EQUITY CONSIDERATIONS AND OTHER IMPACTS CHAPTER 7

As required by applicable statute and executive order, EPA must complete an analysis of the proposed Hazardous Waste Combustion (HWC) MACT replacement standards with regard to equity considerations and other regulatory concerns. This chapter is divided into several sections that assess the potential impacts of the rulemaking associated with the following areas:

- **Regulatory flexibility:** focuses on the potential effects of the rulemaking on small entities;
- **Environmental justice:** considers potential environmental justice issues for minority and low-income populations residing near combustion facilities;
- **Children's health protection:** examines potential impact of the proposed HWC MACT replacement standards on the health of all children exposed to combustion facility emissions;
- **Joint impacts of other EPA rules:** discusses how other proposed rules together with the proposed HWC MACT replacement standards will likely affect the universe of facilities;
- **Unfunded mandates:** introduces the regulatory basis for addressing federal unfunded mandates;
- **Tribal governments:** extends the discussion of federal unfunded mandates to include impacts on Indian tribal governments and their communities;
- **Federalism:** considers potential issues related to state sovereignty;

- **Regulatory takings:** discusses the potential for regulatory takings to occur under the auspices of the proposed HWC MACT replacement standards; and

- **Energy Impacts:** examines the impacts of the proposed HWC MACT replacement standards on energy use, supply, and distribution.

In addition, this chapter addresses other impacts associated with the standards.

ASSESSMENT OF SMALL ENTITY IMPACTS

The Small Business Regulatory Enforcement Fairness Act (SBREFA) of 1996 requires federal agencies to consider impacts on "small entities" throughout the regulatory process.[1] Under these laws, agencies must analyze proposed regulations to determine if they will have a "significant economic impact on a substantial number" of small entities. If a regulation is found to have a significant impact on a substantial number of small entities, further analysis must be performed to determine what can be done to lessen the impact. This section summarizes whether the proposed HWC MACT replacement standards will adversely impact small entities; Appendix H contains the full assessment.

The first step in screening facilities for potential impacts is to identify those combustion facilities that are small businesses. Small businesses are defined either by the number of employees, or by the dollar amount of annual sales. The Small Business Administration (SBA) determines the level at which a business is considered small for each North American Industrial Classification System (NAICS) code.[2] After identifying the small businesses, we calculate site-specific compliance costs of the proposed HWC MACT replacement standards as a percentage of annual gross revenue; we use this figure as the basis for our assessment of small entity impacts. This approach is conservative primarily because it relies on an upper-bound estimate of engineering costs that assumes all facilities upgrade to comply with the standards, regardless of cost (as opposed to the market-adjusted estimate of social costs where facilities may select lower cost waste management options if feasible). In addition, the analysis assumes that commercial facilities do not implement any "price pass-through" (e.g., price increase) to generators (customers) to offset compliance costs. In reality, commercial combustion facilities might mitigate their own compliance costs by increasing prices. Similarly, non-commercial facilities may mitigate compliance costs by changing waste management practices rather than upgrading their facilities.

[1] Small entities include small businesses, small governments, and small nonprofit organizations.

[2] The size eligibility provisions and standards identified by the Small Business Administration (SBA) can be found in 13 CFR 121.201, revised as of January 1, 2003. Additional revisions implemented during 2003 do not affect the size eligibility requirements for any of the industries included in this assessment.

Given the capital intensity of cement production, commercial incineration, and many of the industries (e.g., chemicals) that own and operate on-site incinerators, boilers, hydrochloric acid production furnaces (HAPFs), and process heaters, it is not surprising that few of the hazardous waste combustion facilities meet the definition of a small business. From a list of 150 combustion facilities, only six were classified as being owned by small businesses (Exhibit 7-1). Three of the small combustor facilities are liquid boilers, one is an on-site incinerator, one is a cement kiln, and one is a lightweight aggregate kiln (LWAK). Three of the six facilities are part of larger corporations (e.g., they have parent companies, subsidiaries, affiliates, or additional branches) and annual sales for the six facilities and affiliated corporate entities range from approximately $49 million to $465 million. Complete size information was not available for one non-U.S. parent company, 3V Incorporated, which was therefore assumed to be small.

Under the Agency Preferred Approach, the Thermalkem (Norlite) lightweight aggregate kiln is the only small hazardous waste combustor that will likely incur costs greater than one percent of sales (Exhibit 7-1). This facility, which is owned by United Oil Recovery, Incorporated, employs 70 people, based on data published on August 22, 2003. Engineering-based compliance cost estimates of $1.1 million represent 2.21 percent of the company's reported annual sales, which total $49.1 million. Norlite is one of two LWAKs in the regulatory universe, and one of 17 commercial kilns. Since only one of these commercial kiln facilities will incur costs greater than one percent of sales, we conclude that neither a substantial number of facilities nor a substantial fraction of the affected industry faces this adverse impact. In addition, Norlite's estimated compliance costs may be offset, at least partially, by revenues and fuel savings associated with waste received from boilers and industrial furnaces that stop burning hazardous waste in response to the proposed HWC MACT replacement standards. The combined revenues and fuel savings associated with this additional waste range from $171 per ton to $1,124 per ton, depending on the specific characteristics of the waste. Taking these savings into account, our model predicts that the Norlite facility will not exit the hazardous waste market in response to the proposed replacement standards. In summary, this analysis indicates that the proposed HWC MACT replacement standards would not have a significant economic impact on a substantial number of small hazardous waste combustion facilities.

