0% | 15% | 3% | 0% | 4% |
| High Energy Wet Scrubber | Particulate matter, acid gas, and chlorine | 0% | 23% | 43% | 20% | 46% |
| Low Energy Wet Scrubber | Acid gas and chlorine | 0% | 73% | 57% | 0% | 63% |
| Carbon Injection | Mercury and dioxin/furan | 0% | 4% | 0% | 0% | 0% |
| Quench | Flue gas temperature control | 3% | 77% | 76% | 20% | 88% |
| Dry Scrubber | Acid gas and chlorine | 0% | 46% | 5% | 0% | 8% |
| Carbon Absorber | Mercury and dioxin/furan | 0% | 0% | 2% | 0% | 8% |
| Afterburner | Carbon monoxide and hydrocarbons | 0% | 0% | 0% | 0% | 0% |
| High Efficiency Particulate Air Filter | Particulate matter | 0% | 0% | 3% | 0% | 8% |
| No Control Devices | N/A | 0% | 0% | 13% | 0% | 4% |
| Number of Systems in Sample | N/A | 33 | 26 | 136 | 10 | 24 |

Notes:
1. This analysis excludes one government facility for which no data were available.
2. This exhibit includes imputed data.
3. Sum of percentages will not be 100 percent because a single system may use more than one APCD.

Source: OSW Hazardous Waste Combustion Database prepared by EER, April 23, 1998. This database includes both actual and imputed system information.

percent have quenches and 63 percent have low energy wet scrubbers. In addition, all the lightweight aggregate kilns have fabric filters. Other interesting issues regarding APCDs include the following:

- Only one facility currently uses carbon injection, a control technology which under the BTF-ACI MACT option will frequently be necessary for dioxin/mercury control.

- Lightweight aggregate kilns rely almost entirely on fabric filters for emission control.

## SUMMARY

Establishing the baseline scenario provides the necessary foundation for the assessment of combustion facilities' responses to the Hazardous Waste Combustion MACT Standards. The subsequent chapters rely on the following baseline components:

- **Chapter 4 (Compliance Cost Analysis)** requires baseline pollution control equipment data and emission profiles to project engineering system costs of the MACT standards.

- **Chapter 5 (Social Cost and Economic Impact Analysis)** requires information on baseline revenues, costs, and future capacity.

- **Chapter 6 (Benefits Assessment)** requires baseline emission profiles to determine risk reductions and corresponding benefits.

The key issue addressed in this chapter is future combustion capacity. For on-site incinerators, future capacity could decrease by almost 35 percent over the longer term as on-site incinerators discontinue burning. We expect these economically marginal incinerators will find it less expensive to manage wastes off-site. In the baseline, commercial incinerator capacity is also expected to decrease, by approximately 10 percent. Projecting future capacity allows us to adjust post-MACT costs and economic impacts, such as market exits, so that results are incremental to the baseline. If baseline future capacity estimates are understated, then incremental costs and economic impacts will be overstated. Likewise, if future capacity estimates are overstated, then incremental rule impacts will be understated. To address this uncertainty, we also provide cost and economic impact estimates that do not account for baseline market adjustments.

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