REGULATORY IMPACT ASSESSMENT FOR PROPOSED HAZARDOUS WASTE COMBUSTION MACT STANDARDS

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EXECUTIVE SUMMARY

ES1.1 OVERVIEW

In May of 1993, the Environmental Protection Agency (EPA) introduced a draft Waste Minimization and Combustion Strategy to reduce reliance on the combustion of hazardous waste and encourage reduced generation of these wastes. Among the key objectives of the strategy is the reduction of health and ecological risks posed by the combustion of hazardous waste. As part of this strategy, EPA is developing more stringent MACT emissions standards for waste combustion facilities. These new MACT standards address a variety of hazardous air pollutants (HAPS), including dioxins/furans, particulate matter, mercury, semi-volatile and low-volatility metals, and chlorine. In addition, emissions of carbon monoxide and hydrocarbons will be regulated as proxies for products of incomplete combustion (PICs). The rule sets emission levels for commercial incinerators, waste-burning cement kilns and lightweight aggregate kilns, and on-site incinerators. The proposed rule is scheduled for release in late 1995.

This Regulatory Impact Analysis (RIA) has been completed in accordance with Executive Order 12866, which requires EPA to develop and submit to the Office of Management and Budget (OMB) an RIA for any significant regulatory action. This document also fulfills the requirements of the Regulatory Flexibility Act mandating that EPA evaluate the effects of regulations on small entities.

The RIA assesses the costs of the rule and the impacts that these costs would have on waste burning behavior, and compares these costs to the benefits of the regulation. By evaluating a variety of regulatory alternatives, EPA has identified pollutant control levels that provide cost-effective protection of public health and the environment. At present, the RIA addresses seven regulatory alternatives for existing combustion sources (see Exhibit ES-1), although EPA is in the process of developing five additional options that will be summarized in an addendum. EPA also evaluated three regulatory alternatives for new sources. In addition to insights on the costs and benefits of the proposed standards, the RIA also provides the Agency with important information on how the proposed rule might affect the competitive dynamics in combustion markets.

ES2.1 SUMMARY OF FINDINGS

This RIA provides estimates of the costs and benefits of EPA's proposed MACT standards for hazardous waste combustion facilities. The RIA analysis suggests that the rule may have substantial benefits, including reductions in adverse health effects, reduced levels of toxic substances in ecosystems, and improvements in property values at homes located near combustion facilities. EPA's analysis of the costs and economic impacts of the new standards indicates that, although a sizeable number of combustion facilities may stop burning hazardous waste, the vast majority of them will remain viable production facilities. Most cement kilns and LWAKs that stop burning will be able to continue clinker and aggregate production by shifting to conventional or non-hazardous waste fuels. Decisions to halt waste burning are expected to result in plant closures only at a few commercial incinerators burning small quantities of waste. Although many on-site incinerators are expected to close, industrial production should continue at these sites because waste burning represents only a small fraction of total production costs. In addition, some on-site incinerators may continue to burn non-hazardous wastes. The remainder of this section summarizes the central conclusions of the RIA.

Exhibit ES-1

REGULATORY OPTIONS FOR EXISTING SOURCES

Option	Source Category	D/F (ng/dscm TEQ)	PM (gr/dscf)	Hg (ug/dscm)	SVM (ug/dscm)	LVM (ug/dscm)	HCl (ppmv)	Cl_2 (ppmv)	CO (ppmv)	HC (ppmv)
Floor Levels	Incinerators	0.5	0.015	30	60	80	25	1	100	20
	Cement Kilns	0.5	0.03	40	60	80	60	1	NA	20
	LWA Kilns	0.5	0.015	30	60	80	1300	2.5	100	20
MACT Option 1b: Basic Option (includes common, protective D/F stnd and common Hg standard)	Incinerators	ATF 0.2	0.015	30	60	80	25	1	100	20
	Cement Kilns	ATF 0.2	0.03	ATF 30	60	80	60	1	NA	20
	LWA Kilns	ATF 0.2	0.015	30	60	80	1300	2.5	100	20
MACT Option 1c: Basic Option (includes common, protective standards for both D/F and Hg)	Incinerators	ATF 0.2	0.015	ATF 5	60	80	25	1	100	20
	Cement Kilns	ATF 0.2	0.03	ATF 5	60	80	60	1	NA	20
	LWA Kilns	ATF 0.2	0.015	ATF 5	60	80	1300	2.5	100	20
MACT Option 2a: Basic Option 1c + Improved Combustion	Incinerators	ATF 0.2	0.015	ATF 5	60	80	25	1	ATF 50	ATF 5
	Cement Kilns	ATF 0.2	0.03	ATF 5	60	80	60	1	ATF 50	ATF 5
	LWA Kilns	ATF 0.2	0.015	ATF 5	60	80	1300	2.5	ATF 50	ATF 5
MACT Option 2b: Basic Option 1c + Improved Combustion (W/CK exemption)	Incinerators	ATF 0.2	0.015	ATF 5	60	80	25	1	ATF 50	ATF 5
	Cement Kilns	ATF 0.2	0.03	ATF 5	60	80	60	1	NA	20
	LWA Kilns	ATF 0.2	0.015	ATF 5	60	80	1300	2.5	ATF 50	ATF 5
MACT Option 3: Basic Option 1c + Common Standards	Incinerators	ATF 0.2	0.015	ATF 5	60	80	25	1	100	20
	Cement Kilns	ATF 0.2	ATF 0.015	ATF 5	60	80	60	1	NA	20
	LWA Kilns	ATF 0.2	0.015	ATF 5	60	80	ATF 60	ATF 1	100	20
MACT Option 4: Basic Option 1c + Common Standards + Improved Combustion	Incinerators	ATF 0.2	0.015	ATF 5	60	80	25	1	ATF 50	ATF 5
	Cement Kilns	ATF 0.2	ATF 0.015	ATF 5	60	80	60	1	ATF 50	ATF 5
	LWA Kilns	ATF 0.2	0.015	ATF 5	60	80	ATF 60	ATF 1	ATF 50	ATF 5

- Total Costs of the Rule Assuming No Market Exit range from $189 million to $561 million per year, depending on the MACT alternative. This is an upper bound cost estimate, as a number of facilities will choose to stop burning hazardous wastes rather than incur the rule's compliance costs.

- Total Costs of the Rule Allowing for Market Exit range from $140 to $176 million per year for most MACT options when EPA assumes firms will have little ability to pass through compliance costs to generators ("low price pass-through"). Options requiring PIC control generate much higher compliance costs, ranging from $191 to $285 million per year. Since capital and operating expenditures are tax deductible, the tax-adjusted cost of the rule for individual generators will be somewhat lower, although the exact cost will depend on the marginal tax rates of the individual generators.

- Most Compliance Costs Are Incurred to Reach the Floor. With the exception of MACT options requiring PIC control (2a, 2b, and 4), most of the costs of the rule and decisions to halt waste burning occur in reaching the MACT floor.

- Market Exit in the Short-Term. EPA estimates that, if facilities have little ability to pass on compliance costs to generators in the form of higher combustion prices, 58 to 71 facilities (depending on MACT option) will cease hazardous waste burning. Nearly 90 percent of the exit is in the on-site incinerator sector for regulatory alternatives that do not include PIC controls.

- Market Exit in the Long-Term. As waste burning capital must be replaced, an additional 27 to 34 facilities (depending on MACT option) are expected to stop burning hazardous wastes. Again, these are mostly on-site incinerators.

- Capacity Utilization Drives Exit. Facilities that cease burning wastes are generally those that burn small quantities of waste now, and therefore face high compliance costs per ton of waste burned. For this reason, EPA estimates that decisions to stop burning waste will divert only between three and 10 percent of waste quantities currently burned. Combustion units that adequately utilize existing waste burning capacity will remain viable.

- High Price Pass-Through Scenario. If combustion facilities are able to pass through a greater portion of compliance costs to generators, a lower the number of facilities are expected to exit the waste burning market. While this reduces waste diversions from facilities exiting the market to only two to three percent, greater pass-through does increase the social costs of the rule somewhat.

- Operating Profits. Most combustion facilities will experience reduced operating profits from hazardous waste burning as a result of the rule. Under EPA's low price pass-through scenario, percentage declines in profit margins are largest in the cement and LWAK sectors. Nonetheless, EPA's analysis suggests that, on average, cement kilns and LWAKs will remain profitable, with post-compliance operating margins on waste burning that are still higher than those for commercial incinerators.

- Waste Minimization and Non-Combustion Alternatives. The proposed rule will provide greater incentives for the adoption of waste minimization and other alternatives to combustion, especially in the on-site incinerator sector. For many on-site incinerators, compliance with the proposed rule is predicted to increase waste burning costs substantially; EPA expects that many generators will find waste minimization a cheaper compliance option when compared with the commercial combustion alternative. The Agency, however, is unable to predict exactly how much waste minimization will occur because of the complex nature of existing institutional barriers to further waste reduction. To further encourage waste minimization, EPA is requesting comments on a number of additional provisions in the proposed rule. First, the Agency may require that on-site combustors better characterize their waste streams as a way to improve the applicability of waste minimization plans. Second, in return for specific waste minimization commitments, the Agency may allow combustors additional time to comply with the new regulations or delay calling-in existing permits. While such exceptions will be determined on a case-by-case basis, they could increase the economic viability of particular waste minimization options.

- Compliance Costs Per Ton Similar for New and Existing Sources. This suggests that the proposed rule will not create any substantial barriers to entry in the hazardous waste combustion industry.

- Cost Effectiveness. Average compliance costs per ton of HAP controlled range from about $5,000 to $8,500. Costs are lowest under the floor and options 2A and 4. Control of dioxin, mercury, and semi-volatile metals drive compliance costs under most MACT options. Control expenditures vary little across MACT options for dioxin/furans; variability is greater for mercury controls.

- Benefits: Population risks are considerable for dioxin and mercury in the pre-regulatory baseline. EPA estimates that hazardous waste burning sources represent about nine percent of total anthropogenic dioxin emissions and about four percent of total anthropogenic mercury emissions in the U.S. Under the proposed MACT standard, reductions in dioxin and mercury emissions from hazardous waste burning sources are significant. EPA expects that these reductions, in conjunction with reductions in emissions from other dioxin and mercury-emitting sources, will help reduce dioxin and mercury levels over time in foods used for human consumption and therefore, reduce the likelihood of adverse health effects, including cancer and neurological effects in adults, and developmental abnormalities in children. Screening analyses also suggest that emissions reductions may lead to property value increases, an alternative measure of benefits. While a precise estimate is not possible due to numerous uncertainties, property value increases have the potential to be substantial under the rule.

- Effects of Other EPA Initiatives. Other pending EPA initiatives could substantially alter the results presented in this RIA. Most importantly, the MACT rule governing emissions from non-hazardous waste burning cement kilns could reduce the incremental cost of burning waste in kilns, providing incentives for more kilns to enter the waste burning market. On the other hand, new management standards for cement kiln dust (CKD) could reduce the overall competitiveness of the kilns if waste burners must manage greater quantities of CKD than non-burners. Furthermore, the exemption of on-site boilers from this proposed rule could lead to increased use of boilers, reducing waste quantities flowing to the sectors analyzed here. Finally, a possible exemption for "clean" hazardous waste fuels (i.e., those comparable to conventional fuels in their emissions profiles) from RCRA would probably shift the burden of new compliance costs onto the more highly contaminated solids, sludges, and liquids. The details of this provision continue to be worked out; therefore, EPA is unable to provide a quantitative assessment of how they would alter the estimates presented in the RIA for this rule.

Overall, the RIA analysis suggests that the benefits of the rule are potentially substantial. While these cannot be fully monetized in units comparable to the costs, the analysis suggests that MACT standards for hazardous waste combustion facilities are necessary to provide significant reductions in emissions and exposures from this sector. A screening analysis of property value impacts of the new standards also suggests that benefits could be substantial. Given the severe nature of the adverse health effects caused by dioxin and mercury (cancer, developmental effects in children, and severe neurological effects in adults), EPA believes that substantial reductions in emissions of these pollutants from hazardous waste burners under the MACT standard justifies moving ahead with the proposed above the floor (ATF) option.

ES3.1 ECONOMIC IMPACT ASSESSMENT

EPA's proposed MACT standards will increase the cost of hazardous waste combustion across the industry, and will lead some facilities to stop burning hazardous wastes altogether. The market impacts, however, are expected to be small. Only a few facilities are expected to stop burning wastes in the commercial sectors. While more on-site incinerators will cease waste burning, they currently tend to burn small quantities of hazardous waste. Waste diversions from combustion are likely to be minor as a result. The rule is expected to cost between $140 and $187 million per year, although costs jump to a high of between $285 and $405 million per year if PIC controls at kilns are required. EPA does not expect the rule to trigger large changes in the competitive balance between these sectors.

The quantities of hazardous waste currently combusted are the primary determinant of whether combustion facilities will stop burning. Much of the market exit in all four sectors is driven by the small quantities of waste over which facilities are able to spread the fixed costs of compliance with the new standards. Since the facilities that stop burning hazardous waste tend to be those currently burning small quantities, EPA estimates that only about three percent of the tonnage currently combusted will be diverted to other combustion sites or to non-combustion management alternatives.

Most of the costs of the rule, and market exit from the rule, occur in reaching the proposed MACT floor. With the exception of options that require PIC controls (2a, 2b, and Option 4), the above-the-floor options do not noticeably change the impacts of the rule. Under proposed MACT options requiring PIC controls, compliance costs per ton rise dramatically for cement kilns and LWAKs, suggesting that more substantial changes in the combustion marketplace would occur.

Uncertainty about the cost and availability of waste minimization and non-combustion waste management alternatives for generators makes it difficult to predict how high combustion prices could rise before generators switched substantial waste quantities to non-combustion alternatives. Although EPA bounds this uncertainty by including a zero-percent price pass-through scenario, the impact of price changes on market exit is not large in most sectors. The pricing assumptions have a much more direct effect on the profitability of the units that remain open after complying with the rule.

Since firms that close combustion units in the face of the new rule do not incur compliance expenditures for those units, the estimate of the total costs of the rule excludes the units likely to stop burning hazardous wastes. The total cost estimate includes compliance costs for all combustion units that continue to burn hazardous wastes, plus any cost increases from having to manage wastes from closed facilities in a more expensive manner. For all non-PIC proposed MACT options, total costs of the rule are 22 to 29 percent lower than total engineering costs that assume all units comply with the rule. The costs for PIC options decline by almost 50 percent once market exit is incorporated.

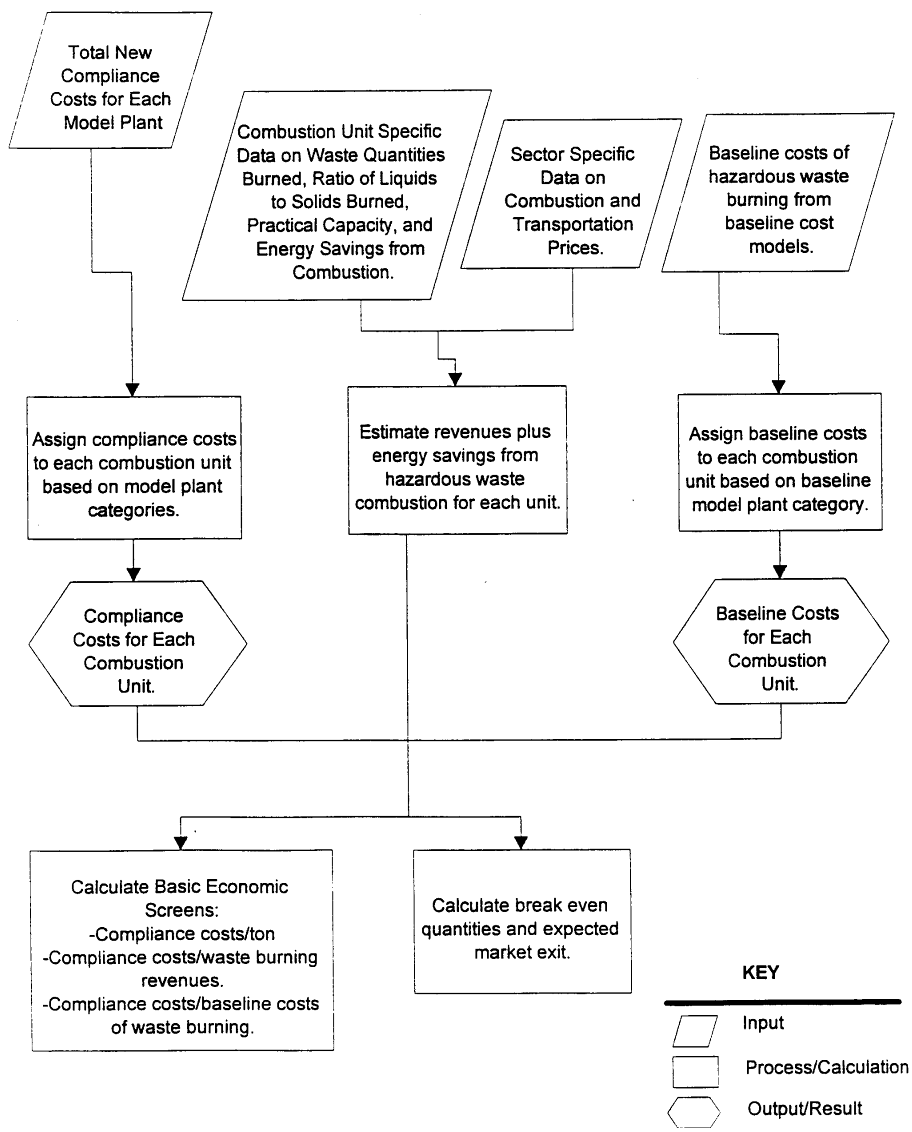
ES3.1.1 Economic Impact Methodology

To estimate compliance costs associated with the MACT proposal, EPA used a model plants approach augmented by certain plant-specific and industry-specific data. The pre-MACT baseline cost of combustion was estimated using one set of model plants, based on existing plant type, size, and installed air pollution control devices (APCDs). Separate model plants for compliance costs were also created, again based on plant type and size, as well as on new APCDs required to comply with the proposed rule. These two sets of model plants form the basis for all the economic impact analysis in the RIA. Additional costs that applied across all combustion units, such as for continuous emission monitors, were added to this total.

As illustrated in Exhibit ES-2, model plant data were combined with plant- and industry-specific data on quantities and prices of waste burned by type. From these core data, EPA estimated compliance costs, waste burning revenues, and energy savings (where applicable) for each combustion unit analyzed. Compliance costs were then evaluated against a variety of economic measures to assess the impact of the rule on combustion markets. Basic screening measures included compliance costs per ton of waste burned, compliance costs as a percentage of waste burning revenues, and compliance costs as a percentage of baseline costs to burn hazardous waste. Each screen provides useful information on the relative magnitude of compliance costs under various regulatory scenarios and helps the Agency gauge the differential impact of the proposed MACT standards across combustion sectors.

Exhibit ES-2

Integration of Model Plants Data and Combustion Unit-Specific Data in Economic Screens



While the basic screens provide rough indicators of how the effects of the rule vary across individual combustion units and combustion sectors, EPA used a breakeven quantity approach (BEQ) as a more precise indicator of when specific combustion units would no longer be profitable as hazardous waste burners. The BEQ, a planning tool commonly used by businesses, measures the quantity of waste that a combustion unit would have to burn to cover the costs of operation. EPA used estimates of breakeven quantity to assess the likelihood that combustion facilities will stop burning waste in the face of increased compliance costs by comparing the BEQ to data on the actual tons burned. Where multiple combustion units at a single site failed to meet BEQ, waste flows were consolidated into fewer combustion units under the assumption that a rational waste combustor would undertake such an action to maximize profits.

The BEQ is the basis for the Agency's estimates of market exit in both the short- and long-term. In addition, because the BEQ changes when prices change, EPA was able to model the effect of three different pricing scenarios on estimated market exit. Each scenario reflected different assumptions about the market price at which waste minimization and/or other alternatives to combustion would become competitive. These pricing scenarios enabled the Agency to bound the estimated impacts of the proposed rule despite uncertainty about the economics of alternatives to combustion.

While providing a general indication of each combustion facility's likely response to the new standards, the BEQ measure does have limitations. The first important limitation involves the quality of data on tons burned, type of waste burned, and prices charged. BEQ results are especially sensitive to the quantity data. The second limitation is inherent in the design of the breakeven measure itself. Even combustion units that meet BEQ may earn profits too low to justify continued waste burning. EPA has therefore assessed changes in operating profits due to the rule. The Agency invites industry to provide supplemental data to address either limitation in order to enhance EPA's evaluation of impacts of the rule on industry or sector profitability.

ES3.1.2 Differential Impacts of the Rule by Market Sector

Although the rule will not cause large changes in sectoral competition, not all market participants will be affected in the same way. This section summarizes the key impacts on the four combustion segments, as well as on fuel blenders and generators. A comparison of important measures of impact across sectors is presented in Exhibit ES-3.

ES3.1.2.1 Cement Kilns

Cement kilns currently have a baseline cost advantage over commercial incinerators due to their ability to use capital equipment (such as the kiln) for joint cement production/hazardous waste destruction. While the proposed MACT standards will greatly change the baseline cost of burning waste at a cement kiln, the existing cost advantage is large enough that cement kilns are expected to remain the lowest-cost combustors under all proposed MACT scenarios.

Kilns likely to exit the market are those that tend to burn little waste now. Under proposed MACT option 1b, between two and three facilities currently burning hazardous wastes are expected to stop doing so. This remains at three facilities if prices could not rise at all. If kilns are required to install PIC controls (as under proposed MACT options 2a and 4), and are not successful in passing the full costs of these controls to generators in the form of higher prices, ten kilns are expected to stop burning hazardous wastes over the long-term (17 if prices couldn't rise at all). This is a more likely scenario than full price pass-through. Although the kilns would have the lowest total combustion costs per ton even with PIC controls, the Agency believes that a tripling of combustion prices at the kiln probably would cause generators to adopt alternative management methods.[1]

Despite the low expected market exit, kilns remaining in the market would experience a substantial decline (on the order of 25 to 30 percentage points) in the profitability of hazardous waste combustion. This decline will make it more difficult for kiln operators to cross-subsidize cement production with hazardous waste profits. While strong cement markets now protect many of these marginal kilns, reduced hazardous waste profits could accelerate plant closures during the next construction industry downturn. EPA currently does not have adequate information on marginal plants to assess the likelihood of such closures. Despite declines in waste burning operating profits due to the new standards, however, most BIFs are expected to maintain operating margins higher than those of commercial incinerators.

Exhibit ES-3

SECTORAL COMPARISON OF IMPACTS OF PROPOSED MACT OPTION 1B

	Cement Kilns	Commercial Incinerators	Lightweight Aggregate Kilns	On-Site Incinerators
Total Compliance Costs ($Millions)				
- Zero pass-through	$51	$19	$3	$72
- Low pass-through	$56	$19	$3	$74
- High pass-through*	$60	$19	$3	$77
Average Compliance Costs Per Ton of Hazardous Waste Burned				
- Zero pass-through	$59	$30	$44	$64
- Low pass-through	$62	$30	$44	$63
- High pass-through*	$69	$30	$44	$90
Number of Combustion Facilities Likely to Stop Burning Hazardous Wastes in the Long-Term**				
- Zero pass-through	3	6	1	89
- Low pass-through	3	6	1	82
- High pass-through	2	6	1	72

Notes:
* Costs rise in the high pass-through scenario because some units with higher compliance costs remain viable.
** Excludes facilities not burning waste in the baseline. Exit over long-term capital cycle; immediate market exit would be lower. Due to the large number of very small on-site burners, on-site incinerators burning less than 50 tons of hazardous waste per year excluded from calculation. For all other sectors, only units burning zero tons per year were excluded.

[1] Kilns burn primarily high-Btu liquid solvent wastes. Solvent recycling would be a cost-effective alternative, limiting the degree to which kilns could increase prices. However, solid hazardous wastes are suspended in the solvents prior to burning. Solvent recycling would eliminate this disposal outlet for solids, suggesting that prices on liquids with suspended solids could rise much more than prices on clean solvents.

The market behavior of waste-burning cement kilns in the short-run and the long-run is quite similar. Because the kilns have little in the way of baseline capital equipment dedicated solely to waste burning, the long-term BEQ is quite similar to the short-term BEQ.

ES3.1.2.2 Commercial Incinerators

Commercial incinerators face lower compliance costs per ton of waste burned than do cement kilns. As a result, commercial incinerators that remain in operation will become somewhat more competitive with the kilns. The dollar value of this benefit, however, is about $40 per ton under all proposed MACT options not requiring PIC controls for kilns, and is therefore not expected to affect market competition significantly. EPA estimates that commercial incinerators will continue to incur average costs per ton of waste burned that are substantially higher than BIFs. Though their ability to handle waste streams that cannot currently be burned in kilns provides the incinerators with a protected niche, the longer-term erosion the commercial incinerators' market is likely to continue.[2]

Facility closure in the commercial incinerator sector is driven almost entirely by waste quantities burned; low quality burners are much more likely to close. Four of the permitted facilities currently burning wastes are expected to close under both the high and the low price pass-through scenarios and are probably marginal even in the current market. Long-term closures increase by two facilities in both price pass-through scenarios for the alternatives without PIC controls. This increase is driven by the high capital costs that must be recovered over the capital replacement cycle in order for incinerators to stay in the market.

Commercial incinerators also experience a decline in operating profit margins — of between 5 and 20 percent in the low price pass-through scenario. As the declines are smaller than for cement kilns, the rule will improve the competitive position of commercial incinerators relative to kilns. EPA, however, does not anticipate that the changes are large enough to cause substantial changes in competitive dynamics.

ES3.1.2.3 Lightweight Aggregate Kilns

LWAKs face average compliance costs per ton of waste burned (before consolidation) up to twice as high as those for cement kilns and commercial incinerators. This differential is overstated, however, because over 30 percent of the permitted LWAKs do not currently burn wastes in their kilns. Once non-viable units are removed from the market, average compliance costs per ton drop below costs to cement kilns for most MACT options. Furthermore, EPA estimates that LWAKs have a baseline cost advantage over commercial incinerators similar to that enjoyed by kilns. Before and after the rule, LWAKs retain a strong competitive position.

[2] This market erosion may not necessarily occur in a linear fashion. For example, some kilns may not refocus on hazardous waste combustion expansion until the demand for cement slows.

Kilns with little or no waste now will most likely stop waste burning in the face of the proposed MACT standards. The substantial required investments in pollution control capital cannot be spread over the small tonnage at these facilities, causing the units to stop burning hazardous wastes. Under the non-PIC control alternatives, two LWAKs are likely to exit the market, only one of which is actively burning wastes. As with cement kilns, exit increases under proposed MACT options requiring PIC controls unless these costs can be passed on to generators in the form of higher prices. Overall, LWAKs currently burning larger quantities of hazardous waste will remain strong competitors in the hazardous waste combustion market for both the short- and the long-run. While operating profit margins for remaining facilities do decline, margins after compliance with the rule are expected to remain higher than those in the commercial incinerator sector.

ES3.1.2.4 On-site Incinerators

On-site incinerators fall into two categories. At one end of the spectrum are facilities with high capacity utilizations and burning large quantities of waste. These facilities are able to spread fixed investments so that costs per ton of waste combusted are competitive with commercial alternatives. At the other end of the spectrum are a large number of incinerators that burn extremely low tonnages; it is these facilities that lead to the very high compliance costs per estimated ton of waste burned for this sector. To the extent that these units also burn large quantities of non-hazardous wastes, some may remain viable under the proposed MACT standards. More likely, however, is that the units will stop burning hazardous waste even if non-hazardous waste continues to be burned. This is because the BEQ on compliance costs alone frequently exceeds the tons of hazardous waste currently burned at the units.

Market exit in this sector is expected to be substantial — between 44 and 61 facilities in the short-term (assuming low price pass-through). As the incinerator capital itself requires replacement, over one-half of the on-site incinerators actively burning are expected to stop burning hazardous wastes. Since quantities burned at each unit are quite low, the overall impact of these shutdowns on the combustion market is expected to be minimal. Units that remain in the market, however, maintain operating profit margins similar to, or better than, commercial incinerators under most MACT options.

ES3.1.2.5 On-site Boilers

On-site boilers are not covered under the proposed MACT standards. To the extent that the same wastes can be combusted in both on-site boilers and on-site incinerators, the rule makes boilers more cost-effective because they do not have to invest in new controls. Therefore, on-site boilers could provide a lower-cost outlet for some of the wastes diverted from on-site incinerator closures (thereby reducing the cost of the rule). Alternatively, the existence of a boiler option could accelerate the closure of incinerators as firms divert wastes even from incinerators that appear capable of meeting their BEQ. Data were not available that to allow EPA to determine the magnitude of these impacts.

ES3.1.2.6 Hazardous Waste Generators

Hazardous waste generators are likely to see price increases for combusted waste streams. With all combustion sectors facing increased costs, and with the compliance costs per ton that are not radically different across commercial sectors, generators will have little flexibility to seek out a lower cost combustion sector. The size of the likely price increases is difficult to determine, and will differ by the type of waste. EPA anticipates that generators of clean solvents and lean waters will face lower price increases due to the availability of non-combustion alternatives. High-Btu liquids without suspended solids can be reclaimed, or possibly burned in exempt facilities, both of which would constrain price increases that could be passed on to generators of the liquids.[3] Land-ban solids and sludges could face more substantial increases.

EPA does not have sufficient information on specific generating sectors to evaluate the impact of price increases on generator processes more specifically. The Agency, however, does expect that a number of waste minimization and non-combustion alternatives are available in the long-term should combustion prices rise significantly. For this reason, EPA anticipates that price increases of between $20 and $90 per ton are more likely than larger increases. These changes would increase waste management costs for generators, although EPA has not analyzed the impact this could have on the prices of products produced by these generators.

ES3.1.2.7 Fuel Blenders

Fuel blenders serve as intermediaries between generators and combustors in both the commercial BIF and commercial incinerator sectors.[4] To the extent that the proposed MACT changes the combustion demand for any one of these parties, blenders would need to react.

The RIA indicates that the impacts of the rule on blenders are likely to be relatively small. Very few combustion facilities can avoid capital equipment purchases for MACT controls by reducing the metals or chlorine in the hazardous waste fuels they burn, even if the new formulations are assumed to cost the same as the old. As a result, blenders are unlikely to be called on to change their fuel blends by more than a handful of customers. Waste diversions from closed facilities are also expected to be quite small. While some localized blender operations may need to ship wastes to different outlets, the magnitude of these changes nationally is unlikely to be large.

One exception involves proposed MACT options requiring PIC controls at commercial BIFs. If the cost of compliance makes a higher number of kilns uncompetitive (a distinct possibility), blenders will lose their key waste outlet. Alternatively, PIC controls could bifurcate the BIF market, with liquids exempted by clean fuels regulations burned in non-waste burning BIFs (or recycled), while solids are burned in commercial incinerators. This could drastically reduce the demand for fuel blending services.

[3] EPA is considering exempting the combustion of clean hazardous waste fuels from regulations governing hazardous waste combustion in general on the grounds that there is little difference between them and conventional fuels such as coal and oil.

[4] Blending operations at commercial incinerators are often done on-site by incinerator employees, whereas blending at cement kilns is often run by outside firms.

ES3.1.3 Uncertainties With Economic Impact Assessment

In addition to the data limitations mentioned in the BEQ discussion, two additional caveats are worth noting:

ES3.1.3.1 Cross Subsidies to Cement Manufacture

The RIA treats combustion activities as an independent profit center for BIFs. That is, combustion units meeting BEQ on waste burning are assumed to remain in operation. EPA has not evaluated the case where profits from waste burning are used to cross-subsidize inefficient cement production activities. While such behavior could not be sustained over a long period of time (such units would be out-competed by units that efficiently produce cement and burn hazardous wastes), it can exist in the short-term, and may be a real concern for a small number of older, wet process kilns in the cement industry.

The Agency does not expect this omission to greatly alter the short-run conclusions of this analysis in any substantial way because cement markets are extremely healthy now and operating profits on waste burning remain quite strong even after the rule. Nonetheless, EPA invites industry to submit supplemental data that would enable the Agency to analyze whether reduced operating profits in a market with cross-subsidies for cement manufacture would lead to additional plant closures.

ES3.1.3.2 Joint Use of On-Site Incinerators

Data available to EPA suggests that many on-site incinerators burn very small quantities of hazardous waste. This yields large baseline capital costs per ton of waste burned. To the extent that industry also burns large quantities of non-hazardous waste in these incinerators, EPA's analysis would overstate the baseline costs of burning, thereby overstating expected market exit somewhat. The extremely high new compliance costs per ton of waste burned (properly attributed entirely to the hazardous waste fraction) are usually sufficient to trigger market exit in the on-site sector, even if baseline costs are assumed to be zero. For this reason, the Agency does not anticipate that better data on the joint use of on-site incinerators for non-hazardous waste would change the conclusions of this RIA. Nonetheless, EPA invites industry to provide additional data on this issue if it is in disagreement.

ES4.1 BENEFITS OF THE RULE

ES4.1.1 Cost Effectiveness

EPA has developed a cost-effectiveness measure that examines cost per unit reduction of emissions for each HAP. The two analytic components of this measure are: (1) estimates of expenditures per HAP for each regulatory option; and (2) estimates of emissions reductions under each regulatory option. EPA has developed a simplified method that distributes expenditures to each HAP based on the cost of the technology that controls the HAP. In cases where the technology controls more than one HAP, costs are split based on the relative percent reduction required. Total mass emission reductions are estimated by summing emissions estimates for all facilities. The emission reductions are then calculated as the difference between the baseline total emissions and the emissions under the regulatory option.

As would be expected, control of dioxin and mercury accounts for the greatest share of expenditures, and the average costs (expenditures per unit reduced) increase with more stringent controls. Across all HAPs, cost per ton of emissions reduced ($5,000 to $8,500 per ton) is somewhat above, but generally comparable to, other combustion rules for municipal and medical waste combustors.

ES4.1.2 Human Health Risk

Population risks are considerable for dioxin and mercury in the pre-regulatory baseline. EPA estimates that hazardous waste burning sources represent about nine percent of total anthropogenic dioxin emissions and about four percent of total anthropogenic mercury emissions in the U.S. Human exposure to dioxin may cause as many as 600 cancer cases each year in the United States. For mercury, health risks include severe neurological effects in the offspring of exposed pregnant women and neurological effects in adults. Adverse health effects are most likely for persons who eat large amounts of freshwater fish, such as recreational or subsistence anglers, because exposures to mercury through this pathway can be substantial.

Under the proposed MACT standard, reductions in emissions from hazardous waste burning sources are significant. At the floor and proposed above-the-floor levels, dioxin emissions from hazardous waste combustion will be reduced by approximately 78 percent and 89 percent, respectively. These reductions correspond to an approximate three percent reduction in total estimated anthropogenic dioxin emissions in the U.S. Under the proposed MACT standard, mercury reductions also are substantial. EPA estimates that mercury emissions from hazardous waste burning sources will be reduced to 3.8 Mg per year at the proposed floor levels and to 2.0 Mg per year at the proposed above the floor standard. These reductions correspond to approximately a three percent reduction of total anthropogenic mercury emissions in the U.S. EPA expects that the decrease in dioxin and mercury levels from hazardous waste combustion sources, in conjunction with reductions in emissions from other dioxin and mercury-emitting sources, will help reduce dioxin and mercury levels over time in foods used for human consumption and therefore, reduce the likelihood of cancer and neurological effects in adults, and developmental abnormalities in children.

ES4.1.3 Ecological Risk

Emissions from waste burning may also affect terrestrial and aquatic ecosystems in the areas around combustion facilities. As an initial screen for assessing risk to aquatic ecosystems, EPA compared the concentration of pollutants in surface water to aquatic toxicity criteria.

The screening analysis of ecological risks considers modeled watershed concentrations relative to risk-based ambient water quality criteria. The analysis suggests that water quality criteria may be exceeded in the most vulnerable watersheds around waste combustion facilities, particularly cement kilns. This generally occurs, however, only under high end emission assumptions. These risks are expected to be eliminated under all the proposed regulatory alternatives.

ES4.1.4 Property Value Benefits

EPA examined potential property value impacts introduced by hazardous waste combustion facilities. A literature review of property value studies provided information on the impact that incinerators, landfills, and waste sites have on the value of surrounding properties. These impacts are generally reflected as an increase in housing prices per unit increase in distance from the waste site. EPA combined this premium information with data on housing densities around combustion facilities to develop a screening estimate of annual property value damages that could be eliminated by emissions reductions at all combustion facilities.

EPA developed a property value screening analysis that uses distance from a combustion facility as a proxy for emissions reduction. The basis for the analysis is a recent study of property value effects around a municipal waste incinerator; this study demonstrated how housing prices increase with distance from the facility. Sensitivity analysis of two key parameters -- the boundary distance within which the premium applies and the mileage distance used as a proxy for emissions reduction -- yields a wide range of benefit estimates. If we assume that only those homes within one mile of the facility are affected and if the reduction in concentration is equivalent to a 0.25 mile shift away from the facility, the resulting benefit is approximately $12 million per year. Alternatively, if all homes within 3.5 miles are affected and the emissions reduction is equivalent to moving a house 2.5 miles further from the facility, we obtain an annual benefit of $840 million. To know whether such benefits occur, however, requires more knowledge about how housing prices respond to changes in air pollution. While the screening analysis performed here allows EPA to conclude that property value damages are potentially significant, this central question can be adequately addressed only through further research.

ES5.1 REGULATORY FLEXIBILITY AND ENVIRONMENTAL JUSTICE

The proposed rule is unlikely to adversely affect small businesses for two important reasons. First, few combustion units are owned by businesses that meet the Small Business Administration (SBA) definition as a small business. Specifically, available data allow the Agency to identify only eight small entities out of the more than two hundred EPA-listed combustion units burning hazardous waste. Furthermore, while over one-half of those that are considered small have a relatively few employees, annual sales for these facilities are in excess of $50 million per year.

Second, facilities most hurt by the rule tend to be those that burn very little waste and hence face very high costs per ton burned. The screening analyses and breakeven quantity analyses used to evaluate the economic impact of the proposed rule demonstrate that tons burned rather than firm size are the primary determinant of market exit. Although EPA does not have data on the waste combusted at every small unit, those that have high capacity utilizations will face relatively small cost increases per ton. Those that burn very little waste in their existing units will close rather than comply with the proposed rule. Since their low quantities led to the closure, it follows that their cost of off-site treatment will also be low.

To evaluate the environmental justice implications of the proposed rule, EPA looked at whether minority percentages within a one mile radius of the waste burning facility were significantly different from the minority percentages in the county as a whole. EPA analyzed all hazardous waste burning cement plants as well as a sample of incinerators. In neither case did EPA find that plants were located disproportionately near populations with higher minority densities than the surrounding area.

ES6.1 SUMMARY

EPA's analysis of the proposed rule indicates that some combustion facilities may experience a substantial change in the cost of burning waste, but that this change is likely to have a limited impact on combustion markets. In terms of effects on waste-burning cost structure, cement kilns and lightweight aggregate kilns (LWAKs) are most affected by the regulation. This is primarily a product of their relatively low baseline costs of burning, meaning that incremental compliance costs represent a large increase in their overall cost of burning waste. For incinerators, compliance costs are lower, represent smaller additions to baseline costs, and change little across regulatory options. The analysis concludes that cement kilns have the lowest waste burning costs even after regulation, and so will continue to have the greatest leverage to increase prices.

To the extent that compliance costs cannot be passed through to generators and fuel blenders, the profitability of waste burning in kilns will fall. Nonetheless, waste burning kilns are expected to have healthy operating profit margins after the rule. Market exit in all sectors is concentrated among facilities that burn small quantities of hazardous waste. While as many as 98 combustion facilities may stop burning hazardous wastes as a result of the proposed MACT options, the small quantities these facilities burn suggest that market dislocations will be minor.

Overall, the social costs of the rule are balanced by a set of potentially substantial benefits. Given the severity of the potential adverse health effects from dioxin and mercury (cancer, developmental effects in children, and severe neurological effects in adults), EPA believes the substantial reductions of these pollutants from hazardous waste burning sources under the MACT standard justifies moving ahead with the proposed ATF option. An alternative way of valuing benefits is the potential increase in property values around closed or more stringently regulated combustion facilities. The fact that this approach also suggests potentially substantial benefits strengthens EPA's belief that the costs of moving forward with the proposed ATF option are justified.

1.1 INTRODUCTION

In May of 1993, the Environmental Protection Agency (EPA) introduced a draft Waste Minimization and Combustion Strategy to reduce reliance on 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 emissions standards for combustion facilities. EPA is proposing revised emissions standards for a number of hazardous air pollutants (HAPs) from three categories of hazardous waste combustion facilities:

- Cement kilns;
- Lightweight aggregate kilns;
- Incinerators, both commercial and on-site.

In coordination with other EPA offices, the Office of Solid Waste has developed this analysis to evaluate the economic impact of the proposed regulatory options. The EPA's proposed rule is currently scheduled for release in late 1995. This analysis assesses the costs of the rule and the impacts that these costs would have on waste burning behavior, and compares these costs to the benefits of the regulation. This economic impact analysis has been completed in accordance with Executive Order 12866, requiring EPA to develop and submit to the Office of Management and Budge (OMB) a regulatory impact analysis for any significant regulatory action. This document also fulfills the requirements of the Regulatory Flexibility Act (at 5 U.S.C. 601 et seq.) mandating that EPA evaluate the effects of regulations on small entities.

The remainder of this chapter provides a discussion of the various regulatory options that EPA is considering under the combustion technical standards rule and a review the organization of this document.

1.2 REGULATORY OPTIONS

The proposed technical standards rule adopts a "maximum achievable control technology" (MACT) approach for establishing emissions standards. Under this approach, emissions concentration limits are developed as a function of control technologies currently in place. Specifically, a MACT standard setting exercise rank orders existing sources by emissions and requires control levels equal to or better than the best performing regulated sources.[1] EPA may require more stringent controls -- referred to as "above-the-floor" controls -- if needed to ensure protection of human health and the environment or in the interest of establishing common standards across combustor types. In this rule, floor and "above-the-floor" levels were developed for nine hazardous air pollutants (HAPs):

- dioxin/furan;
- particulate matter;
- mercury;
- semi-volatile metals (SVM);
- low volatile metals (LVM);
- hydrochloric acid (HCl);
- chlorine (Cl_2);
- carbon monoxide (CO); and
- hydrocarbons (HC).[2]

For more detail on the specific methodology used in developing floor and "above-the-floor" control levels, the reader should refer to the preamble to this rule.

EPA is considering seven different regulatory MACT options for existing sources. Exhibit 1-1 summarizes these options. As shown, the regulatory options begin with standards based on the MACT floor for each HAP and then generally increase in stringency. Several HAPs -- dioxin, PM, and mercury -- vary the most between options. Other HAPs -- HCl, Cl_2, CO, and HC -- vary only for the more stringent options. Semi-volatile and low volatile metals do not change under any of the regulatory options. The regulatory options can be described as follows:

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[1] The MACT pool must include no fewer than five units.

[2] CO and HC are regulated as surrogates for products of incomplete combustion (PICs).

Exhibit 1-1

REGULATORY OPTIONS FOR EXISTING SOURCES

Option	Source Category	D/F (ng/dscm TEQ)	PM (gr/dscf)	Hg (ug/dscm)	SVM (ug/dscm)	LVM (ug/dscm)	HCl (ppmv)	Cl_2 (ppmv)	CO (ppmv)	HC (ppmv)
Floor Levels	Incinerators	0.5	0.015	30	60	80	25	1	100	20
	Cement Kilns	0.5	0.03	40	60	80	60	1	NA	20
	LWA Kilns	0.5	0.015	30	60	80	1300	2.5	100	20
MACT Option 1b: Basic Option (includes common, protective D/F stnd and common Hg standard)	Incinerators	ATF 0.2	0.015	30	60	80	25	1	100	20
	Cement Kilns	ATF 0.2	0.03	ATF 30	60	80	60	1	NA	20
	LWA Kilns	ATF 0.2	0.015	30	60	80	1300	2.5	100	20
MACT Option 1c: Basic Option (includes common, protective standards for both D/F and Hg)	Incinerators	ATF 0.2	0.015	ATF 5	60	80	25	1	100	20
	Cement Kilns	ATF 0.2	0.03	ATF 5	60	80	60	1	NA	20
	LWA Kilns	ATF 0.2	0.015	ATF 5	60	80	1300	2.5	100	20
MACT Option 2a: Basic Option 1c + Improved Combustion	Incinerators	ATF 0.2	0.015	ATF 5	60	80	25	1	ATF 50	ATF 5
	Cement Kilns	ATF 0.2	0.03	ATF 5	60	80	60	1	ATF 50	ATF 5
	LWA Kilns	ATF 0.2	0.015	ATF 5	60	80	1300	2.5	ATF 50	ATF 5
MACT Option 2b: Basic Option 1c + Improved Combustion (W/CK exemption)	Incinerators	ATF 0.2	0.015	ATF 5	60	80	25	1	ATF 50	ATF 5
	Cement Kilns	ATF 0.2	0.03	ATF 5	60	80	60	1	NA	20
	LWA Kilns	ATF 0.2	0.015	ATF 5	60	80	1300	2.5	ATF 50	ATF 5
MACT Option 3: Basic Option 1c + Common Standards	Incinerators	ATF 0.2	0.015	ATF 5	60	80	25	1	100	20
	Cement Kilns	ATF 0.2	ATF 0.015	ATF 5	60	80	60	1	NA	20
	LWA Kilns	ATF 0.2	0.015	ATF 5	60	80	ATF 60	ATF 1	100	20
MACT Option 4: Basic Option 1c + Common Standards + Improved Combustion	Incinerators	ATF 0.2	0.015	ATF 5	60	80	25	1	ATF 50	ATF 5
	Cement Kilns	ATF 0.2	ATF 0.015	ATF 5	60	80	60	1	ATF 50	ATF 5
	LWA Kilns	ATF 0.2	0.015	ATF 5	60	80	ATF 60	ATF 1	ATF 50	ATF 5

- Floor Levels: These levels are based on current performance at existing facilities.

- Option 1: This option introduces above-the-floor (ATF) standards for dioxin, PM and mercury. Option 1b increases the dioxin control level to 0.2 ng/dscm[3] while also introducing a more stringent mercury control level for cement kilns. Option 1c introduces a common, protective mercury control level for all facilities (5 ug/dscm).[4]

- Option 2: This option builds on Option 1c by adding improved combustion requirements, as indicated by CO and HC emissions. Option 2b differs from 2a only in that cement kilns are regulated less stringently (an HC control level of 20 ppmv and no CO requirement).

- Option 3: This option builds on Option 1c by introducing a common PM standard where cement kilns must control at the same level as other facilities (0.015 gr/dscf), a common HCl standard (60 ppmv) for cement kilns and lightweight aggregate kilns, and a common Cl_2 standard (1 ppmv) for all facilities.

- Option 4: This option is the same as Option 3 but also includes the improved combustion requirements found in Option 2a.

These regulatory variations imply significantly different costs and benefits. We give closest attention to the impacts of the floor and Option 1b requirements, the regulatory alternatives that EPA viewed as most likely at the time this report was produced.

In addition to the regulatory options governing existing waste combustion facilities, this rule also proposes MACT standards for new sources. Exhibit 1-2 presents the specific standards for each HAP. As shown, the basic option includes standards commensurate with the more stringent options for existing sources, as well as even more stringent semi-volatile metals and HCl requirements. Option 2 introduces common CO standards for all sources as well as a more stringent low-volatile metals standard. Finally, Option 3 is equivalent to Option 1, except for more stringent dioxin and mercury requirements.

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[3] Nanograms per dry standard cubic meter of flue gas flow, a standardized volumetric measure of air releases.

[4] Option 1a was eliminated from consideration after revisions to floor levels were made.

Exhibit 1-2

REGULATORY OPTIONS
FOR NEW SOURCES

Option	Source Category	D/F (ng/dscm TEQ)	PM (gr/dscf)	Hg (ug/dscm)	SVM (ug/dscm)	LVM (ug/dscm)	HCl (ppmv)	Cl_2 (ppmv)	CO (ppmv)	HC (ppmv)
Option 1: Basic Option	Incinerators	0.2	0.01	30	40	80	25	1	50	5
	Cement Kilns	0.2	0.03	30	40	80	25	1	NA	20
	LWA Kilns	0.2	0.01	30	40	80	25	1	50	5
Option 2: Basic Option + Common Standards + Stringent LVM	Incinerators	0.2	0.01	30	40	30	25	1	50	5
	Cement Kilns	0.2	0.015	30	40	30	25	1	50	5
	LWA Kilns	0.2	0.01	30	40	30	25	1	50	5
Option 3: Basic Option with improved D/F and Hg	Incinerators	0.1	0.01	5	40	80	25	1	50	5
	Cement Kilns	0.1	0.03	5	40	80	25	1	NA	20
	LWA Kilns	0.1	0.01	5	40	80	25	1	50	5

1.3 ORGANIZATION OF THIS REPORT

The remainder of this report consists of six chapters, plus appendices:

Chapter 2: Presents background information on the combustion sectors affected by the technical standards rule, examining current waste burning and market trends as well as current regulations and emissions of relevant HAPs.

