NOTE: *After this Assessment was prepared, EPA modified its proposal for the HWC MACT replacement standards. The results presented in this Assessment do not reflect this change. Information on the costs, benefits, and other impacts of EPA's proposed HWC MACT replacement standards is available in EPA, "Addendum to the Assessment of the Costs, Benefits, and Other Impacts of the Hazardous Waste Combustion MACT Standards: Proposed Rule," March 2004.*

INTRODUCTION AND REGULATORY OPTIONS CHAPTER 1

BACKGROUND

In May 1993, the U.S. Environmental Protection Agency (EPA) introduced a draft Waste Minimization and Combustion Strategy designed to address the combustion of hazardous waste and encourage reduced generation of these wastes. Among the key objectives of the strategy is the reduction of the health and ecological risks posed by the combustion of hazardous waste. As part of this strategy, EPA is developing more stringent performance-based emissions standards based on the "maximum achievable control technology" (MACT) approach. These MACT standards are being promulgated by EPA under Section 112 of the Clean Air Act, as amended (CAA).[1] Four categories of hazardous waste combustion facilities are subject to these standards:

- Hazardous waste incinerators, both commercial and on-site;
- Hazardous waste-burning cement kilns;
- Hazardous waste-burning lightweight aggregate kilns (LWAKs); and
- Hazardous waste-burning boilers and industrial furnaces (BIFs), including process heaters and HCl production furnaces (HAPFs).

[1] Section 112 of the Clean Air Act requires EPA to promulgate MACT standards for major sources emitting hazardous air pollutants, including hazardous waste combustion facilities. While some hazardous waste combustion facilities may qualify as area sources, these sources must also be regulated under the MACT due to the Agency's finding that these sources present a potential threat of adverse effects to human health and the environment.

EPA's efforts to establish MACT standards for hazardous waste combustion began in 1995 with the Agency's proposal of several MACT alternatives. EPA issued a final rule in September 1999 after considering feedback on the 1995 proposal. This rule was challenged in court, and the U.S. Court of Appeals determined that the standards as set forth in the final rule were in violation of Section 7412 of the Clean Air Act.[2] In response to this ruling, EPA established Interim MACT standards in 2002 that temporarily limited emissions of hazardous air pollutants from combustion facilities. EPA is now proposing new Hazardous Waste Combustion (HWC) MACT replacement standards to replace the 2002 Interim standards. The 2002 Interim standards and the proposed HWC replacement MACT standards are designed to decrease hazardous waste combustion-related pollutants. The 2002 Interim standards already create significant pollutant reductions similar to those described in the 1999 *Assessment of the Potential Costs, Benefits, and Other Impacts of the Hazardous Waste Combustion MACT Standards: Final Rule* (the 1999 *Assessment*).[3] The proposed HWC replacement MACT standards would provide incremental reductions beyond those resulting from the 2002 Interim standards.

ANALYTICAL REQUIREMENTS

EPA's Office of Solid Waste prepared this *Assessment of the Potential Costs, Benefits, and Other Impacts of the Hazardous Waste Combustion MACT Replacement Standards: Proposed Rule* to evaluate the benefits and costs of the proposed HWC replacement MACT standards along with other economic, distributional, and equity impacts. This assessment satisfies Office of Management and Budget's (OMB's) requirements for regulatory review under Executive Order 12866 as amended by Executive Order 13258, which applies to any significant regulatory action. According to Executive Order 12866, the economic analysis should "provide information allowing decisionmakers to determine the following:

- There is adequate information indicating the need for and consequences of the regulatory action;
- The potential benefits to society justify the potential costs, recognizing that not all benefits and costs can be described in monetary or even in quantitative terms, unless a statute requires another regulatory approach;

[2] For complete text of the decision, refer to 255 F3d 855.

[3] U.S. EPA, *Assessment of the Potential Costs, Benefits, and Other Impacts of the Hazardous Waste Combustion MACT Standards: Final Rule*, Office of Solid Waste, July 1999.

- The regulatory action will maximize net benefits to society (including potential economic, environmental, public health and safety, and other advantages; distributional impacts; and equity), unless a statute requires another regulatory approach;

- Where a statute requires a specific regulatory approach, the regulatory action will be the most cost-effective, including reliance on performance objectives to the extent feasible;

- Agency decisions are based on the best reasonably obtainable scientific, technical, economic, and other information."[4]

This document also fulfills the requirements of the Regulatory Flexibility Act, as amended by the Small Business Regulatory Enforcement Fairness Act of 1996; Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations"; Executive Order 13045, "Protection of Children from Environmental Health Risks and Safety Risks"; the Unfunded Mandates Reform Act of 1995; Executive Order 13175, "Consultation and Coordination with Indian Tribal Governments"; Executive Order 13132, "Federalism"; Executive Order 12630, "Government Actions and Interference with Constitutionally Protected Property Rights"; and Executive Order 13211, "Actions Concerning Regulations that Affect Energy Supply, Distribution, or Use."[5]

In the development of this economic assessment, we frequently draw on research developed for the original 1999 HWC MACT standards. This research was reported in the 1999 *Assessment* and in some cases continues to be relevant to the analysis of the proposed HWC MACT replacement standards.

NEED FOR REGULATORY ACTION

Like the 2002 Interim standards, the proposed HWC MACT replacement standards will reduce the quantity of hazardous air pollutants and other toxics emitted from combustion facilities. These pollutants include dioxins/furans, mercury, metals, particulate matter, chlorine gas, carbon monoxide, and hydrocarbons. As shown in Exhibit 1-1, particulate matter and total chlorine are the pollutants with the highest total mass emission levels. In addition, energy recovery systems (including cement kilns, LWAKs, and BIFs) typically emit more pollutants per combustion system than incinerators emit, as illustrated in Exhibit 1-2.

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[4] Office of Management and Budget (OMB). January 1996. *Economic Analysis of Federal Regulations Under Executive Order 12866*, 1, as cited in U.S. EPA, *Assessment of the Potential Costs, Benefits, and Other Impacts of the Hazardous Waste Combustion MACT Standards: Final Rule*, Office of Solid Waste, July 1999.

[5] Chapter 7 of this assessment discusses the impacts of the proposed HWC MACT replacement standards in these areas.

Exhibit 1-1

AGGREGATE BASELINE EMISSIONS
(Assuming 2002 Interim Standards Are in Place)

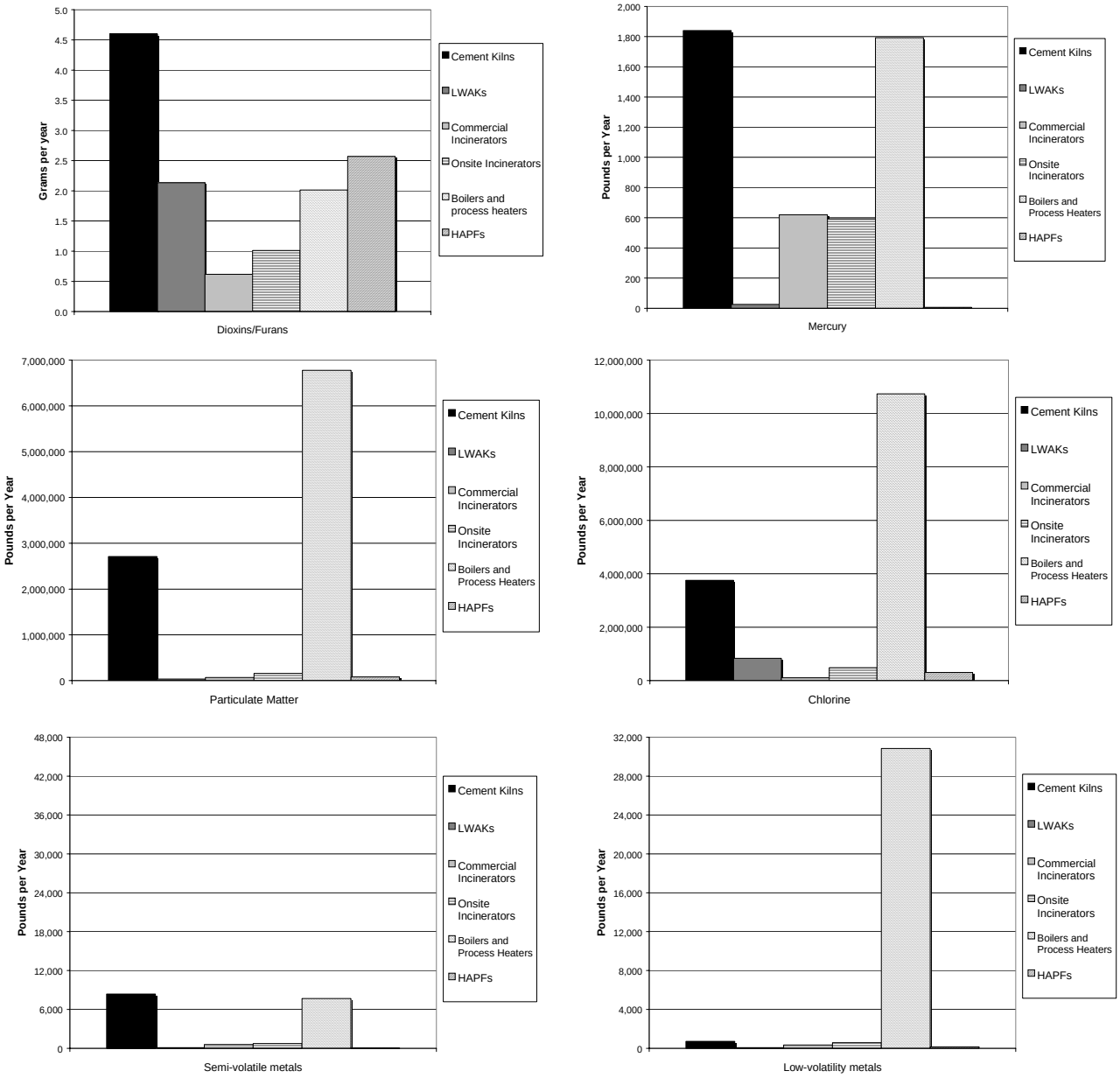
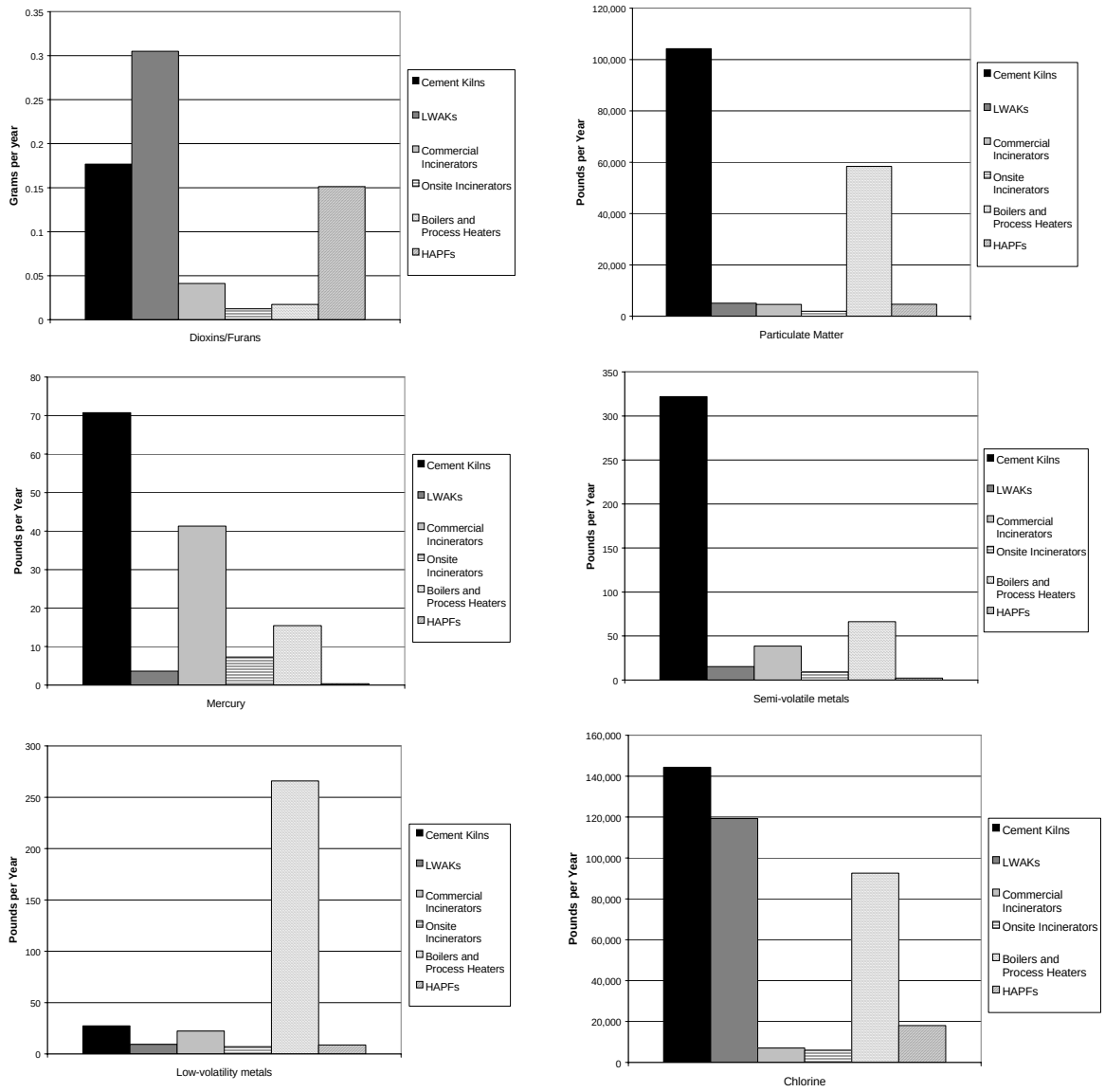


Exhibit 1-2

BASELINE EMISSIONS PER SYSTEM[1]
(Assuming 2002 Interim Standards Are in Place)



[1] A system is defined as having a single source that is the route of air emissions resulting from combustion (i.e. a "stack"). It is subject to environmental testing and is usually the point of remediation. A facility often contains multiple systems, and a system may be connected to more than one combustion unit.

While most combustion facilities will have some air pollution control devices in place under the 2002 Interim standards, pollutants from combustion facilities will still present both human health and ecological risks.[6] Human exposure to air toxics occurs both directly via inhalation of pollutants and indirectly via ingestion of contaminated soil and food products. These exposures may lead to cancer, respiratory diseases, and developmental abnormalities. A preliminary screening analysis of the 1999 regulations also suggests that aquatic and terrestrial ecosystems may be at risk from these air pollutants as well, and that visibility may be effected by baseline emissions.

Several combustion facilities have closed over the past decade, slightly reducing air pollution from hazardous waste combustion facilities. However, while some closures could occur in the near future, the trend in market consolidation has slowed as the industry has reduced capacity. Consequently, supply is now more in line with demand for hazardous waste combustion services than it was during the late 1990s. Thus, EPA expects that existing facilities will continue to operate and the air pollution problem and the human health and ecological damages will continue to exist if the 2002 Interim standards and the proposed HWC MACT replacement standards are not implemented.

The market and other private sector institutions have failed to correct the air pollution problem from hazardous waste combustion facilities for several reasons. First, because individuals not responsible for the air pollution bear the costs in human health and ecological damages, no incentive exists for combustion facilities to incur the additional costs associated with implementing pollution control measures. Therefore, private industry costs of hazardous waste combustion do not fully reflect the human health and environmental costs of combustion. This situation, referred to as an "environmental externality," represents a type of market failure discussed in OMB's Guidelines for assessing federal regulations.[7] Therefore a non-regulatory approach, such as educational outreach programs, would be ineffective because the people who are made aware of the potential health risks (e.g., those people living near combustion facilities) have no power to reduce emissions without incurring significant costs.

Second, parties injured by combustion pollutants cannot obtain compensation from the damaging entity (the combustion facility) through legal or other means, due to the high transaction costs involved and the difficulty in establishing a causal relationship between the damage incurred and activity at the combustion facility. Establishing a direct link between a specific combustion facility and human health and other damages incurred may be especially difficult because many combustion facilities are located in heavily industrialized areas with multiple sources of pollution. Consequently, isolating the damaging effects from the combustion facility is difficult.

Finally, emissions from hazardous waste combustion facilities directly affect the air, which is accessible to all people and thus represents a "public good." Individuals who pay for reduced pollution cannot exclude others who have not paid from enjoying the benefits of improved air quality. As a result, in the absence of government intervention, the free market will not provide

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[6] Chapter 3 of this assessment provides a more detailed description of existing control technologies in place at combustion facilities.

[7] Office of Management and Budget (OMB). January 1996. *Economic Analysis of Federal Regulations Under Executive Order 12866,* 3-5, as cited in U.S. EPA, *Assessment of the Potential Costs, Benefits, and Other Impacts of the Hazardous Waste Combustion MACT Standards: Final Rule,* Office of Solid Waste, July 1999.

public goods, such as clean air, at the optimal quantity and quality desired by the general public.

To internalize the environmental costs and to correct market distortions, government intervention is necessary. Consequently, EPA is issuing the proposed HWC MACT replacement standards for hazardous waste combustion facilities. EPA has selected this approach instead of a non-regulatory approach or another type of government intervention for four key reasons:

- First, Section 112 of the Clean Air Act requires the implementation of MACT standards;
- Second, due to the complex nature of pollutants, waste feeds, and the diverse nature of the regulated entities, alternative schemes (such as taxes, fees, or educational outreach programs) would be difficult to develop and implement;
- Third, the emission standards also satisfy EPA's obligation under RCRA to ensure that hazardous waste combustion is conducted in a manner adequately protective of human health and the environment; and
- Finally, the proposed HWC MACT replacement standards are consistent with the court order in the 2001 case, *Cement Kiln Recycling Coalition, et al., v. Environmental Protection Agency*.[8]

Consequently, establishing the proposed HWC MACT replacement standards is the most effective strategy for internalizing environmental costs and correcting market distortions.

EXAMINATION OF ALTERNATIVE REGULATORY OPTIONS

As part of this proposed rulemaking, EPA considered several regulatory options for limiting emissions of seven hazardous and non-hazardous air pollutants at hazardous waste combustion facilities. These pollutants include the following:

- **Dioxins/furans (D/F):** chlorinated dioxin and furan emission standards are based on toxicity equivalents (TEQs).
- **Total Chlorine (TCl):** the total chlorine standard jointly limits emissions of hydrochloric acid (HCl) and chlorine gas (Cl_2), both of which are designated hazardous air pollutants (HAPs). HCl and Cl_2 are controlled by a combined MACT standard because the test method used to determine HCl and Cl_2

[8] For the complete text of the decision, refer to 255 F3d 855.

emissions may not be able to distinguish between the compounds in all situations. Furthermore, both of these HAPs can be controlled with the same type of pollution control measure.

- **Mercury (Hg):** mercury is the only high-volatility metal for which emission limits are specified.

- **Semi-volatile Metals[9] (SVM):** semi-volatile metals comprise lead and cadmium.

- **Low-Volatile Metals (LVM):** low-volatile metals include arsenic, beryllium, and chromium.

- **Particulate Matter (PM):** in addition to particle control, the particulate matter standard is a surrogate control for the following non-enumerated metal HAPs: antimony, cobalt, manganese, nickel, and selenium. These metals are not included in the volatility groups because of inadequate emissions data and the relatively low toxicity of antimony, cobalt and manganese.

- **Carbon Monoxide (CO) and Hydrocarbons (HC):** carbon monoxide and hydrocarbons are controlled as surrogates for non-dioxin, non-furan toxic organic emissions.[10] The proposed HWC MACT replacement standards and the 2002 Interim standards are the same regarding CO and HC.

In addition to control of these specific pollutants, EPA is also maintaining its current baseline RCRA destruction and removal efficiency (DRE) standard of at least 99.99 percent to ensure MACT control of nondioxin/furan organic hazardous air pollutants.[11]

The "MACT floor" represents the baseline compliance level for air pollution emissions. It is defined as the pollution control practices currently implemented at the12 percent of facilities with the most effective pollution control systems.[12] If the floor is deemed to be not sufficiently protective, "beyond-the-floor" (BTF) standards are implemented that further reduce emissions and risk. After critically analyzing different methodologies for identifying top-performing systems and

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[9] Toxic metals are grouped by volatility because emission control strategies are determined by metal volatility.

[10] Emission standards for municipal waste combustors and medical waste incinerators also limit emissions of CO to control non-D/F organic HAPs.

[11] A 99.9999 percent DRE is required for those hazardous waste combustors burning dioxin-listed wastes (e.g., F020-023 and F026-027); this is also a current baseline RCRA requirement.

[12] Clean Air Act Title I §112 (d) (3).

establishing the MACT floor, EPA has established three potential floor levels reflecting separate methods of assessing performance. These include the Option 1 Floor, the Option 2 Floor, and the Option 3 Floor, as defined below:[13]

> **Option 1 Floor:** The Option 1 PM floor is determined using the "control technology approach, whereby sources are ranked according to their current PM control technology performance. Metals (mercury, SVM, and LVM) and chlorine floors are set using the "SRE-Feedrate" analysis procedure. This involves ranking source performance based on a consideration of both "front end" feedrate control and "back end"system removal efficiency (SRE). Floors are determined based on stack gas emissions levels from the best ranked sources (e.g., those with the lowest combination of feedrate and SRE ranks). Dioxin/furan floors are evaluated using the "straight emissions" approach (see the Option 3 Floor below).
>
> **Option 2 Floor:** PM floors are determined using the "control technology" approach, as described above. Floors for metals (mercury, SVM, and LVM) and chlorine at energy recovery units (kilns and liquid boilers) are set using "thermal emissions" (stack gas emissions divided by the energy content of the hazardous waste feed). All other floors are determined using the "straight emissions" approach (see the Option 3 Floor below).
>
> **Option 3 Floor:** All floors are set using the "straight emissions" approach. Sources are ranked solely by the concentration of pollutants in stack gas emissions. The floor for each HAP is determined from the emissions of those systems in the top 12 percent of this ranking (e.g., the 12 percent of systems with the lowest emissions of each HAP).

In addition, after evaluating the potential “beyond-the-floor” (BTF) options, EPA has developed a recommended beyond-the-floor MACT which will be referred to as the “Agency Preferred Approach” in the remainder of this document. This alternative combines Floor Option 1 with selected BTF standards. Further details on the Agency Preferred Approach are presented in Exhibit 1-3 and in the following section.

Agency Preferred Approach

As indicated by Exhibit 1-3, the Agency Preferred Approach reduces emissions for certain pollutants below some of the Option 1 Floor levels. Emissions reductions beyond those required

[13] For a very detailed discussion of the procedures considered for evaluating the MACT standards, please see the preamble language and EPA Office of Solid Waste, “Technical Support Document for the Hazardous Waste Combustion MACT Standards, Volume III, Selection of MACT Standards,” February 2004.

under the Option 1 Floor are specified for each of the specific pollutants and combustion sectors below:

- **LWAKs:** The Agency Preferred Approach specifies beyond-the-floor control for dioxins/furans at LWAKs. Under the Option 1 Floor, LWAKs must either reduce stack emissions to 0.2 nanograms per dry standard cubic meter (ng/dscm) or control back end kiln temperature to less than 400 degrees Fahrenheit. EPA expects most LWAKs to choose the latter, which may lead to emissions in excess of 0.4 ng/dscm. Under the Agency Preferred Approach, LWAKs must reduce dioxin/furan emissions to 0.40 ng/dscm. BTF control is also specified for total chlorine, reducing emissions from 600 ppmv at the floor to 150 ppmv.

- **Solid Fuel Boilers:** The Agency Preferred Approach calls for beyond-the-floor control for particulate matter at solid fuel boilers, reducing emissions from 0.06 gr/dscf to 0.03 grams per dry standard cubic feet (gr/dscf). BTF control is also required for total chlorine, reducing emissions from 440 ppmv to 110 ppmv.

- **Liquid Fuel Boilers:** The Agency Preferred Approach specifies beyond-the-floor control for dioxin/furans at liquid fuel boilers; the floor standard is reduced from 3.0 ng/dscm to 0.4 ng/dscm.