Exhibit 7-1

SMALL ENTITY ANALYSIS RESULTS

Facility Name/ Parent Company[a]	EPA ID	Combustor Type	Corporate Entity Annual Sales (thousands)[b]	Total Compliance Costs (Agency Preferred Approach)[c] (dollars)	Costs As a Percentage of Sales (CPS)
Reilly Industries, Inc.	IND000807107	Liquid Boiler	$329,600	$715,900	0.22%
Rubicon, Inc.	LAD008213191	Liquid Boiler	$465,000	$848,800	0.18%
Continental Cement Company	MOD054018288	Cement Kiln	$52,400	$238,900	0.46%
Thermalkem (Norlite); subsidiary of United Oil Recovery	NYD080469935	LWAK	$49,100	$1,077,600	2.21%
3V, Inc.[d]	SCD980500052	Liquid Boiler	$62,600	$45,100	0.07%
Velsicol Chemical Corporation	TND007024664	On-Site Incinerator	$150,000	$5,200	0.01%

Notes:
[a] Except in the case of Norlite, the name of each facility's parent company is the same as the name of the facility itself.
[b] Corporate entity data obtained from ReferenceUSA, Dun and Bradstreet, company websites, and company financial documents.
[c] Compliance costs represent the upper-bound engineering costs assuming facilities upgrade to comply with proposed standards.
[d] 3V, Incorporated is an Italian-owned company with facilities in the United States, Italy, and several other countries. Employment in the U.S. is at least 270 people, and overall employment worldwide is likely over 500 people (the small business size threshold). However, we included this facility as a small business because it is an internationally-owned company and we were unable to confirm total employment. Sales data are for the single facility in South Carolina.

ENVIRONMENTAL JUSTICE ANALYSIS

Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" (February 11, 1994), requires federal agencies to identify disproportionately large and adverse human health or environmental effects of their programs,

policies, and activities on minority and low-income populations.[3] Among other actions, the agencies are directed to improve research and data collection regarding health and environmental effects in minority and low-income communities.

To comply with this executive order, we assess whether the proposed HWC MACT replacement standards will have disproportionate effects on minority or low-income populations. We analyze minority populations living within one and five-mile radii of hazardous waste combustion facilities using 2000 U.S. Census Bureau block and block group level data and ArcMap version 8.2.[4,5,6] We compare the percentages of minority individuals living in proximity to the different types of facilities to national averages. Due to the concentration of combustion facilities in the Gulf region (35 percent of facilities in the universe are located in Louisiana and Texas), we also assess minority populations living within one and five-mile radii of combustion facilities in Louisiana and Texas, since these individuals are more likely to be exposed to emissions from multiple facilities.

In addition, we provide a limited screening analysis of low-income populations living within one and five-mile radii of commercial incinerators described in "Race, Ethnicity, and Poverty Status of the Populations Living Near Commercial Hazardous Waste Incinerators in the United States" (EPA, October 1994). We use the data from this study to characterize low-income populations surrounding the six facilities described in the report that continue to operate. Due to resource limitations, we were unable to analyze U.S. Census Bureau 2000 poverty level statistics for the block groups surrounding the current universe of hazardous waste combustion facilities. The 1994 report describes demographics in proximity to 21 commercial hazardous waste incinerators; only six of these continue to operate in the current universe.

Our analysis of the demographic data provide several important findings regarding the

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[3] As stated in Executive Order 12898, a minority is an individual who is a member of the following population groups: American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic.

[4] We analyze minority populations at the "block group" level, the most specific data available, because it best illustrates changes in minority populations between one and five miles from facilities. We use "block" level data for Puerto Rico since block group level data is not available for the Commonwealth.

[5] The available U.S. Census 2000 block and block group level data do not provide the race of individuals of Hispanic origin. Likewise, they do not differentiate between Hispanic and non-Hispanic White populations. Therefore we calculate minority populations as follows: first, we sum the populations of Black, American Indian or Alaskan Native, Asian, Hawaiian or Pacific Islander, and multi-racial individuals as well as individuals of other races. Next, we multiply the number of individuals of Hispanic origin by 47.89 percent, the percentage of Hispanic individuals nationwide that are White, before adding this population to the total minority population in order to prevent the double-counting of non-White individuals of Hispanic origin and thus overestimate minority populations. The minority population percentage equals the total minority population divided by the total population in a given area.

[6] ArcMap version 8.2 GIS software, produced by ESRI, Inc.

environmental justice impacts of the proposed HWC MACT replacement standards:

- In general, hazardous waste combustion facilities are more likely to be located in areas with disproportionately high minority populations. On-site incinerators, boilers, and hydrochloric production furnaces (HAPFs), the most prevalent facilities in the current universe, are located in areas with above-average percentages of minorities. Commercial incinerators, cement kilns, and LWAKs are located in areas with below-average percentages of minorities. These latter three facility types, however, only represent 18 percent of the facilities in the combustion universe. These minority populations living in proximity to combustion facilities may incur some environmental and health benefits as a result of the proposed HWC MACT replacement standards.

- Commercial incinerators with available poverty level data are located in areas where the proportion of the population living below the poverty line is greater than the nationwide average. These populations may also incur some environmental and health benefits associated with the implementation of the proposed HWC MACT replacement standards.

- Above-average concentrations of minority populations living in proximity to hazardous waste combustion facilities located in Louisiana and Texas will be positively affected by the proposed MACT standards.

- The proposed HWC MACT replacement standards should not have any adverse environmental or health effects on minority populations and low-income populations. Any impacts that the rule has on these populations are likely to be positive because it would potentially reduce emissions from combustion facilities near minority and low-income population groups.

We further discuss these findings and our analytical methodology in the remainder of this section.

Approach

Our environmental justice analysis relies on demographic data as an indicator of potential environmental and health impacts from the proposed HWC MACT replacement standards. While a risk assessment would be the preferred way to determine these impacts, the necessary resources were not available to complete such an analysis. Instead, we assess the environmental justice impacts of the proposed HWC MACT replacement standards by examining demographic data using the "population exposure" approach.

The "population exposure" approach considers the total population exposed to emissions from combustion facilities. Unlike a "facility" approach, this method examines the total number of potentially exposed minority and low-income individuals living near combustion facilities. Specifically, we sum the total and minority populations within one and five miles of each combustion facility to derive total and minority population figures for all of the facilities. We then divide the number of minority individuals by the total population living in proximity to combustion facilities and compare these percentages to national statistics. The population exposure approach indicates whether combustion facilities with particularly large surrounding populations have a disproportionate impact on total exposed populations.

When analyzing minority populations, we apply the population exposure approach to all facilities as well as to specific facility types. In addition, we use the approach to assess exposed populations in Texas and Louisiana. We analyze populations living within one and five miles of hazardous waste combustion facilities using U.S. Census 2000 block group data to identify and include populations in block groups with centers within the specific radii surrounding the facilities. We also performed two sensitivity analyses to address uncertainty in estimating populations using block groups. The first analyzes only block groups with boundaries that fall completely within one and five miles of facilities, a method that underestimates exposed populations. The second analyzes all block groups that are at least partly within one and five miles of facilities, a method that overestimates exposed populations. In all cases except for block groups within one mile of facilities in Louisiana, the block groups with centers within the specific distances of facilities produced the median minority level statistics.[7] Therefore we conclude that this method provides reasonable demographic statistics. When analyzing low-income populations, we apply the population exposure approach only to areas in proximity to the six commercial incinerators with poverty data.

Results

We first present our results of the environmental justice analysis for minority populations living in proximity to hazardous waste combustion facilities in 32 states and Puerto Rico. We then describe the populations exposed to hazardous waste combustion facilities in Louisiana and Texas. Following this, we discuss the low-income populations living in proximity to six commercial incinerators. At the end of this section, we summarize our conclusions.

[7] Of the population living in the six block groups with boundaries falling completely within one mile of hazardous waste combustion facilities in Louisiana, 47.37 percent are minorities. Of the population living in the 26 block groups with centers within one mile of facilities, 60.88 percent are minorities. Of the population living in the 66 block groups that are at least partially within one mile of facilities in Louisiana, 48.31 percent are minorities.

Minority Population Analysis

Minorities are disproportionately located near the majority of hazardous waste combustion facilities potentially affected by the proposed HWC MACT replacement standards (Exhibit 7-2). Approximately 38 percent of individuals living within one mile of facilities in the universe are minorities, 23 percent higher than the actual national minority percentage of 31 percent.[8] Over 40 percent of individuals living within five miles of facilities in the universe are minorities, 31 percent higher than the nationwide average of 31 percent.

The percentage of minorities living in proximity to specific types of hazardous waste combustion facilities varies, although as a whole facilities tend to be located in areas disproportionately populated by minorities. The racial demographics surrounding on-site incinerators are fairly representative of the demographics surrounding all hazardous waste combustion facilities. Thirty-seven percent of those within one mile and 38 percent of those within five miles of on-site incinerators are minorities, compared to 31 percent nationwide. Boilers and hydrochloric acid production furnaces (HAPFs) tend to be located in areas with more concentrated minority populations. According to our analysis, almost 43 percent of those within one mile and 45 percent of those within five miles of BIFs are minorities; the percentages are 39 percent and 45 percent greater than the national average of 31 percent, respectively. Commercial incinerators have a below-average percentage of minorities living within one mile of facilities (21 percent) and an above-average percentage of minorities living within five miles of facilities (46 percent). Cement and lightweight aggregate kilns are the only type of facility with below-average percentages of minorities living in proximity to facilities. Less than ten percent of those within one mile of kilns and almost 13 percent of those within five miles are minorities. This is 69 percent and 57 percent below the national average of 31 percent, respectively.

As mentioned in Chapter 2 and in the beginning of this section, the highest concentration of hazardous waste combustion facilities in the universe is along the Gulf of Mexico and in the Mississippi Delta region (EPA Region 6). Consequently, many individuals living in proximity to facilities in this area are exposed to emissions from multiple facilities. Therefore we evaluate the percentage of minorities living within one and five miles of hazardous waste combustion facilities in Louisiana and Texas in order to assess the environmental justice impacts of the proposed HWC MACT replacement standards on populations that are likely to be exposed to some of the highest emissions levels.[9]

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[8] U.S. Census 2000.

[9] When calculating minority populations in Louisiana and Texas, we multiply the number of individuals of Hispanic origin by the percentage of individuals of Hispanic origin who are White in each state in order to avoid double-counting non-White individuals of Hispanic origin. In Louisiana, this figure equals 57.33 percent; in Texas, it equals 57.97 percent.

The percentage of minorities in Louisiana totals over 37 percent, compared to the nationwide average of roughly 31 percent. The percentage of minorities living within one and five miles of facilities in Louisiana is significantly greater than both the state and national averages. Approximately 61 percent of the residents within one mile of facilities are minorities, and almost 56 percent of individuals living within five miles of facilities are minorities.

The percentage of minorities in Texas is also significantly greater than the national average (48 percent). The percentage of minorities living within one mile of facilities in Texas (over 44 percent) is significantly higher than the national average of 31 percent but lower than the state average of 48 percent. The minority percentage of the population living within five miles of hazardous waste combustion facilities in Texas (48 percent) is 57 percent greater than the national average of 31 percent and approximately equal to the state average.

The proposed HWC MACT replacement standards are projected to have positive impacts for minority communities around hazardous waste combustion facilities, particularly on-site incinerators, boilers and hydrochloric acid production furnaces (HAPFs), and facilities located in Louisiana (Exhibit 7-2). The proposed HWC MACT replacement standards are likely to reduce emissions from combustion facilities; therefore, populations near these facilities may accrue significant health and environmental benefits. Thus, the proposed HWC MACT replacement standards may have disproportionately positive health and environmental effects on minority populations.

Low-Income Population Analysis

We use EPA's 1994 study, "Race, Ethnicity, and Poverty Status of the Populations Living Near Commercial Hazardous Waste Incinerators in the United States," to assess the poverty level of individuals living within one and five miles of the six commercial incinerators that are both described in the report and are currently operating today. This study utilizes U.S. Census Bureau data from 1990, at which time approximately 13 percent of the U.S. population lived below the poverty line. According to the 1994 study, 21 percent of individuals living within one mile of the selected commercial incinerators are below the poverty line, which is 65 percent higher than the national average. Similarly of those individuals living within five miles of the incinerators, 27 percent, or more than 100 percent the national average, are below the poverty line. Only two of these facilities are surrounded by above-average percentages of low-income individuals, but these facilities are located among the most densely populated commercial incinerator sites.

Exhibit 7-2

POTENTIALLY EXPOSED GENERAL AND MINORITY POPULATIONS [a]

	Within 1 Mile of Facilities			Within 5 Miles of Facilities		
Facility Type [b]	**Total Population**	**Minority [c] Population**	**Minority [d] Percentage**	**Total Population**	**Minority [c] Population**	**Minority [d] Percentage**
On-site Incinerators	153,088	56,918	37.18%	4,537,046	1,723,769	37.99%
Commercial Incinerators	12,182	2,564	21.05%	391,604	180,489	46.09%
Boilers and Hydrochloric Acid Production Furnaces	124,454	53,465	42.96%	3,559,342	1,592,721	44.75%
Cement Kilns and LWAKs	9,879	955	9.67%	320,621	42,318	13.20%
Total in Louisiana [e]	23,628	14,384	60.88%	364,429	203,849	55.94%
Total in Texas [f]	20,606	9,159	44.45%	878,333	425,588	48.45%
Total Facilities [g]	299,574	113,889	38.02%	8,332,514	3,373,971	40.49%

Notes:

[a] We include blocks and block groups with centers within the one and five mile radii to determine demographic statistics. We also calculate identical statistics for populations within block groups that either intersected or were completely contained by the one and five mile radii. In all cases except the one-mile buffer of facilities in Louisiana, the blocks and block groups with centers within the radii produced the median statistics. Therefore we conclude that this method provides a reasonable basis for demographic analysis.

[b] "Facility type" represents the primary combustion facility type at each location. For facilities with more than one type of combustion system, we assign the facility type based on the type of system combusting the majority of waste.

[c] Minority populations equal the sum of Black, American Indian or Alaskan Native, Asian, Hawaiian or Pacific Islander, and multi-racial individuals, individuals of other races, and individuals of Hispanic origin. We multiply the number of Hispanic individuals by 47.89%, the percentage of Hispanics that are White out of all individuals of Hispanic origin in the United States. This method prevents the double-counting of individuals of Hispanic origin that are not White.

[d] Since 57.33% of individuals of Hispanic origin in Louisiana are White, the total number of Hispanic individuals living within one and five miles of hazardous waste combustion facilities in the state is multiplied by 57.33% instead of 47.89% in order to avoid double-counting when calculating the minority population.

[e] Since 57.97% of individuals of Hispanic origin in Texas are White, the total number of Hispanic individuals living within one and five miles of hazardous waste combustion facilities in the state is multiplied by 57.97% instead of 47.89% in order to avoid double-counting when calculating the minority population.

[f] According to the 2000 U.S. Census, the percentage of minorities is 30.87% nationwide, 37.47 % in Louisiana, and 47.57% in Texas.

[g] The sum of the first four rows is greater than the total population since adjacent facilities expose the same individuals to emissions from multiple facility types.

Although the six incinerators examined in this effort represent only four percent of facilities in the current hazardous waste combustion universe and demographics may have changed since 1990, the 1994 data demonstrating that the two facilities sited in the most densely populated areas are surrounded by populations that are disproportionately below the poverty level indicate that hazardous waste facilities may be located in low-income areas. These low-income populations may therefore benefit from an improved environment and health associated with the proposed HWC MACT replacement standards.

In addition to these conclusions, it is important to note that due to resource limitations we did not perform a separate analysis using U.S. Census Bureau 2000 poverty level data to analyze low-income populations within one and five miles of all facilities in the current hazardous waste combustion universe. However, if such data were readily available we could better evaluate whether low-income populations are disproportionately exposed to emissions from all hazardous waste facilities likely to be affected by the proposed HWC MACT replacement standards.

Summary

Our population exposure analysis indicates that minority and low-income populations in aggregate appear to be disproportionately located near hazardous waste combustion facilities. On-site incinerators, boilers, and hydrochloric acid production furnaces (HAPFs) are located in areas with the highest percentages of minority populations. These facilities also tend to exist in more populated sites than other types of combustion facilities. Thus, using the population exposure approach to estimate environmental justice impacts, the proposed HWC MACT replacement standards may result in significant health and environmental benefits to minority and low-income populations.

CHILDREN'S HEALTH PROTECTION ANALYSIS

Executive Order 13045, "Protection of Children from Environmental Health Risks and Safety Risks" (April 21, 1997), directs federal agencies and departments to evaluate the health effects of proposed health-related or risk-related regulations on children.[10] For economically significant rules concerning an environmental health or safety risk that may disproportionately affect children, Executive Order 13045 also requires an explanation as to why the planned regulation is preferable

[10] In addition, two separate directives issued by EPA, "Policy on Evaluating Health Risks to Children" (October 1995) and "National Agenda to Protect Children's Health from Environmental Threats" (October 1996), both cited in U.S. EPA, *Assessment of the Potential Costs, Benefits, and Other Impacts of the Hazardous Waste Combustion MACT Standards: Final Rule*, Office of Solid Waste, July 1999, also call for consideration of children's health within risk assessments and other components of regulatory analyses.

to other potentially effective and feasible alternatives.[11] The proposed HWC MACT replacement standards are exempt from the requirements of Executive Order 13045 because the rule is a technology-based regulation (MACT) rather than a risk-based regulation and it is not considered to be economically significant.[12] Nevertheless, the risk assessment performed in 1998 for the 1999 HWC MACT standards does address threats to children's health by evaluating reduced risks associated with hazardous waste combustion for children as well as for adults. This section briefly describes some of the health impacts that the proposed HWC MACT replacement standards may have on children's health. We note that the health impacts of the 1999 HWC MACT standards are generally assumed to be similar to the impacts of the 2002 Interim standards.

Particulate Matter

The proposed HWC MACT replacement standards are expected to result in the prevention of less than one premature death and 54 illnesses annually associated with exposure to particulate matter (PM). While separate results are not available for children, we assume that many of respiratory health benefits would be experienced by children because they are considered to be especially vulnerable to the effects of PM exposure.[13]

Mercury

The 1999 Hazardous Waste Combustion MACT standards (and the 2002 Interim standards) were expected to reduce mercury emissions by four tons per year, and the Agency Preferred Approach for the proposed HWC MACT replacement standards are expected to reduce mercury emissions by an additional one ton per year. The 1999 analysis found that risk reductions for recreational anglers potentially exposed to mercury-contaminated fish could be significant. Therefore, since fewer anglers would be at risk of having children with developmental abnormalities, the proposed HWC MACT replacement standards would likely have some positive impact on children's health due to an incremental reduction in mercury and consequent developmental complications.

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[11] As defined in Executive Order 13045, an economically significant rule is any rulemaking that has an annual effect on the economy of $100 million or more, or would adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or state, local or tribal governments or communities.

[12] U.S. Environmental Protection Agency, "EPA's Rule Writer's Guide to Executive Order 13045: Guidance for Considering Risks to Children During the Establishment of Public Health-Related and Risk-Related Standards," Interim Final Guidance, April 21, 1998, 3, as cited in U.S. EPA, *Assessment of the Potential Costs, Benefits, and Other Impacts of the Hazardous Waste Combustion MACT Standards: Final Rule,* Office of Solid Waste, July 1999.

[13] U.S. EPA, *Environmental Health Threats to Children*, EPA 175-F-96-001, September 1996, 4, as cited in U.S. EPA, *Assessment of the Potential Costs, Benefits, and Other Impacts of the Hazardous Waste Combustion MACT Standards: Final Rule,* Office of Solid Waste, July 1999.

Lead

The 1999 Hazardous Waste Combustion MACT standards were expected to reduce lead exposure and consequently result in reduced lead levels for children within sub-populations exposed to especially high levels of the metal. The sub-populations facing the greatest levels of cumulative lead exposure include subsistence fishermen, commercial beef farmers, and commercial dairy farmers. The 1999 standards were expected to reduce lead emissions by 89 tons per year, and the Agency Preferred Approach for the proposed HWC MACT replacement standards are expected to reduce lead emissions by approximately five tons per year. Therefore the children within the high-risk sub-populations would experience further reductions in overall lead exposure as a result of the proposed HWC MACT replacement standards.

Summary

Although the impacts of the proposed HWC MACT replacement standards on children's health have not been evaluated quantitatively, qualitative analysis indicates that children would benefit from the replacement rule. Further reductions in particulate matter, mercury, and lead emissions associated with the proposed HWC MACT replacement standards should incrementally reduce the risk of some illnesses and developmental abnormalities. Children within high-risk sub-populations including recreational anglers, subsistence fishermen, and commercial dairy and beef farmers living in proximity to hazardous waste combustion facilities could potentially experience the greatest positive health effects.

JOINT IMPACTS OF RULES

As discussed in Chapter 2, the universe of regulated facilities is affected by a number of regulations. However, these regulations will not have an aggregate impact on the regulated facilities. Specifically, the Portland Cement MACT and the proposed National Emissions Standards for Hazardous Air Pollutants for Industrial/Commercial/Institutional Boilers and Process Heaters are incorporated into the baseline of this assessment and will affect facilities only if they cease to burn hazardous waste in their boilers, hydrochloric acid production furnaces (HAPFs), and kilns. Under these conditions, the facility will no longer be subject to the proposed HWC MACT replacement standards.

In some cases, compliance with already existing regulations may ease compliance with the proposed HWC MACT replacement standards. For example, criteria pollutants regulated under the proposed standards are also controlled under the Clean Air Act (CAA). For those facilities that are major or area sources under the CAA, compliance with one standard will contribute to adherence with the other. Therefore, implementation of the proposed HWC MACT replacement standards is not expected to jointly impact the actions of facilities already controlled by other regulations.

UNFUNDED MANDATES ANALYSIS

Signed into law on March 22, 1995, the Unfunded Mandates Reform Act (UMRA) calls on federal agencies that issue any significant regulation containing an unfunded mandate to fulfill certain requirements. These include providing a statement supporting the need to issue the regulations and describing prior consultation with representatives of affected state, local, and tribal governments.[14] Requirements in the UMRA apply only to those federal regulations containing a significant unfunded mandate. The UMRA defines a significant unfunded mandate as a federal rule that either:

1. Results in estimated costs to state, local, and tribal governments in aggregate of $100 million or more in any one year; or

2. Results in estimated annual costs to the private sector of $100 million or more in any one year.

Federal rules are exempt from the UMRA requirements if:

1. The rule implements requirements specifically set forth in law; or

2. Compliance with the rule is voluntary for state and local governmental entities.

Based on these criteria set forth by the UMRA, the proposed HWC MACT replacement standards do not contain a significant unfunded mandate. As reported in the economic impact results chapter, the proposed standards are not likely to result in annualized expenditures of $100 million or more either for the private sector or for state and local governments in the aggregate under the Agency Preferred Approach MACT option, especially after allowing for market adjustments. Expenditure estimates presented in this assessment total approximately 2002 $57.1 million per year for the private sector and $447,000 for the government.[15] In any case, because EPA is issuing the proposed HWC MACT replacement standards under the authority of the Clean Air Act (CAA), the rule should be exempt from all relevant requirements of the UMRA. In addition, compliance with the rule is voluntary for non-federal governmental entities since state and local agencies choose

[14] Other requirements include a statement concerning estimated costs and benefits, consideration of regulatory alternatives, consultation with affected government entities, and a small government plan for those rules "significantly or uniquely" affecting small government agencies. Even though the proposed HWC MACT replacement standards are exempt from these requirements, as we explain below, many of them are already satisfied by other components of this assessment.

[15] See Exhibit 5-6, "Total Annual Pre-Tax Compliance Costs: Dynamic Scenario (millions) After Combustion System Consolidations" and Exhibit 4-9, "Summary of Proposed HWC MACT Replacement Standards' Incremental Costs to Government,"as cited in U.S. EPA, *Assessment of the Potential Costs, Benefits, and Other Impacts of the Hazardous Waste Combustion MACT Standards: Final Rule*, Office of Solid Waste, July 1999

whether or not to apply to EPA for the permitting authority necessary to implement the proposed HWC MACT replacement standards.

TRIBAL GOVERNMENTS ANALYSIS

Similar in purpose to the UMRA, Executive Order 13175, "Consultation and Coordination With Indian Tribal Governments" (May 14, 1998), addresses related unfunded mandates concerns with regard to the sovereignty of tribal governments. The applicable sections of Executive Order 13175 impose requirements on federal agencies that promulgate regulations not required by statute and that significantly or uniquely affect Indian tribal governments and their communities. The requirements include description of the extent of prior consultation with affected tribal governments, a summary of the nature of their concerns, and a statement supporting the need to issue the regulation.

For many of the same reasons described in the UMRA discussion, the requirements of Executive Order 13175 do not apply to the proposed HWC MACT replacement standards. As mentioned above, promulgation of the proposed HWC MACT replacement standards is occurring under the statutory authority of the CAA. In addition, while Executive Order 13175 does not provide a specific gauge for determining whether a regulation "significantly or uniquely affects" an Indian tribal government, the standards are not expected to impose substantial direct compliance costs on tribal governments and their communities because we do not expect that a significant number of hazardous waste combustion facilities are located in tribal communities.[16] Finally, tribal governments will not be required to assume any permitting responsibilities associated with the proposed HWC MACT replacement standards because, as previously stated, permitting authority is voluntary for non-federal government entities. In fact, while the CAA does allow tribal governments to implement its permitting requirements, none have yet assumed the authority.[17]

FEDERALISM ANALYSIS

Executive Order 13132, entitled "Federalism" (64 FR 43255, August 10, 1999), requires EPA to develop an accountable process to ensure "meaningful and timely input by State and local officials in the development of regulatory policies that have federalism implications." Policies that have federalism implications are defined in the Executive Order to include regulations that have "substantial direct effects on the States [in terms of compliance costs], on the relationship between the national government and the States, or on the distribution of power and responsibilities among

[16] We did not, however, conduct a quantitative geographic location analysis to verify this assumption.

[17] Kevin Pechulis, U.S. Environmental Protection Agency RCRA Hotline, personal communication, March 19, 1998, as cited in U.S. EPA, *Assessment of the Potential Costs, Benefits, and Other Impacts of the Hazardous Waste Combustion MACT Standards: Final Rule*, Office of Solid Waste, July 1999; and U.S. Environmental Protection Agency, "Air Pollution Operating Permit Program Update: Key Features and Benefits," EPA/451/K-98/002, February 1998.

the various levels of government." In addition, policies have federalism implications if they preempt State law.

The proposed HWC MACT replacement standards do not have federalism implications. They will not have direct financial effects on the States because EPA will be responsible for permitting and monitoring hazardous waste combustion facilities. Furthermore, the proposed replacement standards should not alter the relationship between the national government and the States because the States may voluntarily apply for permitting authority in order to implement the proposed HWC MACT replacement standards. Finally, the proposed replacement regulations do not preempt State law because States may still develop air pollution laws that exceed the stringency of the proposed HWC MACT replacement standards.

REGULATORY TAKINGS ANALYSIS

Executive Order 12630, "Government Actions and Interference with Constitutionally Protected Property Rights" (March 15, 1988), directs federal agencies to consider the private property takings implications of proposed regulations. Under the Fifth Amendment of the U.S. Constitution, the government may not take private property for public use without compensating the owner. Though the exact interpretation of this takings clause as applied to regulatory action is still subject to an ongoing debate, a framework for interpretation has been established by legal precedent through a series of prominent court cases.[18]

Within the current context of mainstream legal precedent, a regulatory taking of private property is generally deemed to result if the court determines that the government action satisfies any of the following criteria:

- Results in a physical invasion of property;

[18] See, for instance, *Pennsylvania Coal Co. v. Mahon,* 260 U.S. 393 (1922), *Penn Central Transportation Co. v. City of New York* 438 U.S. 104 (1978), *Nollan v. California Coastal Commission* 483 U.S. 825 (1987), *Lucas v. South Carolina Coastal Council* 112 S. Ct. 2886 (1992), *Dolan v. City of Tigard* 114 S. Ct. 2309 (1994), as cited in U.S. EPA, *Assessment of the Potential Costs, Benefits, and Other Impacts of the Hazardous Waste Combustion MACT Standards: Final Rule*, Office of Solid Waste, July 1999. Also see *Palazzolo v. Rhode Island* 533 U.S. 606 (2001). It is also worth noting the number of pieces of legislation introduced in recent U.S. Congressional sessions that aim to strengthen the defined framework for analysis of regulatory takings. The main goals of the bills include the following: expansion of the definition of a regulatory takings; introduction of additional administrative requirements for federal agencies issuing regulations likely to result in regulatory takings; and expedition of access to federal courts for parties seeking claims associated with regulatory takings. If passed, however, none of the legislation contains provisions likely to affect the principles of mainstream legal interpretation of regulatory takings that are utilized in the following analysis of the proposed HWC MACT replacement standards.

- Denies the owner all reasonable or economically viable use of property;[19]
- Interferes with reasonable investment-backed expectations for property; or
- Fails to establish a justifiable connection between the requirements imposed (e.g., permit conditions) and the underlying purposes of the regulation.

Even if a regulatory requirement meets any or all of the designated conditions for a regulatory taking, courts may still find it exempt from the takings clause if the regulatory action is meant to prevent a "nuisance" or to provide other benefits to the public. A nuisance is defined as an activity or condition that either interferes with public welfare or with the ability of another private citizen to enjoy his or her own property.[20]

Based on our review of relevant case law, the proposed HWC MACT replacement standards are not likely to result in any regulatory takings. The rule will not require that private property be invaded or taken for public use. The rule also will not interfere with reasonable investment-backed expectations because it does not ban hazardous waste combustion in incinerators, kilns, boilers, or hydrochloric acid production furnaces (HAPFs). Instead, it merely authorizes operating parameters. The investment-backed expectations of anyone introducing the use of a hazardous waste incinerator, kiln, boiler, or HAPF at their facility after the proposed HWC MACT replacement standards are finalized would include a recognition of the existence of impending regulatory requirements. Persons already using these systems would have at least three years to adjust their expectations and to prepare for accommodation of the forthcoming regulation. As a result, no facility owner should be able to assert interference with reasonable investment-backed expectations sufficient to support a takings.[21]

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[19] No universally accepted formula exists for determining at what point direct economic impacts from regulatory action constitute a taking. Rather, courts must make this determination on a case-by-case basis. In the landmark *Lucas* decision, the U.S. Supreme Court proclaimed that a 100 percent deprivation in value most often, but not always, constitutes a taking. Recent case law includes many examples in which regulations deprived owners of as much as 50 percent or more of the value associated with the economic use of property, yet the court still ruled that the regulations did not deny the owner all reasonable economic value. For instance, see *Concrete Pipe and Products v. Construction Laborers Pension Trust for Southern California*, 113 S.Ct. 2264 (1993), as cited in U.S. EPA, *Assessment of the Potential Costs, Benefits, and Other Impacts of the Hazardous Waste Combustion MACT Standards: Final Rule*, Office of Solid Waste, July 1999.

[20] Numerous court decisions ranging from landmark preservation to the control of industrial pollution in residential areas have upheld regulations while at the same time acknowledging the takings claims associated with them on the basis of nuisance prevention and resource protection goals.

[21] See *Ruckelshaus v. Monsanto Co.*, 467 U.S. 986, 1005 (1984), as cited in U.S. EPA, *Assessment of the Potential Costs, Benefits, and Other Impacts of the Hazardous Waste Combustion MACT Standards: Final Rule*, Office of Solid Waste, July 1999.

Because the rule does not prohibit the burning of hazardous waste in incinerators, kilns, boilers, or HAPFs, it does not deny the facility owners all viable economic use of their property. Nor does the rule prevent owners from putting their property to other profitable uses should they decide to cease combustion in the face of the regulation. For many facilities in this universe, the primary economic use of property comes from other activities not directly associated with hazardous waste combustion. Even if these facilities should stop burning waste and switch to an alternative fuel, they would still be able to manufacture their primary products.

This evaluation of the proposed HWC MACT replacement standards corresponds with the mainstream legal thought that only in rare instances will regulations be found to result in takings. Using legal precedent as the basis for this analysis, it is difficult to speculate fully on the potential for extreme takings interpretations as applied to the impacts of these standards. The only areas where such an extreme interpretation of takings potentially *could* arise in the context of the proposed HWC MACT replacement standards are the issues of deprivation of economically viable use of property and interference with reasonable investment-backed property expectations. However, it is still fairly easy to refute an extreme application of the takings clause to the proposed replacement standards that is based on these criteria.

The economic impact results reported earlier do suggest that a number of facilities could stop treating waste in hazardous waste boilers and on-site incinerators in the face of compliance costs associated with the proposed HWC MACT replacement standards. It is important to note, however, that these changes in operation are not likely to affect the ability of companies to produce products or compete in markets. Even under an extreme takings interpretation, it is doubtful that the proposed HWC MACT replacement standards would be found to interfere directly with all viable use or economic value of property. Also, as we described above, the established statutory authority for the standards and the fact that the rule does not prohibit combustion altogether should exempt it from any claims of interference with reasonable investment-backed expectations. Regardless, the proposed HWC MACT replacement standards would most likely qualify for an exemption to any regulatory takings claims because of the doctrines of public and private nuisance law.

ENERGY IMPACT ANALYSIS

Executive Order 13211, "Actions Concerning Regulations that Affect Energy Supply, Distribution, or Use" (May 18, 2001), addresses the need for regulators to more fully consider the potential energy impacts of the proposed rule and resulting actions. Under Executive Order 13211, agencies are required to prepare a Statement of Energy Effects when a proposed regulatory action may have significant adverse effects on energy supply, distribution, or use, including impacts on price and foreign supplies. Additionally, the requirements obligate agencies to consider reasonable alternatives to regulatory actions with adverse effects and the impacts that the alternatives might have upon energy supply, distribution, or use.

The proposed HWC MACT replacement standards address kilns, boilers, and HAPFs that recover energy by burning hazardous waste, and the implementation of these standards will likely result in some facilities deciding to transport waste offsite for combustion instead of treating it themselves. In addition, the proposed rule will likely result in the installation of additional air pollution control devices (APCDs) that require energy to operate. Therefore, this rule will have some impacts on energy use. In order to analyze the potential energy impacts of the proposed standards, we consider the effect of the alternative methods by which facilities might respond to the proposed HWC MACT replacement standards as identified in Chapter 5. Specifically, we consider the energy implications when facilities opt to upgrade their systems in order to comply, dispose of waste in an alternative manner, or consolidate their systems. Facility decisions have the following energy implications:

1. **Upgrade:** APCDs installed at sources to comply with the proposed HWC MACT replacement standards reduce source energy efficiency by requiring energy for APCD operation;

2. **On-Site Incineration:** on-site incineration does not recover significant amounts of energy, so systems currently utilizing energy from hazardous waste combustion (e.g., boilers) that will treat waste in on-site incinerators as a result of the proposed standards will need to purchase replacement fuel;

3. **Off-Site Incineration:** off-site incineration increases energy use by requiring energy associated with transportation;

4. **Off-Site Cement Kilns and LWAKs:** disposal of waste in cement kilns or LWAKs requires replacement fuel for facilities that had previously utilized energy from on-site waste combustion. However, cement kilns and LWAKs also recover energy by using waste in place of conventional fuel. As a result, the only loss associated with this compliance option is transportation-related energy. Note that because we assume that on-site incinerators do not have the option of sending waste to kilns, we do not evaluate the scenario that would result in a net gain in energy.

The following analysis calculates the quantities of energy used and the net energy costs resulting from the proposed standards. The results of this analysis allow a determination of the impacts that the proposed regulatory action will have upon the supply, distribution, and use of energy. Our analysis suggests that the energy impacts associated with the proposed HWC MACT replacement standards will be modest.

Energy Use

One impact of the proposed HWC MACT replacement standards is related to the use and recovery of energy from waste. Below we identify the changes in energy quantity and associated costs for the dynamic social cost scenarios.[22] For all estimates we consider only the Agency Preferred Approach.

Our market-adjusted scenarios assume that facilities will choose to upgrade their incinerators, kilns, boilers, and furnaces to comply with the proposed HWC MACT replacement standards only if it is less costly than pursuing alternative fuel and waste disposal options. According to these assumptions, 218 out of the 276 hazardous waste combustion systems in the universe will upgrade or install APCDs to comply with the proposed standards and 58 systems will seek alternative waste disposal options.[23] Our analysis allows for several different alternatives under the market-based scenario including APCD upgrades, closure and sending waste offsite for treatment at other facilities, and consolidation among systems within the same facility. Each alternative has a different impact on energy use, and we incorporate the least costly option for each facility into our final analysis.[24] According to our cost calculations, of the 58 systems that do not upgrade to comply with the proposed replacement standards, 45 will close and send waste offsite and 13 will consolidate. Of the systems that we project will close (e.g., exit but not consolidate), two are commercial incinerator systems and 21 are on-site incinerator systems, and they will send their waste to commercial incinerators. The remaining 22 are boilers and will send their hazardous waste to cement kilns or LWAKs for treatment.[25] Energy related impacts are as follows:

1. **Upgrade-related energy use increases:** For upgraded sources, energy requirements will increase as described under the full engineering compliance scenario. We do not estimate the exact energy requirements and costs associated with upgrading the 218 systems in this assessment.

[22] The energy impacts of the engineering-based scenario are limited to the costs of energy for operating APCDs. Because we believe that facilities will actually examine least-cost alternatives and will consider energy implications in determining costs, we believe that the dynamic scenarios are more instructive regarding energy use.

[23] The energy impact analysis was carried out using inputed waste volumes for the 11 facilities that did not report waste to the 1999 BRS.

[24] This may not always be the case. Some facilities may choose to continue treating waste rather than sending it offsite even if the latter option is cheaper because of non-economic factors such as liability concerns.

[25] These closures and consolidations represent projections associated with the market-based scenario for the Agency Preferred Approach, for which we estimate that compliance costs will total $57.6 million.

2. **Transport-related energy use increases:** The 45 systems that would opt to close and treat waste off-site will increase energy use by expending fuel associated with waste shipment. Assuming that waste is sent to the nearest combustion facility, these facilities will ship waste slightly more than 13,413 miles per year. This figure incorporates the number of tons that each facility would send offsite, the tons of waste that can be transported per truck, and the miles that each truck would travel. Based on recent statistics from the Department of Transportation, trucks average 6.0 miles per gallon of fuel.[26] Therefore, the transportation required for these facilities to send hazardous waste off-site requires the use of an additional 2,235 gallons of fuel annually. At a unit cost of $0.934 per gallon of diesel fuel, the increase in fuel expenditures will total