Chapter 3: Explains the model plants methodology used to develop engineering compliance costs and compiles these costs across the universe of regulated facilities to arrive at upper bound estimates of national compliance costs.

Chapter 4: Presents our economic impact analysis. Using a series of screening analyses, we examine the differential impact that compliance costs are likely to have on the various combustion sectors. In addition, we evaluate the likelihood of facility closures if facilities are unable to cover new compliance costs.

Chapter 5: Evaluates the cost-effectiveness of the rule by presenting information on expenditures per unit reduction of relevant HAPs. In addition, we assess potential health benefits of the rule.

Chapter 6: Presents the regulatory flexibility analysis for the technical standards rule, examining the potential for impacts on small business.

Chapter 7: Assesses the environmental justice implications of the rule, examining the current impact of combustion facilities on various demographic and socioeconomic subgroups located near combustion facilities.

Appendix A: Provides core data inputs to the combustion cost model such as prices.

Appendix B: Presents baseline costs of hazardous waste combustion for each regulated sector.

Appendix C: Describes waste minimization options for wastes currently combusted.

Appendix D: Discusses waste management alternatives for wastes currently combusted.

Appendix E: Detailed Model Output for the floor and MACT Option 1B.

Appendix F: Detailed data on small business impacts to support the regulatory flexibility analysis.

Appendix G: Presents market impacts assuming no price increase (zero percent price pass-through scenario).

The revised technical standards evaluated in this regulatory analysis address emissions from all facilities burning hazardous waste except on-site boilers. The effect of the rule will not be the same in all combustion sectors. As context for understanding how the rule will affect the industry, this chapter provides a general overview of the combustion industry and the interplay between various sectors. Understanding the changes occurring within the combustion industry, even in the absence of the proposed MACT standards, provides important context for assessing the incremental impact of the rule in Chapter 4.

We first present an overview of the services provided by a combustion unit and the factors that underlie the demand for these services. Next, we describe the facilities that combust hazardous waste, including information on the current market structure and the quantity and characteristics of waste burned. We then provide background information on emissions from combustion devices and the installed base of air pollution control devices (APCDs). Finally, we explore the current market performance of the various combustion sectors and evaluate some of the factors behind the differential performance of the commercial incinerator and the commercial boiler and industrial furnace (BIF) sectors. Factors examined include structural advantages, differences in the regulatory baseline between sectors, and differences in the air pollution control devices currently in operation and in the pollutants released.

2.1 OVERVIEW OF SERVICES PROVIDED BY THE HAZARDOUS WASTE COMBUSTION SECTOR

Hazardous waste combustors provide three principal services to their customers when they burn wastes: regulatory compliance, liability reduction, and, in some cases, energy and raw material recovery. The demand for these services is driven by regulatory requirements, liability concerns, and economics. Regulatory forces affect the demand for combustion both by mandating certain hazardous waste treatment standards and by establishing requirements for the combustion units that affect the cost of combustion. Liability concerns of waste generators drive combustion demand because combustion destroys organic wastes, greatly reducing the risk of future environmental problems from the waste material. Finally, economic forces may encourage combustion where alternative management options are more expensive. Within the combustion segment, these same economic forces underlie the preference for energy and raw material recovery over simple waste destruction as a way to reduce both combustion cost and potential liability.[1]

2.1.1 Regulatory Requirements Encouraging Combustion

While industry began incinerating some of their hazardous wastes as early as the late 1950s, the current market for hazardous waste combustion was essentially created by EPA regulation of hazardous waste disposal.[2] Two major regulatory forces directly encouraging combustion have been the land-ban restrictions under the Hazardous and Solid Waste Amendments (HSWA) of 1984 and clean-up agreements for Superfund sites called "Records of Decision (RODs)."[3]

Prior to the promulgation of EPA's Land Disposal Restrictions (LDRs), hazardous waste generators were free to send untreated wastes directly to landfills. The LDRs mandated alternative treatment for the wastes, known as Best Demonstrated Available Technologies (BDATs). Quite often, combustion was the stipulated BDAT. An assessment of the 1989 Biennial Report estimated that of the 24 waste codes (including mixtures) that comprise 80 percent of the waste reported combusted, 22 contained wastes with BDAT requiring some form of combustion.[4] Pending LDRs could further increase the quantity of wastes flowing into the combustion sector.

The Land Disposal Restrictions have also influenced hazardous waste management under the Comprehensive Environmental Reclamation, Compensation, and Liability Act (CERCLA). The RODs set out the cleanup plan for contaminated sites under CERCLA. A key attribute of the RODs is the choice of remediation technology. Because even soil redeposited at Superfund sites is subject to the LDRs, incineration is often a technology chosen during remediation. While remediation efforts contribute a

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

[2] Cary Perket and Jon Hanke, "The Roots of Overcapacity in the Incineration Sector," EI Digest, February 1995, p. 25.

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

[4] Graff and Walker, op. cit., p. 12; United States Environmental Protection Agency, Office of Solid Waste and Emergency Response, National Biennial RCRA Hazardous Waste Report (Based on 1989 Data), February 1993.

minority of the wastes managed by combustion (between 5 and 20 percent, depending on the incinerator), combustion has been used frequently on remediation projects.[5] Between 1982 and 1991, incineration was the source control remedy selected most often (in 28 percent of RODs issued).[6]

A number of regulations govern allowable emissions from combustion units and the processes by which residuals must be managed. By increasing or decreasing the cost of combustion, these regulations can affect industry demand for combustion services to some degree. These regulations, which can also affect the relative costs of different combustion options, are addressed in more detail in Section 2.4.2.1: Regulatory Advantages.

2.1.2 Liability Concerns

Liability concerns are mostly, but not entirely, driven by regulation as well. CERCLA created a liability system in which a generator who had shipped waste to a licensed disposal site could be held liable for up to the entire cost to clean the site if environmental damages arose. 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. The Hazardous Waste Treatment Council estimates that 15 to 30 percent of waste handled by destructive incineration is not classified as hazardous by any agency.[7] Incinerators are often used to destroy off-specification or expired products that a manufacturer wants to ensure do not enter the marketplace.

2.1.3 Economic Forces Encouraging Combustion

Economic forces can encourage combustion over alternative treatment in two ways. First, because combustion can be used to treat a wide variety of waste streams, it is an attractive option for managers wishing to treat much of their waste on-site. In addition to ensuring control of the waste through its destruction, combustion may be cheaper than segregating and managing multiple small waste streams in different ways.[8]

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[5] Remediation share of combusted waste data are from Hugh Holman and D. Cotton Swindell, "Environmental Research: Chemical Waste Management and Rollins Environmental Services," Alex Brown & Sons, Inc., April 5, 1993, p. 8. Based on data in the 1991 BRS, about 15 percent of total combusted wastes were remediation wastes, treatment residuals, or other "one-time" wastes. See U.S. EPA, Setting Priorities for Hazardous Waste Minimization, July 1994, p. 2-12.

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

[7] Graff and Walker, op. cit., p.15-16. This non-hazardous waste helps combustion units cover their fixed costs of operation, as well as competes for limited combustion capacity.

[8] For larger wastes streams, however, waste segregation can often lead to large cost savings because less toxic fractions may be handled less expensively. See Michael Hoffman, "Waste Minimization Versus Segmentation," EI Digest, January 1994, pp. 45-46.

Second, in a few market segments combustion is actually less expensive than alternative treatment options, even in the absence of liability concerns. Presently, for example, some spent solvents are combusted because combustion costs less than solvent reclamation. Due to the present low price of petroleum, the abundance of petrochemical manufacturing capital, and high compliance costs for solvent recyclers, reclaiming spent solvents has not been as cost-effective as paying facilities to combust the waste.

In addition to encouraging combustion over alternative treatment, economic forces play an even stronger role in determining the competitive balance between sectors of the combustion market. Energy recovery and residual reuse are currently possible in cement kilns and LWAKs, but not in commercial incinerators. This gives the kilns a cost advantage.

These economic forces are constantly changing. Some pending regulations are likely to increase the flow of certain wastes to the combustion sector, while many others could change the relative costs of combustion for different market segments. Superfund liability reform currently under discussion in Congress could alter the importance of liability-reduction as a driver of combustion demand as well. Finally, technological changes in waste processing and product manufacturing influence the economic drivers. The impact of these potential changes on market dynamics is addressed in Section 2.3.

2.2 HAZARDOUS WASTE COMBUSTION FACILITIES

Hazardous waste is combusted at a variety of different facility types. Two particularly instructive ways of classifying these facilities are by the type of unit or by whether the facility is commercial or non-commercial. Both factors influence the economics of waste burning at any given site. Unit types include incinerators and boilers/industrial furnaces (BIFs). Incinerators traditionally burned wastes to destroy toxic characteristics, although some now recover a portion of the energy contained in the wastes. BIFs are units used to generate heat and/or power, or to manufacture products (like cement) in an industrial process. While BIFs traditionally burned conventional fuels like coal and oil, many have been modified to burn hazardous wastes as well.

Both incinerators and BIFs may either be commercial or non-commercial. Non-commercial facilities are usually located at the generator's production site, and are referred to as "on-site" incinerators or boilers. Commercial facilities generally receive wastes from generators in the surrounding region. The main commercial combustion segments are commercial incinerators, cement kilns, and lightweight aggregate kilns (LWAKs). The commercial/non-commercial division is not always clear-cut, however; a few on-site facilities do accept some waste commercially even though most of the waste burned originates on-site.

Companies that generate large quantities of waste usually choose to combust the waste themselves. On-site combustion offers a number of benefits to generators:

- Profits otherwise paid to commercial facilities are retained by the generator.
- The generator is somewhat insulated from price fluctuations in the commercial treatment sector.
- Waste transport costs may be avoided all together.

- Generators are able to control the entire treatment process, avoiding possible liability risks.

- If wastes can be burned in an existing boiler or industrial furnace, the incremental cost of waste burning can be very low. In such cases, the generator may also reduce energy costs somewhat by recovering the heat-content of the hazardous wastes.

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 more cost effective than constructing and maintaining an on-site incinerator.

Commercial and non-commercial combustion facilities either burn waste purely for destructive purposes or for both destructive and energy recovery purposes.[9] Incinerators, both commercial and non-commercial, burn waste primarily for destructive purposes. While some incinerators do use the cleaner liquid solvent streams to fuel their afterburners,[10] energy recovery is not an integral part of their production process. In contrast, cement kilns, LWAKs, and generators with boilers are able to recover the energy in hazardous waste. For facilities like cement kilns with high energy requirements, the energy value of the wastes is an added benefit. However, even in the kilns, the waste destruction has a higher financial value than the recovered energy (see Appendix A). Furthermore, because of limitations on the amount of hazardous waste that can be burned without affecting product quality, the majority of energy needed to produce cement and lightweight aggregate is still derived from conventional fuels.[11]

Exhibit 2-1 illustrates the current structure of the combustion market in terms of capacity distribution across sectors and average permitted units per facility. With the exception of on-site incinerators and on-site boilers (not characterized), a relatively small number of facilities combust hazardous waste. Both cement kilns and lightweight aggregate kilns tend to have more permitted waste burning units per facility than do incinerators, and both use the energy content of the wastes to fuel their production process.

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[9] In addition to energy recovery, cement kilns and lightweight aggregate kilns can incorporate a portion of the residual ash from combustion (of both hazardous and non-hazardous fuels) in their products.

[10] Phil Retallick, Rollins Environmental Services, personal communication, September 13, 1994.

[11] During 1991 and 1992, only eight percent of the energy used at kilns came from waste fuel. The hazardous waste fuel fraction was even smaller. See Portland Cement Association, U.S. Cement Industry Fact Sheet Twelfth Edition, June 1994, p. 17.

In addition to the actual combustion units, the combustion market contains a group of intermediaries that move waste between the generator and the combustor. Waste brokers arrange the movement of wastes from the generator to the combustor without additional processing. In contrast, fuel blenders will generally collect waste from a number of generators and process it to meet the requirements of their customers in the combustion sector.[12] As of September 1994, there were approximately 74 active fuel blenders.[13] The National Association of Chemical Recyclers (NACR) estimates that 40 percent of the waste received by its membership is recycled, while 60 percent goes to fuel blending. Of the fraction used in fuel blending, less than 10 percent becomes residual waste that cannot be used as a fuel.[14]

Exhibit 2-1

NUMBER AND SECTOR OF COMBUSTION FACILITIES

Type of Combustion Device	Estimated Number of Units	Number of Facilitie s	Average Waste Burning Units/Facility	Commercial/ Non-Commercial	Function
Cement kilns	50	28	1.8	Commercial	Energy recovery and destruction
Lightweight aggregate kilns	15	7	2.2	Commercial	Energy recovery and destruction
Commercial incinerators	34	30	1.1	Commercial	Primarily destruction
On-site incinerators	184	157	1.2	Non-Commercial	Primarily destruction

Notes and Sources:
(1) All units permitted to burn hazardous wastes have been included; however, some permitted units are no longer actively burning wastes.
(2) IEc estimate.
(3) U.S. EPA, List of Permitted or Interim Status Hazardous Waste Incinerators and Hazardous Waste BIFs, November 1, 1994.

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

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

[13] Jeffrey Smith, "Fuel Blenders 1994," El Digest, September 1994, p. 20.

[14] Chris Goebel, National Association of Chemical Recyclers, personal communication, August 11, 1994.

2.3 THE QUANTITY AND CHARACTERISTICS OF COMBUSTED HAZARDOUS WASTE

Over the years, the quantity of waste combusted for destruction and energy recovery has steadily increased. Between 1989 and 1991, the tonnage combusted grew by 43 percent. Further increases were apparent in the commercial sector between 1991 and 1993, although similar data for the on-site sector were not available.[15]

The overall growth of the market somewhat masks a slight increase in market share for commercial BIFs between 1991 and 1993. In 1991, an almost equal quantity of waste was burned by incinerators and those facilities that burn waste for energy recovery. As shown in Exhibit 2-2, commercial and non-commercial incinerators burned 1.9 million tons with most of this occurring in on-site incinerators. Commercial BIFs burned more than 1.1 million tons, or about 62 percent of commercially combusted wastes. By 1993, commercial BIFs had captured 66 percent of the commercial combustion market, burning 1.2 million tons compared to the 0.6 million burned in commercial incinerators.[16] Although on-site BIFs are not included in this proposed MACT, we have included them in Exhibit 2-2 because wastes could conceivably flow to them once the other sectors are regulated more stringently.

The characteristics of waste used for fuel differ from those of wastes sent to incineration, although fuel blenders have blurred the lines somewhat. The waste forms burned for energy recovery appear to be those wastes most suitable for use as fuels (e.g., solvents and organic liquids). These waste forms are likely to have a high heat content, be easy to pump, and result in a relatively small amount of solid residues. The wastes managed in incinerators include those typically used as fuels as well as those wastes not amenable to energy recovery (e.g., lower Btu sludges and contaminated soil).

Under the Boiler and Industrial Furnace (BIF) rule,[17] the waste burned for energy recovery must have a minimum heat value of 5,000 Btu/lb. In practice, the waste burned by cement kilns has an average heat value of 12,000 Btu/lb,[18] whereas incinerated waste typically has an average heat value of only 6,700 Btu/lb.[19] To make waste with a low heat content more amenable to commercial energy recovery, hazardous waste with a high Btu value is frequently mixed or "blended" with waste with a lower heat value.[20] As

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[15] Jon Hanke, "Hazardous Waste Incineration 1994," EI Digest, June 1994, p. 19; Jeffrey Smith, "Industrial Furnaces 1994," EI Digest, October 1994, p. 23; Christine Seidel, "Another Look at the EPA's 1991 Biennial Report," EI Digest, March 1995, p. 5.

[16] Hanke, op. cit., June 1994, p. 19; Smith, op. cit., October 1994, p. 20.

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

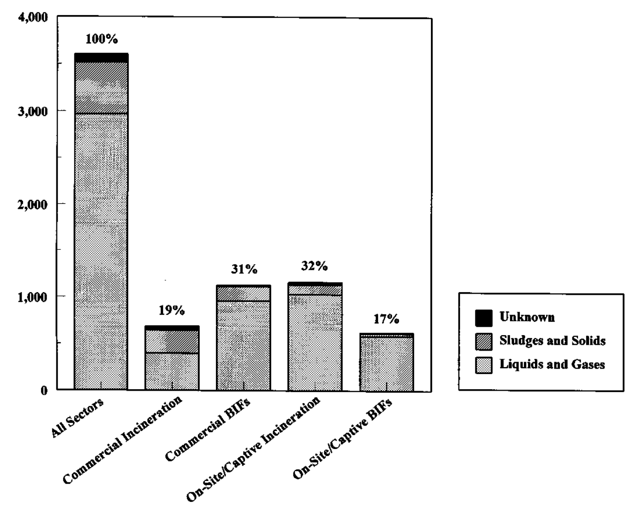
[18] The 1994 weighted average heat value of fuels supplied to kilns by fuel blenders in the National Association of Chemical Recyclers (NACR) was 12,073 Btu/lb., with a minimum value of 8,800 Btu/lb. and a maximum of 14,000 Btu/lb. See NACR, NACR Waste Processing Survey, August 1994, question 1. Values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

[19] Average heat content of waste at medium and large commercial rotary kiln incinerators from EER combustion database. See Appendix B.

[20] Even wastes with a heat content greater than 5,000 Btu/lb. will often need to be blended with higher Btu wastes to keep the fuel feed to the kiln at an appropriate level.

Exhibit 2-2

QUANTITIES OF HAZARDOUS WASTES COMBUSTED IN 1991
(1000s tons)



Source: 1991 Biennial Report, Draft Data Summaries 9/29/94.

mentioned above, blending is also used to ensure that contaminants, such as metals, do not exceed allowable levels in fuels sent to combustion units.

2.4 MAJOR SOURCES OF COMBUSTED HAZARDOUS WASTES

Waste managed by combustion comes from a relatively narrow set of industries. As illustrated in Exhibit 2-3, in 1991, the organic chemical industry (SIC 2869) alone generated nearly 40 percent of all combusted hazardous waste (65 percent for SIC 28 overall). Based on available data, no other single industry generated more than 10 percent and, outside of SIC 28, no single industry generated more than 3 percent. As shown in Exhibit 2-3, however, nearly one-quarter of all wastes combusted could not be traced back to specific generator industries due to limitations in the BRS.

Much of the waste currently combusted is the result of petroleum refining and petrochemical processing. While some producers in these industries are small (e.g., specialty chemical manufacturers), many are extremely large, vertically integrated, multinational firms.

2.5 BASELINE EMISSIONS AND EMISSION CONTROLS

This section presents information on baseline emissions from combustion devices as well as data on the emission controls currently installed. Emissions and pollution control devices vary considerably both across and within combustion sectors.

2.5.1 Baseline Emissions

Baseline emissions data for hazardous air pollutants (HAPs) from combustion suggest that emissions per combustion unit vary widely, and that there are different HAPs of concern in different combustion sectors. Emissions from BIFs arise from conventional fuel combustion as well as from hazardous wastes. Cement kilns and LWAKs have a raw material feed that contributes to emissions as well. While these factors make it difficult to attribute differences in emissions to hazardous waste burning alone, the data do highlight the potential problem areas for each sector.

The main constituents of concern are presented below, with the exception of products of incomplete production (PICs). Characterizing PICs is particularly difficult as the number of organic compounds present in stack emissions can measure in the hundreds and the type and quantity of PIC emissions varies even under controlled operating conditions. Many PICs have not been characterized, and those that have are often difficult to measure in stack emissions. As a result, many permit writers use carbon monoxide (CO) and total hydrocarbon (THC) emissions as proxies for PIC formation.[21] These values are presented in Exhibit 2-4 below.

[21] Clyde Dempsey and Timothy Oppelt, "Incineration of Hazardous Waste: A Critical Review Update," Air & Waste, Volume 43, January 1993, pp. 47-48.

Exhibit 2-3

INDUSTRIAL SECTORS GENERATING COMBUSTED WASTES*

Volume Rank	SIC Code Description	SIC Code	Volume (tons)	% of Volume	Cumulative % of Volume
1	Industrial Organic Chemicals, N.E.C.	2869	1,147,907	37.79	37.79
2	Unknown	Unknown	752,693	24.78	62.56
3	Pesticides and Agricultural Chemicals, N.E.C.	2879	287,214	9.45	72.02
4	Plastics Materials, Synthetic Resins, and Nonvulcanizable Elastomers	2821	172,634	5.68	77.70
5	Pharmaceutical Preparations	2834	114,390	3.77	81.47
6	Medicinal chemicals and Botanical Products	2833	98,137	3.23	84.70
7	Cyclic Organic Crudes and Intermediates, and Organic Dyes and Pigments	2865	85,652	2.82	87.52
8	Petroleum Refining	2911	78,700	2.59	90.11
9	Industrial Inorganic Chemicals, N.E.C.	2819	53,271	1.75	91.86
10	Refuse Systems	4953	31,083	1.02	92.88
11	Business Services, N.E.C.	7389	24,705	0.81	93.70
12	Photographic Equipment and Supplies	3861	21,642	0.71	94.41
13	Chemicals and Chemical Preparations, N.E.C.	2899	20,065	0.66	95.07
14	Nonclassifiable Establishments	9999	17,370	0.57	95.64
15	Synthetic Rubber (Vulcanizable Elastomers)	2822	12,289	0.40	96.05
16	Glass Containers	3221	9,038	0.30	96.34
17	Electric Services	4911	7,579	0.25	96.59
18	Paints, Varnishes, Lacquers, Enamels, and Allied Products	2851	5,788	0.19	96.78
19	Chemicals and Allied Products, N.E.C.	5169	5,559	0.18	96.97
20	Services, N.E.C.	8999	4,706	0.15	97.12
21	Manmade Organic Fibers, Except Cellulosic	2824	4,584	0.15	97.27
22	Manufacturing Industries, N.E.C.	3999	4,454	0.15	97.42
23	Wood Household Furniture, Upholstered	2512	4,341	0.14	97.56
24	Ammunition, Except for Small Arms	3483	3,658	0.12	97.68
25	National Security	9711	3,603	0.12	97.80
	All Other SIC Codes		66,825	2.20	100.00
	Total		3,037,866	100.00	

* Excludes non-routinely-generated wastes and secondary wastes. Includes waste quantities burned in on-site boilers that are not subject to this MACT.

Source: 1991 BRS Data in "Setting Priorities for Hazardous Waste Minimization," EPA, 1994.

Using data on average emissions collected by EPA at a sample of combustion facilities, cement kilns appear to have the highest levels of emissions for all pollutants except low volatile metals (LVMs) and hydrochloric acid (HCl).[22] Both total and per unit emissions of carbon monoxide (CO), mercury (Hg), particulate matter (PM), dioxin/furan toxic equivalents (TEQ), and THC appear considerably higher than emissions levels for the incinerator and LWAK sectors. Incinerators appear to have the highest emissions of LVMs, while LWAKs appear to emit the most HCl in total and per unit.

Exhibit 2-4

BASELINE NATIONAL EMISSIONS OF HAPs FROM COMBUSTION UNITS (pounds/year)

	Cement Kilns		Incinerators		LWAKs	
	Emissions	Avg. Emissions/ Unit	Emissions	Avg. Emissions/ Unit	Emissions	Avg. Emissions/ Unit
Chlorine	421,277	8,426	1,957,156	8,978	58,615	3,908
CO	155,319,149	3,106,383	31,198,222	143,111	1,615,385	107,692
HCl	5,478,723	109,574	2,451,289	11,244	6,726,923	448,462
LVM	7,447	149	60,556	278	480	32
Mercury	29,681	594	10,173	47	696	46
PM	9,297,872	185,957	4,408,444	20,222	101,885	6,792
SVM	67,447	1,349	116,267	533	1,488	99
TEQ	2.07	0.041	0.187	0.0009	0.0002	0.00002
THC	10,393,617	207,872	529,013	2,427	97,385	6,492

Source: "Table 1. Baseline, floor, and above the floor (ATF) options national yearly estimated emissions," prepared by Energy and Environmental Research Corporation for Waste Management Division, U.S. EPA, April 21, 1995. Data were rescaled to estimated units in combustion universe by IEc.

[22] Because emissions data were not subjected to rigorous statistical comparisons, differences in emissions across sectors should be used cautiously.

2.5.2 Baseline Pollution Control

Combustion facilities release a number of constituents of concern when they burn hazardous wastes. These constituents include particulate matter, metals, dioxin, mercury, chlorine and products of incomplete combustion. The proposed regulation is designed to control risks from emissions of these constituents. Although nearly all facilities have installed some air pollution control devices, there are distinct differences in the types of controls installed by various types of combustion facilities.

Exhibit 2-5 lists which constituents of concern are controlled by specific APCDs, as well as the prevalence of those APCDs by facility type. Data on APCDs are from EPA's Combustion Emissions Technical Resources Document (CETRED).[23] Although CETRED is not all-inclusive in its characterization of installed APCDs, it does provide a useful overview of installed pollution controls.[24] The types and efficiencies of controls currently installed has a large impact on the costs specific facilities will face under new emission standards. Some of the interesting points that can be seen include:

- Only one facility currently uses carbon injection, a control technology which under the proposed rule will frequently be required for dioxin/mercury controls.
- Although all cement kilns currently have some form of particulate control installed, our model plants analysis (detailed in Chapter 3) shows that many kilns will need to install a new fabric filter, either for PM control or as part of a carbon injection treatment train for mercury or dioxin controls.
- Lightweight aggregate kilns rely almost entirely on fabric filters for emission control.
- In contrast to the BIF sector, CETRED suggests that a small percentage of incinerators currently operate with no emissions controls.

2.6 COMBUSTION MARKET PERFORMANCE

Throughout much of the 1980s, hazardous waste combustors enjoyed a strong competitive position. In spite of their high capital costs, incinerators were extremely profitable. EPA regulations requiring combustion greatly expanded the waste tonnage requiring treatment. Federal permitting rules, as well as fierce local opposition to incinerator siting, constrained the entry of new combustion units. As a result, combustion prices rose steadily, reaching nearly $640/ton for clean high-Btu liquids and $1,680/ton for sludges and solids in 1987.[25] Profits were equally high. For example, after-tax profits earned by Rollins Environmental Services, a firm operating primarily in the incineration sector, peaked at 16.4 percent that

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[23] U.S. EPA, Combustion Emissions Technical Document (CETRED), May, 1994.

[24] These same data suggest that over half of the on-site boilers currently have no installed APCDs. As boiler emissions are not affected by this proposed rule, the lack of pollution controls may make the on-site boilers more attractive economically.

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

Exhibit 2-5

BASELINE APCDS BY COMBUSTION SECTOR

Control Device (1)	Emissions Controlled	Number (Percentage) of Sample Units Currently Using Device			
		Cement Kilns	Commercial Incinerators	On-Site Incinerators	Lightweight Aggregate Kilns
Fabric Filters	Particulate matter, metals	10 (29%)	10 (53%)	8 (16%)	8 (67%)
Wet or Dry Electrostatic Precipitators (ESPs)	Particulate matter	25 (71%)	2 (11%)	6 (12%)	
Cyclones	Large particulates			2 (4%)	
Wet or Dry Scrubbers	Particulate matter, dioxin, volatile metals, acid gases		14 (74%)	38 (75%)	1 (8%)
Spray Dryers	Particulate matter, acid gases		2 (11%)	1 (2%)	1 (8%)
No Control Devices (2)	N/A		1 (5%)	1 (6%)	
No Information on Controls	N/A		1 (5%)	6 (12%)	4 (33%)
Number of Units in Sample	N/A	35	19	51	12
Percentage of Total Units in Sample	N/A	69%	56%	28%	79%

Notes:

(1) Some controls, such as afterburners used to control PICs and hydrocarbons, were not broken out as an APCD in CETRED. Some units have multiple control devices installed.

(2) Includes units specifically identified in CETRED as having no APCDs.

(3) Model plant analysis uses a more detailed breakout of baseline APCDs.

Source: IEc analysis of U.S. EPA, Combustion Emissions Technical Resources Document (CETRED) , May 1994, Appendices.

year.[26] The high profits induced many firms to enter the permitting and siting process for new combustion units, despite the inevitable delays in obtaining the required operating permits.

Hazardous waste combustion markets have changed significantly since the 1980s. Today there is substantial overcapacity in the markets for both liquids and solids combustion. This has led to fierce competition, declining prices, poor financial performance, numerous project cancellations, and some facility closures. In addition, there has been some consolidation of combustion capacity. The adverse market environment has affected commercial incinerators most significantly. This section describes the current market situation in more detail and discusses the key factors influencing market performance.

2.6.1 Overcapacity and Effects on Poor Market Performance

The hazardous waste combustion industry is currently overbuilt. Capacity utilization rates in commercial incinerators have fallen from 85 percent in 1985[27] to 56 percent in 1993,[28] although they recovered to 70 percent during 1994.[29] Utilization of solids capacity was significantly higher (at 74.3 percent) than for liquids (at 52.4 percent) in 1991, although no comparable data are available for later years.[30] Over this period, however, the increased ability of BIFs to manage solids suspended in liquids has reduced the importance of this distinction. Furthermore, steep pricing declines for solids combustion indicate that solids capacity is no longer scarce.

Capacity utilization of cement kiln hazardous waste combustion capability was at roughly the same level as commercial incinerators in 1991, with approximately 59 percent utilization (versus 60 percent for incinerators). Combined capacity utilization for cement kilns and lightweight aggregate kilns was about 57 percent. Utilization levels in 1992 increased to roughly 81 percent for cement kilns,[31] but declined to 68 percent in 1993.[32] Utilization levels in LWAKs were slightly higher during 1993, at over 70 percent.[33]

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

[27] ICF 1992, op. cit., p. 2-12.

[28] Data on capacity utilization in the commercial incinerator sector during 1993 are from Hanke, June 1994, op. cit., p. 22.

[29] Jon Hanke, "Hazardous Waste Incineration 1995," EI Digest, May 1995, p. 33.

[30] ICF, op. cit., p. 2-15.

[31] Jeffrey Smith, "Industrial Furnaces 1993," EI Digest, September 1993, pp. 19-21.

[32] Smith, October 1994, op. cit., p. 20. Excludes idled facilities and Marine Shale Processors. Utilization including idled facilities in 1993 was under 64 percent.

[33] Ibid.

This overcapacity is the result of a number of factors, including:

- New Supply. The new supply comes both from new and expanded combustion units. Although many projects have been canceled, some units begun prior to the price declines of the past few years continue to come on-line. The elimination of waste processing bottlenecks (e.g., waste storage capacity) has also expanded the capacity of some facilities already in operation.

- Increased Solids-Burning Capability in BIFs. Fuel blenders have improved their ability to suspend solids in liquid wastes. This has greatly expanded the effective solids burning capacity among BIFs that could previously only burn liquids, and driven down prices in this formerly high-profit segment. Between 1989 and 1994, the average suspended solids content in waste fuel rose from 18.2 percent to 22.2 percent.[34] Industry anticipates that the solids content will reach up to 30 percent by the end of the decade.[35]

- Waste Minimization Efforts. Industry efforts to minimize hazardous waste generation have reduced the quantity of wastes requiring treatment. This reduction has been estimated at between 5 and 10 percent per year.[36]

- Substitution of Alternative Technologies in Remediation Market. Much of the future combustion demand for remediation of government-owned sites is likely to be handled by on-site units.[37] New alternative technologies, such as thermal desorbers, have further weakened demand.[38]

While EPA-promulgated land disposal restrictions (LDRs) during this time period increased waste quantities managed in the combustion sector, these increased quantities were insufficient to offset the factors described above. In addition to factors affecting all combustion segments, there have been other forces influencing the competitive balance between commercial incinerators and BIFs.

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[34] Ibid., p. 25.

[35] Perket and Hanke, op. cit., p. 29.

[36] Jon Hanke, "Hazardous Waste Incineration 1993," El Digest, May 1993, p. 14.

[37] Holman and Swindell, op. cit., p. 15.

[38] See Christine Seidel, "Mobile Thermal Treatment 1994," El Digest, December 1994, pp. 21-26.

2.6.2 Existing Market Advantages for BIFs

Industry overcapacity has led to intense competition in the combustion segment and has put pressure on the industry's less-efficient players. Due both to structural and regulatory advantages, BIFs appear to have had the edge recently in the current market place.

2.6.2.1 Structural Advantages

BIFs possess a number of structural advantages in the combustion of hazardous wastes that will remain regardless of federal regulatory actions. Foremost is the ability to use existing production capital equipment to combust hazardous wastes and to utilize the energy content of the wastes in their production process. The result is that the incremental cost to burn a ton of hazardous waste in a BIF is significantly lower than the cost to burn it in an incinerator.

- Energy Recovery. BIFs can make use of the heating value of hazardous waste fuels to offset purchases of virgin fuels that would otherwise be needed to achieve required heating temperatures to a much greater extent than can incinerators.[39] A commercial incinerator uses process heat to break down and destroy hazardous organic wastes, while a cement kiln uses the heat both to break down wastes and to manufacture cement, a saleable end product.

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

2.6.2.2 Regulatory Advantages

Under current regulations, kilns are not required to dispose of their ash in a Subtitle C hazardous waste landfill. In addition, various industry segments have argued that the regulation of emissions is not consistent across the industry. Differences in emissions by unit type and in air pollution control devices (APCDs) currently installed provide some insights into these claims. However, as is noted below, the regulatory baseline is continually changing, and advantages presented here are likely to change as well.

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

Ash Disposal

Ash from hazardous waste incinerators is itself considered a hazardous waste. The material must be disposed of in a permitted hazardous waste landfill at a cost of $96 to $158 per ton.[40] In comparison, ash from cement kilns or LWAKs can either be integrated into the facility's products, sold, or dumped on-site as a non-hazardous material at a cost of slightly over $3/ton.[41]

EPA regulatory initiatives are likely to change this balance within a few years. Future regulation of cement kiln dust (CKD), as ash from cement production is called, will likely increase the cost of managing residuals at kilns that combust hazardous wastes.[42] (However, to the extent that waste-burning and non-waste-burning kilns face the same CKD management costs, cement markets rather than waste-burning markets are likely to be affected.) Similarly, the Hazardous Waste Identification Rule (HWIR), scheduled for release in 1996, may allow some treated hazardous wastes to exit the hazardous waste regulatory system. Thus, if ash from incinerators no longer exhibited hazardous properties, it could be managed as non-hazardous, reducing the cost to incinerators.

Other Differential Regulations

Differences in the requirements for fully permitted facilities can create advantages for one sector over another. In addition, interim status under the BIF rule can create temporary benefits for BIFs that disappear once a unit is fully permitted.[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 differences in the disposal requirements for combustion residuals, already discussed above, commercial incinerator industry representatives claim that:

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[40] Data are for 1993. High-end estimate includes stabilization. Transport costs would be in addition to the prices quoted. See Jon Hanke, "Hazardous Waste Landfills 1994," EI Digest, April 1994, p. 30.

[41] U.S. Environmental Protection Agency, Report to Congress on Cement Kiln Dust, 1993, p. 9-10.

[42] In 1995, EPA issued a regulatory determination stating that CKD management should be regulated. A recent industry proposal, less stringent than some options EPA has developed, which would place CKD in a monofill, has been developed as well. Even this approach would be more expensive than current management methods. See Bureau of National Affairs, "Cement Industry `Enforceable Agreement' Would Replace Agency's Plan for Kiln Dust," Environment Reporter, March 31, 1995, p. 2371.

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

- BIFs have lax standards for metal emissions relative to commercial incinerators.[44]

- The destruction and removal efficiency (DRE) verification does not need to occur for BIFs until a full permit is issued.[45]

Conversely, the BIF industry asserts that incinerators have an advantage under current regulations. They argue that BIF regulations are more stringent, even as implemented during interim status, than the "12-year-old requirements in Subpart O for commercial incinerators."[46] For example, Subpart O regulations do not require extensive feed rate analysis on a continuous basis and do not establish metal-specific emission limits.[47]

The validity of these claims is difficult to gauge. Baseline emissions shown in Exhibit 2-4 suggest that BIFs have higher average emissions of mercury and semi-volatile metals than do incinerators. Incinerators emit more low volatile metals. However, these data cannot be used to compare emissions per ton of waste burned across sectors. Nor to they provide insights into the cost savings to any sector attributable to higher emissions. The proposed MACT will likely eliminate any emissions-based cost advantages by ensuring that hazardous waste combustion in all regulated sectors is done in a manner protective of human health and the environment.

2.6.3 Market Performance Across Combustion Sectors

While the combustion sector overall has experienced declining prices, commercial incinerators have been hit harder than BIFs. In the commercial incineration sector, average prices for liquid organics fell by 10.4 percent between 1991 and 1993. Solids prices declined by 17.4 percent.[48] Prices in the cement kiln sector remained mostly stable over this period, as measured by the prices that fuel blenders paid to cement kilns. Kilns continued to accept wastes for less money than incinerators, earning on average 65 percent less on liquids and about 37 percent less on solids. This may be due in part to the kilns' lower costs and in part to the higher heat content of the waste streams they receive. Although prices began to

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[44] Comment is from Richard Fortuna, "The Combustion Strategy and the HWTC," EI Digest, December 1993, p. 8. A petition introduced to EPA by the Cement Kiln Recycling Coalition in January 1994 called for metals standards five to ten times more stringent than the emissions levels in the current BIF rules. Representatives of the commercial incinerator industry note this act as an admission that controls in the BIF regulations are too lax. (See Bureau of National Affairs, op. cit., p. 1645).

[45] Fortuna, op. cit., p. 8.

[46] See Cement Kiln Recycling Coalition, "The Combustion Strategy and the CKRC," EI Digest, December 1993, p. 12.

[47] The incinerator regulations do not require metal emissions standards, but limit particulate matter emissions. Since low particulate matter emissions do not necessarily correspond with low toxic metals emissions, opponents view the controls as inadequate. (Bureau of National Affairs, op. cit., p. 1645).

[48] Hanke, June 1994, op. cit., p. 23.

strengthen in late 1994, analysts do not think that continued growth in waste volumes will be sufficient to sustain these gains.[49]

Prices charged to generators fell in both the commercial incineration and kiln sectors. Average prices charged to generators seem to be quite similar whether the wastes are burned in incinerators or kilns.[50] In contrast, prices paid to kilns by fuel blenders over this period remained constant, while prices paid to incinerators declined. This trend makes sense given the kilns' lower baseline cost for hazardous waste combustion (see Appendix B), because kilns appear to be the pricing leaders. A number of other market indicators, including profits, returns to shareholders, and capacity expansions and closures highlight the difficulty incinerators face relative to kilns.

2.6.4 Financial Performance

Financial performance indicators help contrast the condition of incinerators and cement kilns, but are subject to two caveats. First, financial data for Rollins Environmental Services is used as a proxy for the entire commercial incinerator sector because data on other firms include substantial non-incinerator assets, and because Rollins is a large portion of the industry.[51] Performance of incinerators owned by other firms may be somewhat different from Rollins, though we have no reason to believe these differences are large. Second, financial performance for cement kilns is heavily influenced by the cement markets. Nonetheless, the baseline costs of hazardous waste combustion in the kilns (detailed in Appendix B) suggest strong returns on waste burning.

Profitability

Examining financial returns for Rollins Environmental Services provides some insights into the economics of the incineration segment of the market because Rollins derives nearly 80 percent of revenues from incineration. The firm's net profit margin peaked at 16.4 percent in 1987, and remained quite high until 1992. Between 1984 and 1992, the net profit margin averaged over 13 percent. This dropped to 5.5 percent in 1993, and the firm lost money in 1994. Analysts expect net profits to increase to 3.8 percent during 1995.[52]

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[49] Perket and Hanke, op. cit., p. 30.

[50] Data on the prices charged to generators are difficult to compare exactly due to differences in the timing of data collection and a lack of information about the contaminant level in the waste streams. See Hanke, June 1994, op. sit., p. 23 and Smith, September 1994, op. cit, p. 28.

[51] Rollins (including combustion units recently purchased from Aptus) owned an estimated 25.5 percent of commercial incinerator practical capacity as of May 1995. See Hanke, May 1995, op. cit., p. 35.

[52] Wayne Nef, "Rollins Environmental Services," Value Line, March 24, 1995, p. 350.

Profits in the cement industry are presently stronger than in the commercial incineration segment. From a minuscule 0.1 percent net profit margin in 1991, in the midst of the recession, margins recovered to 2.8 percent in 1993 and are estimated at 4.9 percent in 1994. Net margins are projected to reach 6.7 percent by 1995, substantially higher than projected levels for Rollins.[53]

Despite the projected increase in profits for the cement industry, neither sector currently has a strong profit margin. It is important to note, however, that the returns on cement overall, a commodity item, can mask much higher returns currently being earned on the combustion of hazardous wastes at cement plants. It is the return on hazardous waste burning (analyzed in Chapter 4) that will drive decisions by plant operators on whether or not to expand waste handling capacities.

Returns to Shareholders

The return-on-equity ratio (ROE) measures the financial returns to investors in a firm or industry. As these returns fall, it becomes more difficult for firms to raise new funds in capital markets. ROE for the hazardous waste management industry peaked at over 25 percent in 1984, dropping to nine percent in 1989, and recovering to 16.3 percent in 1992.[54]

Again, Rollins Environmental Services can serve as a more direct proxy for commercial hazardous waste incinerators. Rollins' ROE between 1985 and 1988 was above 20 percent, a better performance than the environmental services sector overall. As incineration overcapacity became apparent, Rollins' ROE declined steadily to only 5.6 percent in 1993. After losses in 1994, the firm's ROE is expected to rise to only 4.5 percent this year.[55]

Average returns to shareholders in the cement industry dropped from 8.6 percent in 1990 to only 0.1 percent in 1991 as a result of the recession. Although ROE had recovered only to 6.8 percent in 1993, scarce capacity for cement is expected to increase shareholder returns sharply, reaching 13 percent in 1995.[56] This implies that the cement industry may be able to raise investment capital more readily than the commercial incineration sector over the next few years.

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[53] Thomas Mulle, "Cement and Aggregates," Value Line, January 20, 1995, p. 891.

[54] "Commercial Hazardous Waste Management: Financial Performance and Outlook for the Future," annual report from the July/August 1985, 1987, 1988, 1991, and 1993 issues of The Hazardous Waste Consultant, op. cit.

[55] Nef, March 24, 1995, op. cit., p. 350.

[56] Mulle, op. cit., p. 891.

2.6.5 Capacity Expansions and Cancellations

With industry overcapacity, falling returns, and new alternative technologies on the horizon, new incinerator projects have been canceled at a steady rate over the past five years. Twenty-five projects were canceled between 1990 and 1992, more than in the previous seven years.[57] During 1993, no new incinerators were proposed, and seven pending incinerators and two pending incinerator expansions were abandoned.[58] Three new incinerators plan to come on-line during the coming year despite the glut of capacity.[59] However, these units mark the completion of earlier construction, and the initiation of other new projects seems unlikely at this time.

Cement kiln capacity to combust hazardous wastes, on the other hand, has grown and is expected to increase at 10 to 20 percent per year for the next few years.[60] Eight facilities (over one-quarter of the facilities now burning hazardous wastes) plan capacity increases as they move toward final part B permit status.[61] While some new kilns will be brought on-line, improved load management (such as with waste storage tanks and better waste pumping systems) will be the source of much of the increased capacity.[62]

Despite some planned capacity increases, however, kilns have not been immune from the overall stagnation in combustion markets. While capacity to burn has continued to climb, the number of kilns burning wastes is expected to decline due to the BIF regulations and to market conditions.[63] During 1993, eight cement kiln projects were abandoned, and nine kilns had permit requests denied.[64] The tonnage of waste burned in commercial BIFs actually declined slightly, from 1.20 million tons to 1.16 million tons, in 1993.[65] During 1994, Southdown announced that its two waste burning kilns would exit that market.[66] EPA's combustion strategy, the BIF rule, and increasing local opposition to hazardous waste combustion at the kilns all played a role.

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[57] "1993 Outlook for Commercial Hazardous Waste Management Facilities: A Nationwide Perspective," The Hazardous Waste Consultant, March/April 1993, p. 4.2.

[58] "1994 Outlook for Commercial Hazardous Waste Management Facilities: A North American Perspective," The Hazardous Waste Consultant, March/April 1994, p. 4.4.

[59] Seidel, op. cit., January 1995, p. 6.

[60] Smith, September 1993, op. cit., p. 18.

[61] Smith, October 1994, op. cit., p. 25.

[62] Ibid., pp. 19, 25.

[63] Ibid., p. 24.

[64] Hazardous Waste Consultant, March/April 1994, op. cit., p. 4.4.

[65] Smith, October 1994, op. cit., p. 23.

[66] Seidel, January 1995, op. cit., p. 6.

2.7 SUMMARY

The proposed MACT standards would more stringently regulate emissions of hazardous air pollutants from commercial hazardous waste incinerators, on-site incinerators, waste-burning cement kilns, and lightweight aggregate kilns. BIFs burn the most waste commercially, holding a 31 percent share of the combustion market in 1991. Commercial incinerators had a 19 percent share, but this has been falling in recent years. On-site incinerators were the largest combustion outlet, burning 32 percent of the combusted wastes in 1991. The primary source of these wastes is the chemical industry (SIC 28), which alone comprised approximately 65 percent of all regularly-generated primary waste combusted during 1991. No other single industry generated more than three percent.

The magnitude of current emissions from combustion varies by HAP. For all HAPs other than chlorine, low volatile metals, and HCl, cement kilns had the highest emissions per combustion unit. For many HAPs, including CO, Hg, PM, TEQ, and THC, per unit emissions from cement kilns appear to be considerably higher than from other types of combustion units.

Although hazardous waste combustion markets have recovered slightly in the past year, substantial overcapacity exists in the commercial HW combustion section, a fact acknowledged by most industry participants.[67] While waste generators will continue to demand compliance, liability reduction, and economic efficiency in managing their hazardous wastes, options other than traditional commercial incineration continue to expand. These include combustion in BIFs, other innovative technologies, and source reduction. As a result, the combustion industry is unlikely to recover profitability levels experienced in the late 1980s.

Future market performance will be determined by two key factors: combustion unit closures and changes in the regulatory baseline. Even without additional regulation, closures will be necessary to bring capacity utilizations up. Based on current market dynamics, structural advantages for BIFs suggest that in the long run the bulk of closures will be in the commercial incinerator sector. However, some incinerators will retain market share because of their ability to combust wastes that BIFs either cannot or do not wish to burn. Changing regulations will also affect the degree to which cement kilns retain their cost advantage in combustion markets. We examine the impact of this proposed rule, and other key regulatory changes, on the structure of combustion markets in Chapter 4.

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[67] Hanke, June 1994, op. cit., p. 24.

Combustion facilities complying with the maximum achievable control technology (MACT) emissions standards will likely achieve the required emission reductions by installing pollution control devices and instituting other operating measures. The purpose of this chapter is to review baseline estimates of the costs associated with these compliance actions. We first discuss the methodology used to estimate national compliance costs, including:

- the model plants approach used to assign pollution control measures to individual facilities; and
- the cost aggregation methodology used to scale up the model plant costs to the national level.

The results section of this chapter reviews the estimates of total and per unit compliance costs assuming all facilities in the industry install controls to comply with the regulations. As we explain in Section 3.1.2.1, these costs are likely to represent an upper bound estimate of the expected costs of the proposed rule. Our economic impact analysis (Chapter 4) presents a refined cost estimate that takes into account units that stop burning hazardous waste and changes in waste flows that ultimately reduce the actual costs of regulation. In addition to the total cost estimates for existing waste burning facilities, we also present per unit compliance costs associated with the proposed MACT standards for new sources.

3.1 METHODOLOGY

3.1.1 Model Plants Approach

As a starting point for assessing economic impacts, the Environmental Protection Agency (EPA) developed an analysis of the engineering costs associated with the MACT floor and above-the-floor (ATF) emission standards. Because of the diverse characteristics and large number of regulated combustion units, EPA applied a model plants approach whereby individual units are assigned to a model plant category on the basis of current emissions and types of new air pollution control equipment required to comply with the proposed rule. The model plant designation represents the set of pollution control measures that will be necessary to meet the standards for each Hazardous Air Pollutant (HAP) in a given regulatory option.

From this assignment of pollution control devices, we can derive for each option the capital and operating costs that each modeled unit would incur. The proposed MACT options (shown in detail in Exhibit 1-1) differ from one another in the stringency of the emission limits.

A detailed discussion of the model plants methodology and results can be found in a separate document produced for EPA.[1] We review the general elements of the approach below (also shown in Exhibit 3-1), including the model plants approach and the approach for assessing an alternative compliance option whereby facilities reduce waste fed to the combustion unit. Finally, we review the limitations of the model plants approach.

3.1.1.1 Model Plant Cost Estimation Procedure

The first step in the model plants approach is to identify the emission rates of each HAP at each existing combustion unit. Emission rate data are based on test burn information compiled for EPA's Combustion Emissions Technical Resource Document (CETRED).[2] The analysis assigns a single emission rate for each HAP by taking each combustion unit's average over all test condition runs.