- **Hydrochloric Acid Production Furnaces (HAPFs):** The Agency Preferred Approach specifies beyond-the-floor control for dioxin/furans at HAPFs. The Option 1 Floor for HAPFs uses CO as a surrogate for dioxin/furans, which may lead to emissions exceeding 0.4 ng/dscm. Under the Agency Preferred Approach, HAPFs must reduce dioxin/furan emissions to 0.4 ng/dscm.

MACT Standards for New Sources

In addition to the regulatory options governing existing waste combustion facilities, this rule also establishes MACT standards for new sources (e.g., sources that commence construction or meet the definition of a reconstructed source following the proposal date of the replacement rule). Exhibit 1-4 presents the specific standards for each HAP emitted by new sources. For most source categories and pollutants, the Agency Preferred Approach for new sources is more stringent than the Agency Preferred Approach for existing sources. New solid fuel boilers, however, face the same standards as existing solid fuel boilers for dioxin/furans, mercury, and SVM. In addition, new cement kilns face the same dioxin/furan and LVM standards as existing cement kilns. The dioxin/furan, total chlorine, mercury, CO, and HC standards for LWAKs is also the same for existing and new sources.

POTENTIAL ENVIRONMENTAL BENEFITS OF THE MACT STANDARDS

If the Agency Preferred Approach is implemented, emissions will decrease substantially, as shown in Exhibit 1-5. On average, boilers, process heaters, and hydrochloric acid production furnaces will reduce their hazardous air emissions by the greatest percentage following implementation of the MACT standards. Across all pollutants for which MACT standards are established, the total decrease is 29 percent for cement kilns, 43 percent for LWAKs, 38 percent for commercial incinerators, 39 percent for on-site incinerators, 53 percent for boilers and process heaters, and 31 percent for hydrochloric acid production furnaces (HAPFs). If all HAPFs comply with the Agency Preferred Approach, their total chlorine emissions will fall by 95 percent. Similarly, if all boilers and process heaters comply, mercury emission from these systems will fall by 78 percent and their PM emissions will decline by 47 percent. In addition, cement kilns will reduce PM emissions by 43 percent and LVM emissions by 57 percent. Commercial incinerators will reduce their total chlorine emissions by 92 percent.

None of the combustion sectors are expected to reduce emissions of carbon monoxide or total hydrocarbons because the proposed HWC MACT replacement standards are consistent with the 2002 Interim standards regulating incinerators and kilns for these pollutants. In addition, the 1991 RCRA Boiler and Industrial Furnace (BIF) rule regulating boilers and hydrochloric acid production furnaces is identical to the proposed replacement standards for carbon monoxide, and all boilers and hydrochloric acid furnaces currently comply with the rule. The BIF rule places a limit of 20 ppmv for hydrocarbons while the proposed HWC MACT replacement standards set a maximum hydrocarbon emissions level of 10 ppmv. However, because boilers and hydrochloric acid production furnaces already comply with the carbon monoxide standard, they would not need to comply with the hydrocarbon standard and therefore would not face additional expenditures to comply with the proposed HWC MACT replacement standard.[14]

[14] EERGC Corporation analysis, 2003.

Exhibit 1-3

REGULATORY ALTERNATIVES FOR EXISTING SOURCES

MACT	Source Category	Chlorinated D/F (ng TEQ/dscm) [a]	PM	Hg (µg/dscm)	SVM (µg/dscm)	LVM (µg/dscm)	TCl (ppmv)	CO (ppmv)	HC [b] (ppmv)
Agency Preferred Approach [c]	Incinerators	0.28 for dry apcds and WHBs; 0.2 or 0.40 + 400˚F at inlet for others [d]	0.010 gr/dscf	130 ug/dscm	59 ug/dscm	84 ug/dscm	1.5 ppmv	100* or	10 *
	Cement Kilns	0.20 or 0.40 + 400˚F at inlet to PM control device	0.014 gr/dscf	64 ug/dscm	4.0E-4 lbs SVM in HW per MMBtu in HW	1.4E-5 lbs LVM in HW per MMBtu in HW	110 ppmv	100 or	10 (◆)
								100 or	20 (◇)
	LWAKs	0.4 ng TEQ/dscm	0.017 gr/dscf	67 ug/dscm	3.1E-4 lbs SVM in HW per MMBtu in HW and 250 ug/dscm	9.5E-5 lbs LVM in HW per MMBtu in HW and 110 ug/dscm	150 ppmv	100 or	20
	Solid Fuel Boilers	100 ppm CO or 10 ppmv HC	0.03 gr/dscf	10 ug/dscm	170 ug/dscm	210 ug/dscm	110 ppmv	100 or	20
	Liquid Fuel Boilers	0.4 ng TEQ/dscm for dry apcd sources; CO or TCl as surrogate for others	0.026 gr/dscf	3.7E-6 lbs Hg in HW per MMBtu in HW	1.1E-5 lbs SVM in HW per MMBtu in HW	1.1E-4 lbs Cr in HW per MMBtu in HW	2.5E-2 lbs Cl in HW per MMBtu in HW	100 or	20
	Hydrochloric Acid Production Furnaces	0.4 ng TEQ/dscm	TCl as surrogate	TCl as surrogate	TCl as surrogate	TCl as surrogate	14 ppmv or 99.9927% SRE	100 or	20

Exhibit 1-3

REGULATORY ALTERNATIVES FOR EXISTING SOURCES

MACT	Source Category	Chlorinated D/F (ng TEQ/dscm) [a]	PM	Hg (µg/dscm)	SVM (µg/dscm)	LVM (µg/dscm)	TCl (ppmv)	CO (ppmv)	HC [b] (ppmv)
Option 1 Floor	Incinerators	0.28 for dry apcds and WHBs; 0.2 or 0.40 + 400˚F at inlet for others [d]	0.010 gr/dscf	130 ug/dscm	59 ug/dscm	84 ug/dscm	1.5 ppmv	100* or	10 *
	Cement Kilns	0.20 or 0.40 + 400˚F at inlet to PM control device	0.014 gr/dscf	64 ug/dscm	4.0E-4 lbs SVM in HW per MMBtu in HW	1.4E-5 lbs LVM in HW per MMBtu in HW	110 ppmv	100 or	10 (◆)
								100 or	20 (◇)
	LWAKs	0.20 ng TEQ/dscm or rapid quench of flue gas at exit of kiln to less than 400˚F	0.017 gr/dscf	67 ug/dscm	3.1E-4 lbs SVM in HW per MMBtu in HW and 250 ug/dscm	9.5E-5 lbs LVM in HW per MMBtu in HW and 110 ug/dscm	600 ppmv	100 or	20
	Solid Fuel Boilers	100 ppm CO or 10 ppmv HC	0.060 gr/dscf	10 ug/dscm	170 ug/dscm	210 ug/dscm	440 ppmv	100 or	20
	Liquid Fuel Boilers	3.0 for dry apcd + less than 400˚Fat inlet to dry apcd	0.026 gr/dscf	3.7E-6 lbs Hg in HW per MMBtu in HW	1.1E-5 lbs SVM in HW per MMBtu in HW	1.1E-4 lbs Cr in HW per MMBtu in HW	2.5E-2 lbs Cl in HW per MMBtu in HW	100 or	20
	Hydrochloric Acid Production Furnaces	CO as surrogate	TCl as surrogate	TCl as surrogate	TCl as surrogate	TCl as surrogate	14 ppmv or 99.9927% SRE	100 or	20

Exhibit 1-3

REGULATORY ALTERNATIVES FOR EXISTING SOURCES

MACT	Source Category	Chlorinated D/F (ng TEQ/dscm) [a]	PM	Hg (µg/dscm)	SVM (µg/dscm)	LVM (µg/dscm)	TCl (ppmv)	CO (ppmv)	HC [b] (ppmv)
Option 2 Floor	Incinerators	0.28 for dry apcds and WHBs; 0.2 or 0.40 + 400˚F at inlet for others [d]	0.010 gr/dscf	130 ug/dscm	19 ug/dscm	14 ug/dscm	0.93 ppmv	100* or	10 *
	Cement Kilns	0.20 or 0.40 + 400˚F at inlet to PM control device	0.014 gr/dscf	31 ug/dscm	1.3E-4 lbs SVM in HW per MMBtu in HW	1.1E-5 lbs LVM in HW per MMBtu in HW	41 ppmv	100 or	10 (◆)
								100 or	20 (◇)
	LWAKs	0.20 ng TEQ/dscm or rapid quench of flue gas at exit of kiln to less than 400˚F	0.017 gr/dscf	19 ug/dscm	3.1E-4 lbs SVM in HW per MMBtu in HW and 250 ug/dscm	9.5E-5 lbs LVM in HW per MMBtu in HW and 110 ug/dscm	600 ppmv	100 or	20
	Solid Fuel Boilers	100 ppm CO or 10 ppmv HC	0.060 gr/dscf	10 ug/dscm	170 ug/dscm	210 ug/dscm	440 ppmv	100 or	20
	Liquid Fuel Boilers	3.0 for dry apcd + less than 400˚Fat inlet to dry apcd	0.026 gr/dscf	3.7E-6 lbs Hg in HW per MMBtu in HW	1.1E-5 lbs SVM in HW per MMBtu in HW	7.7E-5 lbs Cr in HW per MMBtu in HW	5.7E-3 lbs Cl in HW per MMBtu in HW	100 or	20
	Hydrochloric Acid Production Furnaces	CO as surrogate	TCl as surrogate	TCl as surrogate	TCl as surrogate	TCl as surrogate	14 ppmv or 99.9927% SRE	100 or	20

Exhibit 1-3

REGULATORY ALTERNATIVES FOR EXISTING SOURCES

MACT	Source Category	Chlorinated D/F (ng TEQ/dscm) [a]	PM	Hg (µg/dscm)	SVM (µg/dscm)	LVM (µg/dscm)	TCl (ppmv)	CO (ppmv)	HC [b] (ppmv)
Option 3 Floor	Incinerators	0.28 for dry apcds and WHBs; 0.2 or 0.40 + 400˚F at inlet for others [d]	0.0033 gr/dscf	130 ug/dscm	19 ug/dscm	14 ug/dscm	0.93 ppmv	100* or	10 *
	Cement Kilns	0.20 or 0.40 + 400˚F at inlet to PM control device	0.011 gr/dscf	31 ug/dscm	68 ug/dscm	8.9 ug/dscm	41 ppmv	100 or	10 (◆)
								100 or	20 (◇)
	LWAKs	0.20 ng TEQ/dscm or rapid quench of flue gas at exit of kiln to less than 400˚F	0.017 gr/dscf	19 ug/dscm	130 ug/dscm	82 ug/dscm	600 ppmv	100 or	20
	Solid Fuel Boilers	100 ppm CO or 10 ppmv HC	0.060 gr/dscf	10 ug/dscm	170 ug/dscm	210 ug/dscm	440 ppmv	100 or	20
	Liquid Fuel Boilers	3.0 for dry apcd + less than 400˚Fat inlet to dry apcd	0.0025 gr/dscf	0.47 ug/dscm	8.7 ug/dscm	28 ug/dscm (Cr only)	2.4 ppmv	100 or	20
	Hydrochloric Acid Production Furnaces	CO as surrogate	TCl as surrogate	TCl as surrogate	TCl as surrogate	2.4 ppmv	2.0 ppmv	100 or	20

Notes:

[a] Across all options, a DRE of 99.99% is required (99.9999% for sources burning dioxin-listed wastes) to control emissions of non-dioxin/furan organic HAPs.

[b] Across all options, cement kilns sources have the option to continuously comply with a CO standard of 100 ppmv in lieu of complying with the HC standard. Cement kilns that choose to do this, however, must demonstrate compliance with the HC standard during the comprehensive performance test.

[c] Shaded cells indicate that the standards represent beyond-the-floor levels compared with Option 1.

[d] WHB are incinerators with waste heat boilers.

(*) Incinerators can comply with either the HC or CO standards.

(◆) Cement kilns with bypass ducts have the option to comply with either a CO standard in the bypass duct of 100 ppmv, or an HC standard in the bypass duct of 10 ppmv (no main stack standard).

(◇) Cement kilns without bypass ducts have the option to comply with either a CO standard in the main stack of 100 ppmv, or an HC standard in the main stack of 20 ppmv.

Exhibit 1-4

REGULATORY ALTERNATIVES FOR NEW SOURCES

MACT	Source Category	Chlorinated D/F (ng TEQ/dscm) [a]	PM	Hg (µg/dscm)	SVM (µg/dscm)	LVM (µg/dscm)	TCl (ppmv)	CO (ppmv)	HC [b] (ppmv)
Agency Preferred Approach [c]	Incinerators	0.11 for dry apcds and WHBs; 0.2 for others [d]	0.0015 gr/dscf	8 ug/dscm	6.5 ug/dscm	8.9 ug/dscm	0.18 ppmv	100* or	10 *
	Cement Kilns	0.20 or 0.40 + 400˚F at inlet to PM control device	0.005 gr/dscf	35 ug/dscm	6.2E-5 lbs SVM in HW per MMBtu in HW	1.4E-5 lbs LVM in HW per MMBtu in HW	78 ppmv	100 or	10 (◆)
								100 or	20 (◊)
	LWAKs	0.40 ng TEQ/dscm or rapid quench of flue gas at exit of kiln to less than 400˚F	0.002 gr/dscf	67 ug/dscm	2.4E-5 lbs SVM in HW per MMBtu in HW	3.2 E-5 lbs/LVM in HW per mmVtu in HW	150 ppmv	100 or	20
	Solid Fuel Boilers	100 ppm CO or 10 ppmv HC	0.015 gr/dscf	10 ug/dscm	170 ug/dscm	190 ug/dscm	73 ppmv	100 or	10
	Liquid Fuel Boilers	0.015 gr/dscf for dry apcd; CO or TCl as surrogate for others	0.0043 gr/dscf	3.8E-7 lbs Hg in HW per MMBtu in HW	4.3E-6 lbs SVM in HW per MMBtu in HW	3.6E-5 lbs Cr in HW per MMBtu in HW	7.2E-4 lbs Cl in HW per MMBtu in HW	100 or	10
	Hydrochloric Acid Production Furnaces	CO as surrogate	TCl as surrogate	TCl as surrogate	TCl as surrogate	TCl as surrogate	1.2 ppmv or 99.99937% SRE	100 or	10

Exhibit 1-4

REGULATORY ALTERNATIVES FOR NEW SOURCES

MACT	Source Category	Chlorinated D/F (ng TEQ/dscm) [a]	PM	Hg (µg/dscm)	SVM (µg/dscm)	LVM (µg/dscm)	TCl (ppmv)	CO (ppmv)	HC [b] (ppmv)
Option 1 Floor	Incinerators	0.11 for dry apcds and WHBs; 0.2 for others [d]	0.0015 gr/dscf	8 ug/dscm	6.5 ug/dscm	8.9 ug/dscm	0.18 ppmv	100* or	10 *
	Cement Kilns	0.20 or 0.40 + 400˚F at inlet to PM control device	0.005 gr/dscf	35 ug/dscm	6.2E-5 lbs SVM in HW per MMBtu in HW	1.4E-5 lbs LVM in HW per MMBtu in HW	78 ppmv	100 or	10 (◆)
								100 or	20 (◇)
	LWAKs	0.20 ng TEQ/dscm or rapid quench of flue gas at exit of kiln to less than 400˚F	0.002 gr/dscf	67 ug/dscm	2.4E-5 lbs SVM in HW per MMBtu in HW	3.2E-5 lbs LVM in HW per MMBtu in HW	600 ppmv	100 or	20
	Solid Fuel Boilers	100 ppm CO or 10 ppmv HC	0.036 gr/dscf	10 ug/dscm	170 ug/dscm	190 ug/dscm	73 ppmv	100 or	20
	Liquid Fuel Boilers	0.015 for dry apcd + 400° F at inlet to dry apcd	0.0043 gr/dscf	3.8E-7 lbs Hg in HW per MMBtu in HW	4.3E-6 lbs SVM in HW per MMBtu in HW	3.6E-5 lbs Cr in HW per MMBtu in HW	7.2E-4 lbs Cl in HW per MMBtu in HW	100 or	20
	Hydrochloric Acid Production Furnaces	CO as surrogate	TCl as surrogate	TCl as surrogate	TCl as surrogate	TCl as surrogate	1.2 ppmv or 99.99937% SRE	100 or	20

Exhibit 1-4

REGULATORY ALTERNATIVES FOR NEW SOURCES

MACT	Source Category	Chlorinated D/F (ng TEQ/dscm) [a]	PM	Hg (µg/dscm)	SVM (µg/dscm)	LVM (µg/dscm)	TCl (ppmv)	CO (ppmv)	HC [b] (ppmv)
Option 2 Floor	Incinerators	0.11 for dry apcds and WHBs; 0.2 for others [d]	0.0015 gr/dscf	8 ug/dscm	5.3 ug/dscm	2.5 ug/dscm	0.18 ppmv	100* or	10 *
	Cement Kilns	0.20 or 0.40 + 400˚F at inlet to PM control device	0.005 gr/dscf	21 ug/dscm	4.3E-5 lbs SVM in HW per MMBtu in HW	1.1E-5 lbs LVM in HW per MMBtu in HW	21 ppmv	100 or 100 or	10 (◆) 20 (◇)
	LWAKs	0.20 ng TEQ/dscm or rapid quench of flue gas at exit of kiln to less than 400˚F	0.002 gr/dscf	6.1 ug/dscm	2.4E-5 lbs SVM in HW per MMBtu in HW	3.2E-5 lbs LVM in HW per MMBtu in HW	600 ppmv	100 or	20
	Solid Fuel Boilers	100 ppm CO or 10 ppmv HC	0.036 gr/dscf	10 ug/dscm	170 ug/dscm	190 ug/dscm	73 ppmv	100 or	20
	Liquid Fuel Boilers	0.015 for dry apcd + 400° F at inlet to dry apcd	0.0043 gr/dscf	3.8E-7 lbs Hg in HW per MMBtu in HW	4.3E-6 lbs SVM in HW per MMBtu in HW	2.7E-6 lbs Cr in HW per MMBtu in HW	7.2E-4 lbs Cl in HW per MMBtu in HW	100 or	20
	Hydrochloric Acid Production Furnaces	CO as surrogate	TCl as surrogate	TCl as surrogate	TCl as surrogate	TCl as surrogate	1.2 ppmv or 99.99937% SRE	100 or	20

Exhibit 1-4

REGULATORY ALTERNATIVES FOR NEW SOURCES

MACT	Source Category	Chlorinated D/F (ng TEQ/dscm) [a]	PM	Hg (µg/dscm)	SVM (µg/dscm)	LVM (µg/dscm)	TCl (ppmv)	CO (ppmv)	HC [b] (ppmv)
Option 3 Floor	Incinerators	0.11 for dry apcds and WHBs; 0.2 for others [d]	0.0015 gr/dscf	8 ug/dscm	5.3 ug/dscm	2.5 ug/dscm	0.18 ppmv	100* or	10 *
	Cement Kilns	0.20 or 0.40 + 400˚F at inlet to PM control device	0.005 gr/dscf	21 ug/dscm	53 ug/dscm	8.9 ug/dscm	21 ppmv	100 or	10 (◆)
								100 or	20 (◇)
	LWAKs	0.20 ng TEQ/dscm or rapid quench of flue gas at exit of kiln to less than 400˚F	0.002 gr/dscf	6.1 ug/dscm	21 ug/dscm	41 ug/dscm	280 ppmv	100 or	20
	Solid Fuel Boilers	100 ppm CO or 10 ppmv HC	0.036 gr/dscf	10 ug/dscm	170 ug/dscm	190 ug/dscm	73 ppmv	100 or	20
	Liquid Fuel Boilers	0.015 for dry apcd + 400° F at inlet to dry apcd	0.0043 gr/dscf	0.16 ug/dscm	3.1 ug/dscm	12 ug/dscm (Cr only)	0.029 ppmv	100 or	20
	Hydrochloric Acid Production Furnaces	CO as surrogate	TCl as surrogate	TCl as surrogate	TCl as surrogate	TCl as surrogate	0.70 ppmv	100 or	20

Notes:

[a] Across all options, a DRE of 99.99% is required (99.9999% for sources burning dioxin-listed wastes) to control emissions of non-dioxin/furan organic HAPs.

[b] Across all options, cement kilns sources have the option to continuously comply with a CO standard of 100 ppmv in lieu of complying with the HC standard. Cement kilns that choose to do this, however, must demonstrate compliance with the HC standard during the comprehensive performance test.

[c] Shaded cells indicate that the standards represent beyond-the-floor levels compared with Option 1.

[d] WHB are incinerators with waste heat boilers.

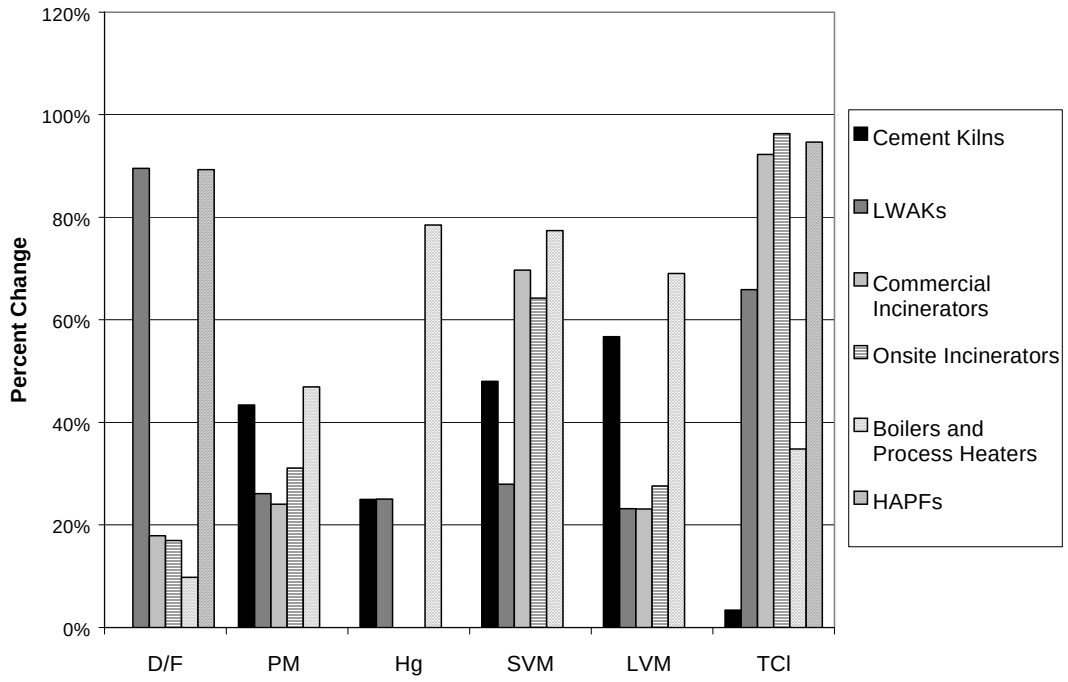
(*) Incinerators can comply with either the HC or CO standards.

(◆) Cement kilns with bypass ducts have the option to comply with either a CO standard in the bypass duct of 100 ppmv, or an HC standard in the bypass duct of 10 ppmv; they must also comply with a 50 ppm HC limit in the main stack.

(◇) Cement kilns without bypass ducts have the option to comply with either a CO standard in the main stack of 100 ppmv, or an HC standard in the main stack of 20 ppmv.

Exhibit 1-5

PERCENT CHANGE IN AGGREGATE EMISSIONS WITH AGENCY PREFERRED APPROACH[1]



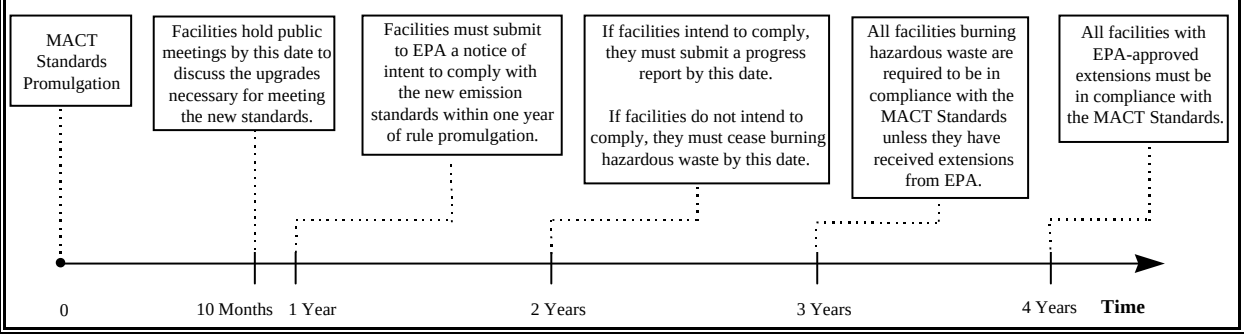
[1] For on-site and commercial incinerators, cement kilns, and LWAKs, percent change in emissions is relative to the 2002 Interim standards. For boilers and HAPFs, percent change is relative to the 1991 RCRA Boiler and Industrial Furnace rule.

EPA anticipates that the proposed HWC MACT replacement standards for hazardous waste combustion facilities will reduce human health and environmental risks from these facilities. In particular, reductions in cancer risks are expected from decreased dioxin emissions, reductions in respiratory diseases are expected from decreased particulate matter emissions, and reductions in developmental abnormalities in children may result from decreased mercury and lead emissions. In addition, chlorine reductions may be associated with decreased risk of health effects and dioxin and mercury reductions may also decrease risks to terrestrial and aquatic ecosystems. Moreover, PM reductions may improve visibility. Finally, coupled with the 2002 Interim standards, the proposed HWC MACT replacement standards may , in the long term, contribute to reduced generation of hazardous wastes and thus further reductions in emissions.

TIMETABLE FOR MACT REQUIREMENTS

EPA allots three years beyond the publication of the Final Rule for hazardous waste combustion facilities to come into full compliance with the MACT standards. A one-year extension may be granted to facilities for which complete system retrofits cannot be implemented within three years despite a good faith effort to do so. Exhibit 1-6 specifies other requirements that must be met during this three- or four-year time-frame. Within the first 10 months following promulgation of the Final Rule, facilities must hold public meetings to discuss the upgrades necessary for meeting the new standards. Within one year following rule promulgation, combustion facilities must submit to EPA a notice of intent to comply with the new emission standards. Two years after rule promulgation, facilities that intend to meet the standards must submit a progress report and facilities that do not intend to comply must cease burning hazardous waste. Three years after promulgation of the Final Rule, all facilities must be in compliance with the proposed HWC MACT replacement standards.

Exhibit 1-6
TIMELINE FOR HWC MACT REQUIREMENTS



ANALYTIC APPROACH AND ORGANIZATION

This assessment evaluates the costs of the proposed HWC MACT replacement standards and impacts that these costs would have on waste burning behavior. It also compares these costs to the benefits of the proposed HWC MACT replacement standards. The assessment analyzes the Agency Preferred Approach along with three alternative MACT floor options that EPA also considered in the development of its approach. For statutory reasons under the Clean Air Act, we also analyze cost-effectiveness (CE), a required metric used for evaluating decisions that go beyond the floor. This measure estimates aggregate compliance expenditures divided by aggregate emissions reduced for each pollutant.

The analysis discussed in the subsequent chapters of this report begins by establishing the baseline waste management practices and costs at facilities affected by the proposed HWC MACT replacement standards. We then determine the change in costs post-MACT and assesses the impacts of these increased costs on the combustion market. We also evaluate the benefits of the proposed HWC MACT replacement standards, the impacts to low-income and minority populations, small businesses, state, local, and tribal governments, and private property owners, and the effects on energy use and distribution. We discuss these analyses in seven subsequent chapters:

Chapter 2: Overview of Combustion Practices and Markets
Presents background information on the combustion market and characterizes the industry and sectors affected by the proposed HWC MACT replacement standards. We examine current waste burning practices, types of hazardous waste managed by combustion sector, types of generating industries that use combustion services, and overall market trends.

Chapter 3: Defining the Regulatory Baseline
Describes the data used for specifying the baseline, which defines "the world absent the proposed HWC MACT replacement standards." We discuss current facility practices and future trends with regard to revenue and cost assumptions, future capacity projections, emission profiles, and pollution control practices.

Chapter 4: Compliance Cost Analysis
Explains how we develop compliance cost estimates for hazardous waste combustion facilities by using engineering cost models and examining other private sector compliance costs and government administrative and implementation costs.

Chapter 5: Social Cost and Economic Impact Analysis
Analyzes social costs and economic impacts of the proposed HWC MACT replacement standards by examining the incentives and reactions of the regulated community. We analyze the following economic impacts: market exits, employment impacts, combustion prices changes, and the quantity of waste that may be diverted from combustion facilities that stop burning hazardous waste.

Chapter 6: Benefits Assessment

Adjusts the estimates from the 1999 *Assessment* to project the human health and ecological benefits of the replacement standards. We use a multiple-pathway risk assessment that estimated baseline risks from hazardous waste combustion emissions as well as expected risks after the 1999 MACT standards were implemented. The risk assessment analyzed both human health and ecological risks resulting from direct and indirect exposure to emissions from facilities combusting hazardous waste.

Chapter 7: Equity Considerations and Other Impacts

Assesses distributional and equity impacts of the MACT standards, including small entity impacts, environmental justice implications, children's health, impacts to Tribal Governments, assessments of the potential for unfunded mandates and regulatory takings, federalism implications, and energy use and distribution effects resulting from the rule.

Chapter 8: Comparison of Costs, Benefits, and Other Impacts

Compares the benefits with the costs of the proposed HWC MACT replacement standards and addresses the cost-effectiveness of the final options under consideration.

OVERVIEW OF COMBUSTION PRACTICES AND MARKETS CHAPTER 2

This chapter presents an overview of the hazardous waste combustion industry in order to provide a context for assessing the costs and economic impacts of the proposed Hazardous Waste Combustion (HWC) Maximum Achievable Control Technology (MACT) replacement standards. 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 proposed HWC MACT replacement 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. Following this, we present an overview of the regulatory and economic factors that underlie the demand for hazardous waste combustion services. Finally, we explore the current regulatory framework as well as the recent market and financial performances of the various combustion industry sectors.

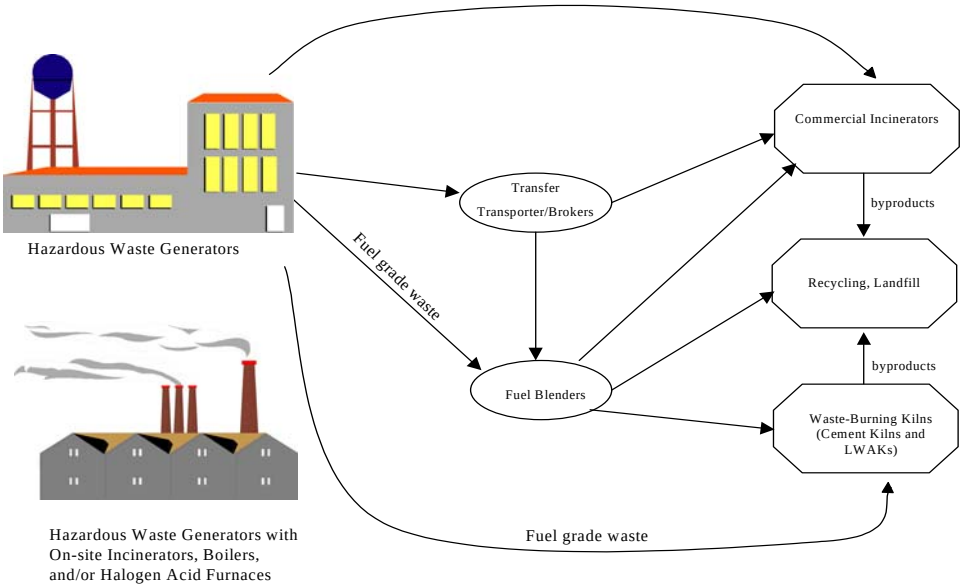
COMBUSTION MARKET OVERVIEW

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. We illustrate the market structure and waste flows in Exhibit 2-1. As the exhibit shows, some hazardous waste generators manage their wastes on site in boilers or on-site incinerators, and some send their wastes directly to commercial combustion facilities such as commercial incinerators and waste-burning kilns.[1] Other generators manage their wastes through waste brokers or fuel blenders who subsequently send the waste to commercial combustion facilities.

[1] 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 the majority of the waste burned originates on site.

Exhibit 2-1

HAZARDOUS WASTE COMBUSTION MARKET STRUCTURE



Types of Combustion Facilities

Hazardous waste is combusted at three specific types of facilities: commercial and on-site incinerators, boilers and industrial furnaces, and waste-burning kilns.[2] These facilities fall into several categories, such as commercial and non-commercial facilities, or facilities that use the energy released from waste combustion for other processes, and those that do not. Solid and liquid fuel boilers, hydrochloric acid production furnaces (HAFS), cement kilns, and lightweight aggregate kilns

[2] The proposed HWC MACT replacement standards also apply to mobile and transportable incinerators, which can be moved and are generally used to treat soils and other contaminated media at Superfund and other hazardous waste sites. Mobile incinerators are typically regulated under the Superfund program, which requires that mobile incinerators meet "Applicable or Relevant and Appropriate Requirements" -- leading to the use of state of the art control equipment, including fabric filters, wet scrubbers, and activated carbon. Specifically, a survey of the control systems used on previous mobile Superfund incinerators indicated that almost all used fabric filters, all used wet scrubbers, and a number used activated carbon beds. Corresponding stack gas emissions levels are consistently below proposed MACT floor levels. (Bruce Springsteen, EERGC, personal communication, September 17, 2003). In addition, according to EPA's February 2001 *Treatment Technologies for Site Cleanup: Annual status Report, 10th Edition* (Report No. 542-F-01-004), only one mobile incinerator operated in 1999. Since mobile incinerators would already comply with the proposed HWC MACT replacement standards and very few mobile incinerators are currently in operation, this assessment does not include mobile incinerators in the cost, economic impact, and benefit analyses for the current universe of facilities.

(LWAKs) recover energy, but incinerators for the most part do not burn waste for energy-production purposes.[3]

Incinerators generally burn wastes to destroy toxic characteristics. Commercial incineration facilities manage a wide variety of waste streams generated across a range of industries and therefore tend to be larger in size. They are usually designed as rotary-kilns, which can manage both solid and liquid wastes. In contrast, the majority of on-site incinerators manage waste streams with specific and relatively uniform characteristics generated by certain product lines. Depending on the wastes generated and burned at these locations, on-site incinerators may be designed as liquid-injection incinerators, which handle liquids and pumpable solids, or as rotary kilns.

Hazardous waste boilers, process heaters, and HCl production furnaces are part of the larger category of boilers and industrial furnaces (BIFs). Boilers and industrial furnaces are used in a wide range of industries, primarily on a non-commercial basis. For the most part these facilities combust waste that is generated on site. Hazardous waste boilers and hazardous waste HAFS provide two services to facilities that use them: production of energy for facility processes and waste disposal. Process wastes with high Btu content can be combusted in order to recover energy and reduce the need for other fuel such as natural gas or coal. Hazardous waste boilers are categorized as solid or liquid fuel boilers according to the types of waste that they can accommodate. Process heaters are regulated as liquid fuel boilers and are thus included in this category of combustion facility throughout the remainder of this assessment.

Cement kilns and LWAKs burn hazardous wastes to generate heat and/or power for manufacturing purposes. While kilns traditionally burned conventional fuels such as 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. 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 LWAKs can also incorporate a portion of the residual ash from combustion of both hazardous and non-hazardous fuels into their products, slightly reducing raw material requirements.[4]

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[3] While energy recovery is possible at some incinerators, their primary function continues to be reduction and stabilization of hazardous waste (Michel Buron, Seghers Better Technology for Solids + Air. "Better Technology for Hazardous Waste Treatment," *Green Pages*, May 4, 2002). Since energy recovery is minor and not a primary function of incinerators, this assessment does not estimate the energy recovery implications of the proposed HWC MACT replacement standards for incinerators.

[4] Waste substitution is possible when it properly balances the chemisty necessary for cement production (Jim Woodford, "MACT Implications of Alternative Raw Materials," presented at *Air & Waste Management Association Hazardous Waste Combustors Specialty Conference*, April 2003).

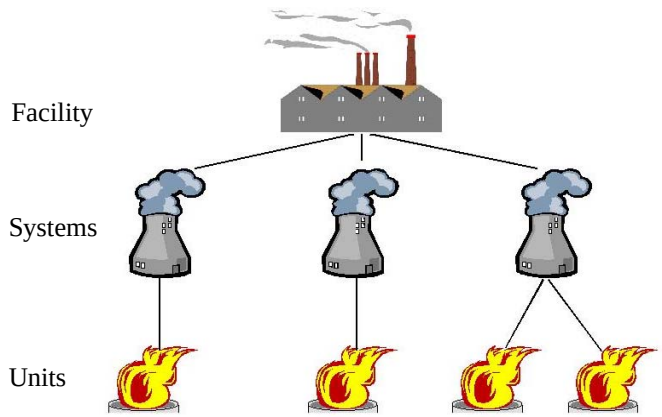
Companies that generate large quantities of hazardous waste typically choose to combust the waste on site with incinerators that are usually located at the generator's production site. Furthermore, generators of specialized wastes may not be able to send their wastes offsite because commercial incinerators will not accept certain wastes (e.g., explosives) or because transportation is too 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, and any wastes not treated at the generating site are shipped to other company locations.[5]

Number of Combustion Facilities and Sources

The universe of hazardous waste combustors can be examined on the facility, system, or unit level. As shown in Exhibit 2-2, at a given location a facility may have more than one combustion "system." A system has a single source that is the route of air emissions resulting from combustion (e.g., a "stack"). The source at each facility is subject to environmental testing and is usually the point of remediation. The proposed HWC MACT replacement standards address air emissions at the source level. In general, a combustion system has one combustion unit connected to a single source. However, some systems have multiple units connected to a shared source.[6] Because each system contains a single source, we use the terms "source" and "system" interchangeably throughout this assessment.

Exhibit 2-2

COMBUSTION FACILITY STRUCTURE



[5] Firms appear to be increasingly moving away from these policies due to the growing costs of on-site incineration and increased legal clarity regarding Superfund liability. We discuss this in greater detail later in the chapter.

[6] Of the 119 individual systems that manage hazardous waste in boilers, two have more than one unit. Three of the 107 incinerator systems also have more than one unit per source. Since few systems have multiple units and emissions and the costs of curtailing them occur at the source or facility level, we consider only source- and facility-level impacts.

Based on EPA's 1999 Biennial Reporting System (BRS) data, permit information from EPA's 10 regions, and recent compliance tests, the Agency estimates that 150 facilities with 276 sources are currently permitted to burn hazardous waste in the United States.[7] Appendix A provides a detailed description of the development of the universe, and Appendix B includes a list of the facilities in the universe and the quantities of waste that they manage. As shown in Exhibit 2-3, the 69 facilities with on-site incinerators constitute the greatest portion of combustion facilities, followed by 67 hazardous waste boilers and/or HCl production furnaces.[8] The commercial sector includes a relatively small number of facilities, comprising only 10 commercial incinerators, 14 cement kilns, and three lightweight aggregate kilns (LWAKs). These represent 18 percent of facilities in the universe. In contrast, fifty-five of the 150 facilities (and 107 of the 276 sources, or 39 percent) have liquid fuel boilers.

Exhibit 2-3

NUMBER OF FACILITIES AND SOURCES IN UNIVERSE

Type of Combustion Device	Number of Facilities[a]	Number of Sources	Average Waste Burning Sources/Facility
On-site Incinerators	69	92	1.3
Commercial Incinerators	10	15	1.5
Cement Kilns	14	26	1.9
LWAKs	3	7	2.3
Liquid Fuel Boilers & Process Heaters [b]	55	107	1.9
Solid Fuel Boilers	4	12	3.0
HCl Production Furnaces	8	17	2.1
Total	**150** [c]	**276**	**1.7**

Note:

[a] A small number of on-site incinerator facilities are not included in the universe because they are either under construction or no longer operating.
[b] Because process heaters are subject to liquid fuel boiler regulations, they are included in this category.
[c] Column does not add to total because 13 facilities have more than one type of system and are represented twice.

Sources: EERGC Corporation and U.S. EPA, *Biennial Reporting System*, 1999.

The number of sources per facility in the combustion universe ranges from one to 12. Typically, facilities with boilers and HAFS (BIFs) have a larger number of waste burning combustion systems per facility than do incinerators and commercial kilns. The average number of systems per BIF facility is 2.0, and the average number of systems per incinerator or kiln facility is 1.5. However, LWAKs are an exception to this pattern; they have an average of 2.3 systems per facility. On-site incinerators, with 1.3 sources per facility, have the lowest average systems per facility in the

[7] EPA's Biennial Reporting System (BRS) is a national database containing information on hazardous waste generation from large quantity generators and waste management practices from treatment, storage, and disposal facilities.

[8] In addition, between six to twelve mobile incinerators were in operation as of 1998, but we do not include them in our current analysis because previous research indicates that they are small in number and would already comply with the proposed HWC MACT replacement standards.

universe.

Geographical Distribution of Universe

The facilities likely to be regulated under the proposed HWC MACT replacement standards are concentrated in the Gulf of Mexico and the Delta region (EPA Region 6), with a number of others in the northeast and central part of the country, and very few in the southeast and west (Exhibit 2-4). This distribution is approximately consistent with the distribution in the chemical industry. Out of the 150 facilities in the universe, 36 (24 percent) are in Texas and 16 (11 percent) are in Louisiana, the two states with the greatest number of facilities. The concentration of boilers and industrial furnaces in the Gulf region is particularly pronounced; thirty-five (52 percent) are located in Texas and Louisiana. In contrast, facilities with incinerators or kilns are relatively evenly distributed among different areas of the country. Although the highest concentration of incinerators is still in Texas, only 15 incinerators out of a total of 79 (19 percent) are in the state. The highest density of cement kilns (21 percent) is in Missouri.

Industry Sectors Represented in the Universe

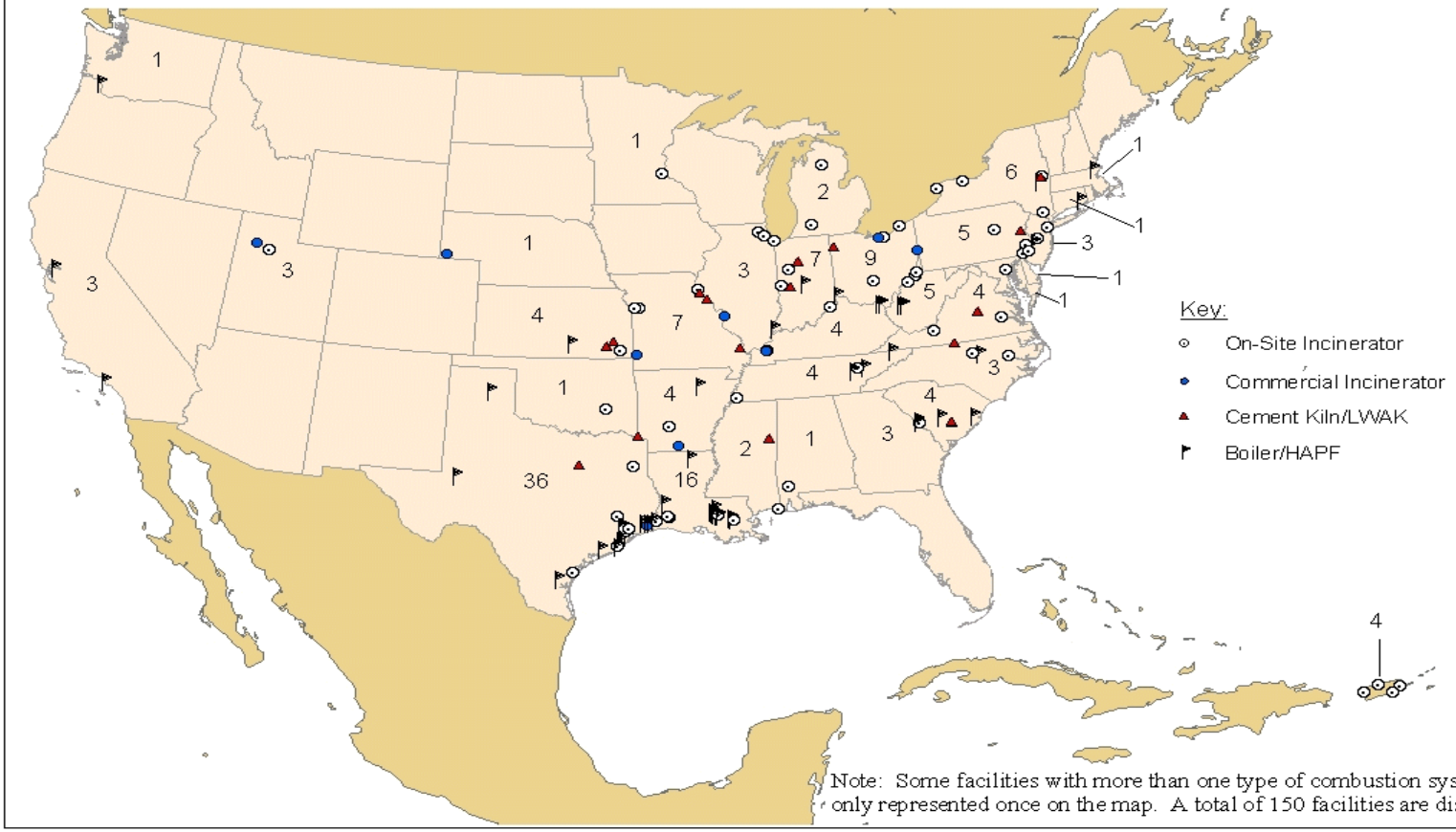
In order to determine which industries and markets are most likely to be affected by changes to the proposed HWC MACT replacement standards, we categorize each facility in the universe by North American Industry Classification System codes.[9] The facilities are grouped by three-digit NAICS codes (e.g. industry subsectors) to provide a general overview of the industries they represent (see Exhibit 2-5). This screening analysis attributes all waste received by a facility to the NAICS code assigned to that facility, not the NAICS code of the facility that generated the waste. In other words, commercial incinerators, which are categorized under SIC code 562 (waste management and remediation services), actually receive waste that was generated from a variety of sources in different industries. That waste is not attributed to the NAICS code of the generating facility; rather, it is included in the code corresponding to the facility ultimately treating the waste. In this way, we can identify the industries most affected by changes in treatment costs. It would be necessary to trace the waste back to the generators in order to see what indirect impacts might occur if changes in waste treatment cost were passed through to generators.[10]

[9] Facilities report NAICS codes in EPA's 2001 Biennial Reporting System (BRS) data. Although the waste quantity data from the 2001 BRS were not available in time to support our analysis of quantities, we were able to obtain facility descriptive data in order to support analysis of industry sectors.

[10] The Regulatory Flexibility Screening Analysis (Appendix H) addresses this issue briefly in the context of small business impacts.

Exhibit 2-4

LOCATIONS OF COMBUSTION FACILITIES IN UNIVERSE



Note: Some facilities with more than one type of combustion system are only represented once on the map. A total of 150 facilities are displayed.

Among the universe of facilities, 70 percent of facilities are in NAICS 325, Chemical Manufacturing. The American chemical industry is one of the nation's largest industries. On a value-added basis, 11.5 percent of all U.S. manufacturing can be attributed to the chemical industry, and the sector accounts for 1.9 percent of U.S. gross domestic product (GDP).[11] The U.S. chemical industry is also the world's largest, responsible for 27 percent ($453 billion) of the $1.59 trillion in world chemical sales. In 1999, the U.S. chemical industry was the nation's largest exporting sector, representing over $70 billion in exports. The hundreds of companies that make up this sector employ over one million workers in the United States and manage over 12,000 plants nationwide. The sector is also very diverse, manufacturing 70,000 different chemical products.[12]

Exhibit 2-5

SUMMARY OF INDUSTRY SECTORS WITH COMBUSTION FACILITIES

Industry Subsector (NAICS Code)	Number of Facilities	Percent of Facilities
325: Chemical Manufacturing	105	70.00%
562: Waste Management and Remediation Services	16	10.67%
327: Nonmetallic Mineral Product Manufacturing	12	8.00%
324: Petroleum and Coal Products Manufacturing	3	2.00%
339: Miscellaneous Manufacturing	3	2.00%
326: Plastics and Rubber Products Manufacturing	2	1.33%
332: Fabricated Metal Product Manufacturing	2	1.33%
422: Wholesale Trade	2	1.33%
928: National Security	2	1.33%
212: Mining (Except Oil and Gas)	1	0.67%
336: Transportation Equipment Manufacturing	1	0.67%
541: Professional, Scientific, and Technical Services	1	0.67%
TOTAL	150	100.00%

Note: We categorized facilities by three digit NAICS codes rather than the more specific six digit categories to illustrate the distribution among sectors without providing unnecessary detail.

Source: U.S. EPA, *Biennial Reporting System*, 2001.

Roughly 11 percent and eight percent of facilities are represented by Waste Management and Remediation Services and Nonmetallic Mineral Product Manufacturing, respectively. The majority of facilities classified as Waste Management and Remediation Services are commercial incinerators (62 percent). Nonmetallic Mineral Product Manufacturing corresponds with cement manufacturing,

[11] "Value-added" is a financial term that allocates value to goods and services based on the final consumer prices. Proportions of the final market prices are allocated throughout the production chain at the point at which the product was improved or enhanced (e.g., the point where value was added).

[12] U.S. Department of Commerce/International Trade Administration, *U.S. Industry & Trade Outlook, 2000*, 2000.

and consequently all facilities within this classification are kilns. The other five kilns are classified as either Waste Management and Remediation Services, Crushed and Broken Limestone Mining and Quarrying, or Miscellaneous Manufacturing. The remaining facilities, which are predominately on-site incinerators and boilers, represent a range of industry subsectors.

CHARACTERISTICS OF COMBUSTED WASTE

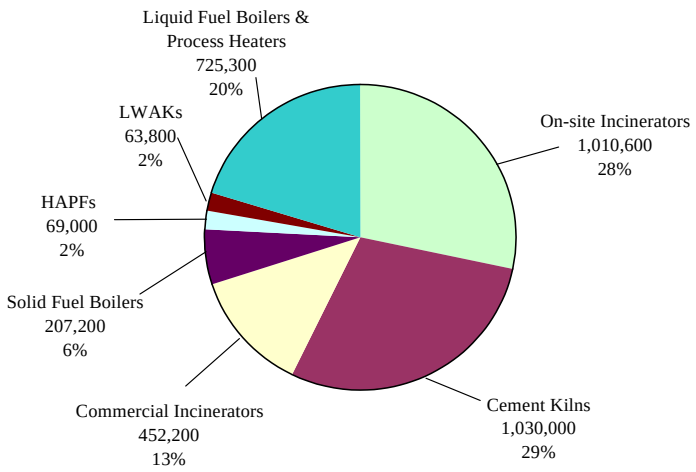
In the following section we describe several characteristics of the waste burned at facilities in the universe. This includes waste quantity as well as the physical form and makeup of the waste. The total quantity of combusted hazardous waste has decreased by 16 percent since the mid-1990s; incinerators and liquid boilers experienced the majority of this reduction.

Waste Quantity

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. Data from the 1999 BRS indicate that combustion facilities burned approximately 3.6 million tons of hazardous waste in 1999 (Exhibit 2-6). Cement kilns and LWAKs burned roughly 31 percent of the total combusted wastes, and commercial incinerators account for 13 percent of waste burned. Both on-site incinerators and BIFs burned approximately 28 percent of the hazardous waste in the combustion universe.[13]

Exhibit 2-6

QUANTITY OF WASTE (TONS) TREATED BY EACH FACILITY TYPE



Although they burn roughly 44 percent of the waste, the larger commercial facilities (cement kilns, commercial incinerators, and LWAKs) represent only 18 percent of the facilities in the universe. According to 1999 BRS data, a comparable amount of waste is treated by facilities which only treat their own waste and facilities which receive it from other sources. Of the 3.56 million tons of waste, generators treated around 2.01 million tons (57 percent) on site; an additional 1.55 million tons (43 percent) were shipped offsite to be treated by other facilities.

[13] U.S. EPA, *Biennial Reporting System*, 1999.

Of the 150 facilities in the universe, we use 1999 BRS waste quantity data to describe activities at 138 facilities. The remaining 12 facilities, including seven on-site incinerators, three liquid fuel boilers, one commercial incinerator, and one cement kiln, did not report treating hazardous waste in 1999. We utilize 1997 BRS information to estimate quantities combusted at four of these facilities. For the final eight facilities, we use a simple regression analysis by facility type with hazardous waste feed rate as the independent variable and waste quantity as the dependent variable to estimate the total waste quantities combusted.[14]

Exhibit 2-7

QUANTITY OF WASTE TREATED AS REPORTED BY COMBUSTION FACILITIES IN 1999 BRS

Type of Combustion Device	Number of Facilities	Percentage of Total Facilities	Waste Treated On Site (annual tons)	Percentage of Total Waste
On-site Incinerators	69	46.0%	1,010,600	28.4%
Cement Kilns	14	9.3%	1,030,000	29.0%
Commercial Incinerators	10	6.7%	452,200	12.7%
LWAKs	3	2.0%	63,800	1.8%
Liquid Fuel Boilers & Process Heaters[a]	55	36.7%	725,300	20.4%
Solid Fuel Boilers	4	2.7%	207,200	5.8%
HCl Production Furnaces	8	5.3%	69,000	1.9%
Total	**150**[b]	**100%**[a]	**3,558,004**	**100%**

Notes:

[a] Since process heaters are subject to liquid fuel boiler regulations, they are included in this category.

[b] Column does not add to total because 13 facilities have more than one type of system and are represented twice. For these facilities, the waste quantity is divided evenly among the types of systems at each facility to avoid double counting.

Sources: EERGC Corporation and U.S. EPA, *Biennial Reporting System*, 1999.

Waste Quantity by Industry Sector

Exhibit 2-8 shows the quantity of waste associated with each industry sector and the number of facilities in the universe that belong to each sector. This analysis attributes waste to the NAICS code of the facility that treats the waste, not the NAICS code of the facility that generated the waste.

A majority of facilities (70 percent) are identified as chemical manufacturers (subsector 325), representing 49 percent of the waste treated. Facilities providing waste management and remediation services (subsector 562) account for almost 11 percent of facilities and treat 22 percent of the waste in the current universe. Nonmetallic mineral product manufacturers (subsector 327)

[14] The incinerator regression analysis was statistically significant, with a coefficient value equaling 1.152 and a standard error of 0.134 (95 percent confidence interval of 0.883 to 1.422). The boiler regression analysis was statistically significant, with a coefficient value equaling 1.178 and a standard error of 0.098 (95 percent confidence interval of 0.980 to 1.375). The kiln regression analysis was statistically significant, with a coefficient value equaling 1.729 and a standard error of 0.197 (95 percent confidence interval of 1.311 to 2.147).

account for eight percent of facilities in the universe and combust 19 percent of the waste. None of the remaining industry subsectors combust over five percent of the waste in the hazardous waste combustion universe.

Exhibit 2-8

WASTE QUANTITIES REPORTED BY COMBUSTION FACILITIES IN 1999 BRS-INDUSTRY SECTOR TOTALS [a]

Industry Subsector (NAICS Code) [b]	Number of Facilities	Waste Treated [c] (annual tons)	Percentage of Total Waste Treated
325: Chemical Manufacturing	105	1,754,400	49.31%
562: Waste Management and Remediation Services	16	767,600	21.57%
327: Nonmetallic Mineral Product Manufacturing	12	685,900	19.28%
324: Petroleum and Coal Products Manufacturing	3	116,500	3.27%
339: Miscellaneous Manufacturing	3	99,500	2.80%
212: Mining (Except Oil and Gas)	1	81,200	2.28%
422: Wholesale Trade	2	34,600	0.97%
326: Plastics and Rubber Products Manufacturing	2	7,800	0.22%
928: National Security	2	7,500	0.21%
541: Professional, Scientific, and Technical Services	1	2,100	0.06%
336: Transportation Equipment Manufacturing	1	700	0.02%
332: Fabricated Metal Product Manufacturing	2	200	0.01%
TOTAL	150	3,558,004	100 %

Notes:
[a] We used NAICS data from the 2001 BRS to categorize waste quantities reported by the same facilities in the 1999 BRS.
[b] We categorized facilities by their three-digit NAICS code rather than the more specific six digit categories in order to illustrate the distribution among sectors without providing unnecessary detail.
[c] Totals may not add due to rounding.

Waste Forms and Constituents

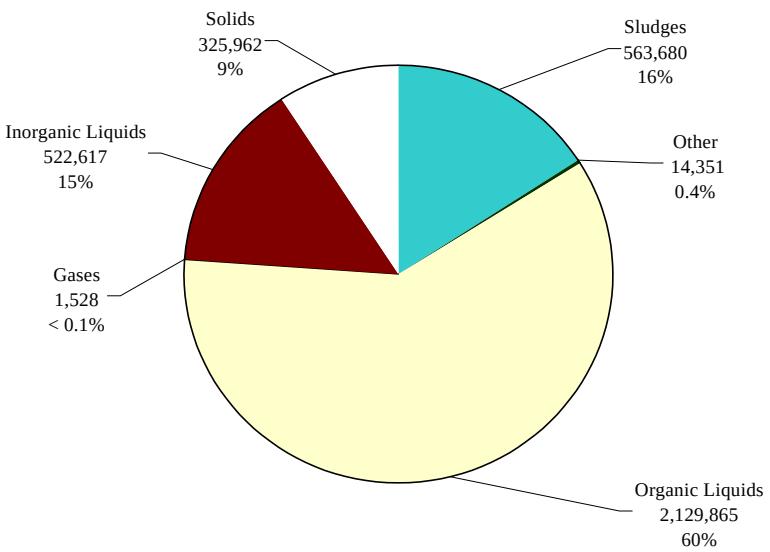
The form of the waste - liquid, solid, or sludge - and the constituents (or waste codes) in waste streams are significant because they drive the combustion market prices. Solids and sludges are typically more highly contaminated and difficult to incinerate. They consequently represent higher priced waste streams. In contrast, liquid wastes are usually easier to incinerate and have a higher energy content, so they generally constitute lower priced waste streams. An exception to this pattern is “halogenated” wastes. Wastes of any form with a high chlorine content generally cost more to treat.

Waste Forms

Exhibit 2-9 illustrates that 75 percent of the total waste treated by hazardous waste combustion facilities is liquid. Of the remaining 25 percent, sludges account for slightly almost 16 percent, solids equal over nine percent, and gases and "other" wastes, which include lab packs and waste at facilities not specifying waste forms, account for less than half a percent. The emphasis on liquid wastes is consistent with the fact that most high-quality fuel grade (e.g. high Btu) wastes are liquid. Therefore, facilities in the universe that burn waste for energy recovery (e.g., boilers, HCl production furnaces, cement kilns, and LWAKs) tend to burn primarily liquid wastes.

Exhibit 2-9

QUANTITY OF WASTE COMBUSTED IN 1999 (TONS) BY WASTE FORM



Note: Other waste forms include lab packs and waste streams for which facilities did not specify waste forms.

Source: U.S. EPA, *Biennial Reporting System*, 1999.

The smaller amounts of non-liquid wastes include lab packs or small containers of hazardous waste packaged together in a larger drum, sludges, solids, or gaseous waste. These wastes are frequently highly contaminated and tend to have limited or no fuel value. As a result, on-site and commercial incinerators generally burn these forms of waste.

Waste Types (Waste Code Data)

Facilities report all of the waste codes counted in each waste stream to BRS. While it is not possible to use these data to isolate highly contaminated waste streams, they do provide a useful overview of the types of waste streams that are handled by different types of facilities.[15]

[15] When submitting forms to BRS, facilities report the total quantity of each treated waste stream and the list of materials contained in the stream. Since the quantity of the stream does not indicate the quantity of each material in the stream and a single stream can contain more than one material, it is not possible to obtain accurate quantities of specific wastes (e.g. waste codes) from BRS data.

An analysis of facility reports to the 1997 and 1999 BRS shows that at least some of the waste streams burned in almost all facilities in the universe typically exhibit ignitable, corrosive, or reactive characteristics (waste codes D001, D002, and D003). Of the 138 facilities in the current universe reporting waste in the 1999 BRS, 127 facilities (92 percent) reported waste streams containing these individual waste codes. These waste codes (particularly D001, "ignitable" waste) are consistent with the high fuel grade waste necessary for powering fuel recovery systems (e.g., boilers and cement kilns).

Boilers, cement kilns, and LWAKs are more limited in the range of waste streams and constituents that they can burn than both commercial and on-site incinerators. For example, while virtually all facilities burn ignitable wastes (D001), the combustion of acute hazardous wastes (e.g. "P" waste codes) is generally limited to incinerators, particularly commercial incinerators. Eight out of 9 commercial incinerators (89 percent) report burning "P" waste, while only five of the 79 facilities (6 percent) with energy recovery systems report managing this type of waste.

Hazardous waste used in energy recovery systems must be "fuel grade;" that is, the waste must have sufficient Btus per pound to efficiently operate BIFs and kilns. These facilities therefore seek waste that is easy to pump, burns cleanly, and results in a relatively small amount of solid residue. The existing RCRA Boiler and Industrial Furnace (BIF) rule requires waste burned in energy recovery systems to have a minimum heat value of 5,000 Btu per pound.[16] In addition, these facilities are required to achieve a 90 percent efficiency rate in recovering the energy from combusted wastes. In practice, we estimate that the blended waste burned by energy recovery systems has an average heat value of 13,500 Btu/lb.[17]

Because boilers are generally on-site, non-commercial facilities, the waste streams tend to have uniform characteristics consistent with specific product lines. Compared with other types of combustors, fewer BIF facilities report burning waste streams with large numbers of waste codes. Cement kilns and LWAKs, however, burn a much broader range of high quality wastes than most boilers because they receive wastes from multiple generators. Moreover, research by IEc for the 1999 *Assessment* suggests that recent 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.[18] 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

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

[17] Estimate is provided by EERGC Corporation, 2001, and represents the midpoint heat values ranging from 12,000 to 15,000 Btu/lb.

[18] 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.

wastes used as fuel typically contained between 20-25 percent suspended solids.[19,20] Blending also ensures that contaminants such as metals and chlorine do not exceed allowable levels in fuels sent to combustion systems.

Exhibit 2-10

NUMBER OF FACILITIES COMBUSTING EACH WASTE TYPE [a,b]

Waste Code	Waste Code Description	Boilers/ HCl Production Furnaces [c]	Cement Kilns/LWAKs	On-site Incinerators	Commercial Incinerators	Total [d]
D001-D003	Ignitable, Corrosive, and Reactive Wastes	54	16	59	9	138
Other D codes	Toxic Wastes	42	15	47	9	113
F002-F005	Spent Halogenated and Non-Halogenated Solvents	27	15	41	8	91
KXXX	Hazardous Waste from Specific	18	16	17	9	60
UXXX	Discarded Commercial Chemical Products, Off-Specification Species, Container and Spill Residues	13	16	27	8	64
F024-F025	Wastes from production of Chlorinated Aliphatic Hydrocarbons	4	3	5	7	19
Other F codes	Waste from nonspecific sources	7	16	12	8	43
PXXX	Acute Hazardous Waste	2	3	14	8	27
Total [d]		**62**	**16**	**62**	**9**	**138**

Notes:

[a] One waste stream may include several different waste codes.

[b] We do not report the quantities associated with each waste code here because BRS only lists quantities by waste stream. A stream is usually made up of more than one material, and therefore is assigned several waste codes. Without knowing the breakdown of each material in the waste stream, we cannot accurately assign quantities to waste codes without significantly over-counting the waste quantities.

[c] Because process heaters are subject to liquid fuel boiler regulations, they are included in this category.

[d] Totals represent the 138 facilities reporting waste codes to the 1999 BRS. Columns do not add to totals because facilities with more than one waste code category are listed multiple times in the table. Rows do not add to totals because facilities with more than one type of combustion system are listed in multiple columns.

Source: U.S. EPA, *Biennial Reporting System*, 1999.

[19] Personal communication with fuel blender, May 29, 1997, in U.S. EPA, as cited in *Assessment of the Potential Costs, Benefits, and Other Impacts of the Hazardous Waste Combustion MACT Standards, Final Rule*, Office of Solid Waste, July 1999.

[20] Although a more recent precise number is not available, if anything the percentage of suspended solids in hazardous waste fuels has increased moderately since 1997 due to improvements in fuel blending technologies (Fred Sigg, Von Roll WTI, personal communication, September 10, 2003).

Incinerators accept wastes that kilns cannot accept, such as highly contaminated solids with low heating value. However, incinerators may also burn liquid and solid wastes with low levels of contaminants. Incinerators burn waste that typically has a low heat value compared to kilns and boilers; the average heat content of waste is only 6,700 Btu/lb.[21] Facilities with incinerators often supplement wastes with conventional fuels to ensure temperatures high enough to destroy organic toxics.

REGULATORY AND ECONOMIC FORCES INFLUENCING COMBUSTION PRACTICES

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 greatly reduces the risk of future environmental liabilities by destroying organic wastes.[22] Finally, if alternative management options are more expensive, hazardous waste generators will likely choose to combust their wastes to increase their overall profitability. However, the commercial combustion industry is not a fluid market in the short term, and changes in waste management practices often present logistical and regulatory challenges. For example, a firm that wants to construct a new facility to burn its own wastes must undertake careful planning to meet many regulatory requirements and finance considerable capital expenditures.

Regulatory Requirements Affecting Combustion

According to Graff and Walker (1993), while industry began incinerating some 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 policies 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.[23]

EPA's Land Disposal Restrictions (LDRs) prohibit hazardous waste generators from sending

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[21] The average heat content of waste at medium and large commercial rotary kiln incinerators is from Energy and Environmental Research Corporation combustion database, 1999, as cited in U.S. EPA, *Assessment of the Potential Costs, Benefits, and Other Impacts of the Hazardous Waste Combustion MACT Standards: Final Rule*, Office of Solid Waste, July 1999.

[22] 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. For some cement kilns and LWAKs, this problem is mitigated because much of the combustion residuals are integrated into the product.

[23] 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, as cited in U.S. EPA, *Assessment of the Potential Costs, Benefits, and Other Impacts of the Hazardous Waste Combustion MACT Standards: Final Rule*, Office of Solid Waste, July 1999.

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.[24]

The Records of Decision establish cleanup plans 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 (28 percent of RODs issued).[25] In more recent years, however, use of incineration as the cleanup method at Superfund sites has declined. EPA selected both off-site and mobile incineration as the treatment technology for eight operational projects in 1999, representing three percent of the Superfund treatment technologies in use.[26, 27]

The Hazardous Waste Identification Rule (HWIR) exempts certain wastes from hazardous classification under the RCRA Subtitle C regulatory system, consequently reducing the quantity of waste sent to combustion facilities.[28] According to the rule, substances derived from wastes identified as hazardous solely because they exhibit the characteristics of ignitability, reactivity, and/or corrosivity that no longer exhibit these characteristics after treatment are no longer classified as hazardous. EPA projects that this exemption will most apply to F003 and certain KXXX, PXXX, and UXXX-listed wastes.[29] EPA also estimates that the chemical and allied products sector would

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[24] The Agency is moving away from technology-based requirements in favor of performance-based standards.

[25] 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, 10, as cited in U.S. EPA, *Assessment of the Potential Costs, Benefits, and Other Impacts of the Hazardous Waste Combustion MACT Standards: Final Rule*, Office of Solid Waste, July 1999.

[26] U.S. EPA, February 2001, *Treatment Technologies for Site Cleanup: Annual Status Report, 10th Edition*, Report No. 542-F-01-004, 16.

[27] The percentage of source control RODs stipulating mobile incinerators as the management technology started at about 6 percent in 1986 and increased to approximately 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, mobile incinerators' share decreased steadily within the category of treatment remedies selected by EPA. As mentioned previously, in 1999 mobile incinerators constituted less than one percent of the treatment technologies selected by EPA according to the EPA's February 2001 *Treatment Technologies for Site Cleanup: Annual Status Report*.

[28] Because this assessment utilizes 1999 BRS data and the rule did not come into effect until August 2001, the full impact of the rule is not known at this time.

[29] U.S. EPA, "Rules and Regulations," *Federal Register* 66(95): 27269-27270.

benefit most from the final rule.[30]

Liability Concerns Affecting Combustion

Remediation regulations 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 of cleaning 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. Many manufacturers want to be certain that off-specification products (e.g., pharmaceuticals) are destroyed so that they do not illegally enter the market. In 1995, the Hazardous Waste Treatment Council estimated that 15 to 30 percent of waste handled by destructive incineration was not classified as hazardous by any agency.[31] Although this varies widely from facility to facility, current industry sources suggest that the percentage has not changed significantly in the past decade.[32]

Historically, many hazardous waste generators (e.g., companies who are members of the American Chemistry Council, or ACC) pursued corporate policies to dispose of hazardous waste on site only in order to avoid CERCLA liability for waste disposed by separate entities. However, this cradle-to-grave policy has become increasingly expensive in recent years according to industry representatives, and many companies are beginning to return to off-site disposal.[33] An analysis of 1999 BRS data indicates that almost 85 percent of ACC members report sending some hazardous waste offsite.[34]

Economic Forces Affecting Combustion

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[30] U.S. EPA, "Rules and Regulations," *Federal Register* 66(95): 27267.

[31] For some facilities, this non-hazardous waste helps combustion systems cover their fixed costs of operation, an important attribute during periods of excess combustion capacity. (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, 15-16, as cited in U.S. EPA, *Assessment of the Potential Costs, Benefits, and Other Impacts of the Hazardous Waste Combustion MACT Standards: Final Rule*, Office of Solid Waste, July 1999).

[32] Fred Sigg, Von Roll WTI, personal communication, September 10, 2003.

[33] Fred Sigg, Von Roll WTI, personal communication, December 19, 2002.

[34] U.S. EPA, 1999, Biennial Reporting System (BRS).

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.[35] In addition, energy recovery is possible with hazardous waste combustion, thus alleviating alternative fuel expenses. Furthermore, combustion is often less expensive than other treatments mandated by LDRs such as hazardous waste recovery or deep-well injection.

Economic forces can also deter hazardous waste combustion. For example, siting a new combustion facility can often be a public relations challenge and can involve considerable legal and administrative costs. Similarly, the practice of on-site combustion can be expensive, requiring costly technical specifications and worker safety requirements. Finally, demand for combustion services may be affected by foreign combustors who accept hazardous waste from U.S. facilities, thus reducing the domestic demand for combustion.

CURRENT REGULATORY FRAMEWORK FOR HAZARDOUS WASTE COMBUSTION

A number of regulations currently govern emissions from combustion systems and the processes by which residuals must be managed. Because different sets of regulations apply to various segments of the combustion market, they influence the relative costs across combustion sectors. We discuss the regulatory framework separately for waste-burning BIFs, kilns, and hazardous waste incinerators (both commercial and on-site systems). 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, Boilers, and HCl Production Furnaces

Currently, emissions from hazardous waste-burning kilns and BIFs are regulated under the 1991 Boiler and Industrial Furnace Rule.[36] 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

[35] 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.

[36] Emissions from cement kilns that do not burn hazardous waste are regulated under the Portland Cement MACT (final rule June 14, 1999; amended July 5, 2002). However, cost estimates in Chapter 4 of this assessment do not account for the Portland Cement MACT. Therefore, compliance costs presented later in this assessment represent an overestimate of costs incremental to the baseline that includes compliance with the Portland Cement MACT.

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 BIFs and kilns have applied for final Part B RCRA permits, only 65 percent of these facilities have obtained a final permit. Hazardous waste-burning BIFs and 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, hydrocarbons, dioxins and furans).

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

In 1998, EPA also finalized the RCRA Comparable Fuel Exclusion rule exempting hazardous waste fuels that meet hazardous constituent concentration specification levels comparable to fossil fuels from RCRA regulations governing hazardous waste. The exclusion applies to gaseous or liquid wastes but not to solids or used oil. To be eligible for the exclusion, wastes must have a minimum energy content of 5,000 British thermal units/pound mass (Btu/lbm) and have a viscosity the same as No. 6 fuel when fired.[37] The rule promotes the use of hazardous waste fuels by easing regulatory obligations for combustors. The finalization of the RCRA Comparable Fuel Exclusion likely contributed to the decrease in the quantity of waste reported in the 1999 BRS.

Industrial, commercial, and institutional boilers not burning hazardous wastes will be regulated by the proposed National Emissions Standards for Hazardous Air Pollutants for Industrial/Commercial/Institutional Boilers and Process Heaters. The proposed rule will require all major sources to meet emissions standards reflecting the maximum achievable control technology.[38] The rule is projected to be more stringent than the proposed HWC MACT replacement standards controlling pollution from hazardous waste combustion systems for particulate matter and hydrogen chloride emissions levels. Therefore, boilers opting to burn conventional fuels instead of hazardous waste will face some compliance costs associated with the non-hazardous MACT standards. However, these costs are not assessed in Chapter 5.

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[37] U.S. EPA, "Rules and Regulations," *Federal Register* 63(118): 33783, 33787.

[38] U.S. EPA, "Rules and Regulations," *Federal Register* 68(8): 1660.

Kilns combusting hazardous waste are currently regulated under the 2002 Interim MACT standards that were implemented in place of the 1999 HWC MACT standards. The proposed standards described in this assessment are incrementally more stringent and would replace the 2002 Interim standards. However, prior compliance with the Interim standards typically results in lower costs for facilities upgrading to comply with the proposed HWC MACT replacement standards.

Regulations Governing Hazardous Waste Incinerators

Title 40 in the *Code of Federal Regulations*, Parts 264 and 265, regulate hazardous waste incinerators.[39] 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 systems, 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).[40] In fact, CERCLA systems do not require Title V permits to operate; they must simply meet applicable, relevant, and appropriate requirements (ARARs).[41]

Commercial and on-site incinerators are regulated by the 2002 Interim MACT standards described in the previous section. As stated previously, the proposed standards evaluated in this assessment are incrementally more stringent and would replace the 2002 Interim standards. Prior compliance with the Interim standards would typically result in lower costs for facilities upgrading to comply with the proposed HWC MACT replacement standards.

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[39] 40 CFR 264.343 (1997).

[40] Robin Anderson, U.S. EPA, OSWER, personal communication, May 21, 1998, as cited in U.S. EPA, *Assessment of the Potential Costs, Benefits, and Other Impacts of the Hazardous Waste Combustion MACT Standards: Final Rule*, Office of Solid Waste, July 1999.

[41] Andrew Opalko, U.S. EPA, personal communication, May 8, 1998, as cited in U.S. EPA, *Assessment of the Potential Costs, Benefits, and Other Impacts of the Hazardous Waste Combustion MACT Standards: Final Rule*, Office of Solid Waste, July 1999.

Ash Disposal

Ash from hazardous waste incinerators is also considered to be a hazardous waste.[42] Facilities must dispose of the material in a permitted hazardous waste landfill at a substantial cost. By comparison, cement kilns and LWAKs often integrate ash 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 significantly lower cost. 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.

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 system is fully permitted. In reality, these temporary benefits can sometimes last many years.[43] 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 the previously discussed differences in the disposal requirements for combustion residuals, industry representatives claim that waste-burning kilns have lax standards for metal emissions relative to commercial incinerators.[44] 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.

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[42] As part of the Hazardous Waste Identification Rule in 2001, EPA finalized the retention of the derived-from rule, reaffirming that solid wastes including ash that are generated from the treatment, storage, or disposal of hazardous waste continue to be regulated as hazardous waste. However, derivatives from hazardous waste that were hazardous solely for the characteristics of ignitability, reactivity, and/or corrosivity are not considered hazardous if they no longer exhibit these characteristics (U.S. EPA, "Rules and Regulations," *Federal Register* 66(95): 27268). A federal appeals court recently upheld this rule by denying a petition alleging that EPA lacked authority under RCRA to issue the regulation (American Chemistry Council v. EPA, D.C. Cir., No. 01-1216, August 8, 2003).

[43] As of September 2003, seven commercial kilns (41 percent), 43 boilers (73 percent), and four HCl production furnaces (50 percent) were operating under interim status (Frank Behan and Sasha Gerhard, U.S. EPA, written communication, September 8, 2003).

[44] Hazardous Waste Treatment Council, *Petition for Rulemaking Under the Resource Conservation and Recovery Act to Establish Uniform National Performance Standards for All Combustion Facilities Based on the Best Available Technology*, May 18, 1994, as cited in Richardson, Mark A., J.D. *Recycling or Disposal of Hazardous Waste Combustion in Cement Kilns*. A briefing paper of the American Lung Association Hazardous Waste Incineration Project, April 1995.

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 at incinerators and do not establish metal-specific emission limits.[45]

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 incinerators. Incinerators tend to 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 proposed HWC MACT replacement standards will alleviate some of the potential cost advantages associated with higher emissions in specific sectors because the standards are likely to ensure that human health and the environment are protected equally across combustion sectors and on a nationwide basis.

Industry Dynamics

The economic decisions about hazardous waste treatment options vary among different types of facilities in the universe. Facilities with energy recovery systems face different economic considerations (e.g., costs of alternative fuels) than incinerators do when considering how to respond to regulations that raise the cost of combustion. The type of waste, capacity at commercial facilities, geographic location, and liability concerns are also key factors in identifying waste treatment options. In this section we briefly outline the different sectors of the hazardous waste combustion industry and the industry dynamics that might affect responses to the proposed HWC MACT replacement standards.

On-Site Facilities (Boilers, HCl Production Furnaces, and On-site Incinerators)

Facilities with on-site combustion systems (both energy recovery systems and on-site incinerators) generally burn wastes generated on site. Companies choose to burn their wastes on site rather than sending wastes offsite 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 also remain somewhat insulated from price fluctuations in the commercial sector. However, if the proposed HWC MACT replacement standards increase the cost of combustion, these facilities must decide whether to continue burning waste on site or send their waste to commercial

[45] The incinerator regulations do not require metal emissions standards, but they do 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,as cited in U.S. EPA, *Assessment of the Potential Costs, Benefits, and Other Impacts of the Hazardous Waste Combustion MACT Standards: Final Rule*, Office of Solid Waste, July 1999).

combustors. Although both facilities with boilers and facilities with on-site incinerators must decide whether or not to continue burning waste on site, different economic constraints factor into the decisions.

Because boilers tend to burn high quality, fuel grade waste, a key consideration in the cost of on-site combustion is the cost of replacement fuel. If upgrade costs exceed offsite disposal costs and fuel replacement costs, then offsite disposal becomes more attractive. One advantage that boilers have in offsite disposal is the quality of their waste. All commercial facilities (e.g., cement kilns, commercial incinerators, and blenders) will generally take fuel grade waste at relatively low costs to the generator. Other constraints such as liability issues and risks in transporting the waste can factor into the decision-making of boilers and HCl production furnaces, but these are likely secondary to fuel costs.[46]

On-site incinerators differ from boilers in that they do not need to consider the prices of alternative fuel sources. However, since they burn a wider variety of waste and most of it is of a lower Btu content, they are likely to have fewer options for the off-site disposal of their wastes. Therefore, price fluctuations and capacity constraints among commercial incinerators will likely affect on-site incinerators more than boilers, who are disposing of waste with higher Btu values.

Although the majority of on-site facilities are not used for commercial purposes, some generating facilities with boilers and HCl production furnaces accept waste, either commercially (e.g., from unrelated companies) or from facilities owned by the same parent company. Nevertheless, most of the waste burned at these facilities originates on site. Nine boilers, three HCl production furnaces, and 21 on-site incinerators report receiving waste from offsite in the 1999 BRS. For these facilities, income lost from off-site waste treatment is another consideration assuming that the waste originates from generators who do not belong to the same parent company.

Commercial Facilities (Cement Kilns, LWAKs, and Commercial Incinerators)

Commercial facilities, including cement kilns, LWAKs, and commercial incinerators, either receive waste directly from generators or from intermediaries such as fuel blenders. However, since cement kilns and LWAKs also recover energy from hazardous waste, they are bound by different economic constraints. 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.

[46] Because boilers are generally integrated into processes at facilities, the cost of disconnecting the waste feed may also be an issue.

Cement kilns and LWAKs are more limited in the waste they accept; they need high-quality liquid waste with high Btu content to burn in their kilns. Therefore, the role of fuel blenders is likely much more central in allowing these facilities to accept lower quality wastes. Cement kilns and LWAKs have the option, however, of using alternate fuel sources if the cost of burning waste from generators or intermediaries is too high.

Commercial incinerators can accept a much greater range of waste. They are not dependent on fuel blenders to guarantee a constant fuel-quality waste stream, but their only income is from generators of hazardous waste (e.g., they do not produce cement or other products). They must therefore compete effectively with other commercial incinerators and kilns in order to remain in operation. This includes the extent to which they are able to pass the cost of compliance through to the generators for whom they provide a service.

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 facilities in the commercial combustion market, primarily cement kilns.[47] Though these facilities are not within the universe directly affected by the proposed HWC MACT replacement standards, they play an important role in the industry.

Fuel blenders mix wastes used as fuels to meet commercial facilities' 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 system. Viscosity affects the ability to pump wastes into the combustion chamber in a uniform manner. 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.

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[47] 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, as cited in U.S. EPA, *Assessment of the Potential Costs, Benefits, and Other Impacts of the Hazardous Waste Combustion MACT Standards: Final Rule*, Office of Solid Waste, July 1999.

Ninety-two active fuel blenders operated in 1997, compared to 58 in 1996, 73 in 1993, and 74 in 1994.[48] Industry sources suggest that this number has decreased slightly since 1997 due to competition among fuel blenders for limited waste quantities and poor economic conditions.[49] Many fuel blenders are vertically integrated with kilns and may be located on site or adjacent to the cement facility.[50] 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.[51]

COMBUSTION MARKET PERFORMANCE

Historical Performance

Throughout much of the 1980s, hazardous waste combustors enjoyed a strong competitive position and were highly profitable. EPA regulations, federal permitting rules, and local opposition to the building of new facilities limited entry into the market and expanded waste tonnage requiring treatment. 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.[52] Profits were also high. For example, after-tax profits earned by Rollins Environmental Services, a firm operating primarily in the

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[48] 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, as cited in U.S. EPA, *Assessment of the Potential Costs, Benefits, and Other Impacts of the Hazardous Waste Combustion MACT Standards: Final Rule*, Office of Solid Waste, July 1999.

[49] Fred Sigg, Von Roll WTI, personal communication, September 10, 2003.

[50] In a 1994 CKRC survey of 21 cement companies, 17 facilities reported having fuel blending done on site or adjacent to the facility (Cement Kiln Recycling Coalition, "CKRC Cement Facility Questions on Hazardous Waste Fuel Blending and Burning," 1994, as cited in U.S. EPA, *Assessment of the Potential Costs, Benefits, and Other Impacts of the Hazardous Waste Combustion MACT Standards: Final Rule*, Office of Solid Waste, July 1999). We were unable to locate more recent information.

[51] Chris Goebel, National Association of Chemical Recyclers, personal communication, May 20, 1997, as cited in U.S. EPA, *Assessment of the Potential Costs, Benefits, and Other Impacts of the Hazardous Waste Combustion MACT Standards: Final Rule*, Office of Solid Waste, July 1999.

[52] 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, as cited in U.S. EPA, *Assessment of the Potential Costs, Benefits, and Other Impacts of the Hazardous Waste Combustion MACT Standards: Final Rule*, Office of Solid Waste, July 1999.

incineration sector, peaked at 16.4 percent that year.[53] The high profits induced many firms to enter the permitting and siting process for new combustion systems, despite the inevitable delays in obtaining the required operating permits. As a result of both capacity additions and reduced waste resulting from pollution prevention efforts, the industry entered a period of substantial overcapacity in the early and mid-1990s, resulting in fierce competition, declining prices, poor financial performance, numerous new project cancellations, and facility closures.

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.[54] 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.[55]

Recent Trends

In 1999, EPA completed a baseline analysis of the hazardous waste combustion industry in support of the development of the previous hazardous waste combustion MACT standards.[56] Over the past four years since that study was completed, several changes have occurred in the combustion industry that affect the universe of facilities potentially subject to the proposed HWC MACT replacement standards (Exhibit 2-11).

The hazardous waste combustion industry has undergone a consolidation over the past several years; overall, the total number of facilities has decreased by 37 percent between those reported in the 1995 and 1997 BRS and those that reported in the 1999 BRS. The 1999 BRS data suggest that the quantity of waste burned is approximately 16 percent than the quantity of waste reported in the 1995 and 1997 BRS. The most significant consolidation has occurred among on-site and commercial incinerators; 47 percent of these facilities described in the 1999 *Assessment* have since closed. The number of kilns combusting hazardous waste has also dropped by 26 percent

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[53] Wayne Nef. June 24, 1994. "Rollins Environmental Services." *Value Line*, 352, as cited in U.S. EPA, *Assessment of the Potential Costs, Benefits, and Other Impacts of the Hazardous Waste Combustion MACT Standards: Final Rule*, Office of Solid Waste, July 1999.

[54] 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, as cited in U.S. EPA, *Assessment of the Potential Costs, Benefits, and Other Impacts of the Hazardous Waste Combustion MACT Standards: Final Rule*, Office of Solid Waste, July 1999.

[55] 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, as cited in U.S. EPA, *Assessment of the Potential Costs, Benefits, and Other Impacts of the Hazardous Waste Combustion MACT Standards: Final Rule*, Office of Solid Waste, July 1999.

[56] U.S. EPA, *Assessment of the Potential Costs, Benefits, and Other Impacts of the Hazardous Waste Combustion MACT Standards: Final Rule*, Office of Solid Waste, July 1999.

since 1999. A small number of new facilities have recently opened, but closures typically have offset these openings. Only hydrochloric acid production furnaces have increased in number, with one facility being added between 2001 and 2003.

It is important to note that "closure" does not necessarily mean that facilities shut down. While commercial incinerators exit the market and physically close when they stop treating waste, other facilities burning waste to power production or to dispose of process wastes typically continue to produce goods even if they cease combustion activities. Facilities with on-site incineration may close incineration systems and seek off-site disposal, but this is not likely to alter production. Similarly, energy recovery systems such as boilers and cement kilns may cease burning hazardous waste and therefore switch to another fuel source to support operations.

Exhibit 2-11

COMPARISON OF HAZARDOUS WASTE COMBUSTION UNIVERSE IN 1999 AND 2003

Type of Combustion Device	1999 Assessment of Hazardous Waste Combustion MACT Standards		2003 Assessment of Proposed Hazardous Waste Combustion MACT Replacement Standards	
	Number of Facilities	Quantity of Waste (tons)	Number of Facilities	Quantity of Waste[e] (tons)
Liquid Fuel Boilers & Process Heaters [a,b]	58	879,200 [b]	55	725,300
Solid Fuel Boilers [b]	4	54,500 [b]	4	207,200
Hydrochloric Acid Production Furnaces [b]	7	45,300 [b]	8	69,000
Subtotal	67	933,700	67	1,001,500
On-site Incinerators [c]	129	1,610,000 [c]	69	1,010,600
Commercial Incinerators [c]	20	665,600 [c]	10	452,200
LWAKs [c, d]	5	219,000 [c]	3	63,800
Cement Kilns [c, d]	18	788,400 [c]	14	1,030,000
Subtotal	172	3,283,000	96	2,556,500
Total	239	4,216,700	150	3,558,000

Notes:

[a] Since process heaters are subject to liquid fuel boiler regulations, they are included in this category.

[b] These sources are included in the *Assessment of the Potential Costs, Benefits, and Other Impacts of the Phase II Hazardous Waste Combustion MACT Standards* (2001) for boilers and industrial furnaces. Waste quantities are based on 1997 BRS data.

[c] These sources are included in the *Assessment of the Potential Costs, Benefits, and Other Impacts of the Hazardous Waste Combustion MACT Standards: Final Rule* (1999) for incinerators, cement kilns, and LWAKs. Waste quantities are based on 1995 BRS data.

[d] The 1999 *Assessment* did not distinguish the quantity of waste treated by LWAKs and Cement Kilns. We divided the total quantity associated to commercial kilns (1,007,400 tons) weighted by the number of cement kilns and LWAKs.

[e] Waste quantities are derived from the 1999 BRS (as revised).

The most significant change in the composition of the hazardous waste combustion universe is the recent shift away from on-site incinerators. While on-site facility closures would imply that more waste is being sent to commercial facilities, the trends among commercial facilities are difficult to decipher. The number of commercial facilities has dropped by over 37 percent since 1999, but the quantity of waste burned at commercial facilities has only decreased by eight percent. Cement kilns, in particular, have increased in prominence and are burning almost 31 percent more waste. This could at least partly represent a transfer of waste from recently closed LWAKs to cement kilns, and it could also reflect changes in the technology for blending and burning fuel grade waste.

Capacity and Competition

As of 1999, practical capacity utilization at commercial and on-site incinerators and cement kilns ranged from around 42 to 58 percent.[57,58] Since that time the closure of 16 commercial systems has contributed to a trend of increasing capacity utilization. Practical commercial kiln capacity is currently approximately 69 percent, and commercial incinerators now utilize approximately 78 percent of their practical capacity, resulting in a total commercial capacity utilization of 71 percent. Despite the consolidation activity in the combustion industry, the 29 percent of unutilized capacity suggests that the industry remains a price taker due to competition for wastes. In addition, hazardous waste combustors currently face two issues that may affect competitiveness:

- **Increased Solids-Burning Capacity in Kilns.** Fuel blenders have improved their ability to suspend solids in liquid wastes. Suspending solids in liquid waste has greatly expanded the effective solids burning capacity among boilers and kilns that could previously only burn liquids and has driven down prices in this formerly high-profit segment. As a result, commercial incinerators now face higher competition with their cement kiln and LWAK counterparts.

- **International Competitors**. Commercial facilities outside the US, including those in Canada and Mexico, are sources of competition for both commercial incinerators and kilns in the universe.[59] The extent to which foreign

[57] U.S. EPA, *Assessment of the Potential Costs, Benefits, and Other Impacts of the Hazardous Waste Combustion MACT Standards: Final Rule*, Office of Solid Waste, July 1999.

[58] In practice, incinerator facilities do not combust the total amount of waste that they are permitted to combust. Therefore practical capacity is a more accurate measure of capacity utilization than permitted capacity, which overestimates the amount of waste that facilities would realistically combust.

[59] Mexico has hazardous waste kilns but not commercial incinerators. Canada and the European Union have commercial incinerators combusting hazardous waste.

> competition affects US facilities is difficult to determine. However, recent changes in trade regulations under NAFTA, coupled with the fact that combustion generators of fuel grade waste are concentrated in the Gulf region, suggests that this issue could be significant.[60]

Finally, almost all facilities in the universe must consider the implications of other regulations. For example, combustion facilities produce ash as a by-product when they combust hazardous waste. Therefore, changes in ash disposal requirements might change the economics of the market.

While commercial incineration facilities currently utilize a higher percentage of available capacity than five years ago, in general sufficient excess capacity remains to curtail the ability of facilities to increase prices in the short term on all waste forms. Due in part to the counteracting trends of decreasing domestic incineration capacity and increasing competition among combustors in the U.S. and elsewhere, the future market performance among commercial combustors remains unclear. If capacity utilization continues to increase, facilities may be able to pass through more of the costs of compliance to generators, particularly for waste forms that are difficult to treat by other methods. However, increased competition among kilns and commercial incinerators or continued reduction in hazardous waste generation may act to stabilize or even lower prices. At the moment, however, there appears to be both adequate commercial capacity and demand for services to support existing facilities.

[60] BRS lists facilities that send their waste offsite to facilities in other countries to be incinerated. However, it is not clear from the 1999 BRS how much waste is going to Canada and Mexico specifically.

DEFINING THE REGULATORY BASELINE CHAPTER 3

This chapter provides the necessary information for specifying the regulatory "baseline," which describes the world absent the proposed hazardous waste combustion (HWC) maximum achievable control technology (MACT) replacement 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 proposed HWC MACT replacement standards (e.g., market exits, employment shifts). In this case, in order to clearly identify the impacts of the proposed HWC MACT replacement standards, the baseline assumes that all facilities in the universe have achieved compliance with the 2002 Interim Standards. EPA uses the 2002 Interim Standards as the baseline for this analysis because hazardous waste combustion facilities are required to comply with the 2002 Interim Standards before the replacement standards are finalized.[1]

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." [2] While Chapter 2 provides a general description of the hazardous waste combustion market, current waste management practices, and existing and emerging regulations, this chapter explains how such factors affect the regulatory baseline. We organize this chapter into two main sections -- a baseline profitability analysis and a discussion of emissions and pollution

[1] Compliance with the 2002 Interim Standards may closely resemble controls currently in place. In 1999, EPA promulgated hazardous waste combustion MACT standards for hazardous waste incinerators and hazardous waste burning kilns. Although these standards were later vacated in July of 2001 by the U.S. Court of Appeals for the D.C. circuit, several facilities may have implemented new controls prior to the Court's ruling. Since the 2002 Interim Standards are similar to the 1999 HWC MACT standards, facilities that upgraded to comply with the 1999 standards may already be in compliance with the 2002 Interim Standards. Therefore, the 2002 Interim Standards may reflect current operating conditions at several incinerators and waste burning kilns. The full citation for the Court's ruling is U.S. Court of Appeals (D.C. Circuit). Cement Kiln Recycling Coalition v U.S. EPA, 255F3d855. July 24, 2001.

[2] Office of Management and Budget (OMB). 1996. *Economic Analysis of Federal Regulations Under Executive Order 12866*, p. 9, as cited in U.S. EPA, *Assessment of the Potential Costs, Benefits, and Other Impacts of the Hazardous Waste Combustion MACT Standards: Final Rule*, Office of Solid Waste, July 1999.

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 proposed HWC MACT replacement standards. This includes characterization of the following elements:

- **Baseline Waste-Burning Costs —** We require baseline cost estimates to assess the baseline profitability of commercial incinerators, cement kilns, and lightweight aggregate kilns and to identify marginal facilities that may exit the market even in the absence of the proposed HWC MACT replacement standards. Baseline costs also represent costs that on-site incinerators can avoid by sending waste off site. This section summarizes the approach and results from the baseline cost analysis.

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

- **Hazardous Waste Quantities —** Like prices, changes in hazardous waste quantities affect the degree to which combustion systems 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.

- **Energy Cost 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 non-waste fuel prices.

- **Transportation Cost Savings —** For on-site incinerators, boilers, halogen-acid furnaces, and process heaters, avoided costs also include shipping costs. This section describes our data assumptions for transportation costs.

- **Baseline Profitability —** We assess baseline profitability for incinerators, cement kilns, and LWAKs to determine future baseline capacity.

- **Future Capacity —** After developing data assumptions for the components above, we then project longer term capacity trends in light of current profitability and trends in waste generation and management.

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 (e.g., we do not assign pollution control costs if a facility currently employs this particular control).

BASELINE ECONOMIC ASSUMPTIONS

This section presents our assumptions about the baseline costs associated with hazardous waste treatment in the absence of the proposed HWC MACT replacement tandards. This information is then used to assess whether facilities will close in the baseline and to estimate other economic impacts, such as employment shifts and waste quantities diverted, that would result from the implementation of the replacement standards. By identifying the combustion facilities that are not viable in the baseline, we can avoid attributing the market exit of these facilities to the proposed HWC MACT replacement standards.[3] However, on-site incinerators, boilers, and industrial furnaces are not generally used as commercial waste treatment units, and because they are associated with a range of production systems, waste quantities, waste types, and pollution control devices, it is difficult to identify the specific baseline costs associated with waste management in these systems.

[3] On-site incinerators, boilers, and industrial furnaces are considered profitable if the avoided costs of offsite treatment, including costs associated with transportation and alternative fuel, exceed the costs of on-site waste treatment. In the 1999 *Assessment*, we examined both short-term profitability (e.g., revenues minus operating costs) and long-term profitability because several facilities were only marginally profitable in the baseline. However, since the vast majority of these facilities have since exited the market, we have chosen not to examine short-term profitability in this assessment.

To ensure that we do not underestimate costs associated with the proposed HWC MACT replacement standards, we therefore assume that these systems will continue to burn hazardous waste in the baseline, even if limited baseline cost data indicate that some may not be viable.[4]

We assess the baseline profitability of each commercial system by determining whether it is burning enough waste to adequately cover the costs of operation. 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 commercial combustion system. In addition, as described in Chapter 5, baseline operating and maintenance (O&M) costs associated with hazardous waste treatment determine, in part, whether on-site incinerators will continue to treat hazardous waste when the proposed HWC MACT replacement standards go into effect. We therefore include on-site incinerator O&M costs in our description of baseline revenues and costs below. The following section presents the results of our baseline cost analysis.

Baseline Waste-Burning Costs

As part of the 1999 *Assessment*, EPA performed a complete baseline cost analysis for incinerators, cement kilns, and LWAKs in 1998. For this assessment, we use the results of the 1998 analysis for incinerator, cement kiln, and LWAK baseline costs, adjusting costs upward to account for the implementation of upgrades to achieve compliance with the 2002 Interim Standards. These

[4] On-site incinerators, boilers, and industrial furnaces that are not economically viable may remain open in the baseline because of liability concerns or costs associated with system closure. We therefore assume that any on-site incinerators, boilers, or industrial furnaces at which baseline costs exceed the costs of sending waste offsite will not stop burning waste in the baseline.

baseline costs are a core input to the combustion cost model. Estimates of baseline costs for boilers and industrial furnaces are not available. However, such data are not necessary for our analysis since we assume that these systems continue burning hazardous waste in the baseline. To evaluate the baseline profitability of commercial combustion systems, we need estimates of the baseline costs of combustion for each commercial combustion system. In addition, baseline O&M costs for on-site incinerators are necessary to assess whether they will stop burning hazardous waste in response to the proposed HWC MACT replacement standards. Baseline costs also suggest important differences across combustion segments that significantly influence the competitiveness of commercial combustion systems. 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 systems of different types. In the case of incinerators, this baseline cost is simply the variable and fixed costs of the system (prior to new pollution control requirements), since incineration is the system's sole function. Cement kilns and LWAKs, however, must decide whether to burn hazardous waste or some other fuel.[5] 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. However, because we assume that cement kilns and LWAKs will continue operating regardless of hazardous waste combustion activities, no capital costs are included in their baseline cost estimates.

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.

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.[6] For incinerators, key components include the cost of the combustion system and air pollution

[5] Boilers and industrial furnaces face the same decision, but we do not include them in this discussion. Since we assume these systems continue to burn hazardous waste in the baseline, discussion of their baseline costs is not necessary for determining the impacts of the proposed HWC MACT replacement standards..

[6] The energy cost savings associated with burning hazardous waste at kilns is included in our baseline profitability analysis.

control device (APCD) units already installed, labor, and incinerator ash disposal. Both cement kilns and incinerators incur permitting costs, which are also included in our baseline cost estimates.

EPA 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.[7] This includes capital equipment and operating permits. Costs have been annualized using a seven percent interest rate to convert the total capital cost to a series of equal annual payments over the estimated life of the capital.[8] 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 cost analysis, engineering cost models were developed separately for incinerators and kilns to estimate baseline costs for each combustion system.[9] 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 fixed O&M 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. The 1998 baseline cost analysis relied on a number of sources, including trade journals, discussions with 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

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[7] Since we assume that on-site incinerators remain open in the baseline, we do not estimate baseline capital costs for on-site incinerators.

[8] This interest rate is consistent with OMB's estimate of the average opportunity cost of capital. "Economic Analysis of Federal Regulations under Executive Order 12866," U.S. Office of Management and Budge. January 11, 1996, as cited in U.S. EPA, *Assessment of the Potential Costs, Benefits, and Other Impacts of the Hazardous Waste Combustion MACT Standards: Final Rule*, Office of Solid Waste, July 1999.

[9] 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, as included in U.S. EPA, *Assessment of the Potential Costs, Benefits, and Other Impacts of the Hazardous Waste Combustion MACT Standards: Final Rule*, Appendix B, Office of Solid Waste, July 1999.

continuously.[10] On-site incinerators are also assumed to burn only hazardous wastes.[11] To the extent that non-hazardous wastes are also burned, the fixed costs per ton of hazardous waste burned decline.

Baseline combustion costs for the different combustion sectors are summarized in **Exhibit 3-1**. As shown, baseline costs for incinerators differ dramatically from those of kilns. We expect this difference because baseline costs for kilns include only that portion of capital costs associated with hazardous waste incineration. 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 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 burned if much of its combustion capacity is not being utilized.

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

[11] A limited number of facilities may burn non-hazardous waste in their incinerators. In such cases, we likely overestimate available capacity because our waste quantity data only include hazardous waste. Therefore, we may overestimate the number of systems that consolidate and underestimate costs for systems that we expect will consolidate.

Exhibit 3-1

ANNUAL BASELINE COSTS FOR HAZARDOUS WASTE COMBUSTION SYSTEMS[a]

Sector	Average Tons Burned Per System (range of results)	Average Capital (Annualized) Costs (range of results)	Average Fixed O&M Costs (range of results)	Average Variable O&M Costs (per ton) (range of results)	Total Costs (Capital Costs + O&M) (range of results)	Median Total Cost Per Ton (range of results)
Cement Kilns/ LWAKs	33,100 (6,000 - 99,700)	$523,600 ($249,100 - $1,639,700)	$634,100 ($456,600 - $1,359,900)	$35 ($18 - $71)	$2,175,900 ($1,148,900 - $5,360,900)	$77 ($36 - $196)
Commercial Incinerators	30,100 (300 - 82,800)	$1,829,400 ($937,400 - $3,537,700)	$1,360,600 ($241,900 - $2,229,400)	$123 ($37 - $301)	$6,418,300 ($1,231,100 - $15,642,300)	$234 ($128 -$4,300)
Private Incinerators[b]	11,700 (0.39 - 99,200)	$829,200[c] ($208,600 - $1,949,200)	$392,300 ($121,000 - $949,500)	$153 ($8 - $975)	$3,001,400[c] ($364,900 - $16,207,800)	$344[c] ($28 - $42,800)

Notes:

a. 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.

b. 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.

c. Estimates of capital costs and total costs for on-site incinerators are based only on those systems for which capital cost data were available.

Hazardous Waste Combustion Prices

In this assessment we specify prices for eight waste categories, reflecting differences in waste form (liquid, sludge, or solid), as well as other waste characteristics, such as waste halogen content.[12] Pricing data are shown in Exhibit 3-2 and represent average market prices reported by commercial incinerators to the Hazardous Waste Resource Center. The price estimates we use in this document represent the prices received by combustion facilities, not intermediaries (e.g., we use tipping fees paid to cement kilns, and not to fuel blenders).[13]

Exhibit 3-2

HAZARDOUS WASTE DISPOSAL PRICES FOR ECONOMIC IMPACT MODEL[a,b]
(price per US ton in 2002 dollars)

Liquids		Gases	Sludges		Solids		
Halogenated Liquids	**Non-Halogenated Liquids**	**All Gases**	**Halogenated Sludges**	**Non-Halogenated Sludges**	**Lab Packs**	**Halogenated Solids**	**Non-Halogenated Solids**
$1,080	$127	$940	$1,010	$560	$2,820	$1,068	$557

Notes:

a. We base the prices on information obtained from the Hazardous Waste Resource Center (http://www.etc.org/costsurvey6.cfm).

b. The Cement Kiln Recycling Coalition (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). (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)as cited in U.S. EPA, *Assessment of the Potential Costs, Benefits, and Other Impacts of the Hazardous Waste Combustion MACT Standards: Final Rule*, Office of Solid Waste, July 1999. Since cement kiln pricing data are not available, we are unable to explain the apparent discrepancy between CKRC's estimate and the weighted average of $845 per ton we derived from prices published by the Hazardous Waste Resource Center. We generated this estimate by dividing annual cement kiln/ LWAK waste treatment revenues, based on the pricing presented in this exhibit, by the total quantity of waste cement kilns and LWAKs received in 1999. However, as described below, our assessment of baseline profitability includes a sensitivity analysis in which commercial kilns receive approximately $199 per ton on average.

[12] Our combustion market model includes 12 waste forms, each of which fits into one of the eight pricing categories displayed in Exhibit 3-1.

[13] This practice is consistent with the approach developed for the 1999 *Assessment* and was supported by public comments submitted as part of that rulemaking effort.

We apply the prices in Exhibit 3-2 to estimate waste-burning revenues at commercial combustion facilities. However, for the one facility known to burn specialized waste, such as explosives, we adjust prices upward to reflect the actual market prices for these waste types.[14]

Since the prices presented in Exhibit 3-2 reflect average prices at commercial incinerators, they may not accurately represent prices at cement kilns and LWAKs. This uncertainty may be most significant for halogenated waste, because the concentration of halogens in any given waste stream affects its disposal price. To the extent that halogen concentrations differ between commercial kilns and commercial incinerators, the prices for halogenated wastes in Exhibit 3-2 may not accurately reflect cement kiln and LWAK pricing. Although BRS differentiates between halogenated and non-halogenated waste, it does not specify the halogen content of the waste streams at individual facilities. However, the Cement Kiln Recycling Coalition estimates that cement kiln waste has an average halogen content of 1.87 percent, whereas commercial incinerator waste has an average halogen content of 15.58 percent.[15] Assuming that the premium charged to treat halogenated waste (e.g. the price changes between halogenated and non-halogenated waste) is proportional to the halogen content of the waste, we estimate that the halogen premium for commercial kilns may be approximately 11.9 percent (1.87/15.58=0.119) of that charged by commercial incinerators. To capture this uncertainty in our baseline profitability assessment, we conducted a sensitivity analysis, analyzing how this lower halogen premium may affect cement kiln and LWAK profitability in the baseline.

Hazardous Waste Quantities

The viability of any combustion system (either commercial or on-site) in the baseline depends significantly on the quantity and type of waste it treats. Commercial systems generate more revenue when they treat higher quantities of waste and when they treat wastes with high halogen levels. Similarly, energy recovery systems realize greater fuel savings as they receive higher quantities of high-Btu waste. It is therefore important to consider the waste quantities and waste forms that facilities are likely to treat in the baseline.

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[14] We use a price of $8.25 per pound ($16,500 per U.S. ton) for an explosives incinerator included in the HWC MACT universe. This estimate is the average of two prices quoted in Addendum 4 to State of Kansas Department of Administration Contract 00694, PR 1341, September 18, 2002.

[15] Cement Kiln Recycling Coalition Comments to EPA's Proposed HWC MACT Rule, "Revised Standards for Hazardous Waste Combustors," *Federal Register*, Vol. 61, No. 77, pg 17358, April 19, 1996.

As indicated in Chapter 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 two years detailing the quantities and composition of their waste, along with the management method used for handling the waste. Since 1999 is the most recent year for which final BRS data are currently available, we use the 1999 BRS to estimate facilities' baseline waste quantities.[16]

Industry sources do not reveal any systematic shifts in demand for hazardous waste services since 1999. Recent industry publications reveal that treatment of hazardous waste at cement kilns and LWAKs has changed very little since 1999. Commercial incinerator demand has fluctuated with overall macroeconomic performance. However, commercial incinerator demand data for the past several years reveal fairly steady growth of 2 percent per year.[17] We therefore assume that 1999 quantities are generally accurate and that there will not be any significant changes in demand during the next few years.[18,19] It is important to note, however, that economic impact results are sensitive to waste quantity estimates. If waste generation or management behavior were to change markedly, we may need to revisit this analysis. Exhibit 3-3 presents our estimated waste quantities by system type. Chapter 2 contains more detailed waste quantity information based on 1999 BRS data.

To match each facility's waste streams with available pricing data, we group waste quantities by BRS waste form for each facility. For facilities for which there is no waste form information, we use waste profiles for each system type to distribute the total waste quantity across the eight waste categories. For facilities that have more than one combustion system, we distribute waste quantities proportionally across systems according to permitted system capacity.

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[16] 2001 BRS data are in the process of publication, but detailed waste stream data were not available to support this analysis.

[17] According to Environmental Information Limited, commercial incinerator demand in the North American market (e.g., the U.S. and Canada) fell by 9 percent in 2001; however, industry experts believe this decline was a reflection of the economic downturn of 2001, not the beginning of a downward trend in demand for incineration. Environmental Information Limited, "Commercial Incinerators' Demand Down 9% in 2001." Press Release, September 25, 2002.

[18] Our estimate of the quantity of hazardous waste treated per year is also consistent with an estimate provided by Fred Sigg of WTI in December 2002.

[19] For some individual facilities, waste treatment quantities may vary significantly from year to year. This variability may affect our analysis of baseline viability if the 1999 BRS data do not reflect the quantity of waste treated at these facilities during a typical year. Since this uncertainty is fairly random, it is uncertain how it affects the results presented in Chapter 5.

Exhibit 3-3 1999 HAZARDOUS WASTE QUANTITIES BY SYSTEM TYPE (tons)	
Liquid Boilers[a]	725,300
Solid Boilers	207,200
Halogen-Acid Furnaces	69,000
On-site Incinerators	1,010,600
Cement Kilns	1,030,000
Lightweight Aggregate Kilns	63,800
Commercial Incinerators	452,200
Notes a. Liquid boilers includes process heaters.	

Energy Cost Savings

Many cement kilns, LWAKs, boilers, and industrial furnaces in the HWC MACT universe realize significant energy cost savings because of the high energy content of the hazardous waste they treat on site. If these systems stop burning hazardous waste, they will incur costs associated with replacing the lost fuel value of the hazardous waste. To calculate these energy savings and potential fuel costs, we first convert the waste quantities burned into an energy equivalent (in million Btus per pound).[20] 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 that would be necessary to replace the energy content of the hazardous waste. We assume that conventional fuel for cement kilns and LWAKs is 91.1 percent coal and 8.9 percent natural gas.[21] We assume that liquid boilers replace hazardous waste fuel with natural gas and that coal boilers replace hazardous waste fuels with coal.

[20] We used the average Btu/lb estimates used in the baseline cost models. These models assumed 13,500 Btu/lb for waste burned by cement kilns, lightweight aggregate kilns, boilers, and industrial furnaces. *See Appendix B for more information*.

[21] Portland Cement Association, Economic Research Department. 1996. *U.S. Cement Industry Fact Sheet: 14th Edition, Table 24: Fossil Fuel Mix*, 17. Any recent trends away from coal would likely result in increased costs for alternative fuels, thereby increasing the savings associated with treating hazardous waste, as cited in U.S. EPA, *Assessment of the Potential Costs, Benefits, and Other Impacts of the Hazardous Waste Combustion MACT Standards: Final Rule*, Office of Solid Waste, July 1999.

Transportation Cost Savings

Facilities that generate and treat waste on site avoid the costs associated with transporting hazardous waste to commercial treatment facilities. These avoided transportation costs include shipping fees, loading and unloading costs, tanker washout, and wages.[22, 23] Per system transport cost savings are $717,600 for on-site incinerators and $430,137 for boilers and industrial furnaces.[24] These savings range from $2,575 to $7.3 million for on-site incinerator systems and from $3,646 to $2.5 million for boilers and industrial furnaces. This variation is largely due to differences in waste quantities and transport distances across combustion systems. Note that in cases where transport costs are very high, it is unlikely that facilities will select off-site disposal.

Baseline Profitability

We project future capacity in the combustion industry by assessing the baseline operating profitability of each combustion system. We generate future capacity projections so that costs and economic impacts are incremental to the baseline. In other words, if a system is not currently covering its costs, we do not attribute market exit to the proposed HWC MACT replacement standards because we expect that over the longer term, this facility will exit the market even in the absence of the MACT standards.

We do not assess the baseline profitability of boilers and industrial furnaces because we assume that these systems will continue to burn hazardous waste in the baseline. Although we assume that on-site incinerators will also remain open in the baseline, we present baseline profitability for these systems since baseline cost data are available for them. Such data are not available for boilers and industrial furnaces.

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[22] We calculate transportation costs based on great-circle distances (e.g., surface distance between points of latitude and longitude). To the extent that road distances exceed great-circle distances, we underestimate the transportation cost savings associated with treating waste on site.

[23] We assume that facilities with on-site incinerators would otherwise send their waste to commercial incinerators. We therefore overestimate avoided transportation costs for any incinerators that would send their waste to a commercial kiln.

[24] These averages exclude systems that treat such high quantities of waste that no single commercial facility has enough available capacity to accept all of their waste.

We assess baseline profitability 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.[25] This is an estimate of operating profits and does not address financial profitability or costs related to other corporate activities. As Exhibit 3-4 shows, commercial systems are more profitable than on-site incinerators. In addition, cement kilns and LWAKs may be more profitable than commercial incinerators, depending on differences between kiln and incinerator pricing for halogenated waste streams. Even if cement kiln pricing is lower than incinerator pricing, kilns are still nearly as profitable as commercial incinerators, due in part to their low baseline capital costs. Most of commercial kilns' capital costs are related to cement or lightweight aggregate production, not hazardous waste combustion. In addition, cement kiln and LWAK fuel savings also have a positive impact on system profits. In contrast, incinerators do not realize these savings. We do not present average profits for boilers and industrial furnaces because baseline data for waste treatment costs are not available for these systems.

Exhibit 3-4

MEAN AND MEDIAN ANNUAL OPERATING PROFITS PER SYSTEM IN THE BASELINE

Source Category	Mean Profits per System	Median Profits per System
Commercial Incinerators	$10,015,900	$7,930,600
Cement Kilns/LWAKs[a,b,c]	$5,779,700 - $27,897,500	$5,244,800 - $18,790,900
On-site Incinerators[a,d,e]	$3,189,700	$1,102,300

Notes:
a. Estimated profits for on-site incinerators, cement kilns, and LWAKs are based only on incineration activities at these facilities. Profits associated with sales of cement and other products are not included.
b. Cement kiln and LWAK profits include avoided fuel costs associated with hazardous waste that they burn.
c. The range in cement kiln and LWAK profits reflects uncertainty about the prices these facilities charge to accept different waste forms. The high-end of the range assumes that cement kilns/ LWAKs receive approximately $845 per ton on average. The low-end estimate assumes they receive $199 per ton on average.
d. Average profits for on-site incinerators are based on systems for which baseline capital cost data are available.
e. Average on-site incinerator profits include the transportation costs they avoided by treating waste on site.

Most commercial combustion systems are adequately covering their baseline waste-burning costs, as indicated in Exhibit 3-5. Based on the pricing in Exhibit 3-2, every cement kiln and LWAK system is currently burning enough waste to cover costs associated with burning hazardous waste. However, our sensitivity analysis revealed that one commercial kiln may be marginally unprofitable if commercial kilns charge a lower halogen premium than commercial incinerators. Due to the

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

uncertainty associated with this sensitivity analysis, we assume that this system will continue burning hazardous waste in the baseline. All but two commercial incinerator *systems* appear to be meeting their costs. On-site systems, however, appear less "profitable." Of those on-site incinerators for which baseline capital cost data are available, approximately 40 percent are not covering their costs.

Although this analysis reveals two unprofitable commercial incinerator systems, we assume that these two systems will remain open in the baseline.[26] The losses we estimate for these systems are relatively small, and in both cases the results of the profitability analysis depend on the allocation of waste to individual systems within the same facility. Since BRS reports waste quantities at the facility level rather than the system level, we estimated system waste quantities based on the relative capacity of each system at the facility. If the systems receive more waste than we estimate, then our baseline profitability assessment understates their revenues and profits. In addition, if the facility uses these two systems to treat highly contaminated wastes, such as halogenated liquids, their revenues are greater than we estimate because the per ton price of treating highly contaminated waste forms exceeds that of managing less contaminated waste forms.

The profitability analysis also provides us with insights regarding economic performance across combustion sectors. As Exhibit 3-5 shows, cement kilns and LWAKs may have higher operating profits per ton on an absolute dollar basis than commercial incinerators, depending on differences between commercial kiln and incinerator pricing. Based on our analysis, this potential difference reflects cement kiln and LWAK savings associated with avoided energy costs. In addition, according to the 1999 BRS, kilns annually receive approximately 800,000 tons of halogenated liquids from waste generators. Since the treatment of halogenated waste commands a significant premium, this waste generates considerable revenues for kilns. Also, kilns have relatively low hazardous waste treatment costs because they use the same capital for both cement production and hazardous waste combustion.

This profitability 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. As described above, the calculations are also sensitive to combustion prices. We rely on national average prices, and therefore may understate or overstate waste burning revenues for specific systems. Similarly, the waste form categories available in BRS do not specify the halogen

[26] As described in Chapter 5, these two systems may exit the hazardous waste market in response to the proposed HWC MACT replacement standards. If we exclude these two systems from the regulatory baseline, our estimate of the total private costs of the proposed HWC MACT replacement standards increases by approximately 5.7 percent. The primary source of this increase is foregone O&M savings. If these two systems are included in the regulatory baseline, their fixed and variable O&M costs are counted as a negative cost when the model projects the closure of these systems. If these systems are excluded from the baseline, the model does not include these O&M savings in estimate of net costs.

content of the waste streams that facilities generate or treat. Since combustion prices depend significantly on the halogen content of waste, we recognize that our estimate of baseline revenues may not be accurate.[27]

Exhibit 3-5

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

	<$0	**$0-$100**	**$100-$500**	**$500-$1,000**	**>$1,000**
Cement Kilns/LWAKs[a,b]	0 - 1	1- 9	4 - 23	0 - 18	0 - 10
Commercial Incinerators	2	1	7	3	2
On-site Incinerators[c,d]	7	3	9	3	0

a. Cement kiln and LWAK profits per ton include avoided fuel costs.
b. The range in cement kiln and LWAK estimates reflect uncertainty about the prices these facilities charge to treat different waste forms.
c. These results show profits per ton only for those incinerators for which baseline capital cost data are available.
d. On-site incinerator profits include savings associated with transportation costs avoided by treating waste on site.

Future Capacity

With the possible exception of two commercial incinerator systems that may be unprofitable, as described above, our baseline profitability analysis does not suggest that additional consolidation will occur over the next few years among commercial incinerators or cement kilns and LWAKs that treat hazardous waste. Although industry overcapacity was a significant problem in the mid-1990s, several treatment sites have exited the market in recent years. Since 1999, ten commercial incinerator facilities have closed, and 19 cement kilns have stopped burning hazardous waste. As a result, utilization in the commercial hazardous waste treatment sector has increased significantly.

[27] We suspect that our estimates of commercial kiln prices may be high since waste at these systems typically has a lower halogen concentration than commercial incinerator waste.

All of the commercial combustion systems currently operating appear profitable–with the possible exception of the two systems mentioned above.[28] We therefore conclude that future consolidation is unlikely and capacity should remain at its current level.

We also assume that all on-site incinerators, boilers, and industrial furnaces will continue burning hazardous waste in the baseline, despite the fact that some on-site incinerators may not be economically viable in the baseline.[29] Our analysis found that offsite treatment would be less expensive than on-site incineration for approximately 30 percent of on-site incinerator systems.[30,31] This finding is not surprising since some facilities choose to treat waste on site for non-economic reasons.[32] However, as shown in Exhibit 3-6, in a 1998 survey, most industry staff identified economic issues as the main factor 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 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.

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[28] This assessment only considers long-run profitability (e.g., revenues minus total costs). We do not examine short-term profitability (e.g., revenues minus variable costs).

[29] We also assume that all waste generators that currently send their waste off site will continue to do so. However, some of these facilities may choose to develop on-site treatment capabilities if their waste generation significantly increases because they will then be able to spread the fixed costs of on-site treatment over a much higher quantity of waste.

[30] We do not assess potential savings of off-site treatment for boilers because we expect such savings to be minimal since boilers will continue to operate if they stop burning hazardous waste.

[31] Unlike the on-site incinerator baseline profitability assessment presented above, our comparative cost assessment of on-site versus off-site treatment does not account for baseline capital costs since these are sunk costs that cannot be avoided.

[32] Waste generators typically send waste off site if it is more economical to do so, regardless of liability and other issues. However, a limited number of facilities' decisions are driven largely by liability concerns. Personal communication with Fred Sigg of LWD, December 2002.

Exhibit 3-6

Summary of 1998 report: Influencing The 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.

Source: EERGC communications with facilities during the development of the 1999 *Assessment.*

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 (e.g., we do not assign pollution control costs if a facility currently employs this particular control).

In specifying baseline emissions and pollution control practices, we assume that all combustion systems are in compliance with the 2002 Interim Standards by the compliance deadline of September 30, 2003.[33] Upgrades made to comply with the 2002 Interim Standards are therefore the incremental cost of the Interim Standards, not the proposed HWC MACT replacement standards.

Emissions

The analysis of risk reduction for the proposed HWC MACT replacement standards uses baseline emissions as the starting point for estimating the health and ecological benefits of the rule (see Exhibit 3-7 and Exhibit 3-8). In this assessment, baseline emissions are defined as emissions levels estimated after implementation of the 2002 Interim Standards. 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.[34] (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 during 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 proposed HWC MACT replacement standards.

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[33] Facilities that need to install pollution control equipment to comply with the 2002 Interim Standards can receive a one year extension to this deadline.

[34] These emissions data are based on an updated and significantly expanded database of emissions and ancillary information. "Technical Support Document for the HWC MACT Standards, Volume II: Hazardous Waste Combustion Database," U.S. Environmental Protection Agency, Office of Hazardous Waste and Emergency Response. February 2004.

Air Pollution Control Practices

Our specification of the regulatory baseline assumes the same pollution controls and operational conditions as required to meet the 2002 Interim Standards. The baseline also includes current pollution controls and operational processes that go beyond the 2002 Interim Standards. This baseline pollution control information is used in the compliance costing analysis of Chapter 4. We require information on baseline pollution controls so that we do not assign pollution control measures to systems that already have this equipment installed. At the same time, baseline pollution control information is important because a system may be able to implement design or operational changes to existing controls to meet the proposed HWC MACT replacement standards at a lower cost than installing a new air pollution control device.

Although most systems (with the exception of liquid boilers) have installed at least one air pollution control device, there are distinct differences in the types of controls installed by various types of combustion systems. Exhibit 3-9 lists the APCDs that control various pollutants, as well as the prevalence of those APCDs by system type. The majority of cement kilns (69 percent) already have dry electrostatic precipitators, which control particulate matter. A significant number of commercial incinerators have low energy wet scrubbers, which control acid gas and chlorine; water quenches, which control flue gas temperature to reduce formation and emissions of dioxins and furans; and fabric filters, which control particulate matter and metals. Several private on-site incinerators also have water quenches (61 percent), low energy wet scrubbers (66 percent), and high-energy wet scrubbers (47 percent).

Exhibit 3-7

BASELINE NATIONAL EMISSIONS FROM COMBUSTION SYSTEMS (AGGREGATE POUNDS PER YEAR)[a]

	Total Chlorine	Particulate Matter	Semi-volatile Metals	Mercury	Low-volatility Metals	Dioxin/ Furans
Cement Kilns	3,752,292	2,709,607	8,373	1,840	712	4.6
LWAKs	834,873	35,631	108	25	66	2.1
Boilers and Industrial Furnaces	11,041,440	6,855,650	7,717	1,800	30,991	4.6
Incinerators	590,987	226,644	1,315	1,211	916	1.6

Notes:
a. Dioxin/furans emissions expressed in grams.
b. Incinerators include commercial facilities and facilities with on-site systems.
Source: EERGC, August 7, 2003.

Exhibit 3-8

AVERAGE BASELINE NATIONAL EMISSIONS PER SYSTEM (POUNDS PER YEAR)

	Total Chlorine	Particulate Matter	Semi-volatile Metals	Mercury	Low-volatility Metals	Dioxin/ Furans
Cement Kilns	180,005	142,193	1,411	84	35	0.004
LWAKs	454,937	11,168	67	4	42	0.009
Boilers and Industrial Furnaces	83,018	51,546	58	14	233	0.0001
Incinerators	20,076	16,318	776	227	75	0.0005

Note: Incinerators include commercial facilities and facilities with on-site systems.
Source: EERGC, August 7, 2003.

Exhibit 3-9

BASELINE APCDS BY COMBUSTION SECTOR[a,b]
(assuming compliance with the 2002 interim standards)

Control Device	Emissions Controlled	Number (Percentage) of Systems Currently Using Device[c]						
		On-site Incinerators	Commercial Incinerators	Cement Kilns	Lightweight Aggregate Kilns	Liquid Fuel Boilers	Solid Fuel Boilers	Halogen Acid Furnaces
Fabric Filter	Particulate matter, metals	10%	60%	35%	100%	4%	17%	0%
Dry Electrostatic Precipitator	Particulate matter	3%	7%	69%	0%	3%	83%	0%
Wet Electrostatic Precipitator	Particulate Matter	9%	7%	0%	0%	0%	0%	0%
Ionizing Wet Scrubber	Acid gas and particulate matter	9%	13%	0%	0%	0%	0%	0%
Heat Exchanger	Nothing	10%	7%	0%	29%	0%	0%	6%
High Energy Wet Scrubber	Particulate matter, acid gas, and chlorine	47%	7%	0%	29%	3%	0%	29%
Low Energy Wet Scrubber	Acid gas and chlorine	66%	73%	0%	0%	10%	0%	100%
Carbon Injection	Mercury and dioxin/furan	0%	20%	0%	0%	0%	0%	0%
Cyclone	Very low efficiency control of particulate matter, semi-volatile metals, and low volatile metals	13%	0%	0%	29%	0%	0%	6%
Quench	Flue gas temperature control	0%	0%	0%	0%	0%	0%	0%
Quench Column	Cools gases	1%	0%	0%	0%	0%	0%	0%
Water Quench	Cool gases	61%	20%	4%	43%	6%	0%	53%
Dry Scrubber	Acid gas and chlorine	3%	0%	0%	0%	0%	0%	0%
Carbon Absorber	Mercury and dioxin/furan	0%	0%	0%	0%	0%	0%	0%

Exhibit 3-9

BASELINE APCDS BY COMBUSTION SECTOR[a,b]
(assuming compliance with the 2002 interim standards)

Control Device	Emissions Controlled	Number (Percentage) of Systems Currently Using Device[c]						
		On-site Incinerators	Commercial Incinerators	Cement Kilns	Lightweight Aggregate Kilns	Liquid Fuel Boilers	Solid Fuel Boilers	Halogen Acid Furnaces
Carbon Bed	Mercury and dioxin/furan	1%	0%	0%	0%	0%	0%	0%
Spray Dry Adsorber		0%	27%	0%	0%	0%	0%	0%
Afterburner	Carbon monoxide and hydrocarbons	0%	0%	0%	0%	0%	0%	0%
High Efficiency Particulate Air Filter	Particulate matter	0%	0%	0%	0%	1%	0%	0%
Waste Heat Boiler	Nothing	16%	7%	0%	0%	0%	0%	65%
Gas Reheat	Warms gases prior to passing through carbon bed	0%	0%	0%	0%	1%	0%	0%
No Control Devices	N/A	4%	0%	0%	0%	82%	0%	0%
Number of Systems in Sample	N/A	79	15	26	7	104	12	17

Notes:
a. Not all units had available APCD information. Percentages are derived from those units with APCD data.
b. This exhibit includes imputed data.
c. Sum of percentages will not be 100 percent because a single system may use more than one APCD.

Source: "Technical Support Document for the Hazardous Waste Combustion MACT Standards, Volume II, Hazardous Waste Combustion Database," U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. February 2004.

In addition, all of the lightweight aggregate kilns have fabric filters. Other interesting issues regarding APCDs include the following:

- Very few systems currently use carbon injection, a control technology which under the Agency Preferred Approach will frequently be necessary for dioxin/mercury control.

- The vast majority of liquid boilers (82 percent) have no air pollution control devices in place.

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 several 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.

Based on our analysis, capacity among hazardous waste combustion facilities is unlikely to change in the baseline. All cement kiln and LWAK systems appear profitable in the baseline, largely due to the energy savings derived from hazardous waste combustion. Commercial incinerator systems appear profitable, with the possible exception of two systems. Several on-site incinerators may not be profitable in the baseline, but we expect these systems to continue operating, as several non-economic factors affect the decisions of facilities with on-site hazardous waste treatment. Although we are unable to completely assess the baseline viability of boilers, industrial furnaces, and on-site incinerators, we assume that they will continue burning hazardous waste in the baseline. This assumption helps ensure that we do not underestimate the costs of the proposed HWC MACT replacement standards.

NOTE: *After this Assessment was prepared, EPA modified its proposal for the HWC MACT replacement standards. The results presented in this Assessment do not reflect this change. Information on the costs, benefits, and other impacts of EPA's proposed HWC MACT replacement standards is available in EPA, "Addendum to the Assessment of the Costs, Benefits, and Other Impacts of the Hazardous Waste Combustion MACT Standards: Proposed Rule," March 2004.*

COMPLIANCE COST ANALYSIS CHAPTER 4

INTRODUCTION

Hazardous waste combustion facilities complying with the proposed hazardous waste combustion (HWC) maximum achievable control technology (MACT) replacement standards will likely achieve the required emission reductions by installing pollution control devices, limiting toxics in the waste feed, limiting the total waste feed, or through some combination of the three. In addition, facilities will need to comply with monitoring, reporting, and record keeping requirements that are part of the standards. This chapter of the *Assessment* focuses on the incremental costs associated with all potential activities to achieve compliance with the proposed HWC MACT replacement standards for both existing facilities and potential new sources.[1] We analyze costs incurred by facilities, as well as costs incurred by various government entities as they administer compliance activities. The chapter is organized into five sections:

- **Costing Methodology.** This section provides the methodology for estimating compliance costs borne by facilities, which involves assigning pollution control measures to individual combustion systems and estimating engineering costs for these control measures. This section also describes other compliance cost components such as permit modifications, testing and analysis, and other reporting and record keeping requirements.

- **Results of Compliance Cost Analysis.** The results section provides compliance cost estimates for combustion systems and shows how these costs vary across combustion sectors, assuming all sources choose to come into compliance with the proposed HWC MACT replacement standards.

[1] To isolate the activities required under the "replacement standards," this analysis assumes that facilities have already completed upgrades required for full compliance with the 2002 Interim standards.

- **Caveats and Limitations of Compliance Cost Analysis.** This section describes data limitations and uncertainties that are important to highlight as caveats to the compliance cost analysis.

- **Government Costs.** This section reviews the incremental costs for government entities as they administer and enforce the proposed HWC MACT replacement standards.

- **Summary.** We conclude the chapter with a brief review of key findings from the cost analysis.

This chapter is designed to provide a summary of the costs that would be faced by combustion facilities to upgrade to achieve compliance with the proposed HWC MACT replacement standards. It represents a potential high-end estimate of costs. Based on these costs, facilities must decide whether to continue burning waste or to opt for any available, less expensive options. We discuss the market response of facilities to the proposed HWC MACT replacement standards in Chapter 5.

COSTING METHODOLOGY

Total compliance costs for existing hazardous waste combustion facilities are developed using engineering models that assign pollution control measures and their costs to each combustion system.[2] Included along with these pollution control costs are other compliance costs associated with monitoring requirements, sampling and analysis, permit modifications, and other record keeping and reporting requirements. Exhibit 4-1 provides an overview of the procedure used in this system-specific compliance cost analysis.

Compliance cost components include those that are estimated using combustion system-specific parameters and those that are consistent across a particular combustion sector (e.g., cement kilns) or across the entire regulated universe of hazardous waste combustion facilities. As we discuss below, cost estimates include the following components:[3]

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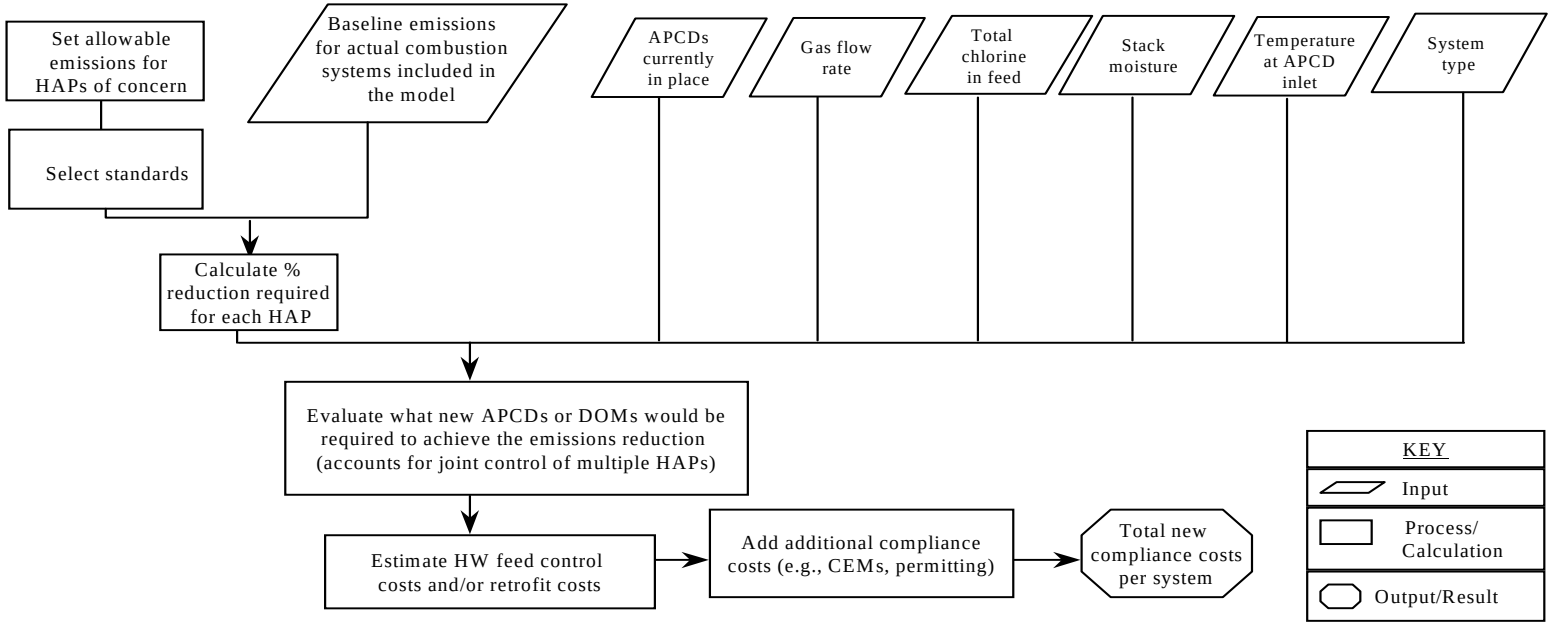
[2] These engineering models differ from the model plants approach used to estimate incinerator and LWAK costs for the 1999 *Assessment*. In contrast to the 1999 analysis, the engineering models used for this assessment account for system-specific parameters for each facility in the universe and estimate costs for actual sources included in the economic impact model.

[3] We do not include continuous emissions monitoring (CEM) because no new CEM requirements are introduced under the proposed HWC MACT replacement standards.

Exhibit 4-1

OVERVIEW OF SYSTEM-SPECIFIC COMPLIANCE COST ANALYSIS



NOTES

1. Setting of allowable emissions for hazardous air pollutants (HAPs) based on MACT analysis using Trial Burn Reports. Baseline emissions also determined using Trial Burn Reports (measured at the stack) and imputation. See U.S. EPA, *Technical Support Document for HWC MACT Standards, Volume II: HWC Database*, forthcoming February 2004.
2. All other data inputs from U.S. EPA, *Technical Support Document for HWC MACT Standards, Volume II: HWC Database*, forthcoming February 2004.
3. A DOM is a design, operation, or maintenance change to an existing Air Pollution Control Device (APCD). CEMs are continuous emission monitoring systems.

- Pollution control measures;
- Other compliance costs:
  - -- Permitting and other record keeping and reporting requirements,
  - -- Testing requirements, and
  - -- Shutdown costs.

Air Pollution Control Measures

We developed pollution control costs using engineering models that assign controls and associated costs to individual combustion systems based on a variety of system-specific parameters, including system type (e.g., liquid injection, rotary kiln, coal boiler), gas flow rate, and kiln temperature. The measures that systems are assumed to implement are those projected under EPA's statistical design level (SDL).[4] Pollution control systems may include both end-of-pipe controls, which are listed in Exhibit 4-2, as well as controlling the waste feed, either by limiting the total volume of waste or by limiting toxics in the waste feed.[5]

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[4] We examined two different methods for assessing the regulated community's response to the proposed HWC MACT replacement standards. Under the first method, the 70 percent design level, we assume that systems will make upgrades to ensure that they emit no more than 70 percent of the emissions allowable under the proposed HWC MACT replacement standards. Under the second method, the statistical design level (SDL), we assume that systems undertake the more stringent of two upgrade options: the 70 percent design level or the average performance of those systems that make up the 12 percent of sources with the best performance. The average performance of the top 12 percent of systems accounts for the variability in combustion systems' emissions measurements. Additional information is contained in the "Technical Support Document for the HWC MACT Standards, Volume III: Selection of MACT Standards," U.S. Environmental Protection Agency. February 2004. Appendix C (Detailed Cost Model Results) also presents analyses using the 70 percent design level.

[5] Feed control costs in this analysis are based on the cost of technology retrofit that would potentially be required to control the pollutant in the absence of feed control. Since such technologies are generally more expensive than feed control, the estimates of feed control costs presented in this analysis are upper bound estimates. We also considered estimating feed control costs based on lost revenues (which are a function of both waste quantities and waste type); however, because detailed waste specifications are not available for each combustion facility, we developed conservative cost estimates for feed control using retrofit costs. A more detailed discussion of the feed control cost analysis is found in the "Technical Support Document for the HWC MACT Standards, Volume V: Emission Estimates and Engineering Costs," U.S. Environmental Protection Agency. February 2004.

Exhibit 4-2

AIR POLLUTION CONTROL MEASURES ASSIGNED IN COMPLIANCE COST ANALYSIS

Pollutant	Pollution Control Measures	Comments
PM, Low-Volatile Metals, Semi-Volatile Metals	— Fabric Filter — Feed Control (SVM/LVM only) — Add improvements to existing control devices	Depending on flue gas temperature and other site-specific factors, additional flue gas cooling equipment (e.g., water quench) may be required to integrate the fabric filter into any existing wet scrubbing systems.
HCl and Chlorine	— Packed Tower Scrubber — Spray Tower Scrubber — Feed Control — Add improvements to existing control devices	
Mercury	— Carbon Injection/Carbon Bed — Feed Control	Carbon injection must be accompanied by a dry particulate matter (PM) control device; Carbon injection and carbon bed is assigned only under the Agency Preferred Approach.
Dioxin/Furan	— Temperature Control — Carbon Injection/Carbon Bed	Temperature control applicable only at systems operating at higher temperatures.

Notes:
1. "Technical Support Document for the HWC MACT Standards, Volume V: Emission Estimates and Engineering Costs," U.S. Environmental Protection Agency. February 2004.
2. Control measures assigned in compliance cost analysis include installation of new devices, changes in design, operation, and maintenance (DOM) to existing devices, or adoption of waste feed control for particular constituents.
3. Controls for CO and hydrocarbons are not presented here because the proposed CO/HC standards do not require any incremental reductions in CO/HC emissions.

The engineering cost model uses baseline (e.g., full compliance with the 2002 Interim Standards) emission estimates for each system, and compares these with the design-adjusted emission requirements under the proposed HWC MACT replacement standards. For each combustion system, the system-specific MACT emission requirement is subtracted from the system-specific baseline emission level to determine the percentage reduction required for each pollutant. For example, a cement kiln with a baseline mercury emission level of 84μg/dscm, consistent with the 2002 Interim Standards, would need a 23.8 percent mercury emission reduction to meet the proposed HWC MACT replacement standard of 64 μg/dscm.

$$\textit{Emissions Reduction} = \frac{\textit{Baseline Emission Level - MACT Standard}}{\textit{Baseline Emission Level}}$$

$$= (84 - 64) / 84$$

$$= 0.238 = 23.8\%.$$

The engineering cost model then compares the percentage emission reduction with a variety of controls that achieve certain emission reductions, assigns the least-cost control that can attain the necessary level of control, and then assigns retrofit costs associated with the selected control measure. For each regulatory option and pollutant, the engineering cost model optimizes compliance across pollutants, unless technological requirements specified in the standards preclude optimization.

If the emissions reduction required for a particular air pollutant is modest and can be achieved with devices already existing at the facility, the assigned control measure will involve changing the design, operation, and maintenance (DOM) of the existing equipment. For example, a modest particulate matter (PM) reduction may be achievable by optimizing the cleaning cycles and test procedures on an existing fabric filter system.

Other Compliance Costs

In addition to the pollution control costs that are detailed above, combustion systems will also incur costs associated with other compliance components of the MACT standards, including permitting and performance testing requirements. A brief description of these components follows. As shown in Exhibit 4-3, these costs total approximately $6.6 million annually for the 136 boilers and industrial furnace systems and the 140 incinerator and commercial kiln systems in the universe. Boilers and HCl production furnaces incur most of these costs because incinerators and commercial kilns are already required to meet most of these requirements under the 2002 Interim Standards.

- **Performance Testing Requirements:** With an annual cost of $2.2 million, incremental compliance testing requirements make up the greatest portion of other compliance costs under the proposed HWC MACT replacement standards.[6] These incremental costs are associated with two levels of performance testing of the pollution control equipment used to comply with the standards: the Comprehensive Performance Test and the Confirmatory Performance Assessment. The Comprehensive Performance Test includes stack sampling for metals, PM, dioxins/furans, total chlorine and organics at

[6] "Technical Support Document for the HWC MACT Standards, Volume V: Emission Estimates and Engineering Costs," U.S. Environmental Protection Agency. February 2004.

two worst-case operating conditions and is to be performed once every five years for all types of combustion systems.[7] The Confirmatory Performance Assessment includes sampling for dioxins/furans at normal operating conditions and is to be performed once every five years for all combustion systems, halfway between Comprehensive Performance Tests.

- **Permitting and Other Reporting and Record Keeping Requirements:** The proposed HWC MACT replacement standards require a number of facility record keeping and reporting procedures that are associated with permitting and other compliance activities. These record keeping and reporting procedures are related to both new compliance activities as well as to modifications of existing CAA and RCRA permitting and compliance schemes. New reporting requirements include weekly testing of the automatic waste feed cutoff system, emission monitoring requirements, and general record keeping and reporting. The incremental reporting and record keeping requirements total approximately $4.1 million annually across all combustion systems.[8] Other costs associated with permitting, excluding performance testing, total approximately $287,000 million per year.

[7] There will be additional costs for "problematic" sources (e.g., those facilities currently not demonstrating compliance with RCRA destruction and reduction efficiency (DRE) standards). These additional costs are not included in our estimates because they would be incurred absent the proposed HWC MACT replacement standards.

[8] As part of the "fast track" component of this rule, EPA promulgated a streamlined process for modifying the RCRA permit, so that affected sources can make necessary changes to their RCRA permits that may be required during the three year compliance period as sources transition to MACT compliance and CAA Title V permitting. However, we do not specifically address the cost savings from this permit streamlining here. However, these impacts are accounted for in an earlier analysis that provides some relevant data (see U.S. Environmental Protection Agency, *Economic Analysis Report for the Combustion MACT Fast-Track Rulemaking*, March 1998, as cited in U.S. EPA, *Assessment of the Potential Costs, Benefits, and Other Impacts of the Hazardous Waste Combustion MACT Standards: Final Rule*, Office of Solid Waste, July 1999).

Exhibit 4-3

SUMMARY OF OTHER COMPLIANCE COST COMPONENTS[a]

Compliance Component	Annual Cost per Respondent/Activity		Annual Estimated Number of Systems		Estimated Total Annual Costs[c]
	Incinerators and Commercial Kilns[b]	Boilers and HCl Production Furnaces	Incinerators and Commercial Kilns[b]	Boilers and HCl Production Furnaces	
Reading of the Regulations (See Note 5)	$340	$340	140	136	$93,800
Compliance with Standards and General Requirements (e.g., weekly testing of the automatic waste feed cutoff (AWFCO) system and operating and maintenance plan)	$0	$12,030	140	136	$1,636,100
Performance Testing Requirements	$0	$16,047	140	136	$2,182,400
Monitoring	$0	$446	140	136	$60,700
CMS Performance Evaluations	$0	$5,535	140	136	$752,800
Notification and General Reporting and Record Keeping Requirements (e.g., Notice of Intent to Comply (NIC) with standards)	$3,832	$5,270	140	136	$1,253,200
Request for an Extension of Compliance	$0	$125	140	136	$17,000
CEMS Quality Assurance	$0	$2,968	140	136	$403,600
Miscellaneous Requirements	$0	$1,292	140	136	$175,700
ESTIMATED TOTAL ANNUAL INCREMENTAL IMPACT =					**$6,575,000**

Notes:
a. With the exception of those for performance testing, estimates reflect only the first three years following the promulgation of the rule, the time period covered by the Information Collection Requests (ICRs). The total costs of performance testing, a component that will probably not occur until the fourth year of the rule, are calculated based on the number of estimated systems in the universe multiplied by the median annual costs for the testing procedures at the system level. Hour and cost estimates for reading the regulations are optimistic (e.g., they may be underestimates of the true costs). Because these costs are small relative to the total costs of the rule, even if these costs are significantly underestimated, this should not affect our estimates of the overall cost and economic impacts of the rule.
b. Incinerator and commercial kiln costs are lower than boiler and industrial furnace costs because the former must already performance testing and other requirements under the 2002 Interim Standards.
c. Estimated annual costs are calculated based on the cost per respondent or activity multiplied by the estimated number of respondents or activities per year. Each type of component has a number of sub-components (not listed) associated with it, all varying in the number of estimated respondents or activities per year. Total may not add due to rounding.

Source: U.S. EPA, *Supporting Statement for EPA Information Collection Request #1773.10 "New and Amended Reporting and Recordkeeping Requirements for National Emissions Standards for Hazardous Air Pollutants from Hazardous Waste Combustors,"* October 2003.

- **Shutdown Costs:** We also investigated the significance of shutdown costs to facilities associated with the installation of equipment or implementation of other pollution control measures assigned in the compliance cost analysis. Examination of shutdown periods suggests that virtually all of the installations could be coordinated along with routine maintenance shutdowns (which we assume require at least three weeks per year).[9] Because virtually all technologies have installation times of three weeks or less, we assume that all retrofits could be made simultaneously during a single facility shutdown, suggesting that no significant incremental shutdown time is necessary.

RESULTS OF COMPLIANCE COST ANALYSIS FOR EXISTING SOURCES

Excluding permitting and performance testing, we expect that each combustion system on average will spend between approximately $153,600 and $586,700 annually to comply with the Agency Preferred Approach, as shown in Exhibit 4-4. The wide range across these average cost estimates is largely a result of the significant cost variations of different control measures for different systems. For example, design, operation and maintenance modifications of existing equipment have annual costs of around $60,000 and can be as low as $1,000, whereas the average annualized cost for feed control exceeds $200,000 and can be as high as $1.6 million for larger combustion systems. From the Option 1 Floor to the Agency Preferred Approach, average system costs increase by more than $500,000 for LWAKs and by approximately $414,000 for coal boilers.[10] This cost increase is due to the more stringent chlorine, dioxin, and PM (coal boilers only) controls under the Agency Preferred Approach. Incinerator costs are the same under both the Option 1 Floor and the Agency Preferred Approach. Exhibits 4-5 and 4-6 provide supporting detail for the results in Exhibit 4-4.

Exhibit 4-5 shows the percentage of combustion systems requiring each of the specific control measures under each MACT option. As shown in Exhibit 4-5, under the Option 1 Floor, slightly more than half of all LWAKs implement feed controls, but this figure jumps to 100 percent under the Agency Preferred Approach. No HCl production furnaces install reheaters or carbon beds under the Option 1 Floor, whereas under the Agency Preferred Approach, 58.8 percent of these systems would be required to install reheaters and 41.2 percent install a carbon bed. In Exhibit 4-6, we provide a comparable set of results by showing the percentage of total compliance costs accounted for by each of the control measures under different MACT options and within each combustion sector.

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[9] This estimate is based on EERGC's communication with several facilities during the preparation of the 1999 *Assessment*.

[10] Chapter 1 contains a detailed discussion of the regulatory options considered for the proposed HWC MACT replacement standards.

Exhibit 4-4

AVERAGE COMPLIANCE COSTS PER COMBUSTION SYSTEM[a]
(Assuming No Market Exit)

MACT Option	Cement Kilns	LWAKs	Commercial Incinerators	On-site Incinerators	Liquid Boilers	Coal Boilers	HCl Production Furnaces
Option 1 Floor	$323,705	$73,931	$260,183	$155,489	$364,744	$114,234	$42,454
Agency Preferred Approach	$323,705	$586,685	$260,183	$155,489	$366,000	$528,009	$153,557
Option 2 Floor	$1,107,216	$128,977	$322,612	$189,790	$516,694	$114,234	$64,348
Option 3 Floor	$1,039,991	$163,458	$333,200	$177,793	$595,450	$114,234	$63,315

Notes:
a. Estimates calculated assuming all facilities upgrade to comply with the proposed HWC MACT replacement standards. Estimates do not include permitting and other costs listed in Exhibit 4-3.

Exhibit 4-5

PERCENTAGE OF SYSTEMS REQUIRING CONTROL MEASURES

Control Measure	Option 1 Floor	Agency Preferred Approach	Option 2 Floor	Option 3 Floor
Cement Kilns				
DESP Improvements	57.69%	57.69%	57.69%	73.08%
Fabric Filter Improvements	3.85%	3.85%	3.85%	11.54%
Feed Controls	84.62%	84.62%	100.00%	100.00%
Lightweight Aggregate Kilns				
Fabric Filter	0.00%	100.00%	0.00%	0.00%
Carbon Injection	0.00%	100.00%	0.00%	0.00%
Fabric Filter Improvements	57.14%	0.00%	57.14%	57.14%
Reheaters	0.00%	28.57%	0.00%	0.00%
Feed Control	57.14%	100.00%	57.14%	85.71%
Commercial Incinerators				
Fabric Filter	0.00%	0.00%	0.00%	20.00%
DESP Improvements	6.67%	6.67%	6.67%	6.67%
Fabric Filter Improvements	46.67%	46.67%	46.67%	46.67%
DOM High-Energy Wet Scrubber	0.00%	0.00%	0.00%	6.67%
Quench	40.00%	40.00%	40.00%	40.00%
Feed Control	100.00%	100.00%	100.00%	100.00%
Onsite Incinerators				
Fabric Filter	6.17%	6.17%	4.94%	14.81%
DESP Improvements	4.94%	4.94%	4.94%	2.47%
Fabric Filter Improvements	70.37%	70.37%	70.37%	69.14%
DOM High-Energy Wet Scrubber	8.64%	8.64%	9.88%	4.94%
Quench	8.64%	8.64%	8.64%	8.64%
Feed Control	95.06%	95.06%	98.77%	97.53%
Liquid Boilers				
Fabric Filter	46.15%	46.15%	46.15%	46.15%
Carbon Injection	0.00%	0.96%	0.00%	0.00%
DESP Improvements	2.88%	2.88%	2.88%	2.88%
Fabric Filter Improvements	0.96%	0.96%	0.96%	0.96%
DOM High-Energy Wet Scrubber	1.92%	0.96%	1.92%	1.92%
Quench	0.96%	0.96%	0.96%	0.96%
Feed Control	91.35%	91.35%	91.35%	91.35%
Coal Boilers				
DESP Improvements	41.67%	83.33%	41.67%	41.67%
Fabric Filter	0.00%	16.67%	0.00%	0.00%
Feed Control	75.00%	83.33%	75.00%	75.00%
HCl Production Furnaces				
Fabric Filter	0.00%	17.65%	0.00%	0.00%
Carbon Injection	0.00%	17.65%	0.00%	0.00%
Reheaters	0.00%	58.82%	0.00%	0.00%
Carbon Bed	0.00%	41.18%	0.00%	0.00%
Feed Control	52.94%	52.94%	76.47%	76.47%

Note: Percentages in this exhibit are not additive. Each combustion system may require one or more control measures.

Exhibit 4-6

PERCENT OF TOTAL NEW COMPLIANCE COSTS BY CONTROL MEASURE

Control Measure	Option 1 Floor	Agency Preferred Approach	Option 2 Floor	Option 3 Floor
Cement Kilns				
DESP Improvements	31.25%	31.25%	9.03%	14.01%
Fabric Filter Improvements	4.55%	4.55%	1.32%	0.74%
Feed Controls	64.20%	64.20%	89.66%	85.25%
Lightweight Aggregate Kilns				
Fabric Filter	0.00%	25.97%	0.00%	0.00%
Carbon Injection	0.00%	18.52%	0.00%	0.00%
Fabric Filter Improvements	25.26%	0.00%	14.48%	11.42%
Reheaters	0.00%	9.49%	0.00%	0.00%
Feed Control	74.74%	46.02%	85.52%	88.58%
Commercial Incinerators				
Fabric Filter	0.00%	0.00%	0.00%	10.17%
DESP Improvements	1.71%	1.71%	1.36%	0.41%
Fabric Filter Improvements	7.59%	7.59%	6.03%	6.44%
DOM High-Energy Wet Scrubber	0.00%	0.00%	0.00%	1.72%
Quench	10.80%	10.80%	8.58%	8.37%
Feed Control	79.90%	79.90%	84.03%	72.90%
Onsite Incinerators				
Fabric Filter	3.56%	3.56%	2.37%	7.47%
DESP Improvements	1.05%	1.05%	0.87%	0.63%
Fabric Filter Improvements	7.10%	7.10%	5.86%	6.23%
DOM High-Energy Wet Scrubber	2.32%	2.32%	2.13%	1.14%
Quench	2.28%	2.28%	1.88%	2.01%
Feed Control	83.69%	83.69%	86.89%	82.51%
Liquid Boilers				
Fabric Filter	27.14%	27.17%	18.40%	34.81%
Carbon Injection	0.00%	0.34%	0.00%	0.00%
DESP Improvements	0.49%	0.49%	0.78%	0.38%
Fabric Filter Improvements	0.05%	0.05%	0.04%	0.04%
DOM High-Energy Wet Scrubber	0.34%	0.17%	0.24%	0.00%
Quench	0.13%	0.00%	0.10%	0.08%
Feed Control	71.85%	71.78%	80.44%	64.69%
Coal Boilers				
DESP Improvements	16.65%	19.25%	16.65%	16.65%
Fabric Filter	0.00%	8.50%	0.00%	0.00%
Feed Control	83.35%	72.26%	83.35%	83.35%
HCl Production Furnaces				
Fabric Filter	0.00%	11.66%	0.00%	0.00%
Carbon Injection	0.00%	8.13%	0.00%	0.00%
Reheaters	0.00%	41.09%	0.00%	0.00%
Carbon Bed	0.00%	11.50%	0.00%	0.00%
Feed Control	100.00%	27.63%	100.00%	100.00%

Compliance costs vary even more markedly when comparing across individual systems within a given combustion sector. The following compliance cost results for the Agency Preferred Approach illustrate the wide variability across specific combustion systems:

- **Cement Kilns** -- Annual per-system compliance costs range from $0 to $1,500,000 with an average cost of $323,700 per system.[11]

- **Commercial Incinerators** -- Annual per-system compliance costs range from $10,600 to $612,000, with an average cost of $260,200 per system.

- **LWAKs** -- Annual per-system compliance costs range from $514,000 to $682,000, with an average cost of $586,700 per system.

- **On-Site Incinerators** -- Annual per-system compliance costs range from $0 to $590,000, with an average cost of $155,500 per system.

- **Liquid Boilers** – Annual per-system compliance costs range from $0 to $1,618,000, with an average of $366,000 per system.

- **Coal Boilers** – Annual per-system compliance costs range from $144,000 to $1,240,000, with an average of $528,000 per system.

- **HCl Production Furnaces** – Annual per-system compliance costs range from $0 to $323,000, with an average of $153,600.

COMPLIANCE COSTS FOR NEW COMBUSTION SOURCES

While most of this analysis focuses on the proposed HWC MACT replacement standards for existing sources, this *Assessment* also evaluates the proposed HWC MACT replacement standards for new facilities entering the hazardous waste combustion market. The standards would apply to both newly constructed facilities (e.g., a new commercial incinerator) as well as to boilers, cement kilns, or lightweight aggregate kilns that choose to begin burning hazardous waste.[12]

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[11] The compliance cost estimates for cement kilns do not take into account the Portland Cement MACT, which addresses non-hazardous cement kilns. If the Portland Cement MACT is accounted for in these estimates, the compliance costs for cement kilns under proposed hazardous waste combustion MACT replacement standards would likely be lower.

[12] Rebuilding a facility can also trigger new MACT standards if the renovation effort requires over one-half of the capital expenditures associated with constructing an entirely new facility.

New sources are not included in our universe since system-specific data are not yet available for these systems. However, we estimate that incremental costs for new sources will be negligible. One factor contributing to this low projection is that very few new combustion sources are expected to go online during the next several years. Of the few sources planned to go online, a significant portion are U.S. Department of Defense incinerators specializing in the treatment of chemical weapons. Since the waste that these facilities plan to treat poses a significant threat to human health, we assume that they will use state-of-the-art control methods, even in the absence of the proposed HWC MACT replacement standards. In addition, past experience indicates that most new sources tend to be designed to cost-effectively incorporate the most technologically advanced control devices and generally are compliant with all standards.[13] Therefore, we assume that new sources will not require significant incremental costs to comply with the proposed HWC MACT replacement standards.

CAVEATS AND LIMITATIONS OF COMPLIANCE COST ANALYSIS

The analysis of private sector compliance costs for the proposed HWC MACT replacement standards contains a variety of uncertainties. The most significant include the following:

- Available emissions data are limited for some facilities. Emissions data are the product of trial burns required for combustion facilities, but information for some pollutants often is not available. In these cases, the emissions reduction requirements are assigned to facilities according to the underlying statistical distribution for each pollutant (which is based on emissions of the pollutant at facilities where data are available).[14]

- Due to data limitations with respect to waste feed characteristics, it is difficult to determine the extent to which feed control may be used as a feasible alternative method of compliance with the proposed HWC MACT replacement standards.

As a result of these limitations, individual combustion system decision-making may result in actual compliance behavior different from the pollution control measures assigned using the engineering cost models. While uncertainty exists, we do not believe that compliance costs are systematically biased either upward or downward.

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[13] Personal communication with Bruce Springsteen of EERGC, September 16, 2003.

[14] For more information on the approach taken for estimating emissions reduction requirements, see U.S. EPA, *Draft Technical Support Document for HWC MACT Standards, Volume V: Emissions Estimates and Engineering Costs*, July 1998, as cited in U.S. EPA, *Assessment of the Potential Costs, Benefits, and Other Impacts of the Hazardous Waste Combustion MACT Standards: Final Rule*, Office of Solid Waste, July 1999.

ROLE OF SITE-SPECIFIC RISK ASSESSMENTS

As part of the proposed HWC MACT replacement standards rulemaking, the Agency is proposing to explicitly codify the authority for permit writers to evaluate the need for and, where appropriate, require Site Specific Risk Assessments (SSRAs). The Agency is also proposing to codify the authority for permit writers to add conditions to RCRA permits that they determine are necessary to protect human health and the environment based on the results of an SSRA. The intent is to change the regulatory mechanism that is the basis for SSRAs while retaining the same SSRA policy from a substantive standpoint for combustion facilities.[15] SSRAs are currently implemented as part of the RCRA permitting process to address cases in which existing practices and standards (including MACT standards) may not be fully protective of human health and the environment. The policy recommends that for hazardous waste combustors subject to the proposed standards, permitting authorities should evaluate the need for an SSRA on a case-by-case basis. While SSRAs are not anticipated to be necessary for every facility, they should be conducted where there is some reason to believe that operation in accordance with the proposed MACT standards alone may not be fully protective of human health and the environment. Should the SSRA demonstrate that supplemental requirements are needed to protect human health and the environment, additional conditions and limitations should be included in the facility's RCRA permit pursuant to the omnibus authority.

Facilities that must conduct an SSRA will incur either a portion of the cost (i.e., the permitting authority conducts the SSRA) or the entire cost to conduct the risk assessment.[16] This analysis assesses the potential facility-level costs of conducting an SSRA under various conditions.

To assess the potential magnitude of these costs, EPA examined typical costs associated with risk assessments conducted in support of SSRAs. Our assessment indicates that the average cost of an SSRA for a facility is between $141,000 and $370,000, including collection of emission data. Excluding the collection and analysis of emission risk data, SSRAs cost approximately $84,000. T h e

[15] The policy regarding site specific risk assessments (SSRAs) originated as part of EPA's 1994 final Combustion Strategy, and a revised Site-Specific Risk Assessment Policy was articulated as part of the 1999 HWC MACT standards rulemaking. EPA provided further clarification of the appropriate use of the SSRA policy and technical guidance in an April 10, 2003 memorandum from Marianne Lamont Horinko, Assistant Administrator for OSWER, to the EPA Regional Administrators titled *Use of the Site-Specific Risk Assessment Policy and Guidance for Hazardous Waste Combustion Facilities*. This document is available in the docket (Docket # RCRA-2003-0016).

[16] EPA estimates that in approximately 33 percent of the cases where there is a need for an SSRA, the permitting authority incurs some or all of the cost of conducting the study.

emission risk data is projected to add on average between $286,000 (if the facility must conduct a separate emission test solely for the purpose of collecting data for the SSRA) and $57,000 (if the facility collects its emission risk data at the same time as its emission standards performance data).[17]

Information available from EPA regions suggests that currently permit writers are finding SSRAs necessary for the majority of hazardous waste combustion facilities. As of July 2003, available data from regions suggested that of 164 facilities in the analysis, as many as 149 may require an SSRA.[18] Of these 149 facilities, 51 have completed the SSRA. The other 98, however, have either not started the SSRA or have an SSRA currently underway.[19] For these facilities, the total cost of the SSRA process might be affected by the proposed HWC MACT replacement standards.

While implementation of the proposed HWC MACT replacement standards may reduce the need for SSRAs, it is difficult to project how significant the decrease may be. Although the replacement standards are generally more stringent than both the interim and 1999-promulgated standards, certain conditions may require additional protective measures. For example, thermal emissions standards under the proposed HWC MACT replacement standards will not address the contribution of non-hazardous wastes or raw materials to a combustor's total emissions, and SSRAs may continue to be needed in some cases to address these pollutants. In addition, certain site-specific factors or circumstances beyond the standards themselves may affect the decision to require an SSRA for an individual combustor. For example, a source's close proximity to a water body or an endangered species habitat, or to sensitive receptors with potentially significantly different exposure pathways, such as Native Americans, will likely influence a permitting authority's decision of whether or not an SSRA is necessary.

A high-end estimate of SSRA implementation cost impacts is based on the assumption that the remaining 98 facilities in the universe with unfinished SSRAs will all require SSRAs. Assuming an average facility-level cost of $141,000, the completion of 98 SSRAs would cost $13,825,000, annualized to roughly $3.3 million per year for five years, assuming a seven percent discount rate.[20] In addition, some facilities may be required to implement permit conditions beyond MACT standards. However, a screening-level comparison by EPA regional staff suggests that the Agency

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[17] Note that this estimate is considerably less than a cost range provided by the Cement Kiln Recycling Coalition of $200,000 to $1,000,000 (with an upper bound of $1,300,000). EPA's research suggested that the costs of conducting SSRAs have decreased in recent years. A full comparative discussion of the cost estimates is available in the document *Hazardous Waste Combustion MACT - Replacement Standards: Proposed Rule. Preliminary Cost Assessment for Site Specific Risk Assessment*, November, 2003, included in the rulemaking docket.

[18] Note that this is a high-end estimate, and includes some facilities where a final determination has not been reached. Moreover, the universe of 164 facilities includes 14 that have been confirmed as non-operating since July, 2003.

[19] Information provided by EPA staff, July 2003.

[20] The analysis assumes that the risk assessment will be expensed over five years as a non-capital cost.

Preferred Approach for the proposed HWC MACT replacement standards is generally as stringent as requirements under SSRAs. This, in turn, may indicate that the proposed HWC MACT replacement standards might reduce the need to conduct SSRAs in the future.

GOVERNMENT COSTS

In addition to costs incurred by the private sector, the proposed HWC MACT replacement standards also will affect EPA and other government entities. The rulemaking will result in incremental costs to government entities as they administer and enforce the new emissions standards and related MACT requirements for boilers and industrial furnaces. This section reviews these incremental costs for government entities associated with revised permitting and reporting requirements. No incremental government costs will be associated with incinerators, cement kilns, or LWAKs since these facilities are already regulated under the 2002 Interim Standards.

The incremental government costs resulting from the proposed HWC MACT replacement standards are mainly associated with the review of permits and other combustion facility documents required by provisions of RCRA and the CAA. Facility documents that require agency review include the following: performance test plans, emergency safety valve (ESV) and automatic waste feed cutoff (AWFCO) violation reports, and notices of intent to comply (NIC) with the standards. Exhibit 4-7 presents the total annual government costs for reviewing these documents.[21] These figures represent annual costs expended over the first three years following rule promulgation. Overall, incremental government costs are projected to be approximately $543,368 per year. Government costs will be assumed by U.S. EPA Offices as well as by state and local agencies that hold relevant permitting responsibilities. The distribution of these costs across different government entities depends on which agencies have responsibility for permitting as well as on the number of combustion facilities in specific permitting jurisdictions and the current permitting status and other site-specific characteristics of the facilities.

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[21] Sources: U.S. EPA, *Supporting Statement for EPA Information Collection Request #1773.02 New and Amended Reporting and Recordkeeping Requirements for National Emissions Standards for Hazardous Air Pollutants from Hazardous Waste Combustors*, September 1998, as cited in U.S. EPA, *Assessment of the Potential Costs, Benefits, and Other Impacts of the Hazardous Waste Combustion MACT Standards: Final Rule*, Office of Solid Waste, July 1999; U.S. EPA, *Supporting Statement for EPA Information Collection Request #1361.08 for "New and Amended RCRA Reporting and Recordkeeping Requirements for Boilers and Industrial Furnaces Burning Hazardous Waste,"* September 1998, as cited in U.S. EPA, *Assessment of the Potential Costs, Benefits, and Other Impacts of the Hazardous Waste Combustion MACT Standards: Final Rule*, Office of Solid Waste, July 1999.

Exhibit 4-7

SUMMARY OF PROPOSED HWC MACT REPLACEMENT STANDARDS' INCREMENTAL COSTS TO GOVERNMENT[a]

HWC MACT Component	Annual Cost per Respondent/Activity	Annual Estimated Number of Systems	Estimated Total Annual Costs[b]
Review of Compliance with Standards and General Requirements (e.g., review of operator training and certification programs)	$507	136	$68,952
Review of Performance Testing Requirements	$1,161	136	$157,896
Review of Monitoring Requirements (e.g., review of feedstream analysis plans)	$734	136	$99,824
Review of Notification, General Reporting and Record Keeping Requirements (e.g., review of Notice of Intent to Comply (NIC)	$1,592	136	$216,512
ESTIMATED TOTAL ANNUAL INCREMENTAL IMPACT =			$543,368

Notes: a. No government costs are associated with facilities regulated by the 2002 Interim Standards. Government costs are only associated with boilers and industrial furnaces. Estimates reflect only the first three years following the promulgation of the MACT replacement standards, the time period covered by the Information Collection Requests (ICRs), and are based on a universe of approximately 172 HWC potential respondents or facilities.

b. Totals may not add due to rounding.

Source: Estimates from U.S. EPA, *Supporting Statement for EPA Information Collection Request #1773.10* "*New and Amended Reporting and Recordkeeping Requirements for National Emissions Standards for Hazardous Air Pollutants from Hazardous Waste Combustors*," October 2003.

SUMMARY

We use engineering cost models based on system-specific parameters to estimate compliance costs for the proposed HWC MACT replacement standards. Under this approach, individual combustion systems are assigned air pollution control measures and corresponding cost estimates using engineering parameters, such as gas flow rates, waste feed composition, and combustion chamber temperature. From this assignment of pollution control measures, we derive the capital, and fixed and variable operating costs that each combustion system in the economic analysis would incur in complying with the standards. The estimates of compliance costs also include the costs associated with permitting, testing, and record keeping and reporting requirements. Key insights from the compliance cost analysis include the following:

- Average system costs of complying with the proposed HWC MACT replacement standards tend to be lower for incinerators than for kilns, especially under the Agency Preferred Approach. Per system LWAK costs, however, are less than per system incinerator costs under the Option 1 Floor, the Option 2 Floor, and the Option 3 Floor.

- Cement kilns have the highest average system compliance costs across the three floor options.

- Changes in record keeping and reporting activities associated with new compliance requirements and permit modifications result in total costs of about $6.2 million across all combustion facilities per year. The majority of these costs are associated with boilers and industrial furnaces; incinerators and commercial kilns generally perform these activities to comply with the 2002 Interim Standards.

- Government administrative costs, borne primarily by EPA offices and state environmental agencies, total approximately $543,000 per year.

These cost estimates, along with cost estimates for government administration of the rule, form the basis for assessing the social costs and other economic impacts of the rule provided in the following chapter.