Once this emission rate is established, the second step in the analysis is to calculate the emission reduction that is required to meet the MACT floor or ATF level at each combustion unit. In cases where emissions data for a particular HAP at a particular unit are not available, the percentage emission reduction is assigned (0, 25, 50, or 75 percent) based on the distribution of emission reductions required for other facilities in the same combustion category. While the value for any one HAP may be incorrect, the population of combustors as a whole will be fairly represented.

In the third step of the model plants analysis, the appropriate control devices are selected based on required emission reduction estimates. If the emissions reduction required for the HAP is modest and can be achieved with devices that currently exist 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. If no existing device controls the HAP, or if a significant reduction is required, the model plants analysis assumes that a new device will be installed at the facility. Exhibit 3-2 provides a brief overview of the categories of control devices included in the model plants analysis. The specific criteria driving the selection of control devices can be found in the model plant document referenced above.

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[1] Cost Estimates for Air Pollution Control Device (APCD) Requirements for Existing Facilities to Meet Proposed MACT Standards for the Floor and Above the Floor Options for Cement Kilns, Lightweight Aggregate Kilns, and Incinerators, prepared for U. S. EPA, Office of Solid Waste, prepared by Energy and Environmental Research Corporation, April 1, 1995.

[2] Combustion Emissions Technical Resource Document (CETRED), U.S. EPA, Solid Waste and Emergency Response, May 1994. Note that use of test burn data may bias the measurement of emissions by including data from spike testing and other abnormal operating conditions.

Exhibit 3-1

Overview of Compliance Cost Model Plant Analysis

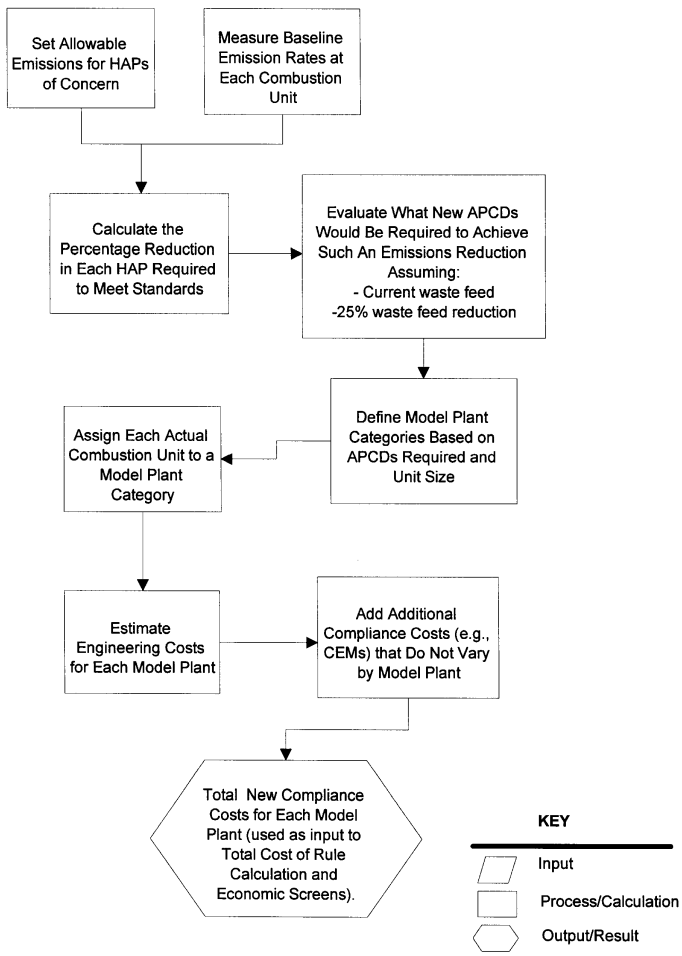

Exhibit 3-2

EMISSION CONTROL DEVICES ASSIGNED IN MODEL PLANTS ANALYSIS

HAP	Devices Applied	Comments
PM, Low-Volatile Metals, Semi-Volatile Metals	- Fabric filter	
HCl and Chlorine	- Packed tower - Wet scrubber - Spray tower (Lightweight Aggregate Kilns (LWAKs))	
Mercury	- Carbon injection/carbon bed	Carbon injection must be accompanied by a dry PM control device.
Dioxin/Furan	- Temperature control - Carbon injection	Temperature control applicable only at units operating at higher temperatures.
Hydrocarbons and CO	- Afterburner	Must be accompanied by a water quench system. For incinerators requiring limited reductions, operating changes are sufficient.

Source: Energy and Environmental Research Corporation, Cost Estimates for APCD Requirements for Existing Facilities to Meet Proposed MACT Standards for the Floor and Above the Floor Options for Cement Kilns, Light Weight Aggregate Kilns and Incinerators , Draft Report prepared for the Office of Solid Waste, U.S. EPA, April 1, 1995.

The fourth step is to define model plants based on different combinations of required control measures. The set of emission controls required by the units in the group defines that particular model plant. For example, Model Plant Group 8 for cement kilns is defined as those kilns that must add carbon injection, a packed tower, and a fabric filter. Each model plant is further subdivided into size classifications. Grouping units by size is important because the cost of APCDs can vary widely across large and small units. The average flue gas flow for each subgroup is used in the model plant assessment. For example, all cement kiln model plants are divided into large and small cement kilns; small kilns are defined as having a gas flow of 147,000 actual cubic feet per minute (acfm) while large kilns have a flow of 370,000 acfm. The definition of these model plants is constant, i.e., it does not change under different regulatory options. Instead, what changes is the distribution of combustion units to the model plant categories. Changes in this distribution are summarized in Table 67 of the model plants report. Across all regulatory options, there are a total of 127 model plants: 30 for cement kilns, 19 for LWAKs, and 78 for incinerators. A single combustion unit can fall into new model plants under different MACT options. [3]

[3] At first glance, there appear to be more model plants than actual combustion units. In reality, this is not the case. Were each combustion unit modeled separately for each proposed MACT option, there would be a total of nearly 2,000 permutations (283 combustion units x 7 MACT options = 1,981).

The fifth step in the model plants analysis involves assigning each of the existing combustion units to model plant groups on the basis of the required devices and DOM measures. The model plants report provides the assignment of individual combustion units to the model plants in the fourth table under each regulatory option (e.g., Tables 4, 9, 13, 17, 21, etc.).

The final step in the model plants analysis is the assignment of engineering costs to each model plant. EPA estimated both capital and operating costs for each air pollution control device using spreadsheet models developed by EPA's Office of Air Quality Planning and Standards (OAQPS). OAQPS spreadsheet models exist for a number of the key air pollution control devices such as scrubbers, fabric filters, and carbon injection units. OAQPS developed the models based on data from municipal waste combustors, pollution control equipment vendors, and the OAQPS Control Cost Manual. Each model requires user-specified inputs on facility size (measured by flue gas flow), operating temperature, and other parameters. The spreadsheet uses these inputs in a series of equations that provide total and annual capital costs, as well as annual operating and maintenance (O&M) costs.

In conducting the model plants analysis, EPA customized the OAQPS cost models for each technology at each model plant. For example, the analysis specifies appropriate parameter values (e.g., gas flow rate for the combustion unit) for a wet scrubber system that would be installed and operated to control HCl emissions from a lightweight aggregate kiln. As mentioned, to account for differences in the size of combustion units, the model plants analysis splits each model plant category into small, medium, and large facilities. Each combustion unit in the analysis is assigned to the size category on the basis of flue gas flow rate. This allows the capital and operating costs to be more accurately calibrated to the units in the model plant category. The compliance cost for any given combustion unit is the sum of the costs associated with each of the control technologies used at that unit. The capital, operating, and total annualized costs for each model plant are summarized in Appendix D of the model plants report.[4]

3.1.1.2 Continuous Emissions Monitoring Costs

EPA is considering whether to require continuous emissions monitoring (CEM) at all of the hazardous waste combustion facilities regulated by the proposed MACT standards. As the name implies, CEMs would allow regulators to track emissions from combustion facilities continuously. Emissions data could either be transmitted from the facility to data receiving points at EPA and/or state agencies, or stored on-site and reviewed during an inspection. This would represent an alternative to the current system wherein emissions are regulated on the basis of trial burn data gathered for permit applications and renewals and routine measurement of operating parameters. CEMs would allow EPA to enforce the proposed MACT standards more closely and would ensure that violations of the standards do not occur between periodic emissions tests.

EPA has estimated the per-unit cost of implementing the CEM requirements. As shown in Exhibit 3-3, these costs depend directly on the set of HAPs monitored. Under one option (Option 1), only carbon monoxide and hydrocarbons would be monitored. The annualized cost for this monitoring is approximately $80,000 per combustion unit. Under the second option being considered, CEMs to monitor PM and mercury, as well as CO and hydrocarbons, would be required. As shown, the mercury monitoring adds significantly to the overall cost of this option (about $40,000 per year). Total costs under Option 2 would

[4] Energy and Environmental Research Corporation (EER), April 1, 1995, op. cit.

be about $130,000 per unit per year. A final option would have each facility monitor an extensive set of HAPs, including CO, hydrocarbons, PM, HCl, Cl_2, Products of Incomplete Combustion (PICs), and mercury. The annualized cost of this option would be approximately $190,000 per unit, with the cost of PIC monitoring being the greatest increment relative to Option 2.[5]

Exhibit 3-3

ESTIMATED PER-UNIT ANNUAL COST OF CONTINUOUS EMISSIONS MONITORING ($ thousands)

HAPs Monitored	Small CK	Large CK	LWAK	Small Incin.	Med. Incin.	Large Incin.
Option 1: Baseline CEM System (CO, HC)	$77.5	$80.5	$84.9	$80.4	$81.5	$84.2
Option 2: Baseline System with PM and Hg CEM	$125.5	$128.4	$132.9	$127.0	$128.5	$131.7
PM Increment	$7.6	$7.6	$7.6	$7.1	$7.3	$7.6
Hg Increment	$40.4	$40.4	$40.4	$39.5	$39.7	$39.9
Option 3: Full CEM System (CO, HC, PM, HCl, Cl_2, PICs, Hg)	$187.5	$190.4	$192.7	$187.3	$188.8	$192.0
PIC and Cl2 Increment	$47.7	$47.7	$45.5	$46.0	$46.2	$46.6
HCl Increment	$14.5	$14.5	$14.5	$14.8	$14.8	$14.9

Source: "MACT Compliance Costs," memorandum prepared for Larry Denyer, EPA, prepared by Greg Kryder, Wyman Clark, EER, April 8, 1995; revised April 24, 1995.

For the purposes of assessing the economic impact of the proposed MACT standards, we have assumed that Option 2 will be required. The annual costs of CEMs are added to the annual costs associated with pollution control measures in the model plants analysis to arrive at total annual cost per combustion unit.

[5] The method for estimating these costs can be found in "Revised MACT Compliance Costs," memorandum prepared for Larry Denyer, EPA, prepared by Greg Kryder, Wyman Clark, EER, April 24, 1995.

We should note that these estimates of CEM costs are subject to significant uncertainty. CEM systems for many of the HAPs are still under development and therefore difficult to cost out with precision. All required CEMs are expected to be readily available by the time the proposed rule is promulgated, however.[6]

3.1.1.3 Other Compliance Costs

In addition to monitoring costs, EPA also anticipates that facilities will incur an incremental annual cost of approximately $5,000 for permit modification expenditures. This includes legal costs, engineering costs, and a trial burn plan. These costs are based on estimates developed for the Commercial Boiler and Industrial Furnace (BIF) rule and will be revised based on an information collection request (ICR) currently being conducted by EPA.

We also investigated the significance of shutdown costs associated with installation of the pollution control equipment assigned in the model plants analysis. Depending upon the model plant category, combustion facilities and their associated enterprises could incur costs during periods when the production process must be discontinued to install controls. For example, if a cement plant must cease operating for several weeks to install and test new pollution control devices, revenues on both cement and waste burning could be lost.

Examination of shutdown times suggests that virtually all of the installations could be coordinated with routine maintenance shutdowns.[7] We assessed shutdown times based on a vendor survey of periods required for device installation, Portland Cement Association comments on the OAQPS cost models, and engineering judgment. We assumed that all retrofits could be made simultaneously during a single facility shutdown. In addition, we assume that combustion units normally would be shut down for at least three weeks during the year. Virtually all technologies have installation times of three weeks or less, meaning that no incremental shutdown time is needed.[8]

3.1.1.4 Waste Feed Reduction Compliance Scenario

As described above, the model plants analysis assumes that combustion facilities are limited to installation of pollution control equipment in responding to the new emissions standards. In fact, some facilities may find it advantageous to reduce the quantity of pollutants fed to the combustion unit by modifying the composition of the hazardous waste fuels they burn. When these reductions are introduced, some facilities may be able to meet the new standards with more modest pollution control measures

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[6] Jon Hanke, "The Search For Continuous Emissions Monitors," EI Digest, March 1995, pp. 8-12.

[7] Installation of an Electrostatic Precipitator (ESP) field DOM is the exception; this change would require between three and eight weeks, depending on the combustor type.

[8] "Shutdown Time Estimates," memorandum prepared for Bob Holloway, EPA, prepared by Greg Kryder, et al., Energy and Environmental Research Corporation, May 5, 1995.

because stack gas concentrations of certain HAPs are reduced.[9] Therefore, the model plants analysis was extended to consider the pollution control measures that would be required if all facilities reduced the quantity of metals (including mercury) and chlorine in the waste fed to the combustion unit by 25 percent.[10] As we will discuss further below, however, relatively few facilities change model plant assignment on the basis of the 25 percent feed reduction; therefore, the impact on engineering compliance costs is limited.

3.1.1.5 MACT Compliance Costs for New Sources

While most of this report focuses on MACT standards for existing sources, the rule also proposes MACT standards for new sources entering the hazardous waste combustion market. These standards would apply to both newly constructed facilities (e.g., a new commercial incinerator) as well as to BIFs that choose to begin burning hazardous waste.[11]

EPA applied the same basic model plants approach in developing engineering costs for new sources as was applied for existing sources. Specifically, EPA determined the set of pollution control devices that would be needed to meet the standards and used the cost models discussed above to estimate engineering costs. These estimates were developed for each category of combustion facility and for different size classes. Estimation of the new MACT costs differs from existing source cost estimation in that we must first assume a set of baseline pollution controls for each combustion unit that allows the unit to meet current regulatory standards (Resource Conservation and Recovery Act (RCRA) and the BIF rule). For all kilns, this baseline control is assumed to be a fabric filter system, while the baseline control for incinerators is assumed to be a water quench cooling tower, a wet scrubber, and a venturi scrubber. The net annual costs of the new MACT standards are then calculated as the incremental pollution control costs beyond these baseline control costs.[12]

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[9] Feedrate-adjusted emissions are estimated by use of partitioning factors that allow translation of feedrate reductions into emissions reductions. These estimates were developed as part of the model plants analysis performed by EPA.

[10] This reduction could be achieved either through reductions in concentrations in waste feed or simply through reductions in the quantity of waste burned. While reductions greater than 25 percent could theoretically reduce required expenditures on APCDs for compliance, practically such reductions seem unlikely. A number of fuel blenders stated that metals reductions greater than 25 percent were not feasible given currently available technology. (Conference call with Chris Goebel, National Association of Chemical Recyclers, and three member companies, February 14, 1995).

[11] New MACT standards can also be triggered when a facility remodels in such a fundamental fashion that it spends over one-half of the capital cost of building a new facility.

[12] A more detailed explanation of the model plants analysis used to determine costs for new sources can be found in the memorandum "MACT Costs for New Sources," prepared for Frank Behan and Bob Holloway, EPA, Office of Solid Waste, prepared by Wyman Clark and Bruce Springsteen (EER), March 31, 1995.

3.1.1.6 Caveats and Limitations

The model plants analysis contains a variety of uncertainties. The most significant include the following:

- The analysis is designed to estimate national compliance behavior, not compliance at specific facilities. By its nature, the model plants analysis abstracts from individual combustion unit decision making and assigns compliance actions in a simplified manner. Actual compliance behavior for any given unit or facility may differ from the pollution control measures assumed for the assigned model plant.

- Emissions data are the product of trial burns conducted at a limited subset of facilities in each combustion sector; these are the facilities included in the model plants analysis. Even for the included facilities, emissions information for some HAPs often is not available; as mentioned, emission reduction requirements are assigned to these facilities according to the underlying statistical distribution for each HAP (which is based on emissions of the HAP at the facilities where data are available).

- The OAQPS spreadsheet models serve as the primary source of capital and operating costs for major pollution control devices. In the case of cement kilns, industry representatives have reviewed the underlying cost models and suggest that they contain significant inaccuracies. These comments were provided too late for integration into the model plants analysis, but will be considered in future revisions. In general, the comments assert that the spreadsheet models underestimate the costs associated with certain control technologies, suggesting that the model plants analysis may understate compliance costs.[13]

- CEM systems for some of the HAPs are still under development, and therefore difficult to cost out with precision. All required CEMs are expected to be readily available by the time the proposed rule is promulgated.

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[13] "Summary of Penta Engineering Review of EPA/OAQPS Cost Models for Cement Kiln Air Pollution Control Devices," prepared for Frank Behan, U.S. EPA, Office of Solid Waste (OSW), April 5, 1995.

3.1.2 Compilation of Costs

3.1.2.1 Total Costs Assuming No Market Exit

We use the results of the model plants engineering cost analysis to develop upper bound estimates of the total costs associated with the rule. In general, we compile these costs by adding the engineering cost estimates across all affected combustion units. These costs represent an upper bound because they assume that all units will comply with the proposed rule by installing the equipment or adopting the design, operation and maintenance (DOM) measures specified in the model plants analysis. In fact, some facilities may close combustion units or stop burning hazardous waste rather than comply with the proposed rule. This will reduce the overall compliance costs relative to a simple compilation of engineering costs that assumes all affected units comply. The economic impact analysis discussed in Chapter 4 of this report reviews our method for estimating the number of units that stop burning hazardous wastes and the revised estimate of total costs. Exhibit 3-4 illustrates the process for calculating both the total engineering costs and the expected total costs of the proposed rule with market adjustments.

For each combustion sector, we compiled compliance costs by first assigning compliance costs to each combustion unit based on its model plant category, and then summing the costs for each unit characterized in the model plants analysis. Because the model plants analysis covers only a subset of the total universe of units, compliance costs were scaled up from the model plants level to the level of all facilities. To do so, we relied on a list of all operating (i.e., permitted and interim status) hazardous waste combustion facilities furnished by EPA's Permits and State Programs Division (PSPD).[14] However, this list provides only the number of operating facilities; because facilities can have multiple combustion units and our costs are on a per unit basis, we need to scale by the number of units. Data are not available on the number of units at every facility, only at facilities in the model plants analysis. Therefore, for facilities in a given combustion category, we assumed the average number of units found at facilities characterized in the model plants analysis.[15]

Total compliance costs allowing for market exit are also illustrated on Exhibit 3-4. This refined value is presented in Chapter 4, and supplements model plant data with a variety of unit specific and sector-specific data.

The degree to which the model plants analysis covers the universe of units varies by combustion sector. Exhibit 3-5 presents information on the scaling factors used for each sector. As shown, the coverage for cement kilns and aggregate kilns is high, with almost 90 percent of the units in these two sectors included. In contrast, the sample of commercial incinerators covers half of the universe, while the sample of on-site incinerators covers about 30 percent of the universe. This degree of coverage has implications for the certainty of the national cost estimates as well as the economic impact analysis (i.e., more limited sampling implies greater uncertainty in the cost and economic impact results). Furthermore, the precise number of operating units in each combustion sector is uncertain. We have included in the

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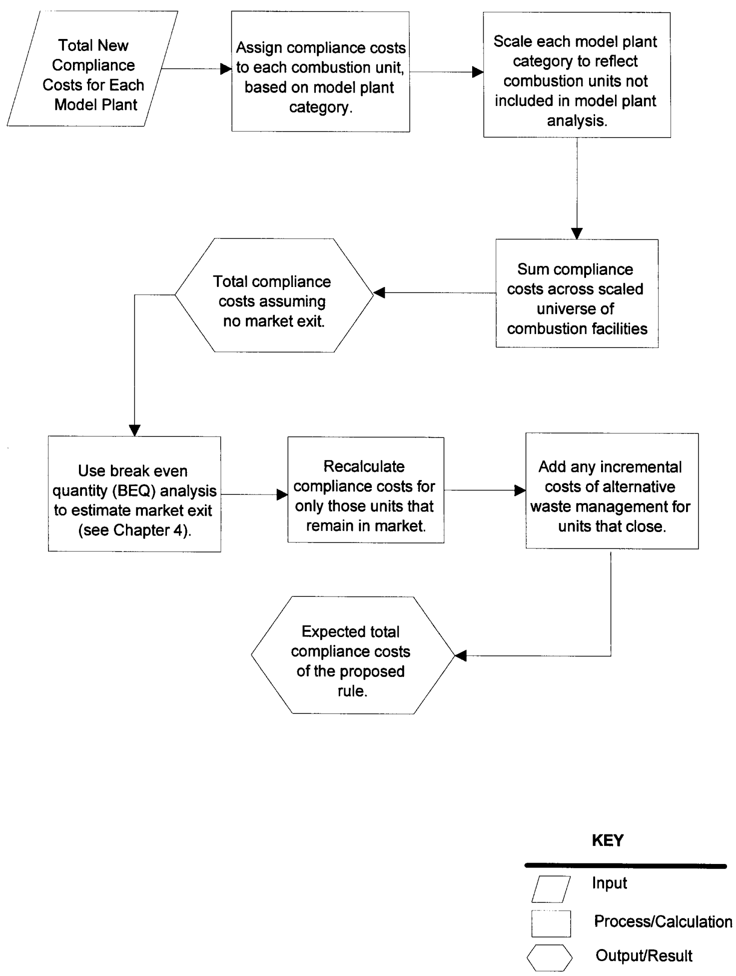
[14] The report issued by PSPD is dated November 1, 1994.

[15] The averages are as follows: 1.8 kilns per cement facility, 2.2 kilns per LWA facility, 1.1 units per commercial incinerator facility and 1.2 units per on-site incinerator facility (see Exhibit 2-1.).

Exhibit 3-4

Calculation of Total Compliance Costs



scaling factors several facilities that the PSPD list shows as permitted but "not operating" on November 1, 1994.[16] If these facilities have permanently discontinued waste burning, we will overstate the national costs of the proposed rule (as well as other impacts discussed elsewhere in this report).

Exhibit 3-5

SCALING FACTORS FOR NATIONAL COST ESTIMATES

	Total Number of Units in Model Plants Analysis	Total Number of Units in Universe	Scale Factor
Cement Kilns	45	50	1.1
Lightweight Aggregate Kilns	13	15	1.2
Commercial Incinerators	17	34	2.0
On-Site Incinerators	54	184	3.4

3.1.2.2 Costs Per Unit

In addition to compiling the model plant estimates onto a national level, we also used the data to characterize typical costs per unit in each combustion sector. The average cost per unit is simply the average of capital and annual costs across all units in the model plant analysis. For example, average cement kiln capital costs are based on the capital costs for all cement kilns in the model plants analysis.

3.2 RESULTS OF MODEL PLANTS COST ANALYSIS

In this section, we review the results of the engineering cost analysis. First, we present estimates of compliance costs nationwide by combustion sector, as well as estimates of average costs per combustion unit. We also discuss the factors that drive the cost changes between regulatory options.

3.2.1 Compliance Costs-Engineering Estimates

The proposed MACT standards will introduce cost burdens that differ greatly by regulatory option and by combustion sector. At the simplest level, we can first consider the total sector expenditures on pollution control measures as estimated in the model plants analysis. As discussed, this provides an upper bound estimate of the social costs of the rule because it assumes that all facilities will continue waste burning and install the requisite pollution control measures. Exhibit 3-6 presents total annual compliance costs nationally and by sector. As shown, total costs range from $189 million per year for the MACT floor, to $561 million per year for Option 4 where a variety of above-the-floor controls are introduced.

[16] These facilities were included in the analysis because they are permitted to burn waste and could therefore resume waste burning at any point in time.

Looking across combustion sectors shows that cement kilns and on-site incinerators make up the majority of the national costs under any given regulatory option. For cement kilns, this is due to a relatively large number of units as well as a high cost per unit (see below). For on-site incinerators, the high costs are primarily due to the large number of combustion units.[17] Total costs are less for commercial incinerators (because of relatively limited costs per unit) and for LWAKs (because of the limited number of units).

Looking across options, several patterns are noteworthy:

- Achieving the floor is between 67 and 91 percent of the total costs of compliance for all options not requiring improved combustion. This is because achieving the floor levels requires the bulk of the expenditures on new APCDs needed even to meet many ATF levels.

- Adding the above the floor dioxin standard (from 0.5 to 0.2 dioxin/furan toxic equivalent (TEQ)) and improved cement kiln mercury standard (from 40 to 30 ug/dscm) under Option 1b adds about 10 percent to the national cost of the rule.

- Adding the protective dioxin and mercury standards for all facilities (Option 1c) increases national compliance costs by approximately 31 percent relative to the floor (about 19 percent relative to Option 1b). These increases are driven by the addition of carbon systems to many combustion units.

- The improved PM control for cement kilns and more stringent acid gas control requirements for LWAKs under Option 3 add less than one percent to the national cost of the rule, because few units need to purchase incremental controls.

- The most prominent changes occur when improved combustion standards are introduced under Options 2 and 4. For example, moving from Option 1c to Option 2a increases national costs by more than 100 percent. While costs for all sectors increase, the major change occurs for cement kilns, where the cost of improved combustion far outstrips the cost of other emissions control measures (under Options 2a and 4). These large increases are due to the use of large quantities of fuel to heat afterburners.

[17] Note that the PSPD document used to characterize the universe of combustion facilities lists several facilities as "not operating" as of November 1, 1994. This implies that we may overstate national costs.

EXHIBIT 3-6

TOTAL ANNUAL COMPLIANCE COSTS (millions)
(Assuming no Market Exit)

Options	Cement Kilns	LWA Kilns	Commercial Incinerators	On-site Incinerators	Total
Original Floor	$65	$9	$21	$94	$189
Option 1b	$71	$9	$24	$103	$207
Option 1c	$91	$12	$27	$117	$247
Option 2a	$366	$32	$31	$128	$558
Option 2b	$91	$32	$31	$128	$282
Option 3	$91	$14	$27	$117	$249
Option 4	$366	$35	$31	$128	$561

Notes:

1. Compliance costs include CEM costs.
2. Range of CEM costs per unit:

minimum	$125,509
maximum	$132,914

- Continuous emissions monitors play a major role in the overall costs of the rule. CEM costs add $37 million to the total annual costs of the rule and do not change between regulatory options.

The patterns in the national (and per-unit) compliance costs are due to changes in the pollution control measures that must be implemented to meet the proposed MACT standards. While the changes among regulatory options are complex, Exhibits 3-7 and 3-8 present information that helps identify the control technologies driving the cost changes. Exhibit 3-7 demonstrates how usage of different control measures changes, showing the percentage of units in a given combustion sector that must introduce particular technologies to meet the standards. Exhibit 3-8 presents similar data, but shows the percentage of engineering compliance costs that are attributable to each technology or control measure.[18]

To reach the MACT floor control requirements, about half of all cement kilns and incinerators must add carbon systems. These systems control emissions of mercury, dioxins, and furans. About half of the units in all sectors must add fabric filters to control PM or metals, or to capture carbon used in carbon systems. Other control measures are specific to each combustion sector. For example, quench systems for dioxin control are introduced at cement kilns, packed tower systems at incinerators, and wet scrubbers at LWAKs. On a cost basis (Exhibit 3-7), the most significant devices are carbon systems and fabric filters for cement kilns; afterburners, carbon systems and fabric filters for incinerators; and fabric filters and scrubbers for LWAKs.

The increase in compliance costs across Options 1b and 1c are the result of dioxin and mercury control measures. For example, note that under the floor, 47 percent of cement kilns employ carbon injection; this increases to 91 percent under Option 1c (with increased mercury and dioxin standards). Likewise, expenditures on carbon injection rise from 19 to 29 percent of pollution control costs (Exhibit 3-8). Because fabric filters are used in tandem with carbon injection, they are increasingly employed as well.

The primary change under Option 3 is the introduction of more stringent acid gas controls for LWAKs. This increases the usage of spray towers to nearly 70 percent and enhances the role of spray towers in LWAK pollution control expenditures. The increased PM control requirement for cement kilns adds little to costs because fabric filters have already been installed as an element of mercury and dioxin control (to capture particles from the carbon injection system).

Compliance costs in Options 2 and 4 are driven by the cost of afterburners for improved combustion. For example, under Option 2a and 4, all cement kilns must install afterburners. Exhibit 3-8 shows that afterburners go from being zero to 74 percent of engineering compliance costs. This same pattern applies to LWAKs. This is due to the operating costs of the afterburners and the large gas flow that must be handled at cement kilns and LWAKs. Operating costs for afterburners are driven by the cost of fuel for firing the afterburner.

[18] Note that this table does not take into account CEMs.

EXHIBIT 3-7

PERCENT OF UNITS REQUIRING CONTROL DEVICES
(Using Zero Percent Feed Control)

	Original Floor	Option 1b	Option 1c	Option 2a	Option 2b	Option 3	Option 4
Cement Kilns							
Afterburners	0%	0%	0%	100%	0%	0%	100%
Carbon injection/beds	47%	62%	91%	91%	91%	91%	91%
DOM	13%	7%	2%	2%	2%	2%	2%
Fabric filters	67%	78%	96%	96%	96%	96%	96%
Packed towers	22%	24%	27%	27%	27%	27%	27%
Reheat	0%	0%	0%	0%	0%	0%	0%
Spray Towers	0%	0%	0%	0%	0%	0%	0%
Quenchers	56%	51%	49%	100%	49%	49%	100%
Wet Scrubbers	7%	4%	2%	2%	2%	2%	2%
None	4%	2%	0%	0%	0%	0%	0%
Incinerators							
Afterburners	10%	8%	8%	20%	20%	8%	17%
Carbon injection/beds	48%	61%	79%	79%	79%	79%	79%
DOM	34%	31%	28%	39%	39%	28%	41%
Fabric filters	45%	52%	62%	59%	59%	62%	62%
Packed towers	34%	38%	44%	44%	44%	44%	44%
Reheat	27%	45%	61%	58%	58%	61%	61%
Spray Towers	0%	0%	0%	0%	0%	0%	0%
Quenchers	10%	6%	7%	7%	7%	7%	7%
Wet Scrubbers	18%	15%	10%	13%	13%	10%	10%
None	1%	1%	0%	0%	0%	0%	0%
LWAKs							
Afterburners	0%	0%	0%	100%	100%	0%	100%
Carbon injection/beds	23%	23%	85%	85%	85%	85%	85%
DOM	0%	0%	0%	0%	0%	0%	0%
Fabric filters	46%	46%	85%	85%	85%	85%	85%
Packed towers	0%	0%	0%	0%	0%	0%	0%
Reheat	0%	0%	0%	0%	0%	0%	0%
Spray Towers	15%	15%	31%	31%	31%	69%	69%
Quenchers	0%	0%	0%	100%	100%	0%	100%
Wet Scrubbers	23%	23%	8%	8%	8%	8%	8%
None	23%	23%	8%	0%	0%	0%	0%

EXHIBIT 3-8

PERCENT OF NEW COMPLIANCE COSTS BY CONTROL DEVICE
(Using Zero Percent Feed Control)

	Original Floor	Option 1b	Option 1c	Option 2a	Option 2b	Option 3	Option 4
Cement Kilns							
Afterburners	0%	0%	0%	74%	0%	0%	74%
Carbon injection/beds	19%	22%	29%	7%	29%	29%	7%
DOM	4%	2%	0%	0%	0%	0%	0%
Fabric filters	40%	42%	45%	11%	45%	45%	11%
Packed towers	13%	12%	11%	3%	11%	11%	3%
Reheat	0%	0%	0%	0%	0%	0%	0%
Spray Towers	0%	0%	0%	0%	0%	0%	0%
Quenchers	8%	7%	6%	3%	6%	6%	3%
Wet Scrubbers	6%	5%	2%	0%	2%	2%	0%
CEM Costs	10%	9%	7%	2%	7%	7%	2%
Incremental Permitting Costs	0%	0%	0%	0%	0%	0%	0%
Total	100%	100%	100%	100%	100%	100%	100%
Incinerators							
Afterburners	13%	10%	9%	18%	18%	9%	18%
Carbon injection/beds	17%	20%	24%	21%	21%	24%	21%
DOM	3%	2%	2%	2%	2%	2%	2%
Fabric filters	15%	16%	17%	15%	15%	17%	15%
Packed towers	10%	10%	11%	10%	10%	11%	10%
Reheat	7%	12%	15%	13%	13%	15%	14%
Spray Towers	0%	0%	0%	0%	0%	0%	0%
Quenchers	2%	1%	1%	1%	1%	1%	1%
Wet Scrubbers	8%	6%	3%	3%	3%	3%	2%
CEM Costs	24%	22%	19%	17%	17%	19%	17%
Incremental Permitting Costs	1%	1%	1%	1%	1%	1%	1%
Total	100%	100%	100%	100%	100%	100%	100%
LWAKs							
Afterburners	0%	0%	0%	59%	59%	0%	55%
Carbon injection/beds	10%	10%	27%	10%	10%	22%	9%
DOM	0%	0%	0%	0%	0%	0%	0%
Fabric filters	19%	19%	26%	9%	9%	21%	9%
Packed towers	0%	0%	0%	0%	0%	0%	0%
Reheat	0%	0%	0%	0%	0%	0%	0%
Spray Towers	14%	14%	21%	8%	8%	36%	15%
Quenchers	0%	0%	0%	4%	4%	0%	4%
Wet Scrubbers	34%	34%	8%	3%	3%	7%	3%
CEM Costs	23%	23%	17%	6%	6%	14%	6%
Incremental Permitting Costs	1%	1%	1%	0%	0%	1%	0%
Total	100%	100%	100%	100%	100%	100%	100%

3.2.2 Average Costs Per Combustion Unit

Considering annual costs per combustion unit further highlights the variation in costs across sectors and regulatory options. Exhibit 3-9 presents average annual costs per combustion unit. Except in one regulatory option (Option 2b), cement kilns incur the greatest costs per unit -- typically between $1 million and $2 million. As shown, average per-unit costs for other sectors are roughly half the per-unit costs for cement kilns under most regulatory options. Again, these costs are primarily attributable to the large sizing of the APCDs to handle the large volume of stack gas that must be controlled at cement kilns.

As with the aggregate costs, per-unit costs are greater in those regulatory options with more stringent standards. For example, the average per unit costs at a commercial incinerator increase from $617,000 to $800,000 as above the floor (ATF) levels for dioxin and mercury are introduced (i.e., moving from the floor to Option 1c). As shown, per-unit costs are greatest in the options (Options 2 and 4) that require ATF controls for CO and hydrocarbons (indicators of complete combustion).

The variability in per-unit costs is limited by the constant flat cost of CEMs that apply to each unit. On a per-unit basis, CEMs add about $130,000 per year to the cost of compliance at each unit (under CEM option 2).

3.2.3 Cost Reductions Associated with Feed Reduction

Exhibit 3-10 demonstrates that the 25 percent feed reduction compliance option has little effect on national costs. For example, under the floor, national costs fall from $189 million to $180 million, a decrease of only four percent. Overall cost reductions are equally limited for other regulatory options. The primary reason, as will be discussed later in this report, is that relatively few combustion units are able to meet the standards by feed reduction alone; very often full APCD trains are still needed. As a result, the change in overall engineering compliance costs is relatively minor.

3.2.4 MACT Costs for New Sources

Exhibit 3-11 presents the incremental annual cost per combustion unit to comply with the new MACT standards (i.e., compliance costs beyond those associated with existing RCRA and BIF standards). The costs shown include pollution control equipment, plus CEMs for CO, HC, PM, and Hg as described in Section 3.1.1.2. The estimated compliance costs for new sources are generally on par with those for existing sources since the new MACT standards in Options 1 and 3 are similar to the more stringent standards for existing sources. Costs for cement kilns under new MACT Option 2 are significantly higher than those for any of the existing sources because of the strict requirements for low volatile metals (30 ug/dscm).

Consistent with the existing source standards, cement kilns and LWAKs face higher compliance costs per unit because of their large gas flow rates. For cement kilns, costs are especially high under Option 2 where afterburners must be installed to meet the stringent carbon monoxide (50 ppmv) and hydrocarbon (5 ppmv) requirements.

EXHIBIT 3-9

AVERAGE TOTAL ANNUAL COMPLIANCE COSTS PER UNIT
(Assuming no Market Exit)

Options	Cement Kilns	LWA Kilns	Commercial Incinerators	On-site Incinerators
Estimated Number of Combustion Units	50	15	34	184
Original Floor	$1,290,676	$579,942	$617,021	$508,834
Option 1b	$1,411,732	$579,942	$713,245	$559,008
Option 1c	$1,799,664	$771,843	$799,632	$634,662
Option 2a	$7,265,445	$2,142,555	$917,020	$693,335
Option 2b	$1,799,664	$2,142,555	$917,020	$693,335
Option 3	$1,799,664	$949,174	$799,632	$634,662
Option 4	$7,265,445	$2,325,167	$917,020	$695,272

Notes:

1. Compliance costs include CEM costs.
2. Range of CEM costs per unit:
   minimum $125,509
   maximum $132,914

EXHIBIT 3 - 10

EFFECT OF 25 PERCENT WASTE FEED REDUCTION ON TOTAL ANNUAL NATIONAL COSTS

	(millions)		
	No Feed Control	**25 Percent Feed Control**	**Percentage Difference**
Original Floor	$189	$180	4%
1b	$207	$203	2%
1c	$247	$235	5%
2a	$558	$547	2%
2b	$282	$268	5%
3	$249	$239	4%
4	$561	$547	2%

Notes:

1. Compliance costs include CEM costs.

Large and medium sized incinerators face higher costs under new source MACT Option 3. This is primarily due to the cost of carbon beds that are needed to meet the stringent dioxin and mercury standards that would apply. For small incinerators, the cost of meeting the new MACT standards does not change between regulatory options because the same control devices are used in all cases.

3.3 CONCLUSIONS

We have employed a model plants approach to estimate the compliance costs for the proposed MACT standards for hazardous waste combustion facilities. Under this approach, individual facilities are assigned to a model plant category on the basis of current emissions and types of new air pollution control equipment required to comply with the proposed rule. The model plant designation represents the set of pollution control measures that will be necessary to meet the standards for each HAP in a given regulatory option. From this assignment of pollution control devices, we can derive the capital and operating costs that each modeled facility would incur in complying with the proposed rule. The estimates of compliance costs also include the costs associated with continuous emissions monitoring that may be required.

The model plants analysis yields the following conclusions:

- If all facilities continued waste burning and complied with the rule, expenditures to reach the MACT floor requirements would be approximately $189 million per year. Complying with the above-the-floor dioxin requirements in Option 1b would increase annual costs to approximately $207 million. Cement kilns and on-site incinerators account for most of these costs.

- Per unit costs under these options are greatest for cement kilns (about $1.5 to $2 million) because of the large gas flows that must be managed. Per unit costs for other facility types are about half of those for cement kilns. CEMs contribute about $130,000 to annual per unit costs for all combustor types.

- In meeting the floor and Option 1b standards, costs would be driven by installation of carbon injection/bed systems and fabric filters at most facilities, as well afterburners and scrubbers at some facilities.

- Total costs increase greatly when improved combustion is required (Options 2 and 4). These costs are primarily driven by the need for afterburners at cement kilns.

- Only a limited number of units could reduce expenditures on pollution control by reducing waste feed. Therefore, the reduction in total engineering costs is only about two to five percent.

EXHIBIT 3-11

PER-UNIT INCREMENTAL ANNUAL COSTS FOR NEW SOURCES

Category	Regulatory Options		
	1	2	3
Cement Kilns			
Small	$1,755,500	$5,324,500	$2,336,500
Large	$3,445,400	$12,005,400	$4,986,400
LWAKs			
Medium	$1,434,900	$1,434,900	$1,495,900
Incinerators			
Small	$336,000	$336,000	$336,000
Medium	$514,500	$514,500	$720,500
Large	$772,700	$772,700	$1,188,700

Note:
CEM costs assume CEMs for CO, HC, PM, and Hg. CEM costs at new facilities are assumed to be equal to the costs at existing units.

Sources:
"MACT Costs for New Sources," memorandum to Frank Behan, EPA/OSW, from Wyman Clark and Bruce Springsteen, EER, March 31, 1995.
"MACT Compliance Costs," memorandum prepared for Larry Denyer, EPA, prepared by Greg Kryder, Wyman Clark, EER, April 8, 1995; revised April 24, 1995.

- Per-unit compliance costs for new sources are on par with the costs for existing sources. Under all regulatory options, cement kilns would incur the greatest costs; this is especially true in new source Option 2 where more stringent PIC controls are introduced.

The engineering costs discussed here provide only an upper bound estimate of the total costs of the proposed rule because they assume that all facilities will comply with the regulation and continue waste burning. The unit-specific cost estimates from the model plants analysis serve as a primary input into our economic impact analysis in Chapter 4 where we arrive at a revised estimate of total costs.

While Chapter 3 presents an upper bound estimate of the total economic costs of the proposed hazardous waste combustion maximum achievable control technology (MACT) standards, actual costs will depend upon the incentives and reactions of the regulated community. In this chapter the Environmental Protection Agency (EPA) draws on a diverse set of data to characterize the economics of hazardous waste combustion and estimate how increased compliance costs would affect the incentive that combustion facilities have to continue burning and the competitive balance in combustion market segments. In addition, the Agency considers the costs that would be imposed on groups other than combustion facilities -- particularly, waste generators and fuel blenders. The overall objective is to develop a refined estimate of the total costs that will actually be incurred by the regulated community.

The discussion below is divided into methodology and results. The methodology section introduces a screening process used to assess economic impacts. In addition, we describe how these screens can be combined with information on alternatives to combustion (i.e., waste management alternatives and waste minimization) and data from the model plants analysis to assess how waste flows might change when new combustion standards are introduced that increase the cost of combustion. The results section presents and interprets these screening measures and discusses how the reactions of the regulated community would affect the total costs of the rule and the flow of waste.

Overall, the economic impact analysis indicates that some combustion facilities may experience a substantial change in the cost of burning waste, but that this change is likely to have a limited impact on combustion markets. In terms of effects on waste-burning cost structure, cement kilns and lightweight aggregate kilns (LWAKs) are most affected by the regulation. This is primarily a product of their relatively low baseline costs of burning, meaning that incremental compliance costs represent a large increase in their overall cost of burning waste. For incinerators, compliance costs are lower, represent smaller additions to baseline costs, and change little across regulatory options. The analysis concludes that cement kilns have the lowest waste burning costs even after regulation, and so will be able to set the market price.

The availability of waste management alternatives other than combustion may constrain the magnitude of the price increase passed to generators. Because there are limited economic data on waste minimization and other non-combustion waste management alternatives, EPA was unable to predict precisely how much combustors could raise prices in the face of higher compliance costs. The Agency therefore conducted a sensitivity analysis, using a low and a high price pass-through scenario, as well as bounding the assessment using zero percent pass-through. The low price pass-through scenario assumes that waste minimization and non-combustion alternatives become viable at combustion prices only two to 13 percent higher than the current market.[1] The high price pass-through scenario assumes that the most efficient combustors could raise prices to recover much of their new compliance costs without generators shifting to alternatives. Zero-percent pass-through assumes that all costs of the rule are borne by existing profits.

To the extent that compliance costs cannot be passed through to generators and fuel blenders, the profitability of waste burning in kilns will fall. EPA estimates that if prices can be increased by less than 13 percent, a significant number of facilities may cease to burn waste. However, because the facilities that are likely to cease waste burning are those that have little waste over which to spread costs, the waste shifts that result are quite minor (less than five percent of all combusted waste), leaving the competitive balance relatively unaffected. These conclusions vary little across regulatory options, except those where products of incomplete combustion (PICs) must be controlled; under these options, kilns incur much larger costs and may be more adversely affected.

4.1 METHODOLOGY

The methodology for assessing economic impacts is divided into several components:

- Assessment of waste management alternatives;
- Assessment of waste minimization;
- Basic economic impact indicators;
- Breakeven quantity analysis;
- Effect of waste feed reductions; and
- Effect of removing the small quantity burner exemption.

Each of these components is discussed in the sections below. Before doing so, the basic data used in the screens and in other aspects of the economic impact analysis are discussed.

Prior to presenting the various screening analyses we use for determining economic impacts, two issues should be noted. First, the screening analyses all seek to characterize the incentive that combustion facilities have to burn waste and determine if combustion units will continue to operate in the face of increased costs. Implicit in this analysis is the assumption that combustion units operate as separate profit centers. In fact, a chemical plant employing an on-site incinerator could subsidize the incinerator operations with profits from some other component of the facility. Similarly, a large waste management company may subsidize commercial incinerator operations with income from another line of business.

[1] Since price pass-through has been calculated on a pre-tax basis, and new investments can be deducted from taxable income, reducing their cost to the corporation, combustors would have an impetus to recover less than the pre-tax costs per ton through price increases.

Such actions, however, would violate basic microeconomic assumptions of profit maximization. Therefore, the analysis assumes that hazardous waste combustion activities must be profitable to justify continued operation.

A second issue to note concerns our rationale for choosing the model plants and unit profitability approach over the econometric approach sometimes used to assess regulatory impacts. The econometric approach uses historical price and output information to predict changes in industry output given marginal changes production costs. Two factors make this approach less desirable for assessing the economic impact of the proposed MACT standards. First, the cost increases implied for some sectors are substantial, and go beyond the marginal cost changes most readily analyzed by the econometric approach. Second, hazardous waste combustion markets have changed rapidly over the last several years, with new entrants (e.g., cement kilns) as well as new regulations. These exogenous changes make it difficult to predict industry behavior on the basis of historical price and output data.

4.1.1 Data Inputs for Economic Impact Analysis

Our economic impact screens are developed using facility-specific data in conjunction with a number of industry standard values for pricing. These are combined with model plant estimates for the baseline costs of combustion and new compliance costs at each category of combustor. As the new compliance costs were described in detail in Chapter 3, we describe only the other key data inputs in Chapter 4. Exhibit 4-1 illustrates how all of the pieces were combined to evaluate the economic impact of the proposed rule.

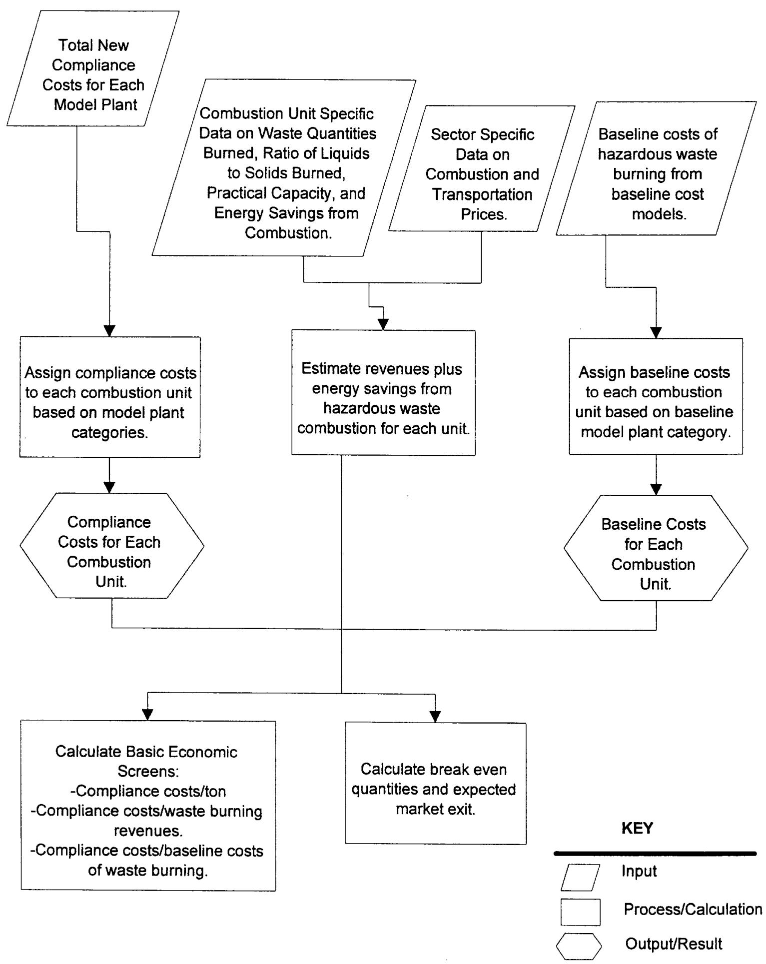
4.1.1.1 Facility-Specific Data and Other Key Inputs Used in Economic Screens

Evaluating the impact of the proposed standards on existing combustion units required a variety of data inputs. Facility revenue estimates required data on waste quantities burned, energy savings from burning hazardous wastes, and the market prices of combustion. For on-site incinerators, transportation costs were also needed in order to estimate the avoided cost of off-site treatment. This section summarizes our key data sources.

Data on the total quantity of waste burned were available at the facility level for all combustion sectors. The 1991 Biennial Report Survey (BRS) provided quantity data by source and form code for each waste stream burned at an on-site incinerator. To match the waste streams with the available pricing data, we grouped them by general type of waste (i.e., liquids, sludges and solids). The waste streams with unknown source and form codes were distributed among the other waste types, assuming the same percentage of liquids and solids for each facility.

Exhibit 4-1

Integration of Model Plants Data and Combustion Unit-Specific Data in Economic Screens



More recent data were available for the commercial sector from EI Digest, a trade journal.[2] EI Digest surveyed the commercial incinerator, cement kiln, and lightweight aggregate kiln sectors for information on the quantity of waste burned. As these data represent total quantities and are not broken down by general type of waste, we extrapolated from other data sources to estimate the percentage of liquids, sludges, and solids burned at each facility. For facilities for which there were no available data, we assumed the average mixture of liquids, sludges, and solids for each sector. The available data on the mixture of waste types burned at each facility were more recent for the cement and lightweight aggregate kiln sectors than for the commercial incinerator sectors.[3]

Facilities with more than one unit permitted to burn hazardous waste often reported waste quantities burned at the facility-level rather than by combustion unit. In such circumstances, we evenly split the total quantity of waste burned among all the permitted units. Although this method does not take into account the capacity of each unit, data on the practical waste burning capacity were not available at the combustion unit-level.

The revenues commercial combustion units earned from burning hazardous waste were estimated by multiplying the quantity of waste combusted by the average prices that facilities charge to combust the waste. As pricing data on sludge wastes were not available, we assumed that commercial incinerators charged generators the same price for sludges as they did for liquids ($293/ton).[4] Because liquids prices are significantly lower than solids prices, this represents a conservative assumption that could overstate the impact of the rule on commercial incineration facilities. The prices used to calculate the revenues earned by cement and lightweight aggregate kilns were the average price that fuel blenders paid to kilns. These prices ranged from $100/ton for liquids to $740/ton for solids.[5]

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[2] Data for the commercial incinerator sector are from Jon Hanke, "Hazardous Waste Incineration 1994," EI Digest, June 1994, p. 25. Data for the cement and lightweight aggregate kiln sectors are from Jeffrey Smith, "Industrial Furnaces 1994," EI Digest, October 1994, p. 20.

[3] For the commercial incinerator sector, we used Office of Solid Waste, U.S. Environmental Protection Agency, Background Document for Capacity Analysis for Newly Listed and Hazardous Debris to Support 40 Code of Federal Regulations (CFR) 268 Land Disposal Restrictions (Final Rule), Volume 1: Capacity Analysis Methodology and Results, June 1992, Exhibit 2-5. Data for the cement and lightweight aggregate kiln sectors are from Office of Solid Waste, U.S. Environmental Protection Agency, Background Document for Capacity Analysis for Land Disposal Restrictions Phase II - Universal Treatment Standards, and Treatment Standards for Organic Toxicity Characteristic Wastes and Other Newly Listed Wastes (Final Rule) Volume I: Capacity Analysis Methodology and Results, August 1994, Exhibit 2-7.

[4] We inflated the 1993 prices to 1994 prices using the Gross Domestic Product (GDP) implicit price deflator for services reported in the Survey of Current Business, Table 7.1. Pricing data are from Hanke, op. cit., p. 23.

[5] Jeffrey Smith, "Fuel Blenders 1994," EI Digest, September 1994, p. 28.

The costs on-site incinerators avoid by not shipping the hazardous waste off-site were estimated by multiplying the quantity of waste by the price they would pay to ship the waste to a commercial incinerator. Both the fee charged by the commercial incinerator and the cost of transporting the waste were included. Assuming an average distance of 200 miles, the cost of transporting liquid waste to a commercial incinerator was estimated to be $51/ton. The cost of transporting sludges and solids was estimated to be $49/ton.[6]

In addition to the revenues facilities earn from combustion fees, we estimated the savings to cement and lightweight aggregate kilns from avoided energy purchases. These are the result of recovering the heating value of the hazardous waste fuels burned in their kilns. To calculate energy savings, we first converted the waste quantities burned into an energy equivalent (in million Btus per pound).[7] The energy content of the waste fuels was then compared to the energy content of conventional fuels to calculate the conventional fuels displaced by waste burning.

The conventional fuels burned in the kilns varied by sector. For cement kilns, we used the average mixture of coal and natural gas burned in the industry, as reported by the Portland Cement Association.[8] For lightweight aggregate kilns, we assumed the kilns would replace the hazardous waste they burn with residual fuel oil.[9] Data on the energy content and prices of these conventional fuels were taken from the 1993 Annual Energy Survey.

These data provide key inputs to our combustion model. While the model provides important information on differential impacts of the proposed regulation on particular combustion sectors, it is not intended to precisely predict the impact of the rule on specific combustion units. The results are sensitive to the quality of several key inputs: quantity of wastes burned per unit; the mixture of solids and liquids burned at each unit; and pricing of combustion services. Data in all cases are several years old. Pricing data use market averages, and therefore do not reflect variability due to geography or to the specific waste stream being burned. Were more recent data substituted into the model, some facilities that appear non-viable may turn out to be healthy, and vice-versa. However, such improvements to the approach are not possible using current publicly-available data.

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[6] DPRA, Incorporated, September 1994. Data were inflated to 1994 prices using the GDP implicit price deflator.

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

[8] U.S. Cement Industry Fact Sheet (12th edition), Table 24.

[9] We assumed the price of coal for Cost, Insurance, and Freight (CIF) Electric Utility Power Plants (Table 7.8). For natural gas, we used the price for industrial customers (Table 6.9). For residual fuel oil, the price to end users (Table 5.21). We inflated preliminary 1993 prices to 1994 prices using the GDP implicit price deflator for services.

4.1.1.2 Baseline Cost Analysis

To evaluate the impacts of the proposed rule on hazardous waste combustors, baseline costs of combustion in the current marketplace must first be established. Baseline costs suggest important differences across combustion segments that significantly influence competitiveness. The results of the baseline cost analysis provide a core input to the combustion cost model. Below, we summarize how these baseline costs are estimated. A more detailed description of the approach, as well as detailed results, can be found in Appendix B.

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

The baseline cost analysis involved four key tasks:

- Identification and classification of combustion cost components;
- Development of model plant categories;
- Quantification of combustion cost components; and
- Development of annualized baseline combustion cost estimates for each model plant category.

EPA first identified the key elements of baseline costs for kilns and incinerators. For cement kilns, key cost components include waste storage, waste sampling and analysis, and waste-specific labor. For incinerators, key components include the cost of the combustion unit and air pollution control device (APCD) units already installed, labor, and incinerator ash disposal. Annualized permitting costs are relatively more significant for BIFs than for incinerators.

We then classified the baseline cost components into three categories: fixed annual capital; fixed operating and maintenance costs (O&M); and variable costs. Fixed annual capital costs refer to expenditures lasting multiple years. This includes capital equipment and operating permits. Costs have been annualized using a 10 percent interest rate to convert the total capital cost to a series of equal annual payments over the estimated life of the capital.[10] 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 some labor costs that increase in proportion to the amount of waste burned. Annual variable costs are derived by multiplying variable costs per ton of waste burned by the number of tons burned.

After identifying the key cost components to include in the baseline analysis, model plant classifications were developed to characterize the current combustion universe. Model plants were developed for each industry sector, including commercial incinerators, cement kilns, lightweight aggregate kilns, and on-site incinerators. Within each sector, additional model plants were developed where cost differences across combustion units were large. Unit type (e.g., wet kiln versus dry kiln); unit size; and installed APCD train all affected model plant classifications. Six model plants were developed for commercial incinerators; 12 for on-site incinerators; four for cement kilns; and three for lightweight aggregate kilns. The model plants in the baseline cost analysis are based on the type and size of the combustion unit. They differ from the model plants developed to estimate the new cost of compliance that are described in Chapter 3 of this report.

As with any modeling, the model plants used in the baseline cost analysis are approximations of actual units rather than precise replications. Model plants are assumed to operate continuously for every sector except on-site incinerators. On-site incinerators are assumed to operate in batch mode because they are generally small, combust relatively small quantities of hazardous waste, and would consume a great deal of energy if they were to be operated continuously.[11] On-site incinerators are also assumed to burn only hazardous wastes. To the extent that non-hazardous wastes are also burned, the fixed costs per ton of hazardous waste burned would decline.

A number of sources were used to quantify baseline cost components. These included trade publications, engineering cost models, and best engineering judgment. The sources for each component are detailed in Appendix B. The components were then compiled into a cost model that divided the costs into fixed and variable costs per ton of hazardous waste combusted. We have separated annual capital recovery figures shown in Appendix B from the other annual fixed costs in the exhibit below. This is 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.[12] "Adjusted" variable costs are shown for the on-site incinerator sector and reflect the batch operations of the incinerators mentioned above.

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

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

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

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

Baseline combustion costs by model plant category are summarized below in Exhibit 4-2. With the exception of some on-site liquid injection incinerators, baseline costs of hazardous waste burning are substantially lower for BIFs than for incinerators. In all sectors, larger units have a lower fixed cost per ton of capacity. These economies of scale illustrate the importance of capacity utilization; a large facility can have extremely high costs per ton of waste actually burned if much of its combustion capacity is not being utilized.

4.1.1.3 Baseline Operating Profits

To provide additional perspective on the baseline competition between different combustion sectors, EPA calculated the average baseline operating profits per ton of waste in each sector. Operating profits are calculated as follows:

Operating Profits = Waste Burning Revenues - Waste Burning Costs

Where:

Waste Burning Revenues = Weighted average price per ton for combustion services + Weighted average avoided energy costs per ton of waste burned + Any price increases to recover new compliance costs (zero in the baseline)

Waste Burning Costs = Average baseline costs per ton to burn hazardous waste + Average new compliance costs per ton (zero in the baseline).

Operating profits are calculated before tax and deductions for plant and corporate overhead. After-tax profits would be lower.

Baseline operating profits by sector are shown in Exhibit 4-3. The combustion units in all sectors that burn very little waste have negative baseline operating profits before consolidation. Cement units have lower operating profits per ton on an absolute dollar basis than commercial incinerators, reflecting the fact that they burn lower-priced liquid wastes. However, the kilns have higher average percentage operating profit margins due to their low baseline cost of burning. Both LWAKs and on-site incinerators have many unprofitable units as well as many profitable ones.

4.1.2 Method for Analyzing Waste Management Alternatives

Under the proposed regulation, combustion costs and prices will rise. As the price of combustion rises, new alternatives to combustion become competitive. The greater the tons of waste currently combusted that can be managed less expensively in some other way, the larger the impact of waste diversions is likely to be on combustion facilities, and the more difficulty combustors will have raising prices.

EXHIBIT 4 - 2

BASELINE COST PER TON OF PRACTICAL CAPACITY OF HAZARDOUS WASTE BURNING
(Excludes Energy Savings for BIFs)

	Group	Kiln Type	Assumed APCD	Annualized Total Capital	Annualized O & M Total Fixed	Annualized O & M Variable/ Ton of Waste	Practical Capacity (lbs/hour)	Hours of Operation/ Year	Practical Capacity (tons/year)	Fixed Costs/ Ton of Practical Capacity	Implied Total Cost/ Ton of Practical Capacity
				1	2	3	4	5	6=[4*5]/2000	7=[1+2]/6	[7+3] (Note)
Cement kilns	1	Wet kiln (S)	ESP	643,211	617,445	28	11,800	8,000	47,200	26.71	54.71
	2	Wet kiln (L)	ESP	697,628	622,319	31	23,500	8,000	94,000	14.04	45.04
	3	Dry kiln (S)	ESP	521,094	579,291	42	9,200	8,000	36,800	29.90	71.90
	4	Dry kiln (L)	FF	673,612	614,513	26	15,600	8,000	62,400	20.64	46.64
LWAKs	1	LWAK (M)	FF	354,757	397,321	36	3,000	8,000	12,000	62.67	98.67
	2	LWAK (M)	FF	397,751	410,402	37	4,000	8,000	16,000	50.51	87.51
	3	LWAK (M)	FF/VS	483,501	438,991	27	6,500	8,000	26,000	35.48	62.48
Commercial Incinerators	1	Rot. kiln (M)	FF/PBS	3,007,622	1,662,513	137	12,927	8,000	51,708	90.32	227.32
	2	Rot. kiln (M)	SD/FF/PBS/IWS	3,419,121	1,795,487	165	12,927	8,000	51,708	100.85	265.85
	3	Rot. kiln (L)	FF/ST	4,579,105	2,194,138	250	20,679	8,000	82,716	81.89	331.89
	4	Rot. kiln (L)	SD/Q/PBS/ESP	5,089,841	2,357,531	292	20,679	8,000	82,716	90.04	382.04
	5	Liq. Inj. (M)	Q/FF/VS/PBS	1,072,120	1,002,986	167	12,930	8,000	51,720	40.12	207.12
	6	Liq. Inj. (M)	Q/PBS	1,010,277	980,560	138	12,930	8,000	51,720	38.49	176.49
On-site Incinerators	1	Liq. Inj. (S)	Q/PBS	325,348	102,191	106	1,235	8,000	4,940	86.55	192.55
	2	Liq. Inj. (S)	Q/VS/PBS/ESP	388,268	119,955	118	1,235	8,000	4,940	102.88	220.88
	3	Liq. Inj. (M)	Q/VS/PBS	696,280	245,105	44	9,198	8,000	36,792	25.59	69.59
	4	Liq. Inj. (M)	Q/PBS	668,534	237,269	38	9,198	8,000	36,792	24.62	62.62
	5	Liq. Inj. (L)	Q/PBS	1,087,055	416,530	32	25,563	8,000	102,252	14.70	46.70
	6	Liq. Inj. (L)	Q/VS	1,060,439	408,642	28	25,563	8,000	102,252	14.37	42.37
	7	Rot. kiln (S)	WHB/FF	948,536	313,271	264	602	8,000	2,408	524.01	788.01
	8	Rot. kiln (S)	Q/WHB/VS/PBS	996,355	327,777	314	602	8,000	2,408	549.89	863.89
	9	Rot. Kiln (M)	Q/VS/PBS/IWS	2,859,771	975,074	105	8,091	8,000	32,364	118.49	223.49
	10	Rot. kiln (M)	Q/PBS/ESP	2,850,113	972,347	88	8,091	8,000	32,364	118.11	206.11
	11	Rot. kiln (L)	VS	3,918,801	1,382,635	71	15,576	8,000	62,304	85.09	156.09
	12	Rot. kiln (L)	Q/IWS	4,173,246	1,458,468	77	15,576	8,000	62,304	90.39	167.39

Notes:

1. On-site incinerator costs uses costs adjusted for batch feeds.
2. APCD Abbreviations are as follow: ESP = electrostatic precipitator; FF = fabric filter; IWS = ionizing wet scrubber; PBS = packed bed scrubber; Q = quench; SD = spray dryer; ST = spray tower; WHS = waste heat boiler.
3. Practical capacity is a measure of the maximum waste burning capacity available. Because most combustion units burn lower quantities in actuality, baseline costs per ton of waste burned will be higher (see Exhibit 4-6).

Sources: Matthew Gardner, et al., Energy and Environmental Research Corporation, "Development of Baseline Costs for Hazardous Waste Incineration," prepared for U.S. EPA, April 18, 1995.

Exhibit 4-3

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

	<$0	$0 - $50	$51 - $100	$101 - $150	>$150
Cement Kilns	6	15	15	3	12
LWA Kilns	12	0	0	2	1
Commercial Incinerators	14	0	4	0	16
On-site Incinerators	92	10	17	7	58

BASELINE OPERATING PROFITS AS A PERCENTAGE OF BASELINE WEIGHTED AVERAGE PRICES PER TON (Number of Combustion Units Falling in Range)

	<0%	0% - 10%	11% - 25%	26% - 50%	>50%
Cement Kilns	6	0	4	10	30
LWA Kilns	12	0	0	0	4
Commercial Incinerators	14	0	6	6	8
On-site Incinerators	92	10	14	14	55

Notes:

1. Baseline Operating Profits = (weighted average price per ton + weighted average energy savings per ton) - total annual baseline costs per ton. Total annual baseline costs include fixed annual capital costs, fixed annual operating and maintenance costs, and annual variable costs.
2. Baseline operating profits exclude overhead, other administrative costs, and taxes. Actual after-tax profits will be lower.
3. Number of units with average operating profits less than $0 (or <0%) includes those burning very little or no waste.
4. Baseline operating profits are calculated at the unit level. Consolidating burning into fewer units may reduce facility closures, explaining why the unit estimates presented in this exhibit appear higher than the facility closures presented in later exhibits.
5. Includes combustion units not currently burning waste in the cement kiln, LWAK, and commercial incinerator sectors; or burning less than 50 tons per year in the on-site incinerator sector.

Our evaluation of waste alternatives involved five steps:[13]

- Characterizing data on waste shipments to combustion.
- Identifying the key waste streams relying on combustion.
- Identifying alternative treatment technologies for these key waste streams.
- Identifying cost information on these alternatives.
- Assessing the impact of viable alternatives might have on particular combustion sectors.

A complete description of the waste alternatives analysis is included as Appendix D.

Data characterization involved examining the Biennial Report Survey (BRS) data base to group combusted wastes by source and by waste form (e.g., liquid, solid). In this manner, data reported by generation unit were grouped by waste type so that total quantities burned for each type could be calculated. BRS entries containing insufficient source or form information to allow classification were omitted. In addition, gases were also excluded because BRS contained insufficient descriptions to identify alternative treatment options. Finally, remediation and closure wastes were omitted because they represent one-time waste sources rather than a continuing source of waste generation.[14]

From the remaining source code/form code groupings, the ten largest quantity groupings were chosen as the key waste streams. The choice was made on the basis of tonnage because the diversion of large waste streams from combustion will have the greatest impact on the viability of the combustors. These ten source code/form code groupings comprised nearly 80 percent of the total wastes incinerated in 1991. The Vendor Information System for Innovative Treatment Technologies (VISITT) and the Alternative Technology Information Center (ATTIC) databases, as well as recent work done by EPA, were used to identify waste management alternatives for these key waste streams.

Once the alternative treatment technologies were identified, treatment-specific information (i.e., waste-feed characteristics, treatment levels, and cost factors) was collected and summarized. Engineering judgment was used to evaluate the applicability of particular management approaches to the key waste streams. Limitations to the applicability of particular alternatives are also noted.

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[13] Jerome Strauss, "Memorandum: Evaluation of Alternative Treatment Technologies for Wastes that Are Currently Being Sent to Combustion Facilities (Revised-Draft)," prepared for Industrial Economics, Inc., March 30, 1995.

[14] Remediation and other "one-time" wastes comprised about 15 percent of total combusted wastes in 1991. See U.S. EPA, Setting Priorities for Waste Minimization, July 1994, p. 2-12.

While the goal was to develop relatively precise cost estimates for viable alternatives, cost data were scarce. In addition, while a number of alternatives appear to be substantially less expensive than the current cost of combustion, generators continue to burn wastes. This suggests that other factors are at work. These factors, such as liability concerns, are presented below in section 4.2.2 and incorporated into our assessment of shifts from combustion to waste alternatives under the proposed rule. While the alternatives assessment is useful as an indicator of long-term trends, cost data are too imprecise to estimate short-term diversions to alternatives in response to increased combustion prices.

4.1.3 Method for Analyzing the Impact of Waste Minimization

A complete evaluation of how waste management markets will react to the proposed MACT standards must take into consideration the options available to waste generators facing increased combustion costs. One likely response is for generators to consider waste minimization measures that reduce the quantity of waste needing treatment. As with alternative waste management approaches, characterizing the availability of waste minimization options will allow us to assess the elasticity of demand for combustion services. That is, if lower cost waste minimization options are readily available for large portions of combusted waste, combustion facilities will be less able to pass compliance costs along to generators in the form of increased combustion prices.

EPA has developed a screening analysis to characterize the waste minimization potential for wastes that are currently combusted. The methodology for this analysis is summarized here and explained more fully in Appendix C. EPA first compiled BRS data on combusted wastes, segmenting the data by BRS source code (the process generating the waste) as well as SIC. Applying engineering judgment, the Agency identified waste minimization measures that would potentially be applicable for the waste source code and industry in question. Roughly 1.8 million tons of waste (approximately half of all combusted waste) were evaluated.[15] Assignment of waste minimization technologies is subject to a significant degree of uncertainty given the lack of knowledge on the form of the waste, the specific constituents in the waste, and other factors affecting the applicability of specific waste reduction technologies.

To evaluate whether facilities would adopt applicable waste minimization measures, a simplified payback analysis was used.[16] Using information on per-facility capital costs for each technology, EPA estimated the period of time required for the cost of the waste minimization measure to be returned in reduced combustion expenditures. For example, if a waste minimization measure costs $100,000 to install and eliminates 100 tons of waste per year; and if the cost of combustion is $500 per ton, the payback period is: $100,000/($500*100) = 2 years. Several key assumptions were applied in the payback analysis:

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[15] The remainder were non-routinely generated wastes and smaller quantity waste groupings. Non-routine wastes are unattractive options for waste minimization because the available period to recoup investments is short. Larger waste groupings were chosen as a focus to identify the waste minimization options likely to have the largest impact on the market.

[16] Payback analyses do not discount future cash flow back to present dollars, and therefore overstate the benefits of particular investments. Given the large uncertainties associated with the cost of waste minimization options, the payback approach provides a reasonable first approximation of the economic desirability of these approaches.

- Waste minimization measures with a payback of less than three years will be implemented. Measures with a payback period of between three and ten years will be implemented by 50 percent of the generators. Measures with payback periods of greater than 10 years will not be implemented. These simplified cutoff assumptions are based on best engineering judgment.

- The cost of combustion is based on an assessment of the liquid/solid ratio of the wastestream; this ratio is used to develop a weighted price of combustion for the specific waste. Liquid and solid combustion prices are based on commercial incineration prices. The liquid price of combustion is assumed to be $284 per ton while the solids price is $1,335 per ton.[17]

- Recovered process water is re-used at the facility (thereby avoiding potential treatment and disposal costs).

The assessment of waste minimization yields estimates of the tonnage of combusted waste that might be eliminated. It is important to note that comprehensive data to evaluate waste minimization were not available. Improved information on the capital investment and operating costs associated with the waste minimization measure, as well as additional savings to the generator from avoided raw material, labor, or energy costs are needed, and EPA invites industry to provide such data.

Incorporating both the capital and operating costs of waste minimization into a more formal discounted cash flow analysis would reduce the applicability of some waste minimization options that appear viable using the payback approach. Incorporating additional savings to the plant through avoided raw material, energy, and waste handling costs would have the opposite effect.

4.1.4 Economic Impact Screens

The purpose of our economic impact screening measures is to provide information on the relative magnitude of compliance costs under various regulatory scenarios and to help gauge the differential impact of the proposed MACT standards across combustion sectors. Each of the screens is designed to draw on the data discussed above to place compliance costs in a context that allows us to determine if the costs are substantial enough to affect waste burning operations at the combustion facility. We rely on three basic economic impact screens:

[17] Prices are based on EI Digest, June 1994, p. 23. Because the specific form of the waste is unknown and because the wastes are generated by a diverse set of processes and industries, it is difficult to specify the type of combustion used to manage the waste. We have assumed commercial incineration prices are applicable. These prices are higher than those charged by cement kilns, meaning that we may overstate combustion cost savings, understate payback periods, and therefore overstate waste minimization potential.

- New compliance costs per ton of waste burned;
- New compliance costs as a percentage of waste burning revenues; and
- New compliance costs as a percentage of baseline combustion costs.

Each of these is explained below. Additional information can be found in Section 4.2.1.

4.1.4.1 New Compliance Cost Per Ton of Waste

One basic indicator that can be used to measure the economic impact of the proposed MACT standards is the compliance cost per ton of waste burned. This indicator provides information on how much prices per ton would have to increase if combustors are to maintain their existing profits. Obviously, the higher the cost per ton, the more likely that alternatives to combustion, such as waste minimization, will become economic.

For each regulatory option, we estimate the average cost per ton by combustion sector in two steps. First, we calculate the cost per ton for each combustion unit by dividing total annual compliance costs by the tons burned at the unit. We then estimate the average cost per ton for the sector by taking the simple average across all units.[18] As with the other screens, the cost per ton screen relies directly on tonnage data for each combustion unit. Uncertainty in this tonnage affects the accuracy of the cost per ton estimate. In particular, we use BRS data as the source for tonnage burned at on-site incinerators. This tonnage is very low for some units, leading to extremely high costs per ton and skewing the overall sector average to a high cost per ton. This finding may not be legitimate if BRS data do not fully capture the extent of waste burning at these units or if these incinerators also burn non-hazardous waste and are able to spread their fixed costs over a larger quantity than is apparent from BRS.

4.1.4.2 New Compliance Costs as a Percentage of Waste Burning Revenues

The second screening metric involves examining costs as a percentage of waste burning revenues, illustrating what portion of revenues would be absorbed by the costs of the new rule in the absence of any price increase. For each facility in the model plants analysis, we perform the following calculation:

$$\frac{\text{Annual New Compliance Cost}}{\text{Waste Burning Revenue}} = \frac{\text{Annual New Compliance Cost/Ton}}{\text{Average Waste Burning Revenue/Ton} + \text{Energy Savings/Ton}}$$

[18] Units where available data suggest that zero tons are burned are eliminated from the calculation.

As shown, annual compliance costs per ton (based on model plant costs and tonnage burned at the unit) are divided by revenues. Revenue is calculated by multiplying the price received per ton of waste by the tonnage burned at the unit. Using available data on average prices, we apply per-ton prices for liquid, sludge and solid waste burned at each combustion unit. Revenues per ton consist not only of the price the unit receives per ton of waste, but also any savings in conventional fuel that the unit realizes (for cement kilns and LWAKs). These savings are created because the energy value of burning waste allows reduced expenditures on fuel such as coal.

If compliance costs are large in comparison to waste burning revenues, it is more likely that the new costs will affect waste burning behavior. Because of its simplicity, this screen does not definitively characterize a combustion unit's economic incentive to continue waste burning. However, it does provide context for determining if the costs of waste burning exceed the direct financial benefits to the combustor.

Note that this indicator relies on the concept of "imputed revenues" at on-site incinerators. These non-commercial burners do not actually receive revenue when they burn waste on-site. What on-site burning saves, however, is the cost of sending waste off-site to a commercial combustion facility. This would include both the commercial combustion price as well as the avoided cost of transporting waste to an off-site facility. These savings can be treated as implicit revenue for the purposes of comparing compliance costs to waste burning revenues.

This screen has two key uncertainties that should be taken into consideration:

- Data on current quantities burned are somewhat limited, especially for on-site incinerators. The tonnage burned information directly affects the calculation of revenues.

- Prices are based on national averages. Geographic differences in pricing and transport distances reduce the accuracy of the screen and affect the revenue estimates.

4.1.4.3 New Compliance Costs as a Percentage of Baseline Costs

Comparing new compliance costs to the baseline costs of waste burning at different facility types provides a measure of how much a combustor's cost structure will change from the rule.[19] The larger the change, the more prices charged will rise and/or profits on waste burning will fall. For each combustion unit, we compared the model plant's compliance costs to the assigned baseline cost of waste burning developed in the baseline cost analysis.

The estimation of costs as a percentage of baseline costs is subject to both the uncertainties of the model plants analysis (see Chapter 3) as well as the uncertainties surrounding the estimation of baseline costs, as discussed above.

[19] "Cost Structure" refers to the overall magnitude and the components of costs that a combustor incurs. Examples include fixed versus variable costs.

4.1.5 Breakeven Quantity (BEQ) Analysis

The BEQ measures the quantity of waste that a combustion unit would have to burn to cover the costs of operation.[20] We use estimates of breakeven quantity to assess the likelihood that combustion facilities will stop burning waste in the face of increased compliance costs. We calculate two BEQ measures -- short run and long run. Combustion units will continue to operate in the short-run if they can burn enough waste to cover their variable and fixed O&M costs. Units must cover their fixed capital costs as well if they are to continue operating in the long run. In both the long and short run, a combustor will not choose to invest in new capital (i.e., pollution control equipment) unless it is confident that it can burn enough waste to cover the cost of that new equipment.[21]

The methodology for the basic breakeven quantity measure is explained below, followed by a description of how the BEQ is refined to arrive at an improved estimate of likely market exit.

4.1.5.1 Breakeven Quantity Calculation

In its simplest form, the breakeven quantity is calculated assuming that quantities combusted and combustion prices do not change as a result of the rule. While this is not a realistic assumption, it provides a useful way to illustrate the BEQ concept.

Calculating the BEQ is based on a single core economic formula:

Profit = Total Revenues - Total Costs

At breakeven, profit equals zero (i.e., revenues are just large enough to cover all costs):

0 = Total Revenues - Total Costs

Revenues and costs may then be broken into their components:

Total Revenues = [(Price/ton + energy savings/ton) * Tons burned]

Total Costs = [Total fixed costs + (Variable cost/ton * Tons burned)]

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[20] For additional information on breakeven analysis, see Eugene Brigham and Louis Gapenski, Financial Management Theory and Practice, 6th Edition, (Chicago: The Dryden Press), 1991, p. 483; or Leopold Bernstein, Financial Statement Analysis: Theory, Application and Interpretation, (Howewood, IL: Irwin, 1983), pp. 640-652.

[21] As noted in Section 4.1, some firms could decide to operate their combustion unit at a loss. We anticipate that the vast majority of combustion units will shut loss-making operations, however.

We can first define the following variables for the equation:

- Let \$P/ton = price/ton + energy savings/ton
- Let Q = Quantity of waste burned in tons
- Let \$FC = total fixed costs
- Let \$VC/ton = total variable costs/ton of waste burned

We can then solve the following equation to find the zero profit or breakeven quantity point:

0 = [\$P*Q] - [\$FC + \$VC*Q]

\$FC = Q tons (\$P-\$VC)

Q tons = \$FC/(\$P-\$VC) = Breakeven Quantity

Note that in the short-term, \$FC includes only the new fixed costs of the rule, such as new pollution control devices plus baseline fixed O&M costs. All of these fixed costs would be avoided if the facility chose not to continue burning hazardous waste prior to investing in compliance. In the long-term, the company's old equipment will wear out and require replacement. Therefore, \$FC for the long-term BEQ includes both the new fixed costs of the rule and the baseline fixed O&M and capital costs.

The data used in the BEQ calculation come from a number of sources. The fixed and variable costs associated with compliance come from the model plants analysis. Fixed and variable costs in the baseline come from the baseline cost analysis. As mentioned above, data on prices received by kilns and incinerators are taken from EI Digest. We estimate energy savings based on data in EPA's Cement Kiln Report to Congress as well as data gathered under EPA's Combustion Emissions Technical Resource Document (CETRED) effort. Specific citations can be found in Section 4.1.1.1, as well as in Appendices A and E.

Relative to the other basic screens, the BEQ analysis provides a more precise indication of whether a combustion unit is likely to continue burning waste. To assess whether a combustion unit is likely to be able to meet its breakeven quantity, we can compare the BEQ to the quantity of waste currently burned at the unit. If the BEQ significantly exceeds current tons burned, the unit is likely to cease waste burning.

The BEQ analysis is affected by many of the same uncertainties discussed earlier. Most significantly, inaccuracies in the quantity burned at each unit affect our evaluation of each unit's ability to meet the BEQ. The lower quantities burned at on-site incinerators will result in more facilities being unable to meet BEQ (see results discussion below). This result may not be valid if available data understate waste burned quantities. EPA requests additional data from industry on the quantities of hazardous and non-hazardous waste burned in on-site incinerators.

In addition, isolation of variable compliance costs is not possible given the structure of the existing cost models. EPA has made the simplifying assumption that all new compliance costs are fixed. This is essentially true for many technologies. For example, the cost associated with improved electrostatic precipitator (ESP) operation generally will not increase with each ton of waste burned (aside from increments to dust treatment and disposal, a minor component of O&M costs). Similarly, the cost of carbon injection is more a function of flue gas flow than tons burned. Spray towers, packed towers, and ionizing wet scrubbers (IWS) are the only technologies for which the assumption of zero variable costs may be inaccurate; even with these technologies, the percentage of O&M cost that is variable is estimated to be below 30 percent for cement kilns and incinerators.[22] Assuming that all new compliance costs are fixed leads to some inaccuracies in the estimates of BEQ, although the direction of error is difficult to predict.

4.1.5.2 Refined Breakeven Quantity Analysis

To more accurately reflect decisions that might be faced by combustion facilities, the Agency refined the BEQ analysis to incorporate two new contingencies:

- Combustion facilities may be able to cover compliance costs by passing through portions of the cost increase to generators. This would effectively lower the breakeven quantity that the unit must meet.[23]

- Combustion facilities may have the option of consolidating waste burning among multiple combustion units at the facility, allowing them to burn waste at some units while discontinuing hazardous waste combustion at others.

This section discusses our method for modeling these interactions and arriving at more refined estimates of facility closure, price changes, and waste flow changes. Exhibit 4-4 demonstrates, in flow chart form, the process followed in the refined BEQ analysis.

4.1.5.2.1 Pricing Increases

All combustion facilities that remain in operation will experience increased costs under the proposed regulation. To protect their profits, each will have an incentive to pass these increased costs on to their customers in the form of higher combustion prices. Although generators will not want to pay the higher prices, they will have to unless they have less expensive waste management alternatives (see Section 4.2.2).

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[22] Greg Kryder and Bruce Springsteen, Energy and Environmental Resources, memorandum to Doug Koplow, Industrial Economics, June 27, 1995.

[23] In theory, cement kilns could cover compliance costs associated with hazardous waste burning by increasing the prices they charge for cement. Given that cement is a commodity and that many cement kilns do not burn hazardous wastes (and would therefore not incur the compliance costs), kilns are unlikely to be able to finance compliance by raising cement prices.

Exhibit 4-4

COMBUSTION CESSATION ANALYSIS USING BREAK-EVEN QUANTITY

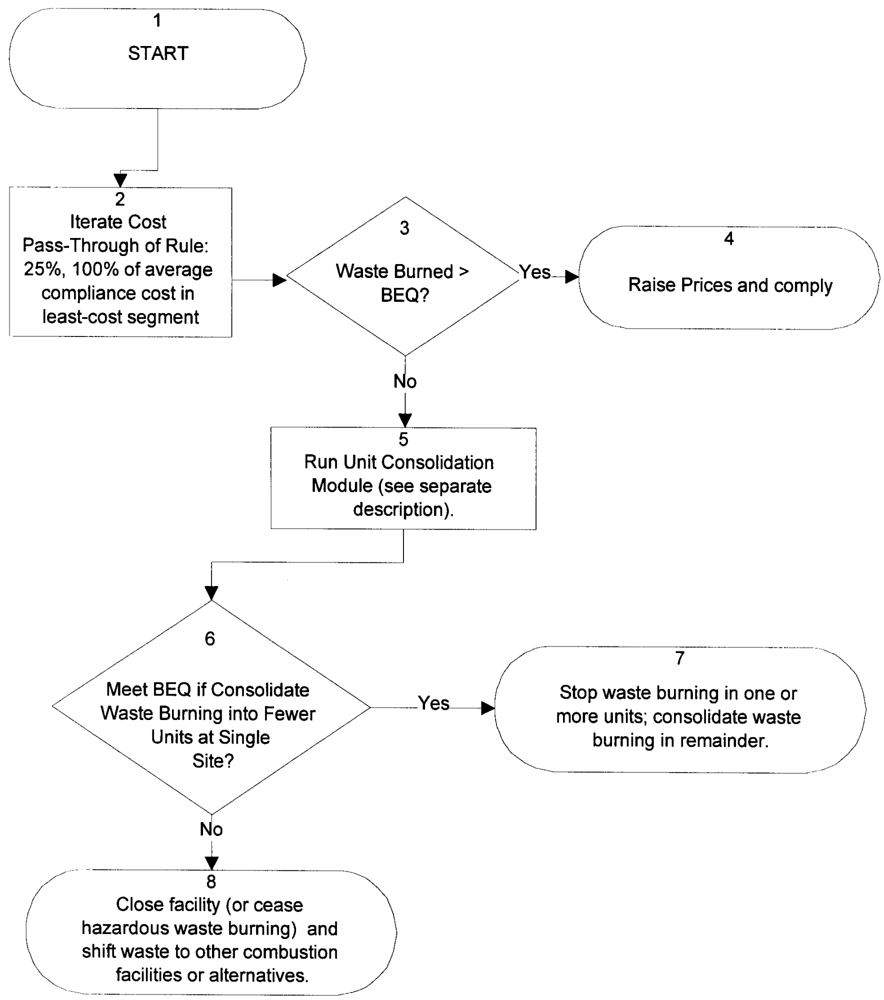

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Exhibit 4-5 (below) illustrates how price pass-through would work in theory. This exhibit illustrates a number of important principles about hazardous waste combustion markets.

- Waste will be sent to the least expensive alternatives first, all else being equal.[24]

- Both baseline costs of hazardous waste combustion and new compliance costs vary significantly across combustion units, even within the same sector. Thus, regulatory changes can affect different units in very different ways.

- Prices will rise to the point at which all demand for waste management is met. In Exhibit 4-5, the last tons are managed in the non-combustion/waste minimization alternative at a cost of $230 per ton. This would become the market price. Combustion units A, B, and C would each set their prices at about $230 per ton in order to maximize their profits. The least efficient management option would earn just enough to stay in business, but would not recover capital costs. Combustion Unit D would exit the market.

Exhibit 4-5

SIMPLIFIED EXAMPLE OF DETERMINATION OF NEW MARKET PRICE FOR COMBUSTION

Assume 100 Tons Require Management	Combustion Unit A	Combustion Unit B	Combustion Unit C	Alternative Management/ Waste Min	Combustion Unit D
Cost/ton of Waste	$145	$175	$220	$230	$240
Tons of capacity	35	25	35	100	300
Remaining tons requiring treatment	100-35 = 65	65-25 = 40	40-35 = 5	5-5 = 0	0

The real hazardous waste combustion marketplace is much more complex than the five options shown above. Estimating the cost of combustion at which the last ton of waste would be combusted is difficult due to pricing variations by region, waste stream, and generator. Rather, we have adopted some simplifying assumptions that should provide a reasonable approximation of these markets:

[24] In fact, other factors such as transportation costs will affect which facilities are the least expensive to particular generators. In addition, the price of combustion will vary by the method of delivery (e.g., bulk versus drum), the form of the waste (e.g., liquid versus solid), and the contamination level (e.g., metals or chlorine content). This makes it more difficult to compare various waste management options.

- We compare the average total cost of combustion by industry sector. This includes both the baseline combustion costs and the new compliance costs. The industry sector with the lowest costs is the most-efficient, and will have the greatest power to pass through compliance costs in the form of higher prices.

- We then calculate the median compliance cost/ton for combustion units in the lowest cost sector after compliance and assume that this amount could be passed to customers in the form of higher prices.

- Using the median compliance costs for the lowest cost sector as the basis for a price increase is a conservative assumption. As Exhibit 4-5 illustrated, the new market price will be set by the most expensive facility that is still needed to manage the existing supply of waste. The capacity that exists at facilities in the least cost segment with compliance costs at or below the median for that segment will not be sufficient to manage all the wastes requiring combustion. We believe that the actual price increase will most likely be higher than the median compliance costs for the lowest cost sector.

- We further assume that the dollar value of this increase would be matched by other combustion sectors, even if it exceeded their new compliance costs, in an effort to maximize profits. We assume that because the price differential (in dollars) between sectors would be the same as before incurring the new compliance costs, that the market share of each combustion sector would not change.

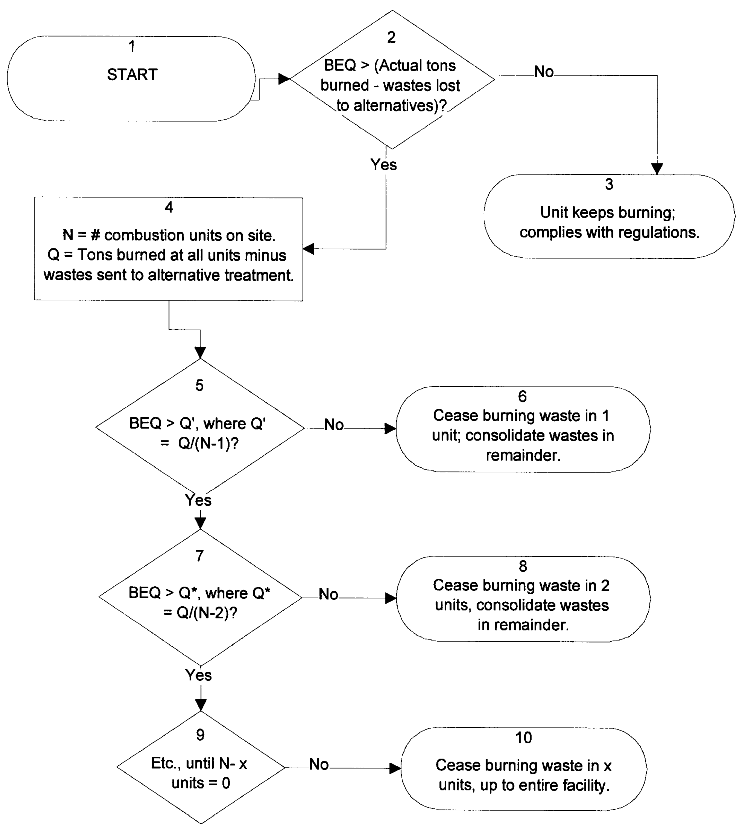
- Price increases will be capped by the availability of substitutes for combustion (i.e., waste minimization and non-combustion treatment alternatives). These alternatives will constrain both price increases by the lowest cost sector, and the ability of higher cost sectors to match these increases. Given an absence of good data on the price at which these alternatives are viable, we evaluate the impact of the proposed rule under both a low and a high price pass-through scenario. The low scenario evaluates market impacts if alternatives are available at close to the current market price of combustion.

4.1.5.2.2 Unit Consolidation

In a further attempt to more accurately model industry behavior, we allow for consolidation of waste burning units at a facility (illustrated in Exhibit 4-6). The logic behind this is that many hazardous waste combustion facilities have more than one permitted combustion unit at the same site. Each unit may burn too little waste to meet the BEQ. However, the facility may be able to move waste between units to minimize regulatory impacts. Consolidation offers two benefits to the combustion facility. First, it

Exhibit 4-6

UNIT CONSOLIDATION MODULE



reduces compliance expenditures because not all units are brought into compliance for hazardous waste burning. Second, it increases the throughput at the units that do remain in operation. Together, the units remaining in operation are more likely to meet their BEQ.[25]

The consolidation routine closes one unit at multi-unit facilities and distributes the waste from the closed unit equally among the remaining open units. If the open units still do not meet BEQ, the process is repeated until either the units remaining open meet BEQ or there is only a single unit left. If the single open unit does not meet BEQ, we assume that the entire facility will cease burning hazardous wastes, and the waste will be diverted to other combustion facilities.[26]

Data limitations regarding unit-level practical capacities create some uncertainty in the consolidation routine. Practical capacity is the best measure of how much hazardous waste a unit can burn without plant modifications. Where particular units have a practical capacity that is less than their BEQ, we may project that they continue to combust hazardous wastes by consolidating wastes from multiple units when this would be impossible in reality due to capacity constraints. Data limitations of this nature are most prevalent in the cement kiln sector. Examining the units for which we do have unit-level data on practical capacity suggests that the BEQ after a price increase is generally well below the unit's practical capacity for hazardous waste combustion. As a result, we do not expect there to be substantial errors in our market exit estimates from this source of uncertainty.

4.1.5.2.3 Limits to the BEQ Approach

The refined BEQ identifies whether a combustion unit is making money on hazardous waste combustion or not, and facilitates comparison across units and sectors. However, even units meeting BEQ may experience reduced profitability, if compliance costs cannot be shifted to generators through price increases. Thus, units meeting BEQ may decide to stop burning hazardous waste if profits fall too low.

In addition, some marginal cement kilns may subsidize low cement profits with hazardous waste combustion profits. While such behavior will not be possible over the long term, it may occur in the short term.[27] Reduced hazardous waste subsidies to cement production could theoretically make some entire plants (joint cement production/hazardous waste combustion) non-viable. Such effects of the rule depend heavily on the operating parameters of specific plants. EPA invites such plants to provide the detailed data necessary for the Agency to assess the likelihood of closure.

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[25] A number of facilities report tons burned at the facility, rather than the unit, level. This method of reporting hides possible variances in tons burned across the units that would illustrate that some units are above BEQ and some below. The consolidation routine helps overcome this gap by evaluating how many units would need to close in order to bring the remaining units above BEQ.

[26] If large, these waste diversions could help remaining combustion units to meet their BEQ.

[27] Over the long-term, kilns that remain in business will need both efficient cement production and efficient hazardous waste combustion services. Otherwise, plants with both will be able to underprice them.

4.1.5.2.4 Operating Profits

As noted above, reduced profits from the rule are likely even if units continue to meet BEQ, and therefore continue to burn hazardous wastes. To evaluate changes in profitability, the Agency has estimated operating profits by sector in the baseline and under the MACT options. Operating profits are calculated as follows:

> Hazardous Waste Combustion Revenues + Avoided Energy Purchases + (Price Pass-Through if applicable x tons burned) - Baseline Cost of Hazardous Waste Combustion - New Compliance costs, if applicable.

Operating profits are before taxes and overhead charges and provide a good basis of comparison across sectors. However, after-tax profits will be lower than operating profits. In the baseline, both price pass-through and new compliance costs equal zero. Note also that if many units are treating waste burning capital as sunk it is possible for operating profits to be negative.

4.1.6 Method for Analyzing the Impact of Feed Reductions

As described above, some facilities may choose to comply with the proposed MACT standards by reducing the quantity of pollutants fed to the combustion unit. Therefore, the model plants analysis considers the pollution control measures that would be required if all facilities reduced by 25 percent the quantity of metals (including mercury) and chlorine fed to the combustion unit. When these reductions are introduced, some facilities will require less costly pollution control measures because stack gas concentrations of certain hazardous air pollutants (HAPs) are reduced.

To gauge the economic impact of these reductions, EPA performed two analyses. First, for each regulatory option we examined the number of combustion units that shift to a new model plant when a 25 percent feed reduction is introduced. These are the only facilities that could potentially have an incentive to pursue reduced feed since such a change would mean reduced expenditures on pollution control. The purpose was to determine whether the feed reduction has a substantial impact on the required pollution control measures.

Second, we evaluated whether combustion facilities would have an economic incentive to pursue feed reduction. While feed reduction may limit necessary expenditures on pollution control, it will also affect waste burning revenues. Revenues would be reduced in one of two ways:

- Combustors may choose to simply burn 25 percent less waste, thereby reducing revenues (or avoided costs in the case of on-site incinerators) proportionately.[28]

- Combustors may request that blenders supply them with waste that contains 25 percent less metals and chlorine. While definitive data do not exist, fuel blenders indicate that there would be a cost associated with supplying this lower-concentration waste (see Section 2.2 for additional information on fuel blenders). Blenders estimated a 50 percent increase in the cost of waste handling, assuming

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[28] This method assumes that on-site incinerators implicitly earn revenue on waste burning, i.e., burning 25 percent less waste would require shipping the waste to a commercial combustion facility. Generators operating on-site incinerators also may be able to reduce waste burning by pursuing waste minimization.

that they can meet demand by segregation and dilution.[29] Blenders will likely pass along at least a portion of this cost increase to combustion facilities.

To characterize the incentive that combustion facilities will have to pursue feed reduction, we discuss several examples demonstrating that, in some cases, the revenue impact of feed reduction outweighs the pollution control equipment savings.

4.1.7 Method for Analyzing Removal of Small Quantity Burner (SQB) Exemption

The Boiler and Industrial Furnace (BIF) Rule, promulgated in 1991, introduced emissions and other operating standards designed to control the emissions from, and the waste handling procedures at, waste-burning boilers and industrial furnaces.[30] The rule included an exemption for facilities burning only small quantities of hazardous waste.[31] Under the proposed MACT, this exemption would be temporarily removed until improved emissions data can be gathered from industrial boilers and other facilities that are likely to claim the exemption.[32]

EPA has developed an analysis to characterize the worst-case impact of the removal of the small quantity burner exemption. The Permits and State Programs Division has compiled a list of the 82 facilities that have filed for the BIF rule exemption. Using Dun & Bradstreet data, we identified the SIC and size (as measured by sales and number of employees) of each facility. To evaluate the economic impact of removing the exemption, we first assume that these facilities would pursue off-site management of the waste. Little is known about the characteristics or specific quantities of waste for each facility. Therefore, we make the following additional assumptions:

[29] Personal communication with fuel blenders, including Brian Dawson (Brian Dawson and Associates); Bob Campbell (Pollution Control Industries (PCI)); Brad Lamont (Romic Environmental Technologies); Scott Ellis (Cadence); George Anderson (Waste Research); and Chris Goebel (National Association of Chemical Recyclers (NACR)); 22 February, 1995.

[30] 40 CFR § 266, Subpart H

[31] § 266.108 Small Quantity On-Site Burner Exemption

[32] EPA investigated alternative approaches for establishing new small quantity burner cutoffs under this rule. Efforts were impeded by a lack of data. A cutoff based on the distribution of burn quantities at all waste burning facilities could not be used because available data from BRS were insufficient for estimating per-unit (as opposed to per-facility) burn quantities. A risk-based cutoff for waste burning similarly could not be used due to the absence of emissions profiles for the small units.

- The quantity of waste assumed for each facility is the maximum quantity allowed under the exemption -- 91.2 tons per year. This quantity corresponds to the annual burn quantity for a facility with a stack height of 115 meters or greater.[33]

- The assumed price of off-site disposal of wastes currently burned by SQBs is based on reported prices charged by fuel blenders. The inherent assumption is that SQBs will likely send waste to blenders, not directly to combustion facilities. For the lower bound, we assume a per-ton cost equivalent to the price charged by blenders for liquid wastes ($260) while in the upper bound we assume the price charged for solids ($1,280).[34]

To place the estimated off-site waste management costs in context, we compare these costs to facility revenue where revenue data are available.[35] If costs represent a substantial portion of sales, removal of the exemption is more likely to have an effect on the economic viability of the facility. EPA requests additional data from industry to help refine this portion of the analysis prior to final rulemaking.

4.2 RESULTS OF ECONOMIC IMPACT ANALYSIS

4.2.1 Results of Basic Economic Screens

Our basic economic screens are designed to characterize how the proposed MACT standards would change the cost structure of combustion facilities. While this change in cost structure is useful for assessing the immediate impacts of the rule, it is not sufficient for predicting changes in industry behavior. This is the objective of the breakeven quantity analysis discussed later in this chapter.

Below, we review the results of the three basic economic impact screens: cost per ton of waste burned, costs as a percent of revenues, and costs as a percent of baseline burning costs.

4.2.1.1 Cost Per Ton of Waste Burned

Compliance costs per ton of waste burned illustrate the impact of the proposed MACT standards on a standard basis across different plant sizes. Exhibit 4-7 presents compliance costs per ton for the seven regulatory options. In the commercial sectors, lightweight aggregate kilns bear the greatest cost per ton under all options. This is a result of both the larger per-unit cost incurred as well as the relatively limited tonnage burned per unit. The regulatory burden per ton of waste burned is similar for cement kilns and

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[33] Under the exemption, greater quantities are allowed at greater stack heights because of the improved dispersion of pollutants experienced with higher stacks. See 40 CFR § 266.108(a)(1).

[34] EI Digest, September, 1994.

[35] Data were insufficient to calculate BEQs for small quantity burners.

commercial incinerators (about $100 per ton), except where kilns must install PIC controls (Options 2a and 4). Costs per ton in the on-site incinerator sector are extremely high (thousands of dollars per ton), driven by very low quantities burned at many facilities, which skew the average cost per ton upward.[36]

Costs vary little across regulatory options. For example, commercial incinerator costs per ton increase from $77 to $103 per ton moving from the floor to Option 1b, but vary little for other options. For kilns, costs increase greatly for PIC control options (2 and 4), but otherwise vary minimally. On-site incinerator costs show the greatest increase between Option 1b to 1c where more stringent mercury controls are introduced.

4.2.1.2 Costs as a Percentage of Waste Burning Revenues

Compliance costs as a percentage of revenue illustrate how much of current waste burning revenues might be absorbed by new compliance costs. Exhibit 4-8 summarizes the comparison of costs and revenues per combustion unit. The figures represent the percentage of combustion units that fall into each percentile tier. For example, in the floor, 7 percent of all cement kilns have compliance costs that are less than 10 percent of the revenues (and energy savings) earned on waste burning.

Looking across sectors, we see that commercial incinerators incur costs that represent a relatively small percentage of revenue. Nearly three-quarters of the units incur costs less than ten percent of revenues for the floor and Option 1b. Only 18 percent of the units incur costs exceeding 20 percent of waste burning revenues. This is because, on average, commercial incinerators burn more higher-revenue solids and sludges than do BIFs. In contrast, cement kiln and LWAK impacts are higher because: (1) a number of kilns burn very little waste, and (2) kilns burn more liquids that earn lower revenues on a per ton basis. More than 60 percent of the LWAKs incur costs exceeding 75 percent of waste burning revenues under all MACT scenarios. On-site incinerator impacts are relatively limited for one-third of the units, despite the extremely high average compliance costs per ton of waste burned. This result is due to a skewed distribution of waste burning across units, with many units burning very little waste; these units have high costs relative to revenue, while units with sufficient waste are less affected.

Based on this measure of impacts, increased stringency across regulatory options has little effect. Moving from the floor to Option 1b entails only a small redistribution of cement kilns, on-site incinerators and commercial incinerators; LWAKs do not change at all.

[36] As we will discuss later, on-site incinerators may be burning both hazardous and non-hazardous waste. Even if this is the case, however, the costs of this rule are attributable to the cost of hazardous waste burning; hence, it is accurate to say that costs per ton of hazardous waste are high.

EXHIBIT 4-7

AVERAGE TOTAL ANNUAL BASELINE COST OF BURNING WASTE AND COMPLIANCE COSTS PER TON OF HAZARDOUS WASTE BURNED (Before Consolidation)

Options	Cement Kilns	LWA Kilns	Commercial Incinerators	On-site Incinerators
Baseline	$104	$194	$806	$28,460
Compliance Costs				
Original Floor	$84	$139	$77	$4,806
Option 1b	$90	$139	$103	$4,970
Option 1c	$112	$193	$107	$7,545
Option 2a	$434	$470	$113	$7,629
Option 2b	$112	$470	$113	$7,629
Option 3	$112	$216	$107	$7,545
Option 4	$434	$494	$113	$7,626

Notes:

1. Compliance costs include CEM costs.
2. Average compliance costs per ton exclude units currently not burning hazardous waste.
3. On-site incinerator baseline and compliance costs per ton are high due to the large number of on-site incinerators that reported low tons burned data to BRS in 1991. If facilities are burning larger quantities of hazardous waste compliance costs per ton would actually be lower. If facilities are burning large volumes of non hazardous waste in addition to the hazardous waste, baseline costs per ton would be lower.

EXHIBIT 4-8

NEW COMPLIANCE COSTS AS A PERCENTAGE OF HAZARDOUS WASTE BURNING REVENUES
(percentage of permitted combustion units; see Note 4)

	Cement Kilns					LWAKs					Commercial Incinerators					On-site Incinerators				
	<10%	10-20%	21-50%	51-75%	>75%	<10%	10-20%	21-50%	51-75%	>75%	<10%	10-20%	21-50%	51-75%	>75%	<10%	10-20%	21-50%	51-75%	>75%
Original Floor	7%	16%	44%	13%	20%	8%	0%	23%	8%	62%	71%	12%	0%	6%	12%	33%	7%	24%	7%	28%
Option 1b	4%	11%	49%	13%	22%	8%	0%	23%	8%	62%	71%	12%	0%	0%	18%	33%	7%	20%	9%	30%
Option 1c	0%	13%	49%	7%	31%	8%	0%	15%	8%	69%	65%	18%	0%	0%	18%	31%	7%	19%	11%	31%
Option 2a	0%	0%	4%	4%	91%	0%	0%	8%	15%	77%	59%	24%	0%	0%	18%	24%	15%	19%	11%	31%
Option 2b	0%	13%	49%	7%	31%	0%	0%	8%	15%	77%	59%	24%	0%	0%	18%	24%	15%	19%	11%	31%
Option 3	0%	13%	49%	7%	31%	0%	8%	15%	0%	77%	65%	18%	0%	0%	18%	31%	7%	19%	11%	31%
Option 4	0%	0%	4%	4%	91%	0%	0%	8%	15%	77%	59%	24%	0%	0%	18%	28%	11%	19%	11%	31%

Notes:

1. Compliance costs include CEM costs.
2. Compliance costs as a percent of revenues = [Total compliance costs per ton]/[Waste burning revenues per ton + Energy savings per ton]
3. On-site incinerator revenues are equal to the costs generators avoid by not shipping the waste to a commercial incinerator (waste fees charged + transportation costs).
4. High-end of range (>75 percent) includes units not currently burning hazardous waste.

4.2.1.3 Compliance Costs as a Percentage of Baseline Costs

To evaluate the impact of the proposed MACT standards on the cost structure of combustion facilities, compliance costs as a percentage of baseline burning costs is an illustrative measure. Exhibit 4-9 presents a percentile breakdown of this measure. Cost increases for BIFs are substantial. For example, three quarters of all cement kilns have over a 50 percent increase in the cost of burning under Option 1b. This occurs because in the baseline, waste burning at BIFs requires only limited investments in storage and waste handling equipment, as well as permitting. Baseline costs for BIFs do not include the purchase and operation of the actual kiln. Therefore, addition of the pollution control equipment needed to comply with the proposed MACT standards represents a significant cost increase.[37] Baseline costs include existing investments in pollution controls driven by existing regulations, but do not include the costs of controls that may be required under pending regulations.

Most commercial incinerators will have smaller changes in their basic cost structure (50 to 70 percent of the units will see baseline costs rise by less than 10 percent). This is due to baseline costs that are already relatively high (because they include basic burning equipment such as the kiln itself). Changes in the cost structure for on-site incinerators are also relatively large, although not as large as experienced by BIFs. Twenty-five to 30 percent of the units will face an increase in costs of more than fifty percent. In addition, one must bear in mind that on-site incinerators may burn non-hazardous wastes in their combustion units. If this is true, we have overstated the baseline costs of burning, and impacts on the cost structure of on-site incinerators may be greater than reflected here.

As noted in reference to the other measures of economic impact, the variation across regulatory options is limited. Meeting the floor standards entails the greatest addition to baseline costs; increasing stringency for various HAPs has little impact on compliance costs relative to baseline costs. Only when PIC control standards are introduced (Options 2 and 4) does the distribution of units change drastically.

4.2.2 Alternatives to Combustion

With an increase in costs, combustion facilities will attempt to increase prices charged to generators and fuel blenders. Large increases in the price of combustion will induce waste generators to search for alternative waste management methods. These alternatives include waste minimization and a variety of non-combustion technologies capable of managing particular waste streams that are now combusted. If these options are available in sufficient capacity, they will increase the elasticity of demand for combustion. The price at which these alternatives to combustion are available will limit how much combustors can increase their prices in the face of new compliance costs.

[37] Note that this cost increase should not be interpreted as an increase in the cost of cement production. Unlike other regulatory impact analyses that treat compliance costs as increases in the cost of producing the primary product (e.g., plastic, wood pulp), our analysis focuses solely on the cost increase in waste burning services.

EXHIBIT 4-9

NEW COMPLIANCE COSTS AS A PERCENTAGE OF BASELINE COSTS OF HAZARDOUS WASTE BURNING
(percentage of permitted combustion units; see Note 4)

	Cement Kilns					LWAKs					Commercial Incinerators					On-site Incinerators				
	<10%	10-20%	21-50%	51-75%	>75%	<10%	10-20%	21-50%	51-75%	>75%	<10%	10-20%	21-50%	51-75%	>75%	<10%	10-20%	21-50%	51-75%	>75%
Original Floor	4%	2%	24%	36%	33%	0%	23%	38%	0%	38%	71%	24%	6%	0%	0%	22%	24%	30%	20%	4%
Option 1b	2%	2%	20%	31%	44%	0%	23%	38%	0%	38%	71%	18%	12%	0%	0%	20%	26%	26%	20%	7%
Option 1c	0%	0%	7%	33%	60%	0%	8%	15%	23%	54%	65%	24%	12%	0%	0%	11%	31%	26%	22%	9%
Option 2a	0%	0%	0%	0%	100%	0%	0%	0%	0%	100%	53%	35%	12%	0%	0%	9%	31%	28%	19%	13%
Option 2b	0%	0%	7%	33%	60%	0%	0%	0%	0%	100%	53%	35%	12%	0%	0%	9%	31%	28%	19%	13%
Option 3	0%	0%	7%	33%	60%	0%	0%	15%	0%	85%	65%	24%	12%	0%	0%	11%	31%	26%	22%	9%
Option 4	0%	0%	0%	0%	100%	0%	0%	0%	0%	100%	53%	35%	12%	0%	0%	9%	30%	28%	24%	9%

Notes:

1. Compliance costs include CEM costs.
2. Compliance costs as a percent of baseline costs = [Total annual compliance costs/Total annual baseline costs]
3. Total annual baseline costs = Annualized fixed capital and fixed operating costs + (Variable operating costs * Hazardous waste burned).
4. Percentages include units not currently burning hazardous waste.

Available economic data on the cost of these waste minimization and management alternatives and their regional distribution are not precise enough for us to pinpoint the maximum price increase that combustors could pass through. However, the discussion to follow suggests that alternatives to combustion do exist for many wastestreams, and may constrain combustion price increases. Therefore, EPA has conducted a breakeven quantity analysis incorporating three price pass-through scenarios to bound our evaluation of the impacts of the rule. The low scenario assumes price increases equal to 25 percent of the median compliance costs in the lowest-cost sector (cement kilns). This scenario would be appropriate if waste minimization and alternatives were available at prices only slightly higher than current combustion prices.[38] The high scenario assumes that the entire median compliance cost in the lowest-cost sector (again cement kilns) could be passed through in the form of higher prices. The higher scenario is appropriate if waste minimization and alternatives are significantly more costly than the current cost of combustion, or if they are not applicable to much of the waste that is now burned. Finally, a zero-percent price pass-through analysis bounds the impacts of the rule by assuming that all new compliance costs must be paid from existing profits. Market exit is highest under the zero-percent scenario.

4.2.2.1 Waste Minimization

This analysis of waste minimization potential suggests that generators currently burning wastes may have a number of options for reducing or eliminating these wastes. The results of the analysis are summarized in Exhibit 4-10. A more complete discussion of results can be found in Appendix C.

Overall, EPA estimates that up to 633,000 tons of waste -- a significant portion of all combusted waste -- may be amenable to waste minimization. Three waste generating processes account for most of the tonnage reduction. First, a large quantity of combusted waste is generated by solvent and product recovery/distillation procedures, primarily in the organic chemicals industry. These generators have practiced recovery/distillation for many years, and therefore may be using outdated equipment that is less efficient than modern technologies. The most widely applicable improvement that could be introduced is use of multi-stage stills. This technology is estimated to reduce total generation of waste streams amenable to recovery/distillation by 75 percent and typically entails a relatively modest capital investment of $60,000 to $180,000.

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[38] An increase equal to 25 percent of new compliance costs translates into increases in the average price of combustion of between two and 13 percent under all MACT options other than PIC control (see Exhibit 4-13).

EXHIBIT 4-10

SUMMARY OF WASTE MINIMIZATION ANALYSIS

Waste Generating Process	Waste Minimization Technology	Waste Reduction (tons per year)	Annual Combustion Savings
Cleaning, Rinsing, and Degreasing	Aqueous detergent systems	4,620	$1,943,082
	Precision cleaning systems (supercritical carbon dioxide)	5,409	$2,208,519
Painting and Coatings	Non-hazardous paint/coating	178	$106,472
	High vol. low pressure/airless painting	133	$79,817
Solvent and Product Recovery/Distillation	Vacuum distillation	22,089	$23,247,448
	Multi-stage distillation	208,235	$215,171,340
Product Processing	Recovery systems (engineered for process)	187,863	$111,540,404
Process Waste Removal and Cleaning	Recovery systems (engineered for process)	122,139	$88,734,254
Waste and Spent Material Removal	Recovery systems (engineered for process)	6,928	$6,646,536
Discarding and Decommissioning	Quality control, extended shelf life, reuse	2,935	$1,974,238
Pollution Control and Wastewater Treatment	Recovery and reuse of waste products	72,651	$68,590,712
	Total =	633,180	$520,242,822

Source: Jerome Strauss and Peter Von Szilassy, Versar Incorporated, "Preliminary Assessment of Waste Minimization Potential for Combusted Wastes," prepared for U.S. EPA, March 30, 1995.

Waste minimization opportunities may also exist for product processing wastes. Product processing wastes are generated from product rinsing, filtering, extraction, and forming. They usually consist of virgin product material mixed with a solvent or water as well as some solids. The primary waste minimization opportunities entail recovering product for reuse as well as reusing the rinsewaters to the maximum extent possible. Typically, a recovery system entailing a combination of gravity settling, various stages of filtration, and membrane technology will cost from $80,000 to $300,000, depending on capacity and degree of automation. Such a recovery system will achieve waste reductions of 75 percent or higher.[39] As shown, over 187,000 tons could potentially be eliminated by this measure. Most of these reductions would occur in the organic chemicals industry.

A third major category of waste potentially amenable to waste minimization is generated by process waste removal and cleaning activities. The wastes generated usually are comprised of product and intermediates mixed with solid contaminants and water or solvent depending on the cleaning methods. For multi-product process lines, the waste is generally virgin product that must be removed prior to product change-over. The technologies and associated costs for waste minimization are similar to those of the product processing group; however, product recovery is usually much less due to higher concentrations of contaminants. As shown, over 122,000 tons of waste reduction could potentially be achieved, with most of this occurring in the organic chemicals and pesticides industries.

This analysis is subject to several key caveats that influence the waste minimization potential reflected in the preceding discussion.

- First, as with our investigation of waste management alternatives, a number of technologies appear to have costs low enough that one would expect them to be implemented already. However, EPA has not evaluated the total costs and benefits associated with the waste minimization measures. For a waste minimization measure to truly be cost effective immediately, the total per ton cost of reducing the waste must be less than the marginal cost per ton of combustion. The payback method of identifying waste minimization options relies on simplified capital cost information that understates the total costs by not incorporating operating costs associated with the option. Conversely, the absence of cost savings from reduced raw material, energy, and labor requirements lead to overly high estimated costs of waste minimization.

- Second, a variety of obstacles could impede the adoption of waste minimization, including lack of information and lack of capital for new investments (for smaller generators).

[39] Note that EPA implicitly assumes that the wastestream managed by the recovery system is primarily product that can be reused, thereby allowing large (75 percent) reductions in waste quantity. In contrast, if the waste generated in product processing is primarily low concentration aqueous waste, product recovery may be high, but the tonnage reduction for the overall wastestream will be more limited. Because the Agency has not factored in the form of the waste, it is likely that tonnage reductions are somewhat overstated.

- Third, it is important to reiterate that the analysis considers wastes characterized at a very general level -- BRS source code and industry. At a greater level of detail, there may be characteristics of any given wastestream that preclude or enhance use of the waste minimization measure identified in the analysis.

- Finally, EPA is requesting comments on a number of additional provisions that could alter the economic viability of waste minimization options presented here. The possible requirement that on-site combustors better characterize their waste streams and target waste minimization plans based on this characterization could encourage additional waste minimization and/or pollution prevention. Similarly, in return for specific waste minimization commitments, the Agency may allow combustors additional time to comply with the new regulations or delay calling-in existing permits. While such exceptions will be determined on a case-by-case basis, they could increase the attractiveness of particular waste minimization options.

These caveats suggest that the specific figures for tonnage reduction presented here are fairly rough. Nonetheless, the analysis suggests that a substantial portion of combusted waste could potentially be reduced through the application of waste minimization approaches. In particular, EPA believes that these impacts are most likely to occur in the on-site incinerator sector, where much of the waste amenable to waste minimization is generated. On-site facilities are the most likely to select alternatives to installing new pollution controls at their facilities because of the relatively small tonnage burned at many of them. Some of these facilities, perhaps even many given the results discussed above, may find that the costs of installing pollution prevention technologies are now less expensive than the prices they would have to pay for commercial combustion of their waste. These added incentives for waste minimization are expected to increase the adoption of new management approaches in this sector of the combustion market. EPA is requesting additional information from industry on the likelihood that the new MACT standards will in fact result in greater reliance of waste minimization approaches.

4.2.2.2 Waste Management Alternatives

To evaluate waste management alternatives to combustion, EPA identified the major waste categories in the BRS, determined which might be amenable to alternative treatment, and then quantified the tonnages in these waste categories. The Agency then assembled available cost information for each of the feasible alternatives.

The analysis of waste management alternatives suggests that, based on the waste descriptions in the BRS data, waste management alternatives might exist for a significant portion of waste that is currently combusted. In terms of quantity, the largest wastestreams that may be manageable by other means are low-concentration aqueous wastes and solvent-based wastes. Although there are many technologies under development, this report highlights several that are technologically well-established and are effective even when metals are present (though not all of them remove the metals). The five alternative treatment technologies most applicable to waste streams currently combusted are shown below in Exhibit 4-11. They include:

Exhibit 4-11

APPLICABILITY OF ALTERNATIVE COMBUSTION TECHNOLOGIES

	Air Stripping	Distillation	Gravity Separation	Ozonation	Solvent Extraction
General Location of Unit	On-site	Off-site	On-site	On-site (liquids); off-site (soils)	On-site
Materials Treated: Liquids? Solids/Sludges? Soils? Specific Wastes	 X 3,4	 (non-aqueous) X 3,4	 X 3,4	 X X 1,2,3,4,5	 X X X 3,4,5
Function	Separation	Separation	Separation	Destruction	Separation
Effective If Waste Contains Metals?	Yes	Yes	Yes	Yes	Yes
Treats Volatile Organics?	Yes	Yes	Yes[1]	Yes	Yes
Treats Semi-Volatiles?	No	Yes	Yes[1]	Yes	Yes
Description of any Hazardous Constituents in Residuals (e.g., residual metals requiring stabilization)	Any semi-volatiles or metals	Any metals, certain hazardous organics	(1) Water saturated with all hazardous organics (2) Water with dissolved metals	Residual hazardous organics and all metals	Metals (unless acids are used as solvent)
Minimum Economic Scale (tons/year)	200[2]	None (can be batch operated)	200[2]	2000[3] (liquids) unknown (solids)	2000[3] (liquids) 10,000[4] (solids, soils, sludges)
Other Limitations?	Only for streams of dilute volatiles, e.g., less than 100 ppm		Only separates immiscible phases (e.g., oil and water), <u>not</u> specific components	Very questionable applicability for soils; not effective on chlorinated compounds	Not effective for many compounds

Key to Waste Streams: (1) inorganics without heavy metals; (2) inorganics with heavy metals; (3) organics without heavy metals; (4) organics with heavy metals; and (5) oil/water

Notes:
[1] If not miscible with aqueous portion of stream
[2] 0.1 gallon/minute (gpm) 526 x 10^{5} minutes/yr.
[3] Use activated carbon for smaller volumes.
[4] Less throughput would probably be thermally desorbed or incinerated.

Source: Jerome Strauss, Versar, Inc., "Evaluation of Alternative Treatment Technologies for Wastes That Are Currently Being Sent to Combustion Facilities (Revised Draft)," memorandum prepared for Lisa Harris, U.S. EPA and Bob Black, Industrial Economics, Inc., March 30, 1995; and subsequent conversations.

- Air Stripping. Uses temperature, pressure, and other parameters to transfer volatile contaminants from water to air. Off-gases must be captured and destroyed to prevent release.

- Distillation. Uses heat to separate volatile organics from mixed contaminants. Common distillation techniques include batch distillation, fractionation, steam stripping, and thin film evaporation. Off-gases must be captured and destroyed to prevent release.

- Gravity Separation. Uses gravity to separate aqueous wastes having different specific gravities (e.g., oil in water).

- Ozonation. Uses dissolved ozone and/or hydrogen peroxide to break down organic compounds in waste.

- Solvent Extraction. Waste mixed with a solvent that dissolves the organic constituent of concern. The dissolved waste is then removed from the solvent by distillation.

Additional information on these alternative treatment methods is presented in Exhibit 4-11. The technologies are applicable primarily to organic waste streams, although ozonation can be used on streams containing organics as well. Treatment units tend to be built on-site, rather than as independent commercial units. As a result, to justify such construction, a facility must generate enough waste to adequately utilize the unit.

While all of the technologies can be used to treat liquid waste streams, applicability to soils and sludges is more limited. Furthermore, only ozonation is a destruction technology; all of the others merely separate the waste constituents for further management (that could involve waste combustion). Each also has limitations regarding the types of waste streams it can treat and the residuals that are generated. These limitations could disqualify their use in specific situations.

4.2.2.3 Impact of Alternative Treatment on Quantities Combusted

EPA's analysis of alternative management suggests that up to 1.5 million tons of wastes currently combusted may be amenable to commercially-available alternative management approaches (Exhibit 4-12). This comprises over 47 percent of the 3.0 million tons burned in the combustion facilities covered by the proposed MACT standards.[40]

Were this quantity of waste actually to move out of the combustion sector, the implications for combustion facilities would be extreme. Many combustion units would no longer burn enough wastes to adequately spread their fixed costs, falling below their BEQ. The impacts would be most pronounced for on-site incinerators because 85 percent of the nearly 1.5 million tons that could be diverted are currently

[40] 1991 Biennial Report, Draft Data Summaries, 9/29/94.

Exhibit 4-12

QUANTITY OF KEY WASTESTREAMS THAT COULD POTENTIALLY BE MANAGED BY EACH OF THE CURRENTLY VIABLE ALTERNATIVE TECHNOLOGIES

Wastestream (Form and Source)	Applicable Alternative Technologies	Quantity That Could Be Managed (Tons)
Wastewaters and Aqueous Wastes (PF06) from Process Waste Removal and Cleaning (S07)	1,2,3,4,5	275,140
Wastewaters and Aqueous Wastes (PF06) From Solvent & Product/ Recovery/ Distillation (S05)	1,2,3,5	247,428
Wastewaters and Aqueous Wastes (PF06) From Product Processing (S06)	1,2,3,5	229,036
Nonhalogenated Solvents & Other Organic Liquids (PF02) From Process Waste Removal & Cleaning (S07)	2,3,4	222,329
Nonhalogenated Solvents & Other Organic Liquids (PF02) From Solvent & Product/Recovery/Distillation (S05)	4	219,892
Still Bottoms (PF03) From Pollution Control & Wastewater Treatment (S13)	2,3,4	180,282
Halogenated Organics/ Solvents (PF01) from Pollution Control & Wastewater Treatment (S13)	1,2,3,4,5	98,939
Total Waste that Could Potentially be Diverted		1,473,046

Codes for Applicable Alternative Technologies: (1) Air Stripping; (2) Distillation; (3) Gravity Separation; (4) Solvent Extraction; (5) Ozonation.

Source: Jerome Strauss, Versar, Inc., "Evaluation of Alternative Treatment Technologies for Wastes That Are Currently Being Sent to Combustion Facilities (Revised Draft)," memorandum prepared for Lisa Harris, U.S. EPA and Bob Black, Industrial Economics, Inc., March 30, 1995.

burned at the on-site facilities. Fourteen percent is currently burned in cement kilns, and less than one percent is currently burned in commercial incinerators.[41]

Such a large diversion of wastes is highly unlikely for a number of reasons. First, several alternatives appear quite inexpensive relative to current combustion prices, yet generators have not stopped burning their wastes. Second, generators used combustion as a management tool even when the cost per ton was significantly higher than today. These factors suggest that the costs of the alternative technologies are higher than estimated here, and/or that their applicability to the waste streams of concern is limited by other factors. The main factors that seem to be limiting the use of alternatives in the current marketplace are presented below:

- Cost Estimates for Alternatives May be Understated. Data on the cost of these alternatives are incomplete (see Exhibit 4-13). The main database that tracks the costs of these alternative technologies (ATTIC) contains voluntarily-reported cost data from vendors. Even where data are available, there is little information on what costs are included in the reported numbers. As a result, there is a strong likelihood that many of the costs reported do not necessarily represent the full annualized cost per gallon of treatment.

[41] EPA analysis of the 1991 BRS. Note that the source and form code information needed to conduct the alternatives analysis is most readily available for wastes burned at on-site incinerators, and is often unknown for wastes burned at other facility types. Therefore, although other facility types may burn wastes that are amenable to alternative management, the lack of form and source code information prevents the Agency from analyzing this potential.

Exhibit 4-13

COST DATA ON MOST-APPLICABLE ALTERNATIVE TECHNOLOGIES

	Air Stripping	Distillation	Gravity Separation	Ozonation	Solvent Extraction
Initial Capital Cost	--	\$1,050,000[3]	--	\$70,000 - \$260,000[1] \$130,000 - \$160,000[2]	\$1,030,000[1] \$3,300,000[3]
Estimated Capital Equipment Life (Years)	~ 5 yrs.	~ 10 yrs.	~ 15 yrs.	~ 10 yrs.	~ 10 yrs.
Estimated Annual Gallons Equipment Can Handle	--	35,280,000[3]***	--	65,700,000[3]*	190,008,000[3]**
Permitting Cost	--	--	--	--	
Fixed O&M Costs: Soils/Sludges (\$/ton) Liquids (\$/1000 gal) Liquids (converted to \$/ton)	 \$0.29 - \$0.66[1] \$0.07 - \$0.16	 \$70 - \$380[1]	 \$27 - \$207[1]	 \$30-\$175[1] \$0.25-\$17[1] \$0.06 - \$4.08	 \$120-\$450[1] \$18[1] \$4.32
Variable O&M Costs Liquids (\$/1000 gal) Liquids (converted to \$/ton)	--	\$0.01[3]	--	--	--
Data Source(s)	[1] - ATTIC	[1] - ATTIC [3] - Standard Handbook of Hazardous Waste Treatment and Disposal, 1995	[1] - ATTIC	[1] - ATTIC [2] - Pollution Prevention October 94	[1] - ATTIC [3] - Standard Handbook of Hazardous Waste Treatment and Disposal, 1995

Notes:
* Annual capacity determination based on a remediation operation; assuming 24 hrs/d times 365 d/y times 7,500 gph (125 gpm) flowrate = 65,700,000 g/yr.
** Annual capacity determined based on 728,000 gals/day capacity times 261 days/year = 190,000,000 gal/year.
*** Annual capacity determined based on 8,400 h/yr operation times 4,200 gph = 35,280,000 g/yr.

Source of Compiled Data: Jerome Strauss, Versar, Inc., "Evaluation of Alternative Treatment Technologies for Wastes That Are Currently Being Sent to Combustion Facilities (Revised Draft)," memorandum prepared for Lisa Harris, U.S. EPA and Bob Black, Industrial Economics, Inc., March 30, 1995; and subsequent conversations.

- Average Combustion Prices Don't Adequately Reflect Certain High-Value Segments Such as Solvents. While average combustion prices are well above the estimated price of alternative technologies, actual prices for high-Btu solvent wastes may be very low. For example, cement kilns and blenders may accept the waste for free or even pay generators for the waste. Thus, alternatives for high-Btu solvents (generally separation technologies) may not, in reality, be less expensive than combustion (that recovers the Btu-value of the waste).

- Alternative Management Options May Not Adequately Treat the Specific Waste Streams Now Combusted. This analysis considers waste characterized at a very general level -- BRS source and form code. At a greater level of detail, there may be characteristics of any given waste stream that preclude use of the technology identified in the analysis. For example, two of the inexpensive technologies are limited for certain waste characteristics. Air stripping is effective in removing volatiles but not semi-volatiles. Ozonation is not effective with chlorinated compounds. BRS data do not provide information at this level of detail.

- Generators Have Insufficient Quantities to Justify Installation of Specialized Recovery Equipment. While incineration can handle a wide variety of wastestreams, some of the alternatives may be more narrow in their applicability. Generators may not have sufficient tonnage to meet the minimum economic scale requirements.

- Many On-site Units May Consider Incinerator Capital "Sunk". According to BRS data, much of the combustion tonnage for which alternative treatment exists is currently managed in on-site incinerators. Since the units have already been built, waste management alternatives (fixed plus variable costs) would need to be less expensive than the variable costs at the on-site incinerator. In such cases, the generator may switch to an alternative once the incinerator needs to be replaced, but not earlier.

- Liability Concerns Lead Generators to Favor Combustion. Most of the applicable technologies are separation, not destruction technologies. Thus, while the incineration of low-concentration (low-Btu); high water content wastes makes little sense, the definitive destruction ability of combustion is attractive for many liability-conscious generators.[42]

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[42] We would expect liability concerns to create a combustion premium for generators. That is, a generator will not switch from incineration as soon as another technology is less expensive. However, at some point the cost differential between combustion and alternatives would grow too large, and even liability-conscious generators would begin shifting from combustion.

4.2.2.4 Summary

This waste minimization and alternative treatments analysis suggests that, over time, alternatives to combustion are likely to erode combustion's market share. Available cost data suggest that generators could already realize savings by adopting alternatives. Paradoxically, generators continue to rely on combustion rather than the alternatives. While it appears likely that the factors described above will continue to keep many wastes in the combustion sector in the face of moderate price increases, data on the cost and applicability of these alternatives are not precise enough to assume with any certainty that combustors could increase prices significantly in order to cover their new compliance costs. For this reason, the Agency has evaluated the impacts of the rule assuming no compliance costs could be passed through, as well as other, more likely, scenarios. Over the longer-term, however, the shift to these alternatives could be more significant. In the case where generators treat their on-site incinerator capital as sunk, large required reinvestments in the units could lead plant managers to reevaluate non-combustion alternatives. Given the limited waste quantities from those on-site units that we expect to stop burning hazardous wastes in the face of the new regulation, the short-term effect on the overall market will be small. Nonetheless, large increases in the cost of combustion overall will lead to increased interest in alternatives, and some shifts are likely.

As noted previously, evaluation of the BRS data suggest that on-site incinerators have the greatest waste quantities amenable to waste minimization.[43] As the analysis discussed in the next section indicates, these on-site facilities are also the most likely to cease burning hazardous waste as a result of the new MACT standards. Facilities that cannot afford to install pollution controls that comply with the new standards must face the choice of either sending their waste to a commercial combustion facility or adopting some alternative approach such as waste minimization. Because the costs of waste minimization are often lower than commercial combustion prices for these industries based on the analysis discussed above, many are likely to find that pollution prevention is their preferred alternative.

4.2.3 Breakeven Quantity Analysis and Changes in Waste Burning Behavior

The breakeven quantity analysis examines regulatory impacts at the unit level. By comparing the current tons burned with the tons a combustion unit needs to burn to cover costs, the BEQ analysis identifies combustion units that require increases in the prices they receive and/or the quantities they burn to continue operating profitably.

EPA evaluated a variety of BEQ measures, each of which provides answers to a different set of questions:

- Price Pass-Through Scenarios. As discussed, available data do not allow EPA to identify precisely the price at which waste minimization and alternative management methods would begin to divert significant waste quantities from combustion. Therefore, the Agency calculates whether combustion units meet their BEQs under both small price increases and large increases, as well as assuming no price increases. Higher prices reduce the BEQ; as a result, the more that prices are allowed to rise, the fewer units stop burning wastes. Stated

[43] The BRS data base does include a major category of waste of "unknown" origin. These may also be amenable to waste minimization, although without further data on the source this cannot be analyzed.

differently, more inelastic demand for combustion allows combustion facilities to pass through costs.

- Short-term Versus Long-Term BEQ. For each BEQ measure, the Agency evaluates both the short-term and the long-term. The long-term measure captures behavior over the capital cycle of the combustion units; some may be able to continue operating in the near term, but do not earn enough to replace their waste burning capital when it wears out.

All measures incorporate waste consolidation prior to evaluating BEQ. Thus, a facility with three units permitted to burn hazardous wastes can consolidate waste burning into two or one units in order to meet the BEQ.

4.2.3.1 Low Price Pass-Through Scenario

Under the low price pass-through scenario, prices are assumed to increase in every sector by an amount equal to 25 percent of the median new compliance costs for the lowest-cost sector. Since total costs per ton combusted are lowest in the cement kiln sector for all proposed MACT options, the price increase equals 25 percent of the median cement kiln compliance costs. Under most scenarios, this translates to an increase of less than $25 per ton (see Exhibit 4-14). On a percentage basis, this price increase is minor (less than 4 percent) for incinerators where current weighted average prices are about $600 per ton. The increase is more substantial for kilns (about 12 percent), where current prices are about $200 per ton.

4.2.3.1.1 Short-Term BEQ

As shown in Exhibit 4-15, compliance costs from the proposed MACT would prevent a significant fraction of LWAKs and on-site incinerators from meeting BEQ, but would have a lesser effect on cement kilns and commercial incinerators. Between 20 and 25 percent of the cement kilns are below BEQ, and would be expected to stop burning hazardous wastes. As nine percent of the permitted kilns do not currently burn hazardous wastes, approximately 10 to 15 percent of the market exit may be properly attributed to this rule. More than half of the units would stop burning hazardous wastes if PIC controls were required. In contrast, over 80 percent of the commercial incineration units would meet BEQ under all options. Of the 18 percent expected to close, one-third do not currently burn any hazardous wastes and would likely close even in the absence of this rule. Market exit in this sector is unaffected by the proposed MACT option chosen.

In the LWAK sector, nearly two-thirds of the units do not meet their short-term BEQ in the low price pass-through scenario. However, 31 percent of the LWAKs are not currently burning any wastes. Therefore, at most only half of the expected market exit can be properly attributed to the proposed rule.

EXHIBIT 4-14

WEIGHTED AVERAGE COMBUSTION PRICE PER TON AND INCREASE IN PRICES DUE TO ASSUMED PRICE PASS THROUGH

Price pass through assumed: **25%**
(percentage of median compliance costs for the most efficient sector)

Options	Cement Kilns	LWA Kilns	Commercial Incinerators	On-site Incinerators	Commercial Sector with Lowest Total cost/ton
Current weighted average price	$178	$188	$646	$580	cement kilns
Increase in price due to compliance costs passed through					
Original Floor	$17	$17	$17	$17	cement kilns
Option 1b	$17	$17	$17	$17	cement kilns
Option 1c	$22	$22	$22	$22	cement kilns
Option 2a	$95	$95	$95	$95	cement kilns
Option 2b	$22	$22	$22	$22	cement kilns
Option 3	$22	$22	$22	$22	cement kilns
Option 4	$95	$95	$95	$95	cement kilns

Notes:

1. Compliance costs include CEM costs.
2. Median compliance costs per ton exclude units currently not burning hazardous waste.
3. The commercial sector with the lowest total cost per ton (baseline + compliance cost) drives the assumed increase in combustion prices.
4. Prices for on-site incinerators reflect the cost per ton of off-site treatment that generators avoid by burning the waste on-site.
5. Weighted average price per ton = (solids percentage of total waste burned in each sector x solids price) + (liquids percentage of total waste burned in each sector x liquids price).

EXHIBIT 4-15

PERCENTAGE OF COMBUSTION UNITS MEETING SHORT TERM BEQ AFTER CONSOLIDATION
(Percentage of combustion units; includes units not burning waste in the baseline)

Price pass through assumed: **25%**
(percentage of median compliance costs for the most efficient sector)

	Cement Kilns			LWAKs			Commercial Incinerators			On-site Incinerators		
	Above	<20% below	>20% below	Above	<20% below	>20% below	Above	<20% below	>20% below	Above	<20% below	>20% below
Original Floor	80%	0%	20%	38%	0%	62%	82%	0%	18%	59%	4%	37%
Option 1b	80%	0%	20%	38%	0%	62%	82%	0%	18%	56%	6%	39%
Option 1c	76%	0%	24%	38%	0%	62%	82%	0%	18%	54%	6%	41%
Option 2a	49%	0%	51%	38%	0%	62%	82%	0%	18%	63%	7%	30%
Option 2b	76%	0%	24%	23%	8%	69%	82%	0%	18%	54%	6%	41%
Option 3	76%	0%	24%	38%	0%	62%	82%	0%	18%	54%	6%	41%
Option 4	49%	0%	51%	31%	8%	62%	82%	0%	18%	63%	7%	30%

Notes:

1. Compliance costs include CEM costs.
2. Percent of units currently not burning waste:

Cement Kilns	9%
LWAKs	31%
Commercial Incinerators	6%
On-site Incinerators (burning less than 50 tons)	11%

On-site incinerators are roughly split between units meeting short-term BEQ and those that do not. This reflects the wide spectrum of waste quantities burned at these units, from a few tons per year up to many thousands. More than 10 percent of the on-sites currently burn less than 50 tons of waste per year according to BRS data, comprising roughly 20 percent of the on-site units that do not meet their BEQ. The on-site incinerator results show that more units meet their BEQ in the more expensive options for cement kilns and LWAKs than at the floor. This outcome reflects the fact that as commercial incineration prices rise, the ability to avoid having to ship wastes off-site becomes more valuable. Thus, more on-site units are able to meet their BEQ.

4.2.3.1.2 Long-Term BEQ

The long-term BEQ measure is most interesting when compared to the short-term BEQ results shown above. Exhibit 4-16 presents the percentage of units in each sector that do not meet their long-term BEQ under the low price pass-through scenario. In most sectors, fewer combustion units meet their long-term BEQ than their short-term BEQ. This reflects the fact that long-term viability requires recovery of all costs of combustion, including baseline waste burning capital.

The difference between short-term BEQ and long-term BEQ is larger in the incinerator sectors because baseline capital costs are higher in these sectors than for BIFs. Commercial incinerator exit increases from 18 to 29 percent, while on-site incinerator exit rises by about 15 percentage points under most proposed MACT options. Both LWAKs and cement kilns show only minor differences between the short-term and long-term BEQs.

As with the short-term BEQ, the choice of the proposed MACT option has little impact on the rate of exit from the hazardous waste combustion market. The exceptions are the options requiring PIC controls at the kilns, which demonstrate markedly higher rates of market exit in both the short- and the long-term.

4.2.3.1.3 Expected Cessation of Hazardous Waste Combustion at the Facility Level

The breakeven quantity analysis provides the information needed to assess whether a particular combustion unit is viable. However, evaluating market dislocations must also incorporate facility-level impacts. The BEQ analysis feeds directly into this evaluation; where no unit at a facility can meet BEQ (even after wastes are consolidated), we assume the facility will cease burning hazardous waste completely.[44]

Facility-level impacts provide the best measure of regional economic dislocations. A cement plant that consolidates hazardous waste burning in two units on site rather than the previous three will generate smaller economic impacts than if the plant stops burning wastes altogether. One important caveat is that, for most sectors, exiting the hazardous waste combustion market is fundamentally different from closing a plant. Cement kilns or LWAKs that stop burning hazardous fuels do not stop making cement and aggregate. On-site incinerators are generally located at large industrial facilities such as chemical plants or refineries. Production is likely to continue even if the wastes are sent off-site for management. Only in the case of a commercial incinerator would exit from hazardous waste combustion markets signal the actual closure of the plant.

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[44] Since some units will stop burning hazardous wastes at facilities that continue to burn wastes at other units, facility exit will be lower than unit-level exit.

EXHIBIT 4-16

PERCENTAGE OF COMBUSTION UNITS MEETING LONG TERM BEQ AFTER CONSOLIDATION
(Percentage of combustion units; includes units not burning waste in the baseline)

Price pass through assumed: **25%**
(percentage of median compliance costs for the most efficient sector)

	Cement Kilns			LWAKs			Commercial Incinerators			On-site Incinerators		
	Above	**<20% below**	**>20% below**	**Above**	**<20% below**	**>20% below**	**Above**	**<20% below**	**>20% below**	**Above**	**<20% below**	**>20% below**
Original Floor	73%	2%	24%	38%	0%	62%	71%	0%	29%	41%	6%	54%
Option 1b	73%	2%	24%	38%	0%	62%	71%	0%	29%	41%	6%	54%
Option 1c	69%	2%	29%	38%	0%	62%	71%	0%	29%	39%	7%	54%
Option 2a	47%	2%	51%	31%	8%	62%	71%	0%	29%	46%	2%	52%
Option 2b	69%	2%	29%	15%	0%	85%	71%	0%	29%	39%	6%	56%
Option 3	69%	2%	29%	31%	8%	62%	71%	0%	29%	39%	7%	54%
Option 4	47%	2%	51%	23%	15%	62%	71%	0%	29%	46%	2%	52%

Notes:

1. Compliance costs include CEM costs.
2. Percent of units currently not burning waste:

Cement Kilns	9%
LWAKs	31%
Commercial Incinerators	6%
On-site Incinerators (burning less than 50 tons)	11%

Exhibit 4-17 summarizes market exit by sector. We estimate that two cement-making facilities currently burning hazardous wastes will stop doing so as a result of the proposed rule (though this jumps to 9 facilities if PIC controls are required). To avoid attributing market exit of facilities not viable even in the baseline, Exhibit 4-16 excludes combustors that currently burn no (or less than 50 tons per year in the case of on-site incinerators) hazardous waste even though permitted to do so. Under all options, we estimate four commercial incinerators will exit, versus one LWAK under most options. As with cement kilns, market exit rises to as high as four facilities if PIC controls are required. On-site incinerator exit is between 44 and 61 facilities.

Again, comparing short-term and long-term exit at the facility level provides some interesting insights (see Exhibit 4-18). Exit increases minimally at BIFs because their relatively low baseline capital costs mean that there is little difference between the short run and long run costs that must be recovered. Likewise, the difference between the long- and short-run is moderate for commercial incinerators because they generally have a substantial quantity of waste over which to spread capital costs. In contrast, closures for on-site incinerators nearly double under many MACT options because of substantial baseline capital costs and sometimes small waste quantities over which to spread the costs.

4.2.3.1.4 Operating Profits

Compliance costs reduce operating profits in two ways. First, some firms stop burning, thereby eliminating any waste burning profits they might have had. Second, the increased costs may not be completely recovered through price increases, depressing the profitability of hazardous waste combustion activities at facilities that continue to operate. Under the low price pass-through scenario (see Exhibit 4-19), average operating profits decline in all sectors under most options as new compliance costs must be absorbed by profits. Under all MACT options, operating profits per ton fall substantially more in the cement kiln, LWAK, and on-site incinerator sectors than in the commercial incinerator sector. Declines in the operating profits of the BIFs are driven by relatively high compliance costs. Although compliance costs are somewhat lower for the on-site incinerator sector, the tonnage over which to spread these costs is generally lower, driving up the estimates of compliance cost per ton. The commercial incinerators have both relatively low compliance costs and high tonnage, and therefore show small declines in profitability even in the low price pass-through scenario. Since declines are smaller than for cement kilns, the rule would be expected to improve the competitive position of incinerators somewhat.

Although many sectors experience a significant percentage decline in their operating profit margins, profit margins even after the rule for both cement kilns and BIFs remain quite strong -- between two and three times those at commercial incinerators. Thus, even with recovery of only 25 percent of the compliance costs incurred, hazardous waste combustion remains profitable on an operating basis for these sectors. Under the zero-percent price pass-through bounding scenario (see Appendix G, Exhibit G-5), operating profit margins after the rule for all options not requiring PIC controls are very similar to those under the 25 percent pass-through. This again highlights the greater effect that capacity utilization has on performance relative to price pass-through.

EXHIBIT 4-17

NUMBER OF COMBUSTION FACILITIES LIKELY TO STOP BURNING HAZARDOUS WASTE IN THE SHORT TERM (net of facilities not currently burning waste)

Price pass through assumed: **25%**
(percentage of median compliance costs for the most efficient sector)

	Cement Kilns	LWAKs	Commercial Incinerators	On-site Incinerators
Facilities currently not burning waste (Note 2)	2	1	2	14
Incremental Facilities Likely to Stop Burning Waste				
Original Floor	2	1	4	51
Option 1b	2	1	4	58
Option 1c	2	1	4	61
Option 2a	9	1	4	44
Option 2b	2	4	4	61
Option 3	2	1	4	61
Option 4	9	2	4	44

Notes:

1. Compliance costs include CEM costs.
2. Percentage of facilities currently not burning waste in the cement kiln, LWAK, and commercial incinerator sector; or burning less than 50 tons per year in the on-site incinerator sectors. Some additional units may be nonviable in the baseline, leading us to overestimate closures due to the proposed MACT.

EXHIBIT 4-18

NUMBER OF COMBUSTION FACILITIES LIKELY TO STOP BURNING HAZARDOUS WASTE IN THE LONG TERM
(net of facilities not currently burning waste)

Price pass through assumed: **25%**
(percentage of median compliance costs for the most efficient sector)

	Cement Kilns	LWAKs	Commercial Incinerators	On-site Incinerators
Facilities currently not burning waste (Note 2)	2	1	2	14
Incremental Facilities Likely to Stop Burning Waste				
Original Floor	3	1	6	82
Option 1b	3	1	6	82
Option 1c	3	1	6	85
Option 2a	10	2	6	72
Option 2b	3	4	6	85
Option 3	3	2	6	85
Option 4	10	4	6	72

Notes:

1. Compliance costs include CEM costs.
2. Number of facilities currently not burning waste in the cement kiln, LWAK, and commercial incinerator sectors; or burning less than 50 tons per year in the on-site incinerator sector. Some additional units may be nonviable in the baseline, leading us to overestimate closures due to the proposed MACT.

EXHIBIT 4-19

CHANGE IN AVERAGE OPERATING PROFITS PER TON OF HAZARDOUS WASTE BURNED FROM THE PROPOSED MACT

Price pass through assumed: **25%**
(percentage of median compliance costs for the most efficient sector)

Options	Cement Kilns			LWA Kilns			Commercial Incinerators			On-site Incinerators		
	Operating Profit Margin		% Margin after	Operating Profit Margin		% Margin after	Operating Profit Margin		% Margin after	Operating Profit Margin		% Margin after
	$ Change	% Change	the Rule	$ Change	% Change	the Rule	$ Change	% Change	the Rule	$ Change	% Change	the Rule
Original Floor	($35)	-31%	49%	($32)	-21%	60%	($17)	-14%	19%	($56)	-30%	29%
Option 1b	($45)	-39%	44%	($29)	-20%	61%	($15)	-12%	19%	($48)	-25%	33%
Option 1c	($50)	-41%	44%	($35)	-22%	62%	($19)	-16%	19%	($51)	-26%	33%
Option 2a	($127)	-78%	19%	($122)	-66%	27%	$2	-6%	21%	($68)	-48%	16%
Option 2b	($50)	-41%	44%	($158)	-54%	38%	($24)	-19%	18%	($58)	-29%	32%
Option 3	($50)	-41%	44%	($56)	-32%	54%	($19)	-16%	19%	($51)	-26%	33%
Option 4	($127)	-78%	19%	($141)	-64%	29%	$2	-6%	21%	($64)	-46%	17%

Notes:

1. Compliance costs include CEM costs.
2. Operating Profits = (weighted average price per ton + weighted average energy savings per ton + assumed price increase due to compliance costs passed through) - (average baseline costs per ton + average total annual compliance cost per ton). Assumed price pass-through is a set percentage (shown at the top of this exhibit) of the median compliance cost for the most efficient combustion sector. As this is a static model, we have capped the price pass-through using the combustion units expected to remain burning hazardous waste even though the original pass-through value included some units expected to stop burning. This is a better approximation of the impetus combustors have to raise prices, though it is not a precise predictor. To address uncertainty regarding the amount prices will rise, a variety of price increase scenarios were used. All other averages were calculated after consolidation, and include only those units that continue to burn hazardous waste.
3. Operating profits exclude overhead, other administrative costs, and taxes. Actual after-tax profits will be lower.
4. Percentage Operating Profit Margin = average operating profits per ton / (weighted average price per ton + assumed price increase due to compliance costs passed through). Percentage profit margin after the rule is calculated using the same formula with post-rule operating profits and prices.
5. Change in operating profits per ton = Post-rule operating profits per ton - baseline operating profits per ton. Percentage change in operating profits margin = (post-rule operating profits margin - baseline operating profits margin) / baseline operating profits margin. Baseline operating profit margins for units remaining open after consolidation can be calculated by dividing the percentage profit margin after the rule by one plus the percentage change in the operating profit margin. For consistency, baseline values have been calculated using the median compliance cost per ton for facilities that remain in operation after the rule for each MACT option.

4.2.3.1.5 Waste Diversions

As units close, wastes are consolidated at the same facility in the remaining units. However, if a facility closes, the wastes must be managed elsewhere. Waste diversion levels are important primarily if they are large. Small diversions can easily be absorbed by existing spare capacity at other units; new construction or price increases would be unlikely. Large diversions could lead to capacity scarcity and increased prices, changing the viability of the existing units.

Exhibit 4-20 presents estimated waste diversions under the low price pass-through scenario. For most proposed MACT options, diversions are approximately four percent of the current combusted waste universe with the bulk of diversions coming from the on-site incinerator sector. While these shifts could have noticeable localized effects on some combustion facilities, the impact on the market overall is likely to be small. There is currently adequate spare capacity in all sectors to absorb these shifts.

Options 2a and 4, requiring that cement kilns install PIC controls, will lead to higher waste diversions as more kilns exit the market. Even under these options, however, diversions comprise only about 10 percent of combusted wastes.

4.2.3.2 High Price Pass-Through Scenario

The high price pass-through scenario assumes that all of the new compliance costs for the lowest-cost combustion sector (again cement kilns) could be shifted to generators in the form of higher combustion prices. EPA examined increases in the weighted average price charged by each combustion unit, reflecting its particular mix of liquids and solids burned. The weighted average price increase assumed in the high pass-through scenario ranges from $66 to $87 per ton, depending on proposed MACT option. At the extreme, proposed MACT options 2a and 4 assume an increase of over $380 per ton. As shown above in Exhibit 4-6, even with the large cost increases under PIC controls, cement kilns remain the lowest cost sector. This is driven by a more than $700 per ton cost advantage in the baseline.[45]

EPA believes, however, that price increases on the order of $380 per ton would likely lead to widespread changes in current waste management behavior, especially in terms of waste minimization and non-combustion alternatives. While the Agency does not think that such an increase would be sustained in the market, the results for PIC controls even under the high price scenario are presented to demonstrate the degree to which greater price pass-through limits the impact of the rule on combustion facilities. Details on the price increases by sector are shown in Exhibit 4-21.

Because a higher price pass-through means that combustion units earn more on each ton of waste they burn, they need to burn fewer tons in order to cover their costs. Thus, both short-term and long-term BEQs under the high price pass-through scenario are lower than in the low price pass-through scenario. As a result, market exit is expected to be lower.

[45] A direct comparison ignores the fact that commercial incinerators can burn wastes cement kilns cannot, and that incinerators handle more higher-value solids and sludges than do kilns.

EXHIBIT 4-20

QUANTITY OF HAZARDOUS WASTE THAT COULD BE DIVERTED FROM COMBUSTION FACILITIES IN THE SHORT TERM

Price pass through assumed: **25%**
(percentage of median compliance costs for the most efficient sector)

	Cement Kilns	LWAKs	Commercial Incinerators	On-site Incinerators	TOTAL	Percentage of all BRS Combusted Hazardous Waste
Original Floor	15,640	1,870	4,860	65,790	88,160	3%
Option 1b	15,640	1,870	4,860	79,640	102,010	3%
Option 1c	15,640	1,870	4,860	85,900	108,270	4%
Option 2a	226,760	1,870	4,860	58,810	292,300	10%
Option 2b	15,640	33,370	4,860	85,900	139,770	5%
Option 3	15,640	1,870	4,860	85,900	108,270	4%
Option 4	226,760	16,100	4,860	58,810	306,530	10%

Notes:

1. Compliance costs include CEM costs.
2. Combusted hazardous waste reported to BRS in 1991 excluding tonnage burned in on-site boilers: 2,977,355
3. Totals may not add due to rounding.

EXHIBIT 4-21

WEIGHTED AVERAGE COMBUSTION PRICE PER TON AND INCREASE IN PRICES DUE TO ASSUMED PRICE PASS THROUGH

Price pass through assumed: **100%**

(percentage of median compliance costs for the most efficient sector)

Options	Cement Kilns	LWA Kilns	Commercial Incinerators	On-site Incinerators	Commercial Sector with Lowest Total cost/ton
Current weighted average price	$178	$188	$646	$580	cement kilns
Increase in price due to compliance costs passed through					
Original Floor	$66	$66	$66	$66	cement kilns
Option 1b	$66	$66	$66	$66	cement kilns
Option 1c	$87	$87	$87	$87	cement kilns
Option 2a	$381	$381	$381	$381	cement kilns
Option 2b	$87	$87	$87	$87	cement kilns
Option 3	$87	$87	$87	$87	cement kilns
Option 4	$381	$381	$381	$381	cement kilns

Notes:

1. Compliance costs include CEM costs.
2. Median compliance costs per ton exclude units currently not burning hazardous waste.
3. The commercial sector with the lowest total cost per ton (baseline + compliance cost) drives the assumed increase in combustion prices.
4. Prices for on-site incinerators reflect the cost per ton of off-site treatment that generators avoid by burning the waste on-site.
5. Weighted average price per ton = (solids percentage of total waste burned in each sector x solids price) + (liquids percentage of total waste burned in each sector x liquids price).

4.2.3.2.1 Short-Term BEQ

EPA's analysis indicates few major changes in the percentage of facilities meeting their short-term BEQ between the low and high price pass-through scenarios. As shown in Exhibit 4-22, the number of units meeting BEQ under the high scenario in the cement kiln, LWAK, and on-site incinerator sectors increases by between five and 10 percentage points. Commercial incinerators show no difference; the units expected to close burn small waste quantities and will close under a wide range of conditions. The largest changes occur in the proposed MACT options that require PIC controls. Were cement kilns able to pass through their entire compliance costs to generators, the percentage of cement kiln units meeting BEQ would jump from 49 percent in the low pass-through scenario to 73 percent.

4.2.3.2.2 Long-Term BEQ

As with the low price pass-through scenario, over the longer run, more units fail to meet BEQs. Shifts are largest in the incinerator sectors, again due to their higher baseline combustion capital (see Exhibit 4-23). About 10 percent of the commercial incinerators and 15 percent of on-site incinerators are expected to stop burning wastes when their waste burning capital needs to be replaced.

Comparing the percentage of units meeting their long-term BEQ in the high and low scenarios shows that more units are viable in the high scenario. The increased viability, however, is not that great. The number of facilities meeting long-term BEQs under the high price pass-through scenario increases by only 10 percentage points or so from the low price pass-through scenario. This once again illustrates the importance of the quantity of wastes burned. Tonnage over which to spread fixed costs is a larger factor in meeting BEQ than is the price of combustion.

As with the short-term BEQ, proposed MACT options requiring PIC controls show larger changes between the low and high scenarios. The number of cement kilns and LWAK units meeting long-term BEQ under the high scenario increases by between 15 and 25 percentage points. Even incinerators are helped, since they can match the price increases put forth by the kilns. In both incinerator sectors, the number of units meeting long-term BEQ under the proposed MACT options requiring PIC controls on BIFs increased by more than 10 percentage points over the low price pass-through scenario. As stated above, however, it is unlikely that price increases of this magnitude would be sustained in the market.

4.2.3.2.3 Expected Cessation of Hazardous Waste Combustion at the Facility Level

Facility-level cessation of hazardous waste combustion is presented in Exhibits 4-24 and 4-25. For most MACT options, only the commercial and on-site incinerator sectors show any differences between the short-term and long-term behavior. With the exception of incinerator closures under proposed MACT options 2A and 4 (requiring PIC controls), facility-exit decisions are unaffected by which above-the-floor option is chosen.

EXHIBIT 4-22

PERCENTAGE OF COMBUSTION UNITS MEETING SHORT TERM BEQ AFTER CONSOLIDATION
(Percentage of combustion units; includes units not burning waste in the baseline)

Price pass through assumed: **100%**
(percentage of median compliance costs for the most efficient sector)

	Cement Kilns			LWAKs			Commercial Incinerators			On-site Incinerators		
	Above	<20% below	>20% below	Above	<20% below	>20% below	Above	<20% below	>20% below	Above	<20% below	>20% below
Original Floor	84%	0%	16%	38%	0%	62%	82%	0%	18%	63%	6%	31%
Option 1b	84%	0%	16%	38%	0%	62%	82%	0%	18%	61%	7%	31%
Option 1c	80%	0%	20%	38%	0%	62%	82%	0%	18%	59%	11%	30%
Option 2a	73%	2%	24%	54%	0%	46%	82%	0%	18%	76%	0%	24%
Option 2b	80%	0%	20%	38%	0%	62%	82%	0%	18%	59%	11%	30%
Option 3	80%	0%	20%	38%	0%	62%	82%	0%	18%	59%	11%	30%
Option 4	73%	2%	24%	54%	0%	46%	82%	0%	18%	76%	0%	24%

Notes:

1. Compliance costs include CEM costs.
2. Percent of units currently not burning waste:

Cement Kilns	9%
LWAKs	31%
Commercial Incinerators	6%
On-site Incinerators (burning less than 50 tons)	11%

EXHIBIT 4-23

PERCENTAGE OF COMBUSTION UNITS MEETING LONG TERM BEQ AFTER CONSOLIDATION
(Percentage of combustion units; includes units not burning waste in the baseline)

Price pass through assumed: **100%**
(percentage of median compliance costs for the most efficient sector)

	Cement Kilns			LWAKs			Commercial Incinerators			On-site Incinerators		
	Above	<20% below	>20% below	Above	<20% below	>20% below	Above	<20% below	>20% below	Above	<20% below	>20% below
Original Floor	80%	0%	20%	38%	0%	62%	71%	0%	29%	46%	4%	50%
Option 1b	80%	0%	20%	38%	0%	62%	71%	0%	29%	46%	4%	50%
Option 1c	78%	0%	22%	38%	0%	62%	71%	0%	29%	46%	2%	52%
Option 2a	69%	4%	27%	46%	0%	54%	82%	0%	18%	61%	2%	37%
Option 2b	78%	0%	22%	31%	8%	62%	71%	0%	29%	46%	2%	52%
Option 3	78%	0%	22%	38%	0%	62%	71%	0%	29%	46%	2%	52%
Option 4	69%	4%	27%	46%	0%	54%	82%	0%	18%	61%	2%	37%

Notes:

1. Compliance costs include CEM costs.
2. Percent of units currently not burning waste:

Cement Kilns	9%
LWAKs	31%
Commercial Incinerators	6%
On-site Incinerators (burning less than 50 tons)	11%

EXHIBIT 4-24

NUMBER OF COMBUSTION FACILITIES LIKELY TO STOP BURNING HAZARDOUS WASTE IN THE SHORT TERM
(net of facilities not currently burning waste)

Price pass through assumed: **100%**
(percentage of median compliance costs for the most efficient sector)

	Cement Kilns	LWAKs	Commercial Incinerators	On-site Incinerators
Facilities currently not burning waste (Note 2)	2	1	2	14
Incremental Facilities Likely to Stop Burning Waste				
Original Floor	2	1	4	44
Option 1b	2	1	4	48
Option 1c	2	1	4	51
Option 2a	3	1	4	24
Option 2b	2	1	4	51
Option 3	2	1	4	51
Option 4	3	1	4	24

Notes:

1. Compliance costs include CEM costs.
2. Percentage of facilities currently not burning waste in the cement kiln, LWAK, and commercial incinerator sector; or burning less than 50 tons per year in the on-site incinerator sectors. Some additional units may be nonviable in the baseline, leading us to overestimate closures due to the proposed MACT.

EXHIBIT 4-25

NUMBER OF COMBUSTION FACILITIES LIKELY TO STOP BURNING HAZARDOUS WASTE IN THE LONG TERM
(net of facilities not currently burning waste)

Price pass through assumed: **100%**
(percentage of median compliance costs for the most efficient sector)

	Cement Kilns	LWAKs	Commercial Incinerators	On-site Incinerators
Facilities currently not burning waste (Note 2)	2	1	2	14
Incremental Facilities Likely to Stop Burning Waste				
Original Floor	2	1	6	72
Option 1b	2	1	6	72
Option 1c	2	1	6	72
Option 2a	4	1	4	48
Option 2b	2	2	6	72
Option 3	2	1	6	72
Option 4	4	1	4	48

Notes:

1. Compliance costs include CEM costs.
2. Number of facilities currently not burning waste in the cement kiln, LWAK, and commercial incinerator sectors; or burning less than 50 tons per year in the on-site incinerator sector. Some additional units may be nonviable in the baseline, leading us to overestimate closures due to the proposed MACT.

Of facilities currently burning wastes, EPA estimates that two to three cement kilns, one LWAK, four commercial incinerators, and between 24 and 51 on-site incinerators will exit the hazardous waste combustion market in the short-term. The greatest degree of exit under the high pass-through scenario is at facilities that burn very little waste now.

While higher prices do reduce facility exit somewhat, the change is not large. Cement kiln exit declines only when PIC controls are required (from nine to three). LWAK exit at the floor is unchanged, but drops by as many as three facilities for options requiring PIC controls. Price pass-through influences commercial incinerator exit decisions only for the PIC-control options, and even there only in the long run. Only in the on-site incinerator sector do higher prices keep more facilities burning hazardous waste to any significant degree over the long-term, with about more on-site facilities staying in the market in the high scenario than in the low scenario. For options with PIC controls, as many as 24 additional facilities remain in operation, an increase of 50 percent.

4.2.3.2.4 Operating Profits

Under the high price pass-through scenario (shown in Exhibit 4-26), the impact on operating profits is substantially reduced from the 25 percent scenario. For cement kilns, absolute profit levels remain constant as they recover full costs under all options. Improvements also occur in all other sectors. Both the LWAK and commercial incinerator sectors see dollar operating profit margins rise because price increases at the level of compliance costs for the most efficient combustion sector (cement kilns) exceed the compliance costs for the LWAKs and commercial incinerators under many MACT options. As with the low price pass-through scenario, gains are largest for incinerators under options 2a and 4 where PIC controls are required at the BIFs.

Under some MACT scenarios within the LWAK and on-site incinerator sectors, absolute operating profits decline even with 100 percent pass-through. The most extreme example of this is MACT option 2b in the LWAK sector, where PIC controls are required for LWAKs but not for cement kilns. In this scenario, price increases are small relative to the LWAKs' compliance cost per ton, resulting in a large decline in operating profits. For the on-site incinerator sector, average absolute margins decline under most options. This result is driven primarily by the number of combustion units that remain in the market. Higher price pass-through allows more marginal units to remain in business in the short-term, operating at a level that does not recover invested capital.

While the situation in terms of absolute operating profits improves for most sectors, the impact on profit margins continues to be negative. This is because the same dollar profits are being earned on a service that sells for more money (the old price plus price pass-through). Essentially, the combustion operator must invest more funds (to buy new emissions control equipment) in order to earn the same money as before the rule. Constant profits coupled with higher levels of investment may result in lower returns on assets for these firms, increasing the difficulty of raising capital somewhat.

EXHIBIT 4-26

CHANGE IN AVERAGE OPERATING PROFITS PER TON OF HAZARDOUS WASTE BURNED FROM THE PROPOSED MACT

Price pass through assumed: **100%**
(percentage of median compliance costs for the most efficient sector)

	Cement Kilns			LWA Kilns			Commercial Incinerators			On-site Incinerators		
	Operating Profit Margin		% Margin after	Operating Profit Margin		% Margin after	Operating Profit Margin		% Margin after	Operating Profit Margin		% Margin after
Options	$ Change	% Change	the Rule	$ Change	% Change	the Rule	$ Change	% Change	the Rule	$ Change	% Change	the Rule
Original Floor	$0	-27%	51%	$22	-11%	67%	$37	15%	25%	($23)	-24%	24%
Option 1b	$0	-27%	51%	$22	-11%	67%	$36	14%	25%	($24)	-24%	25%
Option 1c	$0	-26%	53%	$7	-21%	60%	$30	8%	24%	($29)	-28%	24%
Option 2a	$0	-59%	31%	($6)	-59%	25%	$217	76%	38%	$102	-248%	9%
Option 2b	$0	-26%	53%	($98)	-60%	32%	$25	5%	23%	($35)	-31%	23%
Option 3	$0	-26%	53%	($21)	-32%	52%	$30	8%	24%	($29)	-28%	24%
Option 4	$0	-59%	31%	($32)	-67%	20%	$217	76%	38%	$106	-256%	10%

Notes:

1. Compliance costs include CEM costs.
2. Operating Profits = (weighted average price per ton + weighted average energy savings per ton + assumed price increase due to compliance costs passed through) - (average baseline costs per ton + average total annual compliance cost per ton). Assumed price pass-through is a set percentage (shown at the top of this exhibit) of the median compliance cost for the most efficient combustion sector. As this is a static model, we have capped the price pass-through using the combustion units expected to remain burning hazardous waste even though the original pass-through value included some units expected to stop burning. This is a better approximation of the impetus combustors have to raise prices, though it is not a precise predictor. To address uncertainty regarding the amount prices will rise, a variety of price increase scenarios were used. All other averages were calculated after consolidation, and include only those units that continue to burn hazardous waste.
3. Operating profits exclude overhead, other administrative costs, and taxes. Actual after-tax profits will be lower.
4. Percentage Operating Profit Margin = average operating profits per ton / (weighted average price per ton + assumed price increase due to compliance costs passed through). Percentage profit margin after the rule is calculated using the same formula with post-rule operating profits and prices.
5. Change in operating profits per ton = Post-rule operating profits per ton - baseline operating profits per ton. Percentage change in operating profits margin = (post-rule operating profits margin - baseline operating profits margin) / baseline operating profits margin. Baseline operating profit margins for units remaining open after consolidation can be calculated by dividing the percentage profit margin after the rule by one plus the percentage change in the operating profit margin. For consistency, baseline values have been calculated using the median compliance cost per ton for facilities that remain in operation after the rule for each MACT option.

Average margins in the on-site incinerator sector after the rule are relatively low. This outcome is the result of a combination of two factors. First, there are many units operating at levels that do not recover full capital costs.[46] Second, the average is somewhat skewed downward by the capping of price increases based on the median cement kiln compliance cost for the cement kilns that remain in the waste burning market after consolidation (see Exhibit 4-26, note 3). By capping the post-consolidation price increases at this cost, the calculated operating profit margins for the on-site incinerator sector decline under most options.[47] As stated throughout the report, EPA does not think 100 percent price pass-through under options 2a and 4 is likely to be sustained in the market.

4.2.3.2.5 Waste Diversions

As discussed above, while a large number of facilities decide to stop burning hazardous wastes, the waste quantities they currently manage are quite small (see Exhibit 4-27). EPA estimates that less than three percent of the wastes currently burned at combustion units regulated by the proposed MACT standards will be diverted due to facility closure. Since the PIC control options assume a larger price increase is matched by the other combustion sectors (since they have higher combustion costs than the cement kilns), more facilities stay in the combustion business under PIC control than under other proposed MACT options; hence, projected waste diversions are lower. As stated above, we do not have a high degree of confidence in this particular conclusion. With this exception, we expect minor waste diversions under our high price pass-through scenario across proposed MACT options.

4.2.3.3 Zero-Percent Price Pass-Through Scenario

To bound the impact of the proposed rule on combustors, EPA also evaluated a zero-percent price pass-through scenario. This scenario assumes that new compliance costs from the rule must be paid entirely from existing profits; there will be no increase in the price of combustion services. The zero-percent price pass-through scenario models a market situation where there are many low-cost waste minimization and non-combustion alternatives for waste streams that are currently combusted, preventing price increases. As the price increases under the low price-through scenario were quite small, differences between the that scenario and the zero-percent scenario are also relatively small. A more detailed comparison between the low and zero scenarios can be found in Appendix G.

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[46] The large declines in percentage margins (such as under options 2a and 4 for the on-site incinerators) despite large increases in absolute operating profits are due to negative operating profits in the baseline, implying many burners are treating existing capital equipment as "sunk".

[47] The price increase after consolidation is capped at the median compliance cost per ton for cement kilns that remain in the hazardous waste burning market. While this provides a better measure of the impetus to raise prices after the rule, it generates a price increase of about $90 per ton less than the median compliance cost for the entire universe of hazardous waste burning cement kilns before consolidation, and therefore depresses the calculated operating margins. The impacts from this capping are largest under options 2a and 4.

EXHIBIT 4-27

QUANTITY OF HAZARDOUS WASTE THAT COULD BE DIVERTED FROM COMBUSTION FACILITIES IN THE SHORT TERM

Price pass through assumed: **100%**
(percentage of median compliance costs for the most efficient sector)

	Cement Kilns	LWAKs	Commercial Incinerators	On-site Incinerators	TOTAL	Percentage of all BRS Combusted Hazardous Waste
Original Floor	15,640	1,870	4,860	59,290	81,660	3%
Option 1b	15,640	1,870	4,860	64,480	86,850	3%
Option 1c	15,640	1,870	4,860	70,740	93,110	3%
Option 2a	37,250	1,870	4,860	14,890	58,870	2%
Option 2b	15,640	1,870	4,860	70,740	93,110	3%
Option 3	15,640	1,870	4,860	70,740	93,110	3%
Option 4	37,250	1,870	4,860	14,890	58,870	2%

Notes:

1. Compliance costs include CEM costs.
2. Combusted hazardous waste reported to BRS in 1991 excluding tonnage burned in on-site boilers: 2,977,355
3. Totals may not add due to rounding.

4.2.3.4 Summary of BEQ Analysis

A number of key conclusions arise from our BEQ analysis. First, with the exception of PIC controls, the proposed MACT option chosen has little impact on the number of facilities that stop burning hazardous waste; most impacts arise in achieving the proposed MACT floor. Second, the quantity of wastes burned at a facility is the most important determinant of whether a combustion unit can meet its BEQ. The ability to raise combustion prices does help facilities meet their BEQ in all sectors, but prices are less important than tons burned. Third, additional market exit can be expected in both the commercial and on-site incinerator sectors as waste burning capital needs to be replaced. In contrast, cement kilns and LWAKs that meet their short-term BEQ are likely to continue burning hazardous wastes for the foreseeable future.

In terms of the number of facilities that stop burning hazardous wastes, the BEQ analysis illustrates important differences across sectors. Few cement kilns or commercial incinerators will stop burning hazardous wastes even under the zero price pass-through scenario. While some LWAKs and many on-site incinerators are expected to stop combusting waste, most of these units burn very little waste now. As a result, waste diversions as combustion facilities close are expected to be very small under both high and low scenarios and under all regulatory options except PIC controls with low price pass-through, where diversions reach up to ten percent of the current combustion universe.

In general, although this analysis is subject to numerous uncertainties, EPA believes it tends to overstate closures in the commercial sector. The key uncertainties are as follow:

- As noted above, not all market exit can properly be attributed to the new proposed MACT standards. In addition to permitted facilities that currently burn no hazardous waste (and have been excluded from the Exhibits), there are some facilities that burn extremely small tonnages, and, based on available data, appear to burn at a loss even under the current regulatory environment.

- BEQ calculations are sensitive to data on waste quantities burned, data that may not be fully up-to-date.[48] Units reported to have burned very low quantities of wastes in the past are likely to have either increased tonnages (if they had been in start-up mode) or exited the market already. Either change would reduce the likelihood of market exit attributable to this rule.

- BEQ calculations are also sensitive to combustion prices. We rely on national averages, and therefore may understate waste burning revenues at combustion units that appear to be below BEQ .[49]

[48] Data on commercial BIFs and incinerators are based on surveys conducted by EI Digest, a trade journal. Data are generally one year old, and are sometimes reported at the facility rather than the combustion unit level. Data on on-site incinerators, and on the mix of liquids and solids burned, are based on EPA data such as the BRS. Data are between two and four years old.

[49] While average values also overstate revenues at some facilities (making certain units appear more profitable than they are in reality), few facilities appear so close to BEQ that they would fall below it if their revenues fell slightly.

All of these factors make it more likely that this analysis overstates closures due to the rule. As a result, EPA believes that actual market exit in the commercial sector will be lower than our model predicts, although the model plant approach may over- or understate costs and the likelihood of exit for a specific combustion unit.

One caveat is that declining profits on hazardous waste combustion services provided by cement kilns may reduce the ability of kilns to cross subsidize marginal cement operations with hazardous waste revenues. EPA does not expect this to be a major issue because cement markets are extremely healthy now, and because operating profits on waste burning remain quite strong even under the low price pass-through scenario (although margins do fall).

In the on-site incinerator sector, uncertainties work in both directions. In terms of overstating the number of incinerators likely to stop burning hazardous wastes, three factors are in operation:

- Waste quantity burned data for on-site incinerators is four years old and is self-reported by combustors. Inaccuracies could be substantial.
- Operators of some on-site incinerators may continue to operate units at a loss to avoid liabilities associated with off-site shipments.
- Some on-site incinerators may spread the fixed costs of combustion over both hazardous and non-hazardous wastes burned at the incinerator.

In contrast, one important factor suggests that our model may understate closures for on-site incinerators. In every model plant category, EPA assumes that the uncharacterized universe of facilities follows the same pattern as the characterized universe. There are some indications that the on-site incinerators that were not characterized burned smaller waste quantities than those that were. If this is the case, the units would be more likely to fall short of their BEQ. Without better data, the Agency cannot determine the net effect of these four factors.

4.2.4 Total Costs of the Proposed MACT Standards

Chapter 3 presented the pre-tax engineering costs of the rule, assuming that all facilities would comply with the rule. The breakeven quantity analysis identifies how many combustion units are likely to stop burning hazardous wastes, rather than comply with the rule. Because these units do not need to invest in pollution controls, the total cost of the rule decreases. Wastes diverted as a result of market exit are assumed to be managed by the remaining units, which would probably increase costs slightly.

Because the estimate of total pre-tax costs is affected by the number of combustion units that exit the market, the degree to which compliance costs can be passed through to generators in the form of higher prices will affect the overall cost of the rule. EPA therefore prepared two estimates, one for the low price pass-through scenario and one for the high price pass-through scenario. Exhibits 4-28 and 4-29 present these estimates. The Agency also evaluated a zero-percent pass-through scenario to bound the expected costs of the proposed rule. Total expected costs are approximately 20 to 30 percent below the engineering costs of the rule that were presented in Chapter 3. Because compliance costs are tax-deductible business expenses, the cost of the rule to firms will be a further 20 to 30 percent below this, depending on the firm's marginal tax rate.

The impact of market exit on costs incurred is even clearer when viewed on a cost per ton basis. Exhibits 4-30 and 4-31 present average total annual compliance costs per ton under both the low and high price pass-through scenarios. While there remain differences across sectors, they are relatively small. The most noticeable difference between the after-consolidation numbers and those before consolidation (shown in Exhibit 4-7) is in the on-site incinerator sector. Costs per ton after consolidation are in some cases lower than for BIFs, where before consolidation they were in the thousands of dollars per ton. This shift is due to the exit of the least efficient facilities (i.e., those spreading costs over little or no waste). Again, costs vary minimally across all MACT options with the exception of PIC controls. Also excluding PIC controls, the compliance costs per ton in the zero-percent price pass-through scenario are very similar to the low scenario.

4.2.5 Waste Feed Reduction Compliance Option

As an alternative to installing new pollution control equipment to comply with the proposed MACT standards, facilities may be able to comply by reducing waste feed. However, data suggest that the number of facilities that will institute feed reductions is likely to be small. First, even if one assumes that feed reduction is costless for the combustion facility (which it is not), a relatively limited number of units actually shift to a less costly model plant when the 25 percent feed reduction is pursued. As shown in Exhibit 4-32, the number of combustion units moving to a new model plant varies by regulatory option. Overall, it appears that on-site incinerators and cement kilns (under some regulatory options) have the greatest likelihood of reducing pollution control expenditures with feed reductions. Virtually no commercial incinerators will find it advantageous to reduce feed. In general, the maximum number of combustion units that change model plant assignment is 18 (under Option 4), roughly 14 percent of all the units in the model plants analysis.

The incentive to pursue feed reductions will be further limited by the fact that such reductions will curtail the revenue earned on waste burning. As noted earlier, combustors may choose to simply burn 25 percent less waste, reducing revenues proportionately.[50] In some cases, the revenue loss that follows from

[50] Note that for an on-site incinerator, the "revenue" impact of burning 25 percent less waste is the loss of implicit revenue when waste is sent to a commercial combustion facility.

EXHIBIT 4-28

**TOTAL ANNUAL PRE-TAX COMPLIANCE COSTS (millions)
AFTER UNIT CONSOLIDATIONS**

Price pass through assumed: **25%**
(percentage of median compliance costs for the most efficient sector)

Options	Cement Kilns	LWA Kilns	Commercial Incinerators	On-site Incinerators	Total	Percentage Difference from Engineering Costs
Original Floor	$51	$3	$17	$70	$140	-26%
Option 1b	$56	$3	$19	$74	$152	-27%
Option 1c	$65	$4	$22	$84	$175	-29%
Option 2a	$150	$12	$26	$98	$286	-49%
Option 2b	$65	$7	$26	$93	$191	-32%
Option 3	$65	$5	$22	$84	$176	-29%
Option 4	$150	$10	$26	$98	$285	-49%

Notes:

1. Compliance costs include CEM costs.
2. Compliance costs after consolidation include the costs for those units that will continue to burn waste, as well as the shipping and disposal costs (after the assumed price increase) for on-site incinerators that decide to stop burning wastes on-site. Other types of combustion units that stop burning wastes do not incur compliance costs and therefore are excluded.
3. Because compliance costs are tax-deductible, the portion of pre-tax costs borne by the firm would be between 70 and 80 percent of the values shown above, depending on the specific firm's marginal tax bracket.
4. "Consolidation" allows for non-viable combustion units to consolidate waste flows with other units at the same site, or to exit the waste burning market. As a result, the number of combustion units incurring compliance costs is reduced.

EXHIBIT 4-29

TOTAL ANNUAL PRE-TAX COMPLIANCE COSTS (millions)
AFTER UNIT CONSOLIDATIONS

Price pass through assumed: **100%**
(percentage of median compliance costs for the most efficient sector)

Options	Cement Kilns	LWA Kilns	Commercial Incinerators	On-site Incinerators	Total	Percentage Difference from Engineering Costs
Original Floor	$55	$3	$17	$73	$147	-22%
Option 1b	$60	$3	$19	$77	$159	-23%
Option 1c	$71	$4	$22	$89	$185	-25%
Option 2a	$254	$17	$26	$106	$403	-28%
Option 2b	$71	$12	$26	$97	$206	-27%
Option 3	$71	$5	$22	$89	$187	-25%
Option 4	$254	$19	$26	$106	$405	-28%

Notes:

1. Compliance costs include CEM costs.
2. Compliance costs after consolidation include the costs for those units that will continue to burn waste, as well as the shipping and disposal costs (after the assumed price increase) for on-site incinerators that decide to stop burning wastes on-site. Other types of combustion units that stop burning wastes do not incur compliance costs and therefore are excluded.
3. Because compliance costs are tax-deductible, the portion of pre-tax costs borne by the firm would be between 70 and 80 percent of the values shown above, depending on the specific firm's marginal tax bracket.
4. "Consolidation" allows for non-viable combustion units to consolidate waste flows with other units at the same site, or to exit the waste burning market. As a result, the number of combustion units incurring compliance costs is reduced.

EXHIBIT 4-30

AVERAGE TOTAL ANNUAL PRE-TAX COMPLIANCE COSTS PER TON
(Short Term - After Consolidation)

Price pass through assumed: **25%**
(percentage of median compliance costs for the most efficient sector)

Options	Cement Kilns	LWA Kilns	Commercial Incinerators	On-site Incinerators
Original Floor	$58	$44	$29	$67
Option 1b	$62	$44	$30	$63
Option 1c	$70	$51	$36	$67
Option 2a	$199	$164	$41	$111
Option 2b	$70	$175	$41	$74
Option 3	$70	$72	$36	$67
Option 4	$199	$184	$41	$107

Notes:

1. Compliance costs include CEM costs.
2. Average compliance costs per ton exclude units that are not likely to comply with the rule.
3. Average on-site incinerator compliance costs include direct costs of meeting the new emission levels. Indirect costs to facilities that stop burning wastes and must ship them off-site for management are not included.
4. Because compliance costs are tax-deductible, the portion of pre-tax costs borne by the firm would be between 70 and 80 percent of the values shown above, depending on the specific firm's marginal tax bracket.

EXHIBIT 4-31

AVERAGE TOTAL ANNUAL PRE-TAX COMPLIANCE COSTS PER TON
(Short Term - After Consolidation)

Price pass through assumed: **100%**
(percentage of median compliance costs for the most efficient sector)

Options	Cement Kilns	LWA Kilns	Commercial Incinerators	On-site Incinerators
Original Floor	$63	$44	$29	$89
Option 1b	$69	$44	$30	$90
Option 1c	$79	$59	$36	$95
Option 2a	$279	$264	$41	$156
Option 2b	$79	$164	$41	$102
Option 3	$79	$87	$36	$95
Option 4	$279	$290	$41	$152

Notes:

1. Compliance costs include CEM costs.
2. Average compliance costs per ton exclude units that are not likely to comply with the rule.
3. Average on-site incinerator compliance costs include direct costs of meeting the new emission levels. Indirect costs to facilities that stop burning wastes and must ship them off-site for management are not included.
4. Because compliance costs are tax-deductible, the portion of pre-tax costs borne by the firm would be between 70 and 80 percent of the values shown above, depending on the specific firm's marginal tax bracket.

EXHIBIT 4-32

Number of Units Changing Model Plant Assignments After Waste Feed Reductions

Options	Cement Kilns	LWAKs	Commercial Incinerators	On-site Incinerators	TOTAL Number of Units	TOTAL Percent of All Units
Floor	7	3	0	5	15	12%
Above the Floor						
1b	4	3	0	0	7	5%
1c	3	2	1	9	15	12%
2a	3	2	1	9	15	12%
2b	3	2	1	11	17	13%
3	3	2	1	9	15	12%
4	3	3	1	11	18	14%

Number of Units Included in the Model Plant Analysis:

Cement Kilns	45
LWAKs	13
Commercial Incinerators	17
On-site Incinerators	54

the feed reduction will outweigh the savings on pollution control equipment; in other cases, the revenue loss is less than the savings. Exhibit 4-33 summarizes this effect. In the hypothetical example, the cement kiln would lose more waste burning revenue by feed reductions than it would cost to install the incremental pollution controls. The kiln would therefore install controls. In contrast, the LWAK could save nearly $400,000 in compliance costs by reducing waste feeds. As shown in these two sample cases, depending on facility-specific conditions, the combustor may or may not have the incentive to burn 25 percent less waste.

Exhibit 4-33

REVENUE LOSSES UNDER FEED REDUCTION COMPLIANCE OPTION

Example Facility	Regulatory Option	Savings on Pollution Control if Burn 25% Less Waste	Revenue Loss if Burn 25% Less Waste
Cement Kiln	Floor	$424,000	$894,000
LWAK	1c	$611,000	$228,000

To achieve the feed reduction, commercial combustion facilities (but probably not on-site facilities) also have the option of requesting that blenders supply them with waste that contains 25 percent less metals and chlorine. As noted, fuel blenders indicate that there would be a cost associated with supplying this lower-concentration waste. Blenders estimated a 50 percent increase in the cost of waste handling, assuming that they can meet demand by segregation and dilution.[51] Without knowing the baseline costs of waste blending, however, we are unable to estimate the magnitude of the new costs that blenders would experience. In addition, determining the economic effect of increased blending costs is difficult because the cost of supplying combustion facilities with lower-concentration waste would be split between three groups:

- Combustion facilities could receive a lower price per ton for specially blended wastes;
- Generators could bear a portion of the costs if blenders pass costs back to them in higher prices; and
- Blenders may absorb a portion of the costs from profit.

Consequently, we cannot determine which of these outcomes will dominate. However, to the extent that blenders attempt to pass costs on to combustors, combustors will have a reduced incentive to pursue the feed reduction option.

[51] Personal communication with fuel blenders, including Brian Dawson, et al., 22 February, 1995.

Overall, the feed reduction compliance option is likely to have a minimal effect on the total cost of the rule. First, as noted in Chapter 3, the feed reduction option has very limited impacts on the overall costs of compliance (roughly two to five percent). As shown here, this is because few facilities have sufficiently low emissions to install more modest pollution control when feed reductions are introduced. Finally, as we have demonstrated, the savings on pollution control equipment will, in some cases, be exceeded by the lost revenues; this further limits the likelihood that combustors will pursue the option.

4.2.6 Effects of Removing Small Quantity Burner Exemption

As noted earlier, the new proposed MACT rule will temporarily remove the BIF rule exemption for small quantity burners. Our evaluation of the impact of this action relies on a comparison of waste management costs to overall facility sales for the affected facilities. Exhibit 4-34 reports the results of this analysis. The facilities listed are those that applied for the small quantity burner exemption under the BIF rule as of February, 1994.[52] As shown, roughly half of the firms claiming the exemption are in SIC 4911 (electrical services). Furniture manufacturers are also prominent on the list. While employee data were available for only a subset of facilities, the data suggest that firms claiming the exemption range from large (e.g., 2,400 employees) to very small (e.g., one employee), with an average of 350 employees.

Overall, it appears that removal of the exemption would have a small impact on all but a few affected facilities. As shown, the estimated lower bound cost of off-site management at a fuel blender is approximately $24,000 per year while the upper bound cost is about $117,000 per year. Sales data are available for 23 of the 82 affected facilities. In the case of extremely small facilities, the costs could be substantial; four facilities show upper bound costs greater than four percent of total revenues. However, for most facilities the off-site management costs that would result when the exemption is removed represent a minor portion of facility revenues. On average, the costs are between 0.4 and 1.9 percent of facility revenues. The likelihood of adverse economic impact is especially limited for the electrical services facilities, which make up much of the SQB universe. These facilities tend to be larger and will likely be able to absorb the relatively minor increases in waste management costs.

4.3 SUMMARY OF ECONOMIC IMPACTS ON AFFECTED GROUPS

This section summarizes the impacts of the proposed MACT standards on the combustion market, and then presents the impacts on each key market participant: cement kilns, commercial incinerators, lightweight aggregate kilns, on-site incinerators, hazardous waste generators, and fuel blenders. Although on-site boilers are not covered under the proposed rule, all other combustion sectors are. Therefore, EPA thought it important to summarize how the exempt boilers might interact with the other market sectors subject to the rule. Finally, we provide context for evaluating the proposed MACT standards by examining the impact of a number of other pending market changes on competitive dynamics in the combustion industry.

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[52] Based on "Hazardous Waste Boilers and Industrial Furnaces (BIFs) with Either a Metals Reclamation Exemption or Small Quantity Burner Exemption," U.S. EPA Permits and State Programs Division, February 23, 1994. Metals reclamation facilities are not included in our analysis.

EXHIBIT 4-34
COST IMPACT OF REMOVING SMALL QUANTITY BURNER EXEMPTION

Estimated Waste Per Facility (tons) = 91.2
Price Paid to Fuel Blenders for Liquids = $260
Price Paid to Fuel Blenders for Solids = $1,280
Off-Site Management Cost (Lower Bound) = $23,712
Off-Site Management Cost (Upper Bound) = $116,736

Facility Name	Location	ST	SIC Code	Number of Employees	Estimated Sales	Offsite Waste Management Cost as a Percent of Sales: Lower	Offsite Waste Management Cost as a Percent of Sales: Upper
Citrus Central		FL					
NCDHR - Caswell Center		NC					
Vaughn-Bassett - Elkin		NC					
Hoosier Energy	Merom	IN	1521				
Eau Claire Asphalt	Eau Claire	WI	1611	4	$577,000	4.1%	20.2%
Campbell Soup Company	Maxton	NC	2032	700	$198,683,000	0.0%	0.1%
Campbell Soup Company	Napoleon	OH	2033	2,400	$569,820,000	0.0%	0.0%
Central Soya	Decatur	IN	2041	270	$51,000,000	0.0%	0.2%
Central Soya	Bellevue	OH	2075	101	$70,443,000	0.0%	0.2%
Masonite		NC	24				
IXL Furniture Co.		NC	2434				
Collingwood Furniture		NC	25				
Ethan Allen	Old Fort	NC	2511				
Ethan Allen	Spruce Pine	NC	2511	140	$10,690,000	0.2%	1.1%
Stanley Furn. - Lexington		NC	2511				
Stanley Furn. - Robbinsville		NC	2511				
Hickory Chair		NC	2512				
Gunlocke	Wayland	NY	2531	750	$93,399,000	0.0%	0.1%
Gregson Furniture		NC	2599	150	$13,042,000	0.2%	0.9%
Thomasville Furniture		NC	2599				
Banner Fiberboard	Wallsburg	WV	2631	67	$8,000,000	0.3%	1.5%
DOE - Savannah River		SC	2819				
Olin Chemical	Lake Charles	LA	2865				
Carbose	Somerset	PA	2869	20	$2,000,000	1.2%	5.8%
Union Camp	Dover	OH	2869				
Uniroyal Goodrich Tire Company	Woodburn	IN	3011	1,700	$352,362,000	0.0%	0.0%
Anchor Glass Container		FL	3221				
Anchor Glass Container		GA	3221				
Tri-Cities Barrel Company	Port Crane	NY	3412	1	$164,000	14.5%	71.2%
FMC Corp Naval Systems Division	Minneapolis	MN	3489				
Bruce Hardwood Floors		TN	3999				
Allegheny Power - Armstrong Station	Adrian	PA	4911				
Allegheny Power - Hatfield Station	Masontown	PA	4911				
Arizona Public Services	Challa	AZ	4911				
CP&L - Cape Fear		NC	4911				
CP&L - Lee		NC	4911				
CP&L - Mayo		NC	4911				
CP&L - Roxboro		NC	4911	15	$6,084,000	0.4%	1.9%
CP&L - Sutton		NC	4911				
CP&L - Weatherspoon		NC	4911				
Centralia Steam Electric Plant	Centralia	WA	4911				
Commonwealth Edison Collins Street	Grundy County	IL	4911				
Cooperative Power Association	Underwood	ND	4911				
Interstate Power Fox Lake Station	Fox Lake	MN	4911				
Iowa Public Service	Sioux City	IA	4911				
Kansas City Power & Light	Lacgyne	KS	4911				
Kansas City Power & Light	Clinton	MO	4911	166	$67,330,000	0.0%	0.2%

EXHIBIT 4-34
COST IMPACT OF REMOVING SMALL QUANTITY BURNER EXEMPTION

Estimated Waste Per Facility (tons) =	91.2
Price Paid to Fuel Blenders for Liquids =	$260
Price Paid to Fuel Blenders for Solids =	$1,280
Off-Site Management Cost (Lower Bound) =	$23,712
Off-Site Management Cost (Upper Bound) =	$116,736

Facility Name	Location	ST	SIC Code	Number of Employees	Estimated Sales	Offsite Waste Management Cost as a Percent of Sales	
						Lower	Upper
Kansas City Power & Light	Weston	MO	4911				
Kansas City Power & Light	Kansas City	MO	4911	400	$857,450,000	0.0%	0.0%
Monongahela Power - Ft. Martin Station	Maidsville	WV	4911				
Monongahela Power - Pleasants Station	Willow Island	WV	4911				
Monongahela Powr - Harrison Station	Haywood	WV	4911				
OG&E - Horseshoe	Harrah	OK	4911				
OG&E - Muskogee	Muskogee	OK	4911				
OG&E - Mustang	Oklahoma City	OK	4911				
OG&E - Seminole	Konawa	OK	4911				
OG&E - Sooner	Red Rock	OK	4911				
OPPD North Omaha Station	Omaha	NE	4911				
OPPD Unit One Station	Omaha	NE	4911				
Pacific Power	Glenrock	WY	4911				
Pacific Power	Point of Rocks	WY	4911				
Pacific Power/Utah Power	Gillette	WY	4911				
Portland General Electric	Boardman	OR	4911				
Riverside Generating Station	Davenport	IA	4911				
SW Public Service Center - Jones Station	Lubbock	TX	4911				
SW Public Service Center - Nichola	Amarillo	TX	4911				
SW Public Service Center - Plant X	Earth	TX	4911				
Springfield CWLP	Springfield	IL	4911				
TX - NM Power Company	Fort Worth	TX	4911	75	$30,420,000	0.1%	0.4%
United Power Association	Stanton	ND	4911	79	$32,042,000	0.1%	0.4%
Muscatine Power & Water	Muscatine	IA	4941	262	$106,267,000	0.0%	0.1%
Muscatine Power & Water	Muscatine	IA	4941	262	$106,267,000	0.0%	0.1%
Anchor Glass Container	Hayward	CA	5085	200	$74,936,000	0.0%	0.2%
Occidental Chemical		NC	5169	220	$206,364,000	0.0%	0.1%
Geneva Steel	Provo	UT	7349				
Tristate Auto Transmission	Chapmanville	WV	7537				
Swede's Repair	Cambridge	MN	7538	3	$229,000	10.4%	51.0%
University of Nebraska Medical Center	Omaha	NE	8011				
University of Georgia		GA	8221	70	$3,768,000	0.6%	3.1%
Kennedy Space Center		FL	9661				
PEPCO - Paul Smith Station	Williamsport	MD	Unk.				
			Average =	350	Average =	0.4%	1.9%
					Maximum =	14.5%	71.2%

Sources:

1. PSPD, Hazardous Waste Boilers and Industrial Furnaces (BIFs) with Either a Metals Reclamation Exemption or Small Quantity Burner Exemption, February 23, 1994.
2. Dun & Bradstreet
3. EI Digest, September, 1994.
4. IEc Analysis

4.3.1 Key Conclusions Applicable to Entire Combustion Market

EPA's proposed MACT standards will increase the cost of hazardous waste combustion across the industry, and will lead some facilities to stop burning hazardous wastes altogether. The market impacts, however, are expected to be small. Only a small number of facilities are expected to stop burning wastes in all commercial sectors. While more on-site incinerators will cease waste burning, they tend to burn very low quantities of hazardous waste now. Waste diversions from combustion are likely to be low as a result. The rule is expected to cost between $140 and $286 million per year. Costs jump to a high of $405 million per year if PIC controls at kilns are required. New compliance costs per ton of waste burned are relatively similar across all commercial combustion sectors, suggesting that the rule will not trigger large changes in the competitive balance between sectors.

The quantities of hazardous waste currently combusted are the primary determinant of whether combustion facilities will stop burning. Much of the market exit in all four market sectors is driven by low quantities of waste over which to spread the fixed costs of compliance with the new standards. Since the facilities that stop burning hazardous waste tend to be those currently burning low quantities, EPA estimates that only about three percent of the tonnage currently combusted will be diverted to new outlets.

The compliance cost per ton of waste burned varies little across proposed MACT options. As a result, most of the costs of the rule, and market exit from the rule, occur in reaching the proposed MACT floor. With the exception of options 2a, 2b (LWAKs only), and 4 that require PIC controls, the above-the-floor options do not noticeably change the impacts of the rule. Under proposed MACT options requiring PIC controls, compliance costs per ton rise dramatically for cement kilns and LWAKs, suggesting that larger changes in the combustion marketplace would occur.

Uncertainty with respect to the cost and availability of waste minimization and non-combustion waste management alternatives for generators makes it difficult to predict how high combustion prices could rise before generators switched substantial waste quantities to non-combustion venues. Although EPA bounds this uncertainty by including a zero-percent price pass-through scenario, the impact of price changes on market exit is not large in most sectors. Price pass-through has a more direct effect on the profitability of the remaining units.

Since firms that close combustion units in the face of the new rule do not incur compliance expenditures for those units, the estimate of the total costs of the rule excludes the units likely to stop burning hazardous wastes. The total cost estimate includes compliance costs for all combustion units that continue to burn hazardous wastes, plus any cost increases from having to manage wastes from closed facilities in a more expensive manner. For all non-PIC proposed MACT options, total costs of the rule are 22 percent lower than total engineering costs that assume all units comply with the rule. The costs for PIC options decline by almost 50 percent once market exit is incorporated.

4.3.2 Differential Impacts of the Rule by Market Sector

Although the rule will not cause large changes in sectoral competition, not all market participants will be affected in the same way. This section summarizes the key impacts on the four combustion segments, as well as on generators and fuel blenders. A comparison of important measures of impact across sectors is presented in Exhibit 4-35.

4.3.2.1 Cement Kilns

Cement kilns currently have a very large baseline cost advantage over commercial incinerators due to their ability to use large capital equipment (such as the kiln) for joint cement production/hazardous waste destruction. While the proposed MACT standards will greatly change the baseline cost of burning at a cement kiln, the existing cost advantage is so large that cement kilns remain the lowest-cost combustors under all proposed MACT scenarios.

Kilns likely to exit the market are those that tend to burn little waste now. Under proposed MACT option 1b, approximately 2 facilities currently burning hazardous wastes would stop doing so. This increases to three facilities if prices could not rise at all. If kilns were required to install PIC controls (as under proposed MACT options 2a and 4), and were not successful in passing the full costs of these controls to generators in the form of higher prices, ten kilns are expected to stop burning hazardous wastes (17 if prices couldn't rise at all). Although the kilns would have the lowest total combustion costs per ton even with PIC controls, the Agency believes that a tripling of combustion prices at the kiln would cause generators to utilize alternative management methods.[53]

Despite the low expected market exit, kilns remaining in the market would experience a substantial decline (on the order of 25 to 30 percentage points) in the profitability of hazardous waste combustion. This decline will make it more difficult for kiln operators to cross-subsidize cement production with hazardous waste profits. While strong cement markets now protect many of these marginal kilns, reduced hazardous waste profits could accelerate plant closures during the next industry downturn. EPA does not have adequate information on marginal plants to assess the likelihood of such closures. Despite the declines in operating profits, BIFs continue to enjoy margins more than double those of commercial incinerators.

The market behavior of waste-burning cement kilns in the short-run and the long-run are is quite similar. Because the kilns have little in the way of baseline waste burning capital equipment, the long-term BEQ is quite similar to the short-term BEQ.

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[53] Kilns burn primarily high-Btu liquid solvent wastes. Solvent recycling would be a cost-effective alternative, limiting the degree to which kilns could increase prices. However, solid hazardous wastes are suspended in the solvents prior to burning. Solvent recycling would eliminate this disposal outlet for solids, suggesting that prices on liquids with suspended solids could rise much more than prices on clean solvents.

Exhibit 4-35

SECTORAL COMPARISON OF IMPACTS OF PROPOSED MACT OPTION 1B

	Cement Kilns	Commercial Incinerators	Lightweight Aggregate Kilns	On-Site Incinerators
Total Compliance Costs ($Millions)				
- Before consolidation	$71	$24	$9	$103
- After consolidation, zero pass-through scenario	$51	$19	$3	$72
- After consolidation, low pass-through scenario	$56	$19	$3	$74
- After consolidation, high pass-through scenario*	$60	$19	$3	$77
Average Compliance Costs Per Ton of Hazardous Waste Burned				
- Before consolidation	$90	$103	$139	$4,970
- After consolidation, zero pass-through scenario	$59	$30	$44	$64
- After consolidation, low pass-through scenario	$62	$30	$44	$63
- After consolidation, high pass-through scenario*	$69	$30	$44	$90
Number of Combustion Facilities Likely to Stop Burning Hazardous Wastes in the Long-Term**				
- Zero Pass-Through Scenario	3	6	1	89
- Low Pass-Through Scenario	3	6	1	82
- High Pass-Through Scenario	2	6	1	72

Notes:

* Costs rise in the high pass-through scenario because some units with higher compliance costs remain viable.

** Excludes facilities not burning waste in the baseline. Exit over long-term capital cycle; immediate market exit would be lower. Due to the large number of very small on-site burners, on-site incinerators burning less than 50 tons of hazardous waste per year excluded from calculation. For all other sectors, only units burning zero tons per year were excluded.

4.3.2.2 Commercial Incinerators

Commercial incinerators face slightly lower compliance costs per ton burned than do cement kilns. As a result, commercial incinerators that remain in operation will become slightly more competitive with the kilns. However, the dollar value of this benefit is about $40 per ton under all proposed MACT options not requiring PIC controls for kilns, and is therefore unlikely to affect market competition significantly. We estimate that commercial incinerators continue to face average costs per ton of waste burned more than $700 higher than BIFs. Though their ability to handle waste streams that cannot currently be burned in kilns provides the incinerators with a protected niche, the longer-term erosion the commercial incinerator's market is likely to continue.[54]

Facility closure in the commercial incinerator sector is driven almost entirely by waste quantities burned. Four of the permitted facilities currently burning wastes are expected to close under both the high and the low price pass-through scenarios and are probably marginal even in the current market. Long-term closures increase by two facilities in both scenarios over short-term exit. This increase is driven by the large baseline waste burning capital that must be recovered over the capital replacement cycle in order for facilities to stay in the market.

Commercial incinerators also experience a decline in operating profit margins — of between 5 and 20 percent in the low price pass-through scenario. As the declines are smaller than for cement kilns, the rule will improve the competitive position of commercial incinerators relative to kilns. EPA does not anticipate that the changes are large enough to cause substantial changes in competitive dynamics.

4.3.2.3 Lightweight Aggregate Kilns

LWAKs face average compliance costs per ton of waste burned (before consolidation) are up to twice as high as those for cement kilns and commercial incinerators. This differential is overstated, however because over 30 percent of the permitted LWAKs do not actively burn wastes in their kilns. Once non-viable units exit the market, average compliance costs per ton drop below costs to cement kilns for most MACT options. Furthermore, EPA estimates that LWAKs have a $600 per ton baseline cost advantage over commercial incinerators. Before and after the rule, LWAKs retain a strong competitive position.

Kilns burning little or no waste now will not continue doing so in the face of the proposed MACT standards. The substantial required investments in pollution control capital cannot be spread over the small tonnage at these facilities, and the units will most likely stop burning hazardous wastes. Two LWAKs are likely to exit the market, only one of which is actively burning wastes. As with cement kilns, exit increases under proposed MACT options requiring PIC controls unless these costs can be passed on to generators in the form of higher prices. However, LWAKs currently burning reasonable quantities of hazardous waste will remain strong competitors in the hazardous waste combustion market for both the short- and the long-run. While operating profit margins for remaining facilities do decline, dollar margins actually increase under many MACT options in the high scenario. Margins after the rule return to as much as twice those in the incinerator sectors.

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[54] This market erosion may not necessarily occur in a linear fashion. For example, some kilns may not refocus on hazardous waste combustion expansion until the demand for cement slows.

4.3.2.4 On-site Incinerators

On-site incinerators fall into two categories. At one end of the spectrum are facilities with high capacity utilizations, burning large quantities of waste. These facilities are able to spread fixed investments so that costs per ton of waste combusted are reasonable. At the other end of the spectrum are a large number of incinerators that burn extremely low tonnages; it is these facilities that drive up the extremely high pre-consolidation compliance costs per estimated ton of waste burned for this sector. To the extent that these units also burn large quantities of non-hazardous wastes, some may remain viable under the proposed MACT standards. More likely, however, is that the units will stop burning hazardous waste even if non-hazardous waste continues to be burned. This is because the BEQ on compliance costs alone often exceeds the tons of hazardous waste currently burned at the units.

Market exit in this sector is expected to be quite large — between 44 and 61 facilities in the short-term (assuming low price pass-through). As the incinerator capital itself requires replacement, over one-half of the on-site incinerators actively burning are expected to stop burning hazardous wastes. Since quantities burned at each unit are quite low, the impact on these shutdowns on the combustion market is expected to be minimal. Units that remain in the market, however, have operating profit margins similar to, or better than, commercial incinerators under most MACT options.

Decisions to stop burning hazardous waste at on-site facilities could result in increased investment in waste minimization. Facilities that find it too expensive to come into compliance with the new MACT standards will be faced with the choice of either sending their waste to a commercial combustion facility or finding a non-combustion alternative. The waste minimization analysis conducted for the RIA suggests that many of these on-site generators may have waste minimization options that are less expensive than commercial combustion. In these cases, the profit maximizing generator should choose waste minimization over continued combustion.

4.3.2.5 On-site Boilers

On-site boilers are not covered under the proposed MACT standards. To the extent that the same wastes can be combusted in both on-site boilers and on-site incinerators, the rule makes boilers more cost-effective because they do not have to invest in new controls. Therefore, on-site boilers could provide a lower-cost outlet for some of the wastes diverted from on-site incinerator closures (thereby reducing the cost of the rule). Alternatively, the existence of a boiler option could accelerate the closure of incinerators as firms divert wastes even from incinerators that appear capable of meeting their BEQ. EPA has not estimated the magnitude of these impacts.

4.3.2.6 Hazardous Waste Generators

Hazardous waste generators are likely to see price increases for combusted waste streams. With all combustion sectors facing increased costs, and with the compliance costs per ton similar across commercial sectors, generators will have little flexibility to seek out a lower cost combustion sector.

The size of the likely price increases is difficult to determine, and will differ by the type of waste. EPA anticipates that generators of clean solvents and lean waters will face lower price increases due to the availability of non-combustion alternatives. High Btu-liquids without suspended solids can be reclaimed, or possibly burned in exempt facilities, both of which would constrain price increases that could be passed on to generators of the liquids.[55] Land-ban solids and sludges could face more substantial increases.

EPA does not have sufficient information on specific generating sectors to evaluate the impact of price increases on generator processes more specifically. However, the Agency does expect that a number of waste minimization and non-combustion alternatives are available in the long-term should combustion prices rise significantly. For this reason, EPA price increases of between $20 and $90 per ton seem more likely than larger increases. These changes would increase waste management costs for generators, although EPA has not analyzed the impact this could have on the prices of products produced by these generators.

4.3.2.7 Fuel Blenders

Fuel blenders serve as intermediaries between generators and combustors in both the commercial BIF and commercial incinerator sectors.[56] To the extent that the proposed MACT changes demand patterns of any one of these parties, blenders would need to react.

This analysis indicates that the impacts of the rule on blenders are likely to be relatively small. Very few combustion facilities can avoid capital equipment purchases by reducing the metals or chlorine in the hazardous waste fuels they burn, even if the new formulations are assumed to cost the same as the old.[57] As a result, blenders are unlikely to be called on to change their fuel blends by more than a handful of customers. Waste diversions from closed facilities are also expected to be quite small. While some localized blender operations may need to ship wastes to different outlets, the magnitude of these changes nationally is unlikely to be large.

One exception involves proposed MACT options requiring PIC controls at commercial BIFs. If the cost of compliance makes many kilns uncompetitive (a distinct possibility), blenders will lose their key waste outlet. Alternatively, PIC controls could bifurcate the BIF market, with liquids exempted by clean fuels regulations burned in non-waste burning BIFs (or recycled), while solids are burned in commercial incinerators. This could drastically reduce the demand for fuel blending services.

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[55] EPA has proposed exempting the combustion of clean hazardous waste fuels from regulations governing hazardous waste combustion in general on the grounds that there is little difference between them and conventional fuels such as coal and oil.

[56] Blending operations at commercial incinerators are often done on-site by incinerator employees, whereas blending at cement kilns is often run by outside firms.

[57] In fact, blenders have stated that segregating waste streams to provide certain combustion units with lower metal wastes would be expensive. Personal communication with fuel blenders, op. cit., February 22, 1995.

4.3.3 MACT in Perspective

While the proposed MACT standard is the largest factor in terms of new costs to be borne by waste burners, there are other factors that could have greater effects on the competitiveness of particular industry sectors. These factors are described below.

4.3.3.1 Cement Kiln MACT

The pending cement kiln MACT governs emissions from cement kilns even if they do not burn hazardous wastes. Although final MACT emission levels have not yet been set, the standard is likely to require kilns to install emission controls for a variety of hazardous air pollutants. The more similar the MACT standards for non-burning kilns are to the standards for kilns that do burn hazardous wastes, the more air pollution control equipment that will become "standard" on any cement plant. Thus, the incremental costs of burning hazardous wastes in a kiln will be lower than are reflected in our cost models, suggesting that more kilns will continue to burn wastes. Kilns would become more competitive relative to commercial incinerators.

4.3.3.2 Cement Kiln Dust Regulation

Pending changes to management requirements for cement kiln dust (CKD) will increase the cost of managing residuals from cement production. This change will only affect combustion markets to the extent that net CKD generation is higher for waste burning kilns than for non-waste burning kilns because only in this situation would CKD disposal be an incremental cost of waste burning.[58] While EPA's Cement Kiln Dust report to Congress suggested that net CKD generation is significantly higher at kilns burning hazardous wastes, industry has argued that net CKD generation is unaffected by waste burning.

4.3.3.3 On-Site Boiler Exemption

The proposed MACT standards add a minimum of $65 per ton of waste burned in new compliance costs that on-site boilers will not incur. While this cost advantage is unlikely to be large enough to threaten waste flows now going to the commercial sector, on-site boilers could provide an attractive alternative to on-site incineration for certain waste streams. To the extent that significant waste flows move from on-site incinerators to on-site boilers, closures of the incinerators could be higher than projected here and HAP emissions from boilers would rise.

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[58] Much of the cement kiln dust can be recycled back into the cement. To avoid the buildup of alkalis in the product mix, however, some dust is vented from the process and disposed of. The CKD that is removed from the process is known as "net CKD."

4.3.3.4 Comparable Fuel Exclusion

EPA is proposing that certain hazardous waste fuels meeting specified levels for concentrations of toxic constituents and physical properties that affect burning be excluded from the definition of solid and hazardous waste materials under the Resource Conservation and Recovery Act (RCRA). Generators that comply with sampling and analysis, notification and certification, and recordkeeping requirements would be eligible to claim the exclusion. While these fuels are derived from hazardous wastes, they are "barely distinguishable in constituents and burning properties from conventional fossil fuels."[59] The exemption would allow some BIFs to continue burning hazardous fuels without complying with the new MACT standards. While the spectrum of wastes that would be exempted has not yet been determined, it is likely that a comparable fuel exclusion would affect the type and percentage of hazardous solids that could be suspended in liquid organic fuels by fuel blenders. The market for waste fuels could be split into one for extremely clean fuels and one for blended fuels containing higher levels of contaminants. The Agency does not have enough information at this time to evaluate the likelihood or implications of such a split on combustion markets, but invites comment on this issue.

4.3.4 Summary

The proposed MACT standards should not change the competitive dynamics of hazardous waste combustion markets, except under MACT options requiring PIC controls. Compliance costs per ton of waste burned are similar enough for facilities remaining in the market across all commercial outlets to preserve the existing competitive balance. While the rule will lead a significant number of combustion units to exit hazardous waste combustion markets, these impacts are not skewed across combustion sectors, and are driven primarily by the low quantities of waste the units currently burn. Because facilities with limited quantities are those that are least economically viable, facilities that stop burning hazardous wastes will not cause large waste shifts.

While the exact price increases resulting from the rule cannot be predicted, the brunt of these price increases is likely to be borne by generators of solids and sludges, rather than of hazardous liquids. Under most scenarios, price increases will be small to moderate. Under scenarios with large price increases, generators are likely to shift to non-combustion waste management alternatives for organic liquids and lean waters. Fewer alternatives exist for solids and sludges.

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[59] "Firing Up Discussions on a Clean Fuels Exemption," EI Digest, April 1995, p. 1.

A complete analysis of the effects of the MACT standards for combustion facilities must compare the costs of the rule to its benefits. This chapter considers several different benefit/cost measures:

- Cost-Effectiveness: Provides estimates of the expenditures per unit reduction of emissions for each HAP.
- Health Risk Benefits: Discusses the potential health benefits of this rule.
- Ecological Risk Benefits: Reviews the results of comparing surface water pollutant concentrations and aquatic toxicity criteria.
- Economic Benefits: Provides a description of economic benefits potentially associated with reduced combustor emissions, focusing on property value effects.

5.1 COST-EFFECTIVENESS

5.1.1 Cost-Effectiveness Methodology

EPA has developed a cost-effectiveness measure that examines cost per unit reduction of emissions of each HAP. The two analytic components of this measure are:

- estimates of expenditures per HAP for each regulatory option; and
- estimates of emissions reductions under each regulatory option.

The discussion below describes the method for each of these components.

5.1.1.1 Expenditures Per HAP

The "numerator" in the calculation of cost-effectiveness is the compliance expenditures associated with the specific HAP. Estimation of costs per HAP is complex because of the number of HAPs covered in the rule and because the pollution control devices assumed in the model plants analysis frequently control more than one pollutant. Therefore, precise estimation of expenditures per HAP is not feasible. EPA has developed a simplified method that distributes costs to each HAP based on the following assumptions:

- For each HAP at each combustion unit, we calculate the percentage reduction in emissions required to reach the MACT standard and average the reductions by model plant group. For example, under MACT option 1b, a unit with dioxin emissions of 0.3 TEQ would need a 33 percent reduction to achieve the dioxin limit of 0.2 TEQ.

- Control technologies are then assigned to each HAP. For example, carbon injection can control both mercury and dioxins. For each model plant, we attribute the cost of each technology to the specific HAPs that technology controls weighted by the average percent reduction for those HAPs required by the model plant. For example, if a model plant controls dioxin and mercury with a carbon injection (CI) system, the calculation would be as follows:

  Percent dioxin reduction required to meet standard: 40 percent
  Percent mercury reduction required to meet standard: 60 percent

  $$\left(\frac{40}{40+60} \text{ x CI Cost}\right) + \left(\frac{60}{40+60} \text{ x CI Cost}\right)$$

  This splits the costs of the carbon injection system between dioxin and mercury; the same approach is used to develop a complete cost breakdown by HAP for each technology within a model plant.

- For each HAP, the control costs for all technologies are summed within the model plant, yielding a cost breakdown by HAP for each model plant. We then multiply the cost breakdown by HAP for each model plant by the number of units in the model plant; this yields a total cost by HAP of all units within a model plant group.

- We then sum the total cost by HAP of each model plant group for all model plants within each source category.

- Finally, we scale from the set of units in the model plants analysis up to the total number of units in each source category to arrive at total expenditures per HAP.[1] The total cost by HAP is then summed for each source category to obtain a total cost by HAP for each MACT option.

5.1.1.2 Emissions Reductions

The "denominator" in the calculation of cost-effectiveness is the total mass emission reduction achieved when combustion facilities comply with the standards for the given regulatory option. Estimating total emissions under each regulatory option requires two key assumptions:

- Combustion units that are already emitting below the standard for a given HAP do not change emissions of that HAP; and

- Combustion units with emissions exceeding the standard will control to the standard.

The emission reductions are then calculated as the difference between the baseline total emissions reported in Chapter 2 and the emissions under the regulatory option.

5.1.1.3 Caveats

Our method for calculating cost-effectiveness makes several simplifying assumptions. Most importantly, the method assumes that all facilities install control equipment and continue operating. As discussed, a number of other responses to the MACT standards are possible. For example, some facilities may cease waste burning in the face of increased compliance costs. However, it is difficult to trace the overall effect that these reactions would have on either expenditures per HAP or on total emissions of each HAP.

Beyond this broad caveat, other factors lead us to overstate expenditures per HAP. The assumption that units control emissions to the level of the standard likely leads us to overstate emissions because facilities employing emissions control equipment will likely achieve emissions concentrations below the standard rather than exactly at the standard.

A final caveat concerns the method by which we apportion pollution control device costs by HAP. Costs are currently apportioned according to the percentage reduction required to meet the standard for each HAP controlled by the device. In actuality, there is no "correct" approach for distributing costs. While the approach chosen is reasonable, it does not take into account engineering/technological issues regarding the relative ease with which a device can control one pollutant versus another.

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[1] The scaling method used is the same as that described in Chapter 3.

5.1.2 Cost-Effectiveness Results

Before discussing expenditures per unit reduction of each HAP, it is useful to first review information on total expenditures by HAP. As shown in Exhibit 5-1, the pollution control expenditures for each HAP vary by pollutant and by regulatory option. The following findings appear most significant:

- For most regulatory options, control of dioxin, mercury, and semi-volatile metals contributes the most to total costs. In options requiring improved combustion (PIC control) at cement kilns, expenditures on CO and total hydrocarbons (surrogate PIC measures) increase greatly and dominate total control costs.

- Expenditures on dioxin/furan control vary little by regulatory option, ranging between $37 and $56 million per year. This increase occurs between the floor and Option 1b, when a more stringent dioxin standard is introduced.

- Expenditures on mercury control range between about $28 and $85 million, with the greatest increase coming between Option 1b and 1c, when protective mercury requirements are introduced.

As part of the cost-effectiveness measure, EPA also developed estimates of reduced pollutant loadings under each regulatory option. Estimates of these reduced emissions are presented in Exhibit 5-2. As shown, on a tonnage basis, CO, chlorine, HCl, PM and total hydrocarbons are the most significant. Dioxin, mercury, and metals are reduced in smaller quantities, but have much more significance from a risk reduction standpoint. In particular, dioxin emissions in the baseline are small -- about 2.3 pounds per year. However, the highly carcinogenic nature of dioxin means that even reductions of two pounds per year (as experienced under the various regulatory options) may be significant.

Examination of the data on expenditures per ton reduced confirms that the more toxic pollutants are often much more expensive to control on a per-ton basis. Exhibit 5-3 combines the cost per HAP and loadings reduction information to obtain the cost per unit of HAP reduced. The top portion of the exhibit shows the cost per unit of HAP reduced across all facilities while the bottom three sections show the results for each facility type. Note that there is sometimes minor variation between options in cost per unit of HAP reduced, even when the standards for particular pollutants do not change. This minor variation occurs because the standard for a related pollutant (i.e., one controlled by the same device) may change, affecting how the cost of the device is distributed to multiple pollutants (see methodology discussion above).

Exhibit 5-1

TOTAL COMPLIANCE COSTS
BY TYPE OF HAP CONTROLLED

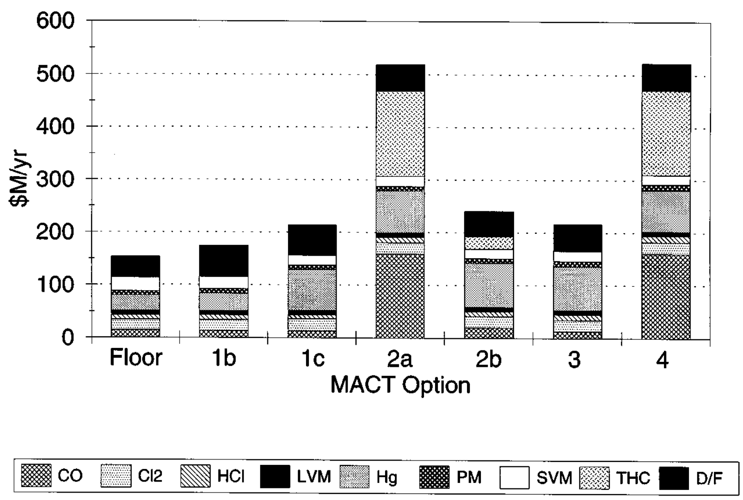

EXHIBIT 5-2

REDUCTION IN HAP EMISSIONS UNDER EACH OPTION (TONS)

	Original Floor	ATF - 1b	ATF - 1c	ATF - 2a	ATF - 2b	ATF - 3	ATF - 4
CO	12,807	12,807	12,807	79,996	13,202	12,807	79,996
Chlorine	950	950	950	950	950	954	954
Total Chlorine	NA	NA	NA	NA	NA	NA	NA
HCl	1,201	1,201	1,201	1,201	1,201	3,803	3,803
LVM	27	27	27	27	27	27	27
Mercury	8	9	11	11	11	9	9
Particulate	2,497	2,497	2,497	2,497	2,497	3,588	3,588
SVM	80	80	80	80	80	80	80
THC	2,597	2,597	2,597	4,177	2,654	2,597	4,177
D/F	0.001	0.001	0.001	0.001	0.001	0.001	0.001
TOTAL	27,564	27,565	27,567	96,336	28,019	31,262	100,031

Unfortunately, the diverse nature of the HAPs precludes direct comparison of costs per HAP normalized for toxicity. For example, dioxin is a carcinogen while mercury is a non-carcinogen. Likewise, the low- and semi-volatile metals categories are made up of different individual metals. However, the general level of concern over dioxin and mercury exposure is consistent with the expenditures per ton reduced. Considering all facilities as a group, the following patterns are evident:

- Costs per unit of dioxin reduced are extremely high ($40,000 to $60,000 per gram) because of the minuscule amounts of dioxin released to the environment.

- Similarly, expenditures per ton of mercury reduced are between $3.7 and $9 million.

- Expenditures per ton of metals reduced range roughly between $200,000 and $300,000.

For other pollutants, expenditures per ton reduced are lower. This is primarily a function of the large loadings reduction that is experienced. For example, despite large overall expenditures on carbon monoxide control in Options 2a and 4, the equally large tonnage reductions result in a limited cost per ton reduced (about $2,000).

As shown in Exhibit 5-3, the pattern in costs per unit of HAP reduced varies somewhat when we look at different facility types. For example, at all facility types, dioxin and mercury control are costly; however, they are more costly on a unit basis at incinerators than at cement kilns. Conversely, control of semi- and low-volatile metals is more costly at cement kilns than at incinerators.

Another noteworthy pattern in the data is the change in cost per ton reduced when more stringent standards are introduced. For example, the cost per ton of dioxin control rises when we move from the floor to the above-the-floor options (moving from a 0.5 ng/dscm standard to 0.2). Similarly, mercury control costs are greater on a per ton basis when we introduce the more stringent mercury standard in Option 1c. These findings are consistent with the basic economic principle of increasing marginal cost. Specifically, the cost of controlling increasing amounts of a pollutant will rise as additional reduction become more difficult technologically and economically.

Exhibit 5-3 also provides an estimate of cost per ton reduced across all HAPs in the rule. As shown, costs for all facilities considered together range from about $5,000 (in Option 4) to about $8,500 (in Option 2b).[2] In general, the cost across all HAPs is lower for incinerators than for cement kilns and LWAKs.

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[2] Across all HAPs, cost-effectiveness is greatest in Option 4 because it involves greatly increased control of the pollutants for which cost per ton is lowest, e.g., carbon monoxide.

EXHIBIT 5-3
COST PER UNIT OF HAP REDUCED
ALL FACILITIES

	Unit	Original Floor	1B	1C	2A	2B	3	4
D/F	$/g	$40,581	$61,072	$59,922	$54,029	$51,884	$52,708	$54,583
Mercury	$/ton	$3,711,855	$3,618,479	$7,394,788	$7,602,764	$7,952,142	$9,212,333	$8,821,427
LVM	$/ton	$337,445	$319,931	$325,032	$281,773	$304,959	$299,420	$297,325
SVM	$/ton	$321,732	$296,255	$218,834	$243,889	$233,577	$227,579	$230,823
Chlorine	$/ton	$20,753	$21,577	$23,992	$22,980	$22,816	$22,098	$22,825
HCl	$/ton	$7,171	$7,418	$6,099	$8,212	$7,771	$3,017	$3,173
Total Chlorine	$/ton	NA	NA	NA	NA	NA	NA	NA
Particulate	$/ton	$3,399	$3,340	$3,194	$3,230	$3,141	$3,142	$3,223
CO	$/ton	$1,158	$1,034	$1,028	$1,991	$1,472	$1,031	$2,008
THC	$/ton	$557	$779	$812	$38,883	$8,583	$795	$38,447
TOTAL ACROSS ALL HAPs	$/ton	$5,564	$6,309	$7,743	$5,389	$8,576	$6,914	$5,220

CEMENT KILNS

	Unit	Original Floor	1B	1C	2A	2B	3	4
D/F	$/g	$24,617	$26,102	$26,013	$26,508	$24,584	$23,844	$25,775
Mercury	$/ton	$1,880,694	$2,616,174	$6,511,581	$5,954,064	$6,692,959	$8,011,037	$7,165,085
LVM	$/ton	$2,549,407	$2,522,016	$2,207,708	$2,005,034	$1,984,893	$1,955,586	$1,959,332
SVM	$/ton	$543,140	$473,196	$330,856	$383,234	$337,140	$299,265	$350,494
Chlorine	$/ton	$54,461	$59,068	$65,090	$64,032	$61,428	$61,020	$64,102
HCl	$/ton	$10,595	$10,917	$10,126	$13,772	$12,301	$12,427	$11,475
Total Chlorine	$/ton	NA	NA	NA	NA	NA	NA	NA
Particulate	$/ton	$1,840	$1,708	$1,408	$1,483	$1,369	$2,218	$2,397
CO	$/ton	NA	NA	NA	$2,094	NA	NA	$2,090
THC	$/ton	$0	$0	$0	$34,018	$0	$0	$34,074
TOTAL ACROSS ALL HAPs	$/ton	$8,219	$9,064	$12,131	$4,830	$12,131	$10,496	$4,761

LWAKs

	Unit	Original Floor	1B	1C	2A	2B	3	4
D/F	$/g	NA	NA	NA	NA	NA	NA	NA
Mercury	$/ton	$6,169,987	$6,169,987	$17,456,175	$18,343,578	$18,343,578	$18,662,141	$20,752,535
LVM	$/ton	$5,010,666	$5,010,666	$5,395,744	$4,832,486	$4,832,486	$3,797,543	$3,595,345
SVM	$/ton	$3,686,954	$3,686,954	$2,086,975	$2,244,050	$2,244,050	$3,840,516	$1,809,622
Chlorine	$/ton	$48,508	$48,508	$101,247	$81,295	$81,295	$46,228	$61,997
HCl	$/ton	$4,556	$4,556	$2,028	$3,386	$3,386	$1,125	$1,453
Total Chlorine	$/ton	NA	NA	NA	NA	NA	NA	NA
Particulate	$/ton	$19,780	$19,780	$16,069	$22,630	$22,630	$48,344	$21,119
CO	$/ton	NA	NA	NA	NA	NA	NA	NA
THC	$/ton	NA	NA	NA	$581,829	$581,829	NA	$575,138
TOTAL ACROSS ALL HAPs	$/ton	$2,017	$2,017	$2,893	$6,627	$6,627	$2,075	$4,174

Notes:
Available data suggest that no reduction in D/F emissions is needed at LWAKs.

INCINERATORS

	Unit	Original Floor	1B	1C	2A	2B	3	4
D/F	$/g	$234,442	$467,505	$454,014	$373,877	$369,170	$388,174	$389,399
Mercury	$/ton	$5,095,076	$4,627,959	$7,869,247	$9,042,768	$8,901,085	$9,977,540	$9,952,900
LVM	$/ton	$190,726	$173,717	$195,894	$163,923	$189,717	$189,570	$187,915
SVM	$/ton	$160,842	$159,272	$135,447	$144,044	$153,091	$145,242	$146,741
Chlorine	$/ton	$15,887	$16,250	$17,119	$16,523	$16,665	$16,545	$16,583
HCl	$/ton	$6,455	$6,779	$5,750	$7,337	$7,281	$6,959	$6,905
Total Chlorine	$/ton	NA	NA	NA	NA	NA	NA	NA
Particulate	$/ton	$4,971	$4,989	$5,014	$4,989	$4,926	$4,785	$4,763
CO	$/ton	$1,158	$1,034	$1,028	$1,472	$1,472	$1,031	$1,591
THC	$/ton	$40,675	$101,314	$105,570	$193,073	$190,327	$103,349	$158,705
TOTAL ACROSS ALL HAPs	$/ton	$5,171	$6,019	$6,898	$7,537	$7,537	$6,898	$7,554

Note:

1. Total annual compliance costs by HAP used to calculate the cost per unit of HAP reduced do not include CEM and permitting costs.

For context, it is useful to compare this cost-effectiveness measure with that estimated for other air pollution regulations. Exhibit 5-4 presents information on the cost-effectiveness of other combustion regulations. As shown, the cost-effectiveness of the hazardous waste MACT standards are roughly on par with the cost-effectiveness estimated for the 1994 Municipal Waste Combustor rule and the recently proposed rules for medical waste incinerators. This outcome is likely due to the fact that the MWC rule included many of the same HAPs as the hazardous waste MACT rule (e.g., HCl, PM, metals, dioxin, mercury); however, the comparison is not direct (e.g., the MWC rule covers SO2), reducing somewhat the validity of the comparison. Note that the comparison is more complex when we consider individual facility types. While incinerator cost-effectiveness compares favorably with other rules ($5,700 to $8,300 under various options), the cost-effectiveness for kilns, particularly LWAKs, significantly exceeds that of the other rules.

Exhibit 5-4

COMPARISON OF COST-EFFECTIVENESS

Rule	Estimated Cost-Effectiveness ($ per ton reduced)
MACT Standards for Hazardous Waste Combustors	$5,000 - $8,500
MWC Proposed 1994 Subpart Cb Guidelines (September, 1994)	$3,903[3]
Medical Waste Incinerators Proposed Rule (February, 1995)	$4,738[4]

5.2 HEALTH BENEFITS

The health benefits sections below discuss the pathways and transport of dioxin and mercury that result in human exposure and the health impacts of dioxin and mercury.

[3] Estimated using Table 3 of Federal Register, Vol. 59, No. 181, September 20, 1994. Total tonnage reduced is 133,400 tons with total estimated annual costs of $445 million ($445 million/133,400 = $3,336). Inflated to 1994 dollars using GDP implicit price deflator.

[4] Estimated using Table 9b of Federal Register, Vol. 60, No. 38, February 27, 1995. Total tonnage reduced is 74,080 tons with total estimated annual costs of $351 million (see p. 10667).

5.2.1 Exposure to Dioxin Emissions and Health Impacts

Polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans, hereafter referred to collectively as dioxins, are ubiquitous in the environment. The more highly chlorinated dioxins, which are extremely stable under environmental conditions, persist in the environment for decades and are found particularly in soils, sediments, and foods. It has been hypothesized that the primary mechanism by which dioxins enter the terrestrial food chain is through atmospheric deposition.[5] Dioxins may be emitted directly to the atmosphere by a variety of anthropogenic sources or indirectly through volatilization or particle resuspension from reservoir sources such as soils, sediments, and vegetation.

The most well known incident of environmental contamination with dioxins occurred in Seveso, Italy in an industrial accident. Symptoms of acute exposures such as chloracne occurred immediately following the incident. Since then, significant increases in certain types of cancers have also been observed.[6] After evaluating a variety of carcinogenicity studies in human populations and laboratory animals, EPA has concluded that 2,3,7,8-tetrachlorodibenzo-p-dioxin and related compounds are probable human carcinogens.[7] EPA estimates that a dose of 0.01 picograms on a toxicity equivalent (TEQ) basis per kilogram body weight per day is associated with a plausible upper bound lifetime excess cancer risk of one in one million (1 x 10-6).[8] Toxicity equivalence is based on the premise that a series of common biological steps are necessary for most if not all of the observed effects, including cancer, from exposures to 2,3,7,8 chlorine-substituted dibenzo-p-dioxin and dibenzofuran compounds in vertebrates, including humans. Given the levels of background TEQ exposures discussed below, as many as 600 cancer cases may be attributable to dioxin exposures each year in the United States.

EPA has also concluded that there is adequate evidence from both human populations and laboratory animals, as well as other experimental data, to support the inference that humans are likely to respond with a broad spectrum of non-cancer effects from exposure to dioxins if exposures are high enough. Although it is not possible given existing information to state exactly how or at what levels exposed humans will respond, the margin of exposure between background TEQ levels and levels where effects are detectable in humans is considerably smaller than previously thought.[9]

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[5] U.S. Environmental Protection Agency, Estimating Exposure to Dioxin-Like Compounds, Volume I, June 1994.

[6] U.S. Environmental Protection Agency, Health Assessment Document for 2,3,7,8-Tetrachlorodibenzo-p-Dioxin (TCDD) and Related Compounds, Volume II, June 1994.

[7] U.S. Environmental Protection Agency, Health Assessment Document for 2,3,7,8-Tetrachlorodibenzo-p-Dioxin (TCDD) and Related Compounds, Volume III, August 1994.

[8] Ibid.

[9] Ibid.

Dioxins are commonly found in food produced for human consumption. Consumption of dioxin contaminated food is considered the primary route of exposure in the general population. EPA evaluated data collected in four U.S. studies, three of which included analyses of all 2,3,7,8 chlorine-substituted congeners of dibenzo-p-dioxin and dibenzofuran. EPA's evaluation concluded that "background" levels in beef, milk, pork, chicken, and eggs are approximately 0.5, 0.07, 0.3, 0.2, and 0.1 parts per trillion fresh weight, respectively, on a toxicity equivalent (TEQ) basis.[10] EPA then used these background levels, together with information on food consumption, to estimate dietary intake in the general population. That estimate is 120 picograms TEQ per day.[11]

EPA has also collected data on dioxins in fish taken from 388 locations nationwide and found that at 89 percent of the locations, fish contained detectable levels of at least two of the dioxin and furan compounds for which analyses were conducted.[12] (Of the 2,3,7,8 chlorine-substituted congeners, only octachlorodibenzo-p-dioxin and octachlorodibenzofuran were not analyzed.) Seven of the compounds, including 2,3,7,8-TCDD, were detected at over half the locations. Detection limits were generally at or below 1 part per trillion on a toxicity equivalent basis. The median (50th percentile) concentration in fish on a toxicity equivalent basis (TEQ) was 3 parts per trillion (ppt) while the 90th percentile was approximately 30 ppt TEQ. Five percent of the sites exceeded 50 ppt TEQ. At most sites, both a composite sample of bottom feeders and a composite sample of game fish were collected. At sites considered representative of background levels, the median concentration was 0.5 ppt TEQ.

EPA has estimated that hazardous waste incinerators and hazardous waste burning cement and lightweight aggregate kilns currently emit 0.08, 0.86, and less than 0.01 kg TEQ of dioxins per year, respectively, or a total of 0.94 kg TEQ per year. Excluding non-hazardous waste burning cement kilns, an emission rate of approximately 9 kg TEQ per year is estimated for all other U.S. sources.[13] Therefore, hazardous waste burning sources represent about 9 percent of total anthropogenic emissions of dioxins in the U.S.[14]

There is information to suggest, however, that dioxin emissions are higher than have been estimated. Public comments on EPA's dioxin reassessment have identified a number of possible additional sources of dioxins, including decomposition of materials containing chlorophenols (i.e. wood treated with PCP), metals processing industries, diesel fuel and unleaded gasoline, PCB manufacturing, and re-entrainment of reservoir sources. Reservoir sources may be a significant source of vapor phase dioxins. On the other hand, emissions from at least one of the sources, medical waste incinerators, is probably

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[10] U.S. Environmental Protection Agency, Estimating Exposure to Dioxin-Like Compounds, Volume II, June 1994.

[11] Ibid.

[12] U.S. Environmental Protection Agency, National Study of Chemical Residues in Fish, Office of Science and Technology, September 1992.

[13] U.S. Environmental Protection Agency, Estimating Exposure to Dioxin-Like Compounds, Volume II, June 1994.

[14] Other major dioxin emitters include medical waste incinerators and municipal waste incinerators. Yearly dioxin emission estimates for these sources are 5.1 kg TEQ and 3.0 kg TEQ, respectively.

significantly overestimated. Supporting the view that dioxin emissions may be higher than previously estimated are indications that deposition may be considerably greater than can be accounted for by presently identified emissions.

The impact of emissions on exposure and risk depends on the relative geographic locations of the emission sources and receptors which contribute to exposure and risk, primarily farm animals. This applies to both near field dispersion and long-range transport and it affects exposure and risk both in determining whether the trajectory of an air parcel impacts receptors of concern and in determining the chemical fate of the emissions. The fate of dioxins depends on degradation processes that can occur in the atmosphere. These processes can increase or decrease the toxicity of the original emissions through dechlorination. This process can have different effects on different emission sources, depending on the congener distributions, residence time in the atmosphere, and climatic conditions.

Considering all these factors, it is apparent that hazardous waste burning sources contribute significantly to the overall loading of dioxins to the environment, although the relative magnitude of the contribution remains to be determined. Similarly, it may be inferred that hazardous waste burning sources contribute significantly to dioxin levels in foods used for human consumption and, to an extent as yet unknown, the estimated 600 cancer cases attributable to dioxin exposures annually.

EPA estimates that dioxin emissions from hazardous waste burning sources will be reduced to approximately 0.03 kg TEQ per year under the MACT standards. These reductions would result in a decrease of between 8 and 9 percent in total estimated anthropogenic U.S. emissions. EPA expects that reductions in dioxin emissions from hazardous waste burning sources, in conjunction with reductions in emissions from other dioxin-emitting sources, will help reduce dioxin levels over time in foods used for human consumption and, therefore, reduce the likelihood of adverse health effects, including cancer, occurring in the general population.

5.2.2 Exposure to Mercury Emissions and Health Impacts

Mercury has long been a concern in both occupational and environmental settings. The most bioavailable form of mercury and, therefore, the form most likely to have an adverse effect, is methyl mercury. Human exposures to methyl mercury occur primarily from ingestion of fish. As a result of mercury contamination, there are currently fish consumption bans or advisories in effect for at least one waterbody in over two thirds of the States.

Nationally, about 60 percent of all fish consumption bans and advisories are due to mercury. In several States the mercury advisories are statewide, with the most widespread concerns being in the northern Great Lakes states and Florida. The bans and advisories vary from state to state with respect to the levels of concern, the recommended limits on consumption, and other factors. Therefore, it is difficult to develop a national estimate of potential risk based on this information. Nevertheless, these bans and advisories provide one indication of the extent and severity of mercury contamination.

Even low levels of mercury in surface waters can lead to high levels of mercury in fish. EPA has estimated that bioaccumulation factors, which represent the ratio of the total mercury concentration in fish tissue to the total concentration in filtered water, range from 5000 to 10,000,000 depending on the species of fish, the age of the fish, and the waterbody the fish inhabit.

The most well known example of mercury poisoning from ingestion of fish occurred in the vicinity of Minamata Bay, Japan. Severe neurological effects resembling cerebral palsey occurred in the offspring of exposed pregnant women. EPA has estimated what it considers a safe level of exposure to methyl mercury. This level, referred to as the reference dose, is 1E-4 mg/kg-day. The reference dose is based on an evaluation of 81 maternal-infant pairs exposed to methyl mercury in an incident in Iraq in which methyl mercury treated seed grain was diverted for use in making bread. The reference dose, which is based on developmental effects in children, is also considered to be protective with respect to neurological effects in adults (e.g., paresthesia). An uncertainty analysis of the Iraqi data concluded that the reference dose falls below the 5th percentile of the threshold for developmental neurologic abnormalities in human infants and, therefore, represents a lower bound estimate of the threshold.[15] A major premise of the analysis is that the 81 pregnant Iraqi women are representative of the most susceptible subgroup in the general population (e.g., in the United States). Other sources of uncertainty are the duration of the maternal exposure (approximately three months), latency in the appearance of effects (from as little as a month to as long as a year), possible misclassification of maternal exposures, differences in the vehicle of exposure (i.e., grain vs. fish), and the selection of neurologic or behavioral endpoints.

EPA collected data on chemical residues in fish taken from 388 locations nationwide and found that at 92 percent of the locations, fish contained detectable levels of mercury.[16] (Detection limits varied between 0.001 and 0.05 parts per million.) The median (50th percentile) mercury concentration in fish was 0.2 ppm while the 90th percentile was 0.6 ppm. Two percent of the sites exceeded 1 ppm. At most sites, both a composite sample of bottom feeders and a composite sample of game fish were collected. The highest concentration, 1.8 ppm, was measured at a remote site considered to represent background conditions.

Similar results have been obtained in other studies, strongly suggesting that long-range atmospheric transport and deposition of anthropogenic emissions is occurring. This conclusion is further supported by a modeling analysis which found that there is no region in the continental U.S. where deposition of mercury is not occurring.[17] Therefore, it is likely that mercury emissions contribute to both regional and global deposition, as well as deposition locally, and subsequent impacts on surface waters.

An indication of the significance of mercury contamination in fish is illustrated by combining data on the levels of mercury in fish with data on fish consumption and comparing it to the reference dose for methyl mercury. For example, a fish consumption rate of 140 g/day (a 90th percentile rate associated with recreational fishing) in conjunction with a mercury concentration of 0.6 µg/g (a 90th percentile concentration) translates into an average daily dose of 1E-3 mg/kg-day, or 10 times the reference dose. Using the same fish concentration with a mean fish consumption rate for recreational anglers of 30 g/day gives a dose that is three times the reference dose. At the median fish concentration of 0.2 µg/g and a fish

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[15] U.S. Environmental Protection Agency, Mercury Study Report to Congress Volume VI: Characterization of Human Health and Wildlife Risks from Anthropogenic Mercury Emissions in the United States, December 1994.

[16] U.S. Environmental Protection Agency, National Study of Chemical Residues in Fish, Office of Science and Technology, September 1992.

[17] U.S. Environmental Protection Agency, Mercury Study Report to Congress Volume III: An Assessment of Exposure from Anthropogenic Mercury Emissions in the United States, December 1994.

consumption rate of 30 g/day, the dose is nearly 90 percent of the reference dose. These results indicate that for persons who eat significant amounts of freshwater fish, exposures to mercury are significant when compared with EPA's estimate of the threshold at which effects may occur in susceptible individuals. However, it must be recognized that EPA's threshold estimate represents a lower bound; the true threshold may be higher than EPA's estimate.

EPA has estimated that hazardous waste incinerators and hazardous waste burning cement and lightweight aggregate kilns currently emit 4.2, 5.6, and 0.3 Mg of mercury per year, respectively, or a total of 10.1 Mg per year. An emission rate of 230 Mg per year has been estimated for all other U.S. sources.[18] Therefore, hazardous waste burning sources represent about 4 percent of total anthropogenic emissions of mercury in the U.S.[19] From these estimates it is apparent that hazardous waste burning sources contribute significantly to the overall loading of mercury to the environment and, by inference, to mercury levels in fish.

EPA estimates that mercury emissions from hazardous waste burning sources will be reduced to 2.8 Mg per year at the floor level and to 1.9 Mg per year at the proposed above the floor standard. These reductions would result in reductions of total anthropogenic U.S. emissions of approximately 3 percent. EPA expects that reductions in mercury emissions from hazardous waste burning sources, in conjunction with reductions in emissions from other mercury-emitting sources, will help reduce mercury levels in fish over time and, therefore, reduce the likelihood of adverse health effects occurring in fish-consuming populations.

5.3 ECOLOGICAL RISKS: METHODOLOGY AND RESULTS

5.3.1 Methodology for Assessing Ecological Risks

Emissions from waste burning may also affect terrestrial and aquatic ecosystems in the areas around combustion facilities. For example, deposition of air pollutants may affect the food web of the surrounding ecosystem in subtle ways that undermine the viability of the ecosystem. Ecological risk assessments should be especially attentive to persistent pollutants that bioaccumulate in plants and animals (e.g., metals) given that these are the pollutants that are not destroyed in the combustion process.

As an initial screen for assessing risk to aquatic ecosystems, EPA compared the concentration of pollutants in surface water to EPA-approved aquatic toxicity criteria. Phone surveys were used to select

[18] U.S. Environmental Protection Agency, Mercury Study Report to Congress Volume II: Inventory of Anthropogenic Mercury Emissions in the United States, December 1994.

[19] Other major mercury emitters include medical waste incinerators, municipal waste incinerators, utility boilers, and commercial/industrial boilers. Mercury emission estimates for these sources are 58.8, 57.7, 47.8, and 26.2 Mg/year, respectively.

waterbodies within 20 kilometers of the facility. The change in pollutant concentrations in the water bodies was calculated as a function of deposition rates and the volumetric flow rates or depth of the water body.[20]

5.3.2 Ecological Risk Results

For the watersheds examined at sample facilities, dioxin exhibits the potential for causing exceedences of ecological risk criteria in surface water. As shown in Exhibit 5-5, central tendency (50th percentile) dioxin emissions from cement kilns may cause exceedences in the most affected watersheds. High end emissions of dioxins (90th percentile) from both incinerators and cement kilns are estimated to cause exceedences of the criterion.

The analysis of ecological risk suggests that water quality criteria may be exceeded in the most vulnerable watersheds around waste combustion facilities, particularly cement kilns. This generally occurs, however, only under high end emission assumptions. The conservative nature of the analysis is also reflected in the fact that the criteria exceeded are based on exposures to species higher in the food chain that feed exclusively on fish from the contaminated water bodies, further reducing the likelihood of ecological effects.

5.4 OTHER SOCIO-ECONOMIC BENEFITS

In addition to the health and ecological benefits described above, the proposed rule for hazardous waste combustion facilities may result in a variety of other economic benefits to society. Most importantly, aesthetic and health risk disamenities may be reflected in a decrease in property values around combustion facilities. The discussion below summarizes EPA's estimates of the potential magnitude of these property value effects. In addition, we qualitatively discuss several other benefit categories that may be influenced by the MACT standards, including materials damage and soiling of buildings, aesthetic nuisances (e.g., noise, odor), and recreational and commercial fishing opportunities.

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[20] A more detailed explanation of the ecological risk method can be found in Risk Assessment Support to the Development of Technical Standards for Emissions from Combustion Units Burning Hazardous Wastes: Background Information Document, draft, prepared for Industrial Economics, Incorporated, prepared by Research Triangle Institute, August, 1995.

Exhibit 5-5

SUMMARY OF BASELINE ECOLOGICAL RISK RESULTS

Facility Type	Ratio of Total Water Concentration to Water Quality Criteria for Dioxin	
	Central Tendency	High End
Incinerators	0.008 - 0.4	0.2 - 13
Cement Kilns	0.1 - 9.0	1.0 - 97
LWAKs	0.003 - 0.2	0.003 - 0.15

Note: Dioxin ratios are based on total water concentrations.

5.4.1 Property Value Benefits

EPA performed a screening analysis to assess the potential magnitude of property value effects caused by the presence of hazardous waste combustors. The underlying hypothesis is that residential property values will reflect not only standard attributes (e.g., house size, city services), but also the presence of environmental disamenities. As discussed below, we performed a literature review to evaluate previous studies of the link between property values and environmental problems such as landfills and incinerators. Using results from the most relevant of these studies, we develop a benefits transfer analysis that employs assumptions that provide conservative, low-end estimates of property value benefits associated with both the closure of commercial incinerators as well as the reduction in emissions from other combustors.

5.4.1.1 Background and Summary of Existing Studies

Researchers have applied several techniques to estimate the impact of a disamenity, such as a waste site, on property values; these include real estate appraiser questionnaires, tax assessor surveys, and hedonic price models. Hedonic price models generally produce the most reliable estimates because they rely on empirical data and employ relatively rigorous modeling approaches. A well-designed hedonic model isolates the effect of the environmental disamenity on housing prices by controlling for other attributes of the house and for neighborhood characteristics. The available hedonic models are quite diverse in their specification, and rely on a variety of estimation techniques and data sources. Thus, model results must be interpreted with care.

A literature search was conducted to assess the range of property value impact estimates and to examine some of the differences among estimates. The ideal study would be one that analyzes property value impacts around a hazardous waste combustor. Such a study would also examine the effect of reduced emissions on property values. While no such ideal study exists, we did identify ten relatively recent studies that used hedonic modeling concepts to estimate property value impacts of environmental disamenities.

A list of these ten studies and a summary of key results is found in Exhibit 5-6. None of the available studies considered hazardous waste combustors. One study examined property value effects from incinerator operations; however, this facility burned only municipal wastes. The remaining studies can be grouped into three categories on the basis of site analyzed -- municipal landfills, hazardous waste landfills, and hazardous waste sites (including Superfund sites).

While these studies all used hedonic modeling concepts to measure property value impacts, the studies differed in their objectives. Some sought to estimate property value impacts as a function of distance from the disamenity. The objective of other studies was to determine sale price effects as a function of the number of disamenities (e.g., the number of hazardous waste sites within a given locality). Since the objectives of the studies were often different, care must be taken in comparing studies. Additionally, since the ideal hazardous waste combustor study was not found, the results in the studies summarized below cannot be directly applied to the issue of hazardouswaste combustion. The Benefit Estimates section explains how previous study results were used to develop property value benefit estimates for hazardous waste combustors.

The key element drawn from the studies is the estimated marginal impact that distance from the site has on property values. This marginal impact will be referred to as the premium, in dollars per mile per household. For example, assume that the distance premium per household is $5,000 per mile. The premium indicates that a home's value will increase by $5,000 for each mile further from the site. The sections below discuss the literature review findings with respect to this distance premium.

Incinerator Study

The recent study by Kiel and McClain (1995) analyzes the impact of a municipal waste incinerator on housing prices. Using data covering the time before the incinerator was even proposed through the time of ongoing incinerator operations, they show that price impacts are not constant over time. Price impacts appear strongest during the time when the incinerator first began operating. The premium during this time was $8,100 per mile per household. This contrasts with a premium of $2,283 during the construction period, and a premium of $6,607 during ongoing operations, seven years after the incinerator began operating. The price response to site proposal and publicity (the rumor stage) was weak. Housing prices increase with distance from the site up to approximately 3.5 miles.

Exhibit 5-6
SUMMARY OF HEDONIC PROPERTY VALUE STUDIES

Study	Years of Data	Location	Type of Facility	Premium ($ per mile per household) (House Sales Price)	Distance Range
Smolen (1992)	1986 through mid 1990	Toledo, Ohio	Hazardous Waste Landfills	Envirosafe Landfill: $9301 - $14,205 $7416 - $22,793 Riga Landfill: $644 - $4640	 0-2.6 miles 2.6-5.75 miles 2.6-5.75 miles
Kiel and McClain (1995)	1974-1992	North Andover, Mass.	Incinerator	Construction: $2283/mile Online: $8100/mile Ongoing Operations: $6670/mile	Effect becomes negligible at 3.5 miles.
Kohlhase (1991)	1976, 1980, 1985	Houston, Texas	Hazardous Waste Sites	$3260 per mile (1985) Insig. for 1976 and 1980	0 - 6.2 miles
Nelson, Genereux, Genereux (1992)	1979-1989	Ramsey, Minnesota	Landfill	$4896 per mile	0 - 2 miles
Mendelsohn, Hellerstein, Huguenin, Unsworth, Brazee (1992)	1969-1988	New Bedford, Mass.	PCB Pollution in the Harbor	$9000 for zone 1 (Inner Harbor) $7000 for zone 2 (Outer Harbor)	Within 2 miles.
McClelland, Schulze, Hurd (1990)	1983-1985	Los Angeles	Hazardous Waste Landfill	House Price reduced by $2084 per 10% increase in the proportion of high risk neighborhood respondents	No distance range.
Smith and Desvousges (1986)	1984	Suburban Boston	Hazardous Waste Landfill	Consumer surplus estimate of $330 to $495 annually.	No distance range.
Bleich, Findlay, Phillips (1991)	1978-1988	Los Angeles	Landfill	No significant property value effects found.	Within one mile of the landfill.
Ketkar (1992)	1980	New Jersey	Hazardous Waste Sites	$1300-$2000 increase in the median property value for one fewer HW site in the municipality	Premium applies to homes in a single municipality.
Michaels and Smith (1990)	1977-1981	Suburban Boston	Hazardous Waste Sites	Full Sample: $115 Premier Market: 461 Above Average: 58 Average Market: 48 (annualized at 10%)	Homes located within 13 miles of the nearest hazardous waste site.

Hazardous Waste Sites

Four of the studies assessed the impact of hazardous waste sites on housing prices. Some of the sites considered are on the National Priorities List. Ketkar (1992) estimated a $1,300 to $2,000 increase in the median property value for one fewer hazardous waste site in the municipality.[21] Kohlhase (1991) estimated a premium of $2,360 per mile per household for homes located within 6.2 miles of the site. This premium was significant only after the site was placed on the NPL. The primary finding was that housing prices were not affected by the presence of the hazardous waste site but rather by the EPA announcement regarding which sites would be placed on the NPL. The study by Michaels and Smith (1990) concluded that different neighborhood submarkets (premier, above average, or average) result in significantly different distance premiums. The premier market commanded an annualized premium of $461 per mile per household, the above average market had a premium of $58 per mile, and the average submarket had an associated premium of $48 per mile.[22]

The fourth study analyzed the price effects of a PCB-contaminated harbor (Mendelsohn, et. al., 1992). The harbor study analyzed repeat sales data to determine the property value impacts of PCB pollution in the New Bedford harbor sediments. Their results indicate that housing prices decreased by 8 percent (median of $9,000) for homes that are closest to the inner harbor and a decrease of 7 percent ($7,000) for homes located near the outer harbor.

Hazardous Waste Landfills

All three studies that looked at hazardous waste landfills concluded that these sites adversely affect prices of nearby homes. The premium estimated by Smolen (1992) was $12,061 for homes within the 2.6 mile range, and $12,106 for homes within 2.6 and 5.75 miles of the site. McClelland et. al (1990) assessed the decrease in home prices as a function of neighborhood risk perception. Neighborhood risk was determined through a survey mailed to 1912 addresses.[23] The proportion of responses that fell into the high risk group was calculated for each neighborhood. The neighborhood risk proportion was calculated both before and after the landfill closure, and the appropriate risk value was attached to the sales price depending upon the sale date. They found an estimated decrease of $2,084 in home sales price per 10 percent increase in the proportion of neighborhood respondents in the high risk group. The third study by Smith and Desvousges (1986) estimated the premium through survey questions, developed using the conceptual framework of a hedonic property value model. A demand for distance model was subsequently estimated using the survey results; consumer surplus was estimated at between $330 and $495 per year per mile from a disposal site.[24]

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[21] Note that the distance premiums reported have not been adjusted to 1994 dollars. In most cases the articles do not specify the dollar year for the figures reported.

[22] These results were annualized assuming a 10 percent discount rate. Total present value premiums would be on the order of $4,610, $580, and $480 for the premium, above average, and average markets, respectively.

[23] Response rate of 45 percent.

[24] The total present value premium per mile would be roughly $3,300 to $4,950 per mile per household, assuming a 10 percent discount rate.

Municipal Landfills

Two studies evaluated the impact on property values from municipal landfills. One study concluded that a "well-designed and well-managed" landfill appears to have no statistically significant impact on surrounding property values. (Bleich, et. al. 1991) The other study concluded that a municipal landfill in Minnesota did, in fact, cause decreases in property values to a distance of about two miles. The estimated property value premium was $4,896 per mile per household, over a range of two miles from the site. (Nelson et. al. 1992)

5.4.1.2 Benefits Transfer Analysis: Methodology and Obstacles

Property value impact estimates are often desired by EPA and other regulatory agencies, but time and financial constraints often prohibit performing original research. To develop an estimate of property value effects near hazardous waste combustors, a benefit transfer methodology is employed.[25] Benefit transfer analysis involves applying results from existing studies to the situation of interest. The accuracy of estimates from this method depends upon the similarity of situations considered. In this section, the applicability of results from the studies summarized above to waste burning is discussed. Specifically, estimates of property value impacts resulting from reduced emissions at facilities that burn hazardous wastes and cessation of burning hazardous wastes at various facilities are desired.

Several issues and problems must be addressed in developing a benefit transfer analysis to estimate the effect of changes in waste burning behavior. First, most studies estimate property value impacts resulting from a total land-use disamenity (e.g., the presence of a waste site). In contrast, the proposed rule produces reduced emissions or cessation of waste burning at large, multi-purpose industrial facilities. It is difficult to determine the extent to which individual factors of a facility are contributing to property devaluation. The mere existence of industrial activity may be a disamenity. Smoke and other emissions are aesthetically displeasing and may produce unpleasant odors. Similarly, increased truck traffic and the associated noise and air pollution also are factors which contribute to depressed property values. The hazardous waste combustion MACT standards will generally only influence one of the factors at the facility, i.e. emission rates. Also, some units will discontinue burning hazardous wastes. But even at these facilities, the primary industrial activities (e.g., cement manufacturing) will remain in operation. Thus, property value effects may be limited relative to studies that measure the influence of an entire facility (e.g., landfill).

Second, while results from air pollution property value studies could be used to determine the property value benefit of reduced emissions at combustion facilities, existing air pollution studies are not adequate for the following reasons:

- The pollutants analyzed in existing studies are not the same as the ten hazardous air pollutants regulated under the proposed MACT standards.

[25] Other EPA studies have employed benefits transfer to estimate property value benefits. For example, see Benefit and Net Benefit Analysis of Alternative National Ambient Air Quality Standards For Particulate Matter, prepared for Office of Air Quality Planning and Standards, March 1983, Volume III.

- Property value effects due to air pollution have been found to depend critically on the market conditions of a given location.[26]

- These studies analyze old data (1960-1978). A comprehensive review of hedonic models and air pollution by Smith and Huang[27] reports that "the most current data set used in a published hedonic model with air pollution evaluated for a U.S. city was 1980."

Finally, premiums may vary between combustion facilities, depending upon facility type, geographic location, baseline emissions, and other location-specific market conditions. For example, baseline emissions data for hazardous air pollutants from combustion suggest that emissions per combustion unit vary widely, and that there could be different HAPs of concern in different combustion sectors.

5.4.1.3 Benefit Transfer Estimates

The issues described above demonstrate the complexities associated with direct extrapolation of results from existing studies. Benefits transfer analysis, however, is possible as long as key parameters are carefully addressed. Specifically, two key questions must be answered before a benefit estimate can be derived: (1) Which premium should be applied to homes? and (2) What distance range should be used? A reasonable premium and distance range can be selected from a study which analyzes a site with characteristics similar to combustion facilities. The most comparable site is the municipal waste incinerator analyzed by Kiel and McClain (1995). The per-household premium averages $6,670 per mile and effects are significant out to a distance of 3.5 miles from the site.[28] Using this premium and distance range could result in understated benefits if the hazardous waste combustion facilities affected by this proposed rule are viewed as more of a threat than the municipal waste incinerator studied by Kiel and McClain. On the other hand, benefits would be overstated if weaker impacts are likely for facilities that reduce emissions, relative to facilities that completely cease operations.[29] The approach used to evaluate the range of potential property value impacts of the proposed MACT standards is described below.

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[26] Kerry Smith and Ju-Chin Huang, "Can Markets Value Air Quality? A Meta-Analysis of Hedonic Property Value Models," Journal of Political Economy, Volume 103 (1) 209-227, 1995.

[27] Ibid, 389.

[28] The study reported premiums for five different phases of operation: the pre-rumor stage (the period before the incinerator was ever proposed), the rumor stage (the period when the incinerator was proposed, but before any construction), the construction period, the online stage (a period of three years, from the time the incinerator began operations), and the ongoing operation stage (four to seven years after the incinerator began operations). The premium estimated for the ongoing operation stage, $6,670, was used because most of the combustion facilities have been operating for at least four years.

[29] Cement kilns, LWAKs, and facilities with on-site incinerators will continue their primary operations even if the facility stops burning hazardous wastes. Commercial incinerators are the only units expected to cease operations altogether when they stop burning hazardous wastes.

The basis for this assessment is an analysis of property value impacts at a sample of ten combustion facilities.[30] The premium from Kiel and McClain was adjusted for each of the ten counties in which these facilities are located to reflect differences in median house values.[31] These adjusted premiums are shown in Exhibit 5-7; all are lower than the premium estimated by Kiel and McClain because home prices in the neighborhood analyzed by Kiel and McClain (North Andover, Massachusetts) are relatively high. Housing densities for the ten counties were calculated at the county level by dividing total occupied households per county by the county land area found in 1990 Census data. The estimates in EPA's analysis assume an even distribution of homes within each county.[32]

The key issue in determining the effects of the proposed rule on property values is how to value the impacts of reductions in concentrations of air pollutants around facilities that continue to burn waste. Past studies such as Kiel and McClain have looked at how the presence of a facility affects property values, not at the impact of changes in emissions levels. In reality, the new MACT standards probably do not fully eliminate all property value impacts resulting from location of homes near hazardous waste combustion facilities. In this case, we need to develop a benefits transfer approach that considers emissions reductions. One possible approach for getting a very rough handle on the impact of pollutant concentration reductions is to view increases in distance from a combustion facility as a proxy for reductions in concentration. For example, after emissions are reduced, a home located one mile from a combustion facility may be exposed to pollutant concentrations similar to pre-rule concentrations at homes two miles from the facility. In this case, the benefit of the rule is an increase in the value of the home by the difference in housing prices between one and two miles (i.e., the increase in value for that home is equal to the per mile premium).

The distance-proxy estimation approach requires three key input parameters: (1) the per-mile premium, (2) the boundary distance within which the premium applies, and (3) the mileage used to proxy emissions reduction (mileage proxy). The boundary distance and the mileage proxy have the greatest impact on the benefit estimates because benefits increase geometrically with distance; the impact of changes over the range of premiums suggested by other studies is much more limited.

Unfortunately, because no studies have ever looked at distance as a proxy for concentration reductions at hazardous waste facilities, all three of these input values are highly uncertain. As a result, EPA has chosen to present an analysis that shows how property value impacts would change as the key parameters are varied over their expected ranges. For this analysis, benefit estimates were calculated under two boundary distance assumptions, one mile and 3.5 miles. For each of these boundary assumptions, property value impacts are graphed as a function of the effective increase in each home's distance from the site that results from the reduction in concentration. To simplify the presentation, the premium is not varied since its effect is much more limited. The results are shown in Exhibits 5-8 and 5-9.

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[30] These same counties were used in the health risk assessment for this rule.

[31] The Kiel and McClain premium was adjusted by multiplying it by the ratio of the median house price in the county in which the sample facility is located to the median house value in Kiel and McClain.

[32] Population density at a more refined scale would improve the analysis because it would more accurately portray the distribution of homes around a site. EPA has performed a GIS analysis that provides more precise population and housing density information. While time was not available to incorporate these data, they will be used in future refinement of this analysis.

EXHIBIT 5-7
ADJUSTED DISTANCE PREMIUM PER HOUSEHOLD

County	State	Median House Value	Adjusted Premium
Putnam	Indiana	$51,600	$1,421
Neosho	Kansas	$28,600	$787
Alpena	Michigan	$41,600	$1,145
Northampton	Pennsylvania	$105,400	$2,902
Albany	New York	$110,900	$3,054
Orangeburg	South Carolina	$50,500	$1,390
Contra Costa	California	$219,400	$6,041
East Baton Rouge	Louisiana	$69,200	$1,905
Ramsey	Minnesota	$83,600	$2,302
Harris	Texas	$63,500	$1,748

A specific example may make the implementation of the approach clearer. Consider a house that is located one mile from a combustion facility. If the change in pollutant concentration resulting from the MACT standards is assumed to be equivalent to moving the house 1.5 miles further from the source, then the change in value is calculated as follows. First, the reduction in the value of a home located one mile from the facility is calculated. This is equal to the premium ($6,670) times the number of miles the house is from the boundary at which there is no longer any property value effect. In the case of the boundary being set at 3.5 miles, the decrease in property value is 2.5 times the premium ($16,675). Next, we estimate the property value reduction for a home that is 1.5 miles further from the site, in this case a house located at 2.5 miles. The reduction in value for this house is 1.0 times the premium ($6,670), since the house is located one mile from the point at which there is no longer any property value impact. The difference between $16,675 and $6,670 represents the increase in value due to the reduction in emissions in our example. This calculation is performed for all houses around each of the ten combustion facilities in the sample. The values for each of the ten facilities are then averaged. The per facility average is then multiplied by the nationwide population of 222 combustion facilities to determine total national impacts. For each of the two assumed boundary distances (1.0 and 3.5 miles), impacts are calculated for a range of concentration distance proxies.

The analysis suggests that the range of potential property value impacts is quite wide and is sensitive to both the boundary distance and the assumed mileage proxy for concentration reduction. If one assumes that only homes within one mile of the combustion facility experience an increase in value, total annual property value benefits range from $12 to $20 million as the distance proxy increases from 0.25 to one mile. Alternatively, assuming reductions in concentration affect all homes within 3.5 miles of the facility, total annual property value impacts increase to between $200 and $840 million, depending on the mileage proxy.[33] The $840 million value is an effective upper bound in that it assumes all homes are moved outside the 3.5 mile range, at which point all the devaluation due to the combustion facility disappears. Overall, the analysis makes clear that increasing the boundary by 2.5 miles changes benefit estimates by more than an order of magnitude.

5.4.1.4 Conclusions

Review of available studies clearly indicates the potential for property value effects around hazardous waste combustion facilities. The types of sites and impacts analyzed in existing studies, however, are not directly analogous to the changes expected under the new MACT standards. In particular, the effect of the MACT standards differs from the effects reflected in available studies because: (1) emissions would be reduced rather than having a disamenity (e.g., landfill) fully removed; and (2) kilns and facilities with on-site incinerators have other disamenities entirely separate from waste burning.

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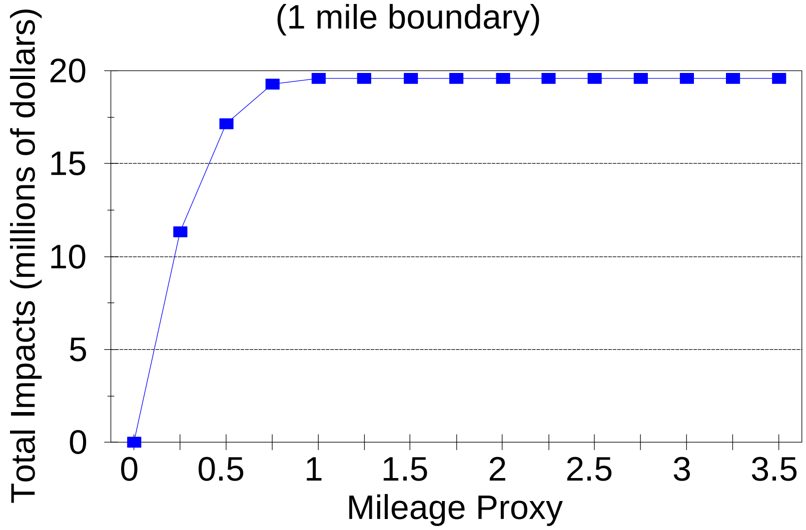
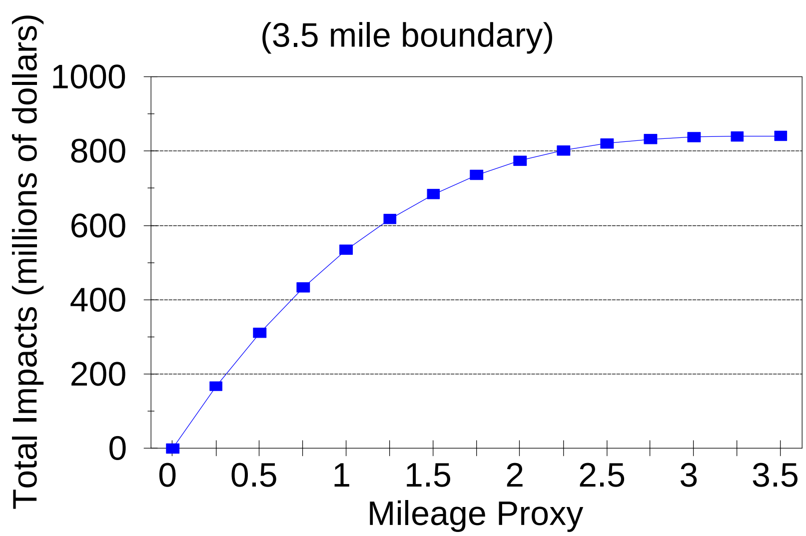
[33] Property value benefit estimates reflect a variety of factors, including reductions in aesthetic nuisances and reductions in health risk to surrounding areas. Because of the latter, these benefits cannot simply be added to the monetized benefits of cancer risk reduction; the degree of overlap may be significant.

Exhibit 5-8
Total Annual Property Value Impacts
(1 mile boundary)



Note: No benefits after 1 mile.

Exhibit 5-9
Total Annual Property Value Impacts
(3.5 mile boundary)



In response to these complexities, EPA conducted an evaluation of potential benefits that uses distance from a combustion facility as a proxy for emissions reduction. The analysis suggests that, if distance is an effective proxy for changes in concentration and if effects occur out to 3.5 miles from the site, then only a very small increase in the effective distance of homes from the site yields property value benefits that exceed the costs of the rule. For example, assuming each house has concentrations of pollutants reduced by an amount that makes it effectively 0.25 miles further from the site than its true distance in the pre-regulatory baseline produces total annual benefits of nearly $200 million.

Unfortunately, to know whether these benefits really occur requires more knowledge about how housing prices would respond to changes in air pollutant concentrations. While the use of distance as a proxy for emissions reduction has a certain commonsense appeal and provides some context for evaluating whether the new MACT standards could have significant impacts on property values, it does not answer the key question -- whether property values are sensitive to changes in air pollution concentrations or whether they are simply a function of the presence or absence of the facility itself. While the analysis described above could be refined in a variety of ways, until this central question is answered, EPA is only able to conclude that property value impacts have the potential to be very significant.[34]

5.4.2 Other Benefit Categories

The MACT standards may also provide a number of other types of economic benefits. Below, we discuss potential effects on soiling and materials damages, aesthetic disamenities (e.g., noise, odor), and commercial and recreational fishing opportunities. Note that these benefits may be partially reflected in the property value effects reviewed above, and therefore cannot simply be added to property value benefits.

5.4.2.1 Soiling and Materials Damage

Hazardous waste combustion facilities release pollutants that have the potential to cause soiling and materials damages. Reductions in these emissions may result in decreases in society's expenditures on cleaning or repair of these damages. The most important combustor pollutant that might cause these types of effects is particulate matter.

Past studies have demonstrated that higher levels of total suspended particulates lead to increases in society's total expenditures on cleaning (both labor and cleaning supplies). In a study of the costs to households of elevated particulate levels conducted in the early 1980s, Mathtech found that the benefits of reductions in particulates were significant.[35] For each microgram per

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[34] In particular, a distance proxy more directly linked to the degree of emissions reduction provided by the MACT standard could be developed using air modeling information. At present, we are unable to gauge the impact this additional analysis would have on the benefits estimates presented here. Further analysis is also needed to determine the appropriate boundary within which property values are responsive to changes in concentration.

[35] Benefits Analysis of Alternative Secondary National Ambient Air Quality Standards for Sulfur Dioxide and Total Suspended Particulates, Mathtech, Inc., prepared for U.S. EPA, 1982.

cubic meter reduction in particulate levels, they estimated a benefit of $0.31 per household. In the case of the particulate reductions under consideration at that time, summing these reductions across all affected households yielded sizeable national benefits -- between $2 and $5 billion (1990 dollars). While the number of households affected by the proposed rule is smaller than the universe analyzed by Mathtech, the localized impacts of combustion facilities might be significant, particularly where there are large reductions in particulate matter around waste burning cement kilns.

5.4.2.2 Aesthetic Damages

Reductions in emissions at waste combustion facilities or facility closures, perhaps due to increased waste minimization incentives, could have a variety of aesthetic benefits for nearby residents. These might include reductions in odor, noise, or traffic, as well as changes in air quality that result in improvements in regional visibility. A wide variety of studies suggest that the public values these types of environmental improvements. Because of the non-market nature of these types of disamenities, most studies rely on survey (contingent valuation) techniques to elicit willingness to pay for reductions in the disamenity. For example, one study surveyed individuals regarding willingness to pay for reductions in diesel odors.[36] The study found a statistically significant annual willingness to pay of between $6 and $21 (1989 dollars) per household for elimination of weekly "odor events." Likewise, researchers have demonstrated a significant property value impact from noise pollution. For example, a study of airport noise found an average price loss of about $2,700 (1981 dollars) per home in areas exposed to peak noise levels.[37]

While it is clear that aesthetic disamenities such as odor and noise can create economic damages, it is less clear whether the MACT standards would reduce or eliminate such disamenities. Odor problems are likely to be specific to the wastes burned, and less directly associated with incremental reductions of specific pollutants. At facilities where waste burning is discontinued, there may be less frequent shipments to the facility, reducing traffic. Similarly, at incinerators that cease operation, there may be significant noise reductions. Overall, however, it seems unlikely that major odor or noise reduction benefits would be derived from the emissions reductions themselves.

Emissions of particulates may also have impacts on regional visibility. Previous studies have demonstrated that the public is willing to pay for visibility improvements. These visibility improvements may enhance residential conditions or recreational experiences (e.g., long-range visibility in hiking/sightseeing areas). For example, an EPA-sponsored study used contingent valuation techniques to value a 2.4 mile visibility increase in urban areas.[38] Respondents expressed an annual willingness to pay of between $18 and $39 (1990 dollars) per household. Earlier contingent valuation studies found even larger annual household willingness to pay estimates ($118 to $582, 1990 dollars) for greater changes in visual range.[39]

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[36] Lareau, Thomas J., and Douglas A. Rae, "Valuing WTP for Diesel Odor Reductions: An Application of Contingent Ranking Technique," Southern Economic Journal, January, 1989, pp. 728-742.

[37] Nelson, Jon P., "Measuring Benefits of Environmental Improvements: Aircraft Noise and Hedonic Prices," Advances in Applied Microeconomics, Vol. 1, 1981, pp. 51-75.

[38] Schulze, William D., et. al., Valuing Eastern Visibility: A Field Test of the Contingent Valuation Method, prepared for U.S. EPA, Office of Policy, Planning, and Evaluation, June 1991.

[39] Rae, Douglas A., Benefits of Visual Air Quality in Cincinnati—Results of a Contingent Ranking Survey, draft report prepared by Charles River Associates for Electric Power Research Institute, 1984;

The evidence from past studies suggests that the proposed rule might yield benefits in these areas. EPA is currently considering whether further analysis of these issues is warranted.

5.4.2.3 Recreational and Commercial Fishing Impacts

Releases from hazardous waste combustion facilities have the potential to adversely affect fisheries. The analysis of human health effects suggests that mercury poses the greatest concern, and could lead to adverse exposures for anglers living around waste combustion facilities. If concern about mercury levels leads to reductions in commercial or recreational fishing activities around waste combustion facilities, society will experience a loss of economic welfare.

Past studies indicate that fish advisories for mercury occur frequently and can have substantial economic costs. For example, a study on mercury deposition to the Great Lakes demonstrates the link between mercury deposition to surface water and fish consumption advisories. Both Lake Superior and Lake Michigan as well as several rivers have experienced fish advisories for various species.[40] The cost of these advisories in terms of lost recreational opportunities can be significant. For instance, a case study of toxics pollution in the Saginaw River/Bay estimated annual recreational fishing losses of between $60,000 and $809,000 due to mercury and other toxic pollution.[41] Another study of Lavaca Bay, Texas estimated lost recreational value of between $60,000 and $450,000 annually due to mercury contamination.[42] These site-specific figures represent relatively modest benefits; however, when we consider that mercury contamination from waste burning may affect multiple sites, the potential for significant aggregate benefits exists.

If reductions in mercury emissions from waste combustion facilities have the potential to eliminate fish advisories or allay public concerns in other ways that increase commercial or recreational fishing, there may be benefits of this type for the proposed rule. EPA is continuing to investigate whether these types of benefits are significant.

Brookshire, D., et. al., Methods Development for Assessing Air Pollution Control Benefits, Vol. 2, prepared for U.S. EPA, 1979; and Tolley, George, et. al., Establishing and Valuing the Effects of Improved Visibility in Eastern United States, prepared for U.S. EPA, Office of Policy, Planning, and Evaluation, 1986.

[40] Deposition of Air Pollutants to the Great Waters, First Report to Congress, prepared by EPA Office of Air Quality Planning and Standards, May 1994, p. 26.

[41] Regulatory Impact Analysis of the Final Great Lakes Water Quality Guidance, prepared for U.S. EPA, January 5, 1995, p. 7-10.

[42] Summary of Potential Economic Damages to the Resources of Lavaca Bay and Matagorda Bay, Texas as a Result of Mercury Contamination, prepared for the National Oceanic and Atmospheric Administration, May 1991.

5.5 CONCLUSIONS

This chapter considers several different approaches to characterizing the benefits of the MACT standards for hazardous waste combustors. The key findings are as follows:

- One method of gauging the benefits of the MACT standards is to consider the cost per unit of emissions reduced. As would be expected, control of dioxin and mercury accounts for the greatest share of expenditures, and the marginal costs (expenditures per unit reduced) increase with more stringent controls. Across all HAPs, cost per ton of emissions reduced ($5,000 to $8,500 per ton) is somewhat above, but generally comparable to other combustion rules for municipal and medical waste combustors.

- Population risk estimates are significant for dioxin and mercury in the pre-regulatory baseline. EPA estimates that hazardous waste burning sources represent about nine percent of total anthropogenic dioxin emissions and about four percent of total anthropogenic mercury emissions in the U.S. Human exposure to dioxin may cause as many as 600 cancer cases each year in the United States. For mercury, health risks include severe neurological effects in the offspring of exposed pregnant women and neurological effects in adults.

- Under the proposed MACT standard, reductions in dioxin and mercury emissions from hazardous waste burning sources are significant. EPA expects that these reductions, in conjunction with reductions in emissions from other dioxin and mercury-emitting sources, will help reduce dioxin and mercury levels over time in foods used for human consumption and therefore, reduce the likelihood of adverse health effects, including cancer and neurological effects in adults, and developmental abnormalities in children.

- EPA developed a screening analysis of ecological risks that considers modeled watershed concentrations relative to risk-based ambient water quality criteria. The analysis suggests that water quality criteria currently may be exceeded in the most vulnerable watersheds around waste combustion facilities, particularly cement kilns.

- Combustion of hazardous waste may also lead to economic damages that would be reduced by the MACT standards. While investigation of economic benefits is not yet complete, preliminary analysis reveals that hazardous waste combustion facilities may reduce surrounding property values. If distance from a combustion facility provides a reasonable proxy for the value of emissions reductions, the screening analysis performed here indicates that benefits range from the tens to hundreds of millions of dollars per year. These estimates may reflect concerns over health risks and aesthetic disamenities and so cannot simply be added to benefits in these areas.

The Regulatory Flexibility Act (RFA) of 1980 requires Federal agencies to consider impacts on "small entities" throughout the regulatory process. Section 603 of the RFA calls for an initial screening analysis to be performed to determine whether small entities will be adversely affected by the regulation. If affected small entities are identified, regulatory alternatives must be considered to mitigate the potential impacts. Small entities as described in the Act are only those "businesses, organizations and governmental jurisdictions subject to regulation." Although the RFA requires a regulatory flexibility analysis to be performed only if a rule has a significant impact on more than 20 percent of the affected small entities, the Environmental Protection Agency (EPA) considers any impacts on any small entities to warrant further evaluation.[1] As a result, we evaluate the impact of the proposed rule on all small entities.

Evaluating the impact of the proposed maximum achievable control technology (MACT) standards on combustors involves first identifying which combustors can be classified as small businesses. We then further evaluate the likelihood of negative impacts. Note that the screening analyses conducted in earlier chapters evaluated the impact of the proposed regulations at the combustion-unit level. This approach provided the greatest insights into the decision to burn or not to burn hazardous wastes. However, the regulatory flexibility analysis focuses at the company level. This is because a large business that owns a small combustion unit is not properly classified as a small business.

[1] Industrial Economics, Inc., "Seminar on Regulatory Impact Analyses and Regulatory Flexibility Analysis," prepared for the Office of Solid Waste, U.S. EPA, March 7, 1984; Habicht, F. Henry II, Deputy Administrator, EPA. "Revised Guidelines for Implementing the Regulatory Flexibility Act," Office of the Administrator, U.S. EPA, April 1992.

6.1 METHODOLOGY FOR IDENTIFYING SMALL ENTITIES AFFECTED BY THE PROPOSED RULE

6.1.1 Statutory Definition

The RFA defines "small business" in the same manner as Section 3 of the Small Business Act. The small business administration (SBA) defines "small" as a business that is independently-owned and not dominant in its field. Size thresholds, in terms of annual revenues or number of employees, vary by business area as classified in the Standard Industrial Classification (SIC) and are drawn from 13 Code of Federal Regulations (CFR) Part 121. Appendix F presents SBA thresholds for combustion facilities, as well as data on actual sales and employee levels at these facilities. Other small entities include small not-for-profit organizations (e.g., private hospitals) and small governmental entities.[2] However, government-owned combustion units affected by this proposed rule are owned by the federal government and would not therefore be subject to regulatory flexibility considerations as a small entity.

6.1.2 Methodology for Evaluating Combustion Units for Regulatory Flexibility Analysis

To evaluate whether companies that own combustion units are small businesses, we developed a list of combustion units that included financial information at the facility and parent company levels. This information was originally compiled from Dun & Bradstreet and the American Business Director for EPA's "Resource Conservation and Recovery Act (RCRA) Expanded Public Participation and Revisions to Combustion Permitting Procedures" proposed rule in June 1994. We have updated the information where possible, including only combustion units on EPA's list of permitted combustion facilities from November 1994.

Company data were then compared to statutory thresholds on employment and annual sales defined in 13 CFR Part 121 using the firm's primary SIC. Combustion units were classified as small businesses only if the sales or number of employees at both the facility-level and the parent company level fell below the SBA threshold.[3] In addition, we classified any firm for which we had no information on revenues and employment as a small business. The lack of information leads us to overstate the number of small businesses.

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[2] EPA, op. cit., "Appendix D: Developing Regulation-Specific Definitions of Small Entities."

[3] In certain instances, data on the parent company were either not available or contained sales and employment information for the headquarters location only rather than for the entire firm. In such cases, where headquarters information suggested a small business classification, we evaluated facility-level information as well.

6.2 NUMBER OF COMBUSTION FACILITIES DEFINED AS SMALL BUSINESSES AND LIKELY IMPACTS OF COMPLIANCE WITH THE PROPOSED RULE

Given the capital intensity of cement production, commercial incineration, and many of the industries (e.g., chemicals) that own and operate on-site incinerators, it is not surprising that few meet the definition of a small business. From a compiled list of more than 250 combustion units, only 13 were classified as owned by small businesses. As shown in Exhibits 6-1 and 6-2, five of these 13 were considered small due to a lack of data. Of the remaining eight units, only three were owned by firms with annual revenues of less than $50 million per year, suggesting that financing new capital expenditures would be less of a barrier than for smaller firms.

Although five units were classified as "small" because they did not employ enough people to meet the SBA employment threshold, the companies that owned these units earn more than $50 million per year in revenues. In three of these cases, annual revenues exceeded $100 million per year. Thus, despite the small number of employees, compliance with the proposed MACT standards is likely to pose a lower financial burden.

Exhibit 6-2 lists the subset of combustion units classified as small businesses. Three commercial combustors (Giant Cement, National Cement, and LWD, Inc.) burn sufficient waste quantities to remain profitable under the most likely regulatory scenarios, although some may consolidate waste burning activity into fewer units. The Featherlite unit does not show up on trade publication lists of active waste-burning kilns, suggesting that it may have already exited the market.[4]

Three on-site incinerators for which we have 1991 Biennial Report Survey (BRS) data on waste quantities burned (Aztec Catalyst, Cook Composites, and Parkens International) all burn less than 700 tons of hazardous waste per year. Assuming they burn the average mix of liquids and solids for the on-site incinerators we have data on, shipping the wastes to an off-site commercial facility would cost about $450 per ton. This comprises between 0.1 and 0.2 percent of parent company revenues for the two facilities we have tons burned data on, although impacts on plant-level operations would be higher. Given the pattern of impacts on firms for which we have data, we do not expect significant impacts on the handful of firms for which we have no information on quantities burned or parent company revenues.

6.3 CONCLUSIONS

The proposed rule is unlikely to adversely affect small businesses for two important reasons. First, few combustion units are owned by businesses that meet the SBA definition as a small business. Specifically, available data allow us to identify only eight small entities out the more than two hundred EPA-listed combustion units burning hazardous waste. Furthermore, over one-half of those that are considered small have a relatively small number of employees, but have annual sales in excess of $50 million per year.

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[4] See Jeffrey Smith, "Industrial Furnaces 1994," EI Digest, October 1994, pp. 17-25.

Exhibit 6-1

Summary of Combustion Units Subject to Regulatory Flexibility Assessment

	Total
Total Number of Units Considered "Small"	13
Considered Small Due to Absence of Data	5
Classified as Small Based on Available Data	8
Parent Revenues < $50 million/year	3
Parent Revenues > $50m < $100m/yr.	2
Parent Revenues > $100m < $250m/yr.	2
Parent Revenues > $250m/yr.	1

Exhibit 6-2: Detail on "Small" Combustion Units

Name	City	State	Commer. Facility?	EPA I.D.	BRS Tons	Type	F_sales	F_Class	Parent-Level Small Business Screen P_name	P_sales	Source	P_Class	Overall Size Class.
Featherlite	Ranger	TX	Y	TXD988040747		AGGREGATE KILN	0	NA				NA	S
Giant Cement	Harleyville	SC	Y	SCD003351699		CEMENT KILN	6,492,000	S	GIANT GROUP LTD	$81,900,000	ABD/D&B	S	S
Keystone Cement Co.	Bath	PA	Y	PAD002389559	41018.406	CEMENT KILN	40,000,000	S	GIANT GROUP LTD	$81,900,000	D&B	S	S
National Cement Co.	Lebec	CA	Y	CAD982444887		CEMENT KILN		NA	NATIONAL CEMENT COMPANY	$119,900,000		S	S
Aztec Catalyst Resources/Dart Indst.	Elyria	OH	N	OHD046202602	46.615	INCINERATOR	0	NA	AZTEC CATALYST CO.	$24,305,000	ABD	S	S
Cook Composites & Polymers Co.	Chatham	VA	N	VAD055046049	697.335	INCINERATOR	10,302,000	S	COOK COMPOSITES & POLYMERS	$156,491,000	ABD/D&B	S	S
Parkens International	Houston	TX	N	TXD008105959	371.58	INCINERATOR	0	NA				NA	S
Rubicon	Geismar	LA	N	LAD008213191		INCINERATOR	0	S				NA	S
Schenectady International	Schenectady	NY	N	NYD002070118	8451.9	INCINERATOR	0	NA	SCHENECTADY INTERNATIONAL	$280,000,000	D&B	S	S
Grant County Waste Mgmt.	Beverly	WA	Y	WAD981765720		INCINERATOR	0	NA				NA	S
Houston Chemical Services	Pasadena	TX	Y	TXD010791184		INCINERATOR	700,000	S			D&B	NA	S
La Posta Recycling Center	Boulevard	CA	Y	CAD983591660		INCINERATOR	1,146,000	S			D&B	NA	S
LWD, Inc.	Calvert City	KY	Y	KYD088438817	25489.166	INCINERATOR	0	NA				NA	S

Second, facilities most hurt by the rule tend to be those that burn very little waste and hence face very high costs per ton burned. Our screening analyses and breakeven quantity analyses presented in Chapter 3 demonstrate that the impact of the proposed rule is a function of tons burned rather than firm size. Although we do not have data on the waste combusted at every small unit, those that have high capacity utilizations will face relatively small cost increases per ton. Those that burn very little waste in their existing units will close rather than comply with the proposed rule. Since their low quantities led to the closure, it follows that their cost of off-site treatment will also be low.

The U.S. EPA completed analyses that identified demographic characteristics of populations near cement plants and commercial hazardous waste incinerators and compared them to the populations of county and state. The analysis focuses on the spatial relationship of cement plants and incinerators to minority and low income populations. The study does not describe the actual health status of these populations, and how their health might be affected by proximity to facilities.

7.1 METHODOLOGY

EPA used digital geographic and demographic data to develop population estimates around the cement plants and incinerators. EPA processed the Census geographic and demographic data along with the incinerator and cement plant location using Geographic Information System (GIS) software. The agency generated concentric circles or buffers for six radii (0.5,1,2,3,4,5 miles) from the site location and computed populations estimations for the six buffer areas. The finest possible data resolution was used - "block" or "block group" (as opposed to zip code or census tract level). EPA then compared the demographics of the buffers to the demographics of the county and state that the facility was in.

EPA used the universe of 29 hazardous burning cement plants and a sample of 12 non-hazardous burning cement plants for a total of 41 cement plants from a universe of 113 cement plants. The summary statistics presented for cement plants then uses the universe of hazardous waste burning plants and an extrapolation of non-hazardous burning plants from the sample of 12. EPA used a sample of 21 commercial incinerators from a universe of 35. The complete methodology results of the analyses are found in two reports filed in the docket titled, Race, Ethnicity, and Poverty Status of the Populations Living Near Cement Plants in the United States and Race, Ethnicity, and Poverty Status of the Populations Living Near Commercial Incinerators.

7.2 SUMMARY RESULTS

The Agency looked at whether minority percentages within a one mile radius are significantly different than the minority percentages at the county for all hazardous burning cement plants and sample of incinerators, the results are as follows:

- 27% of the universe of all cement plants (29 plants) and 37% of the sample of incinerators (21 plants) have minority percentages within a one mile radius which exceed the corresponding county minority percentages by more than five percentage points.

- 36% of the universe all cement plants (41 plants) and 44% of the sample of incinerators have minority percentages within a one mile radius which fall below the corresponding county minority percentages by more than five percentage points.

- 38% of the universe of all cement plants (43 plants) and 20% of sample of the incinerators minority percentages within a one mile radius which fall within five percentage points (above or below) of the corresponding county minority percentages.

The Agency also examined whether poverty percentages within a one mile radius differ significantly from the poverty percentages for the county as a whole. The results are as follows:

- 18% of the universe of all cement plants (20 plants) and 36% of the sample of incinerators (21 plants) have poverty percentages at a one mile radius which exceed the corresponding county poverty percentages by more than five percentage points.

- 22% of the universe of all cement plants (25 plants) and 37% of the sample of incinerators (21 plants) have poverty percentages at a one mile radius which fall below the corresponding county poverty percentages by more than five percentage points.

- 60% of the universe of all cement plants (68 plants) and 28% of the sample of incinerators (21 plants) have poverty percentages at a one mile radius which fall within five percentage points (above or below) of the corresponding county poverty percentages.

7.3 LIMITATIONS

EPA excluded Puerto Rican facilities from the sample of cement plants analyzed because the census data required for the analysis is not readily available for Puerto Rico. In addition, the Census Bureau does not collect race information for Puerto Rico because the population is assumed to be of Hispanic origin. The results of both analyses may underestimate the minority populations near cement plants and commercial incinerators since these facilities were excluded.

The population estimated has important limitations. One limitation is the assumption that the population is evenly distributed across a census polygon. Another limitation to the analysis is the result of limitations inherent in the U.S. Census data. For example, the census data used is from 1990; therefore, there are issues with changes of populations characteristics over time. Also, the Census Bureau does not determine poverty status for all people (e.g. persons in college or in prison). Therefore, the poverty statistics may underestimate the below poverty populations. Lastly, the accuracy of the facility location and the quality of the location coordinate will also affect the number of people represented around a facility.

LIST OF ACRONYMS

ACFM	Actual Cubic Feet per Minute
APCD	Air Pollution Control Device
ATF	Above-the-Floor
ATTIC	Alternative Technology Information Center
BDAT	Best Demonstrated Available Technology
BEQ	Breakeven Quantity
BIF	Boiler or Industrial Furnace
BRS	Biennial Report Survey
CEM	Continuous Emissions Monitoring
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CETRED	Combustion Emissions Technical Resources Document
CIF	Cost, Insurance and Freight
CFR	Code of Federal Regulations
CK	Cement Kiln
CKD	Cement Kiln Dust
CKRC	Cement Kiln Recycling Coalition
Cl_2	Chlorine
CO	Carbon Monoxide
CRF	Capital Recovery Factor
CWA	Clean Water Act
D/F	Dioxin/Furan
DOM	Design, Operation, and Maintenance
DPRA	DPRA, Incorporated
DRE	Destruction and Removal Efficiency
EER	Energy and Environmental Research Corporation
EPA	Environmental Protection Agency
ESPs	Electrostatic Precipitators
GDP	Gross Domestic Product
GPM	Gallons per Minute
HAP	Hazardous Air Pollutant
HC	Hydrocarbons
HCl	Hydrochloric Acid
Hg	Mercury
HSWA	Hazardous and Solid Waste Amendments
HWIR	Hazardous Waste Identification Rule
ICR	Information Collection Request
IWS	Ionizing Wet Scrubbers
LDR	Land Disposal Restrictions
LVM	Low Volatile Metals
LWA	Lightweight Aggregate
LWAK	Lightweight Aggregate Kilns
MACT	Maximum Achievable Control Technology
NACR	National Association of Chemical Recyclers
NSPS	New Source Performance Standards
O&M	Operating and Maintenance

LIST OF ACRONYMS
(continued)

OAQPS	Office of Air Quality Planning and Standards
OMB	Office of Management and Budget
OSW	Office of Solid Waste
PCDD	Polychlorinated Dibenzo-P-Dioxins
PCDF	Polychlorinated Dibenzo Furans
PCI	Pollution Control Industries
PIC	Products of Incomplete Combustion
PM	Particulate Matter
POTW	Publicly Owned Treatment Work
PSPD	Permits and State Programs Division
RCRA	Resource Conservation and Recovery Act
RFA	Regulatory Flexibility Act
SBA	Small Business Administration
SQB	Small Quantity Burner
SVM	Semi-Volatile Metals
TEQ	Dioxin/Furan Toxic Equivalents
THC	Total Hydrocarbons
VISITT	Vendor Information System for Innovative Treatment Technologies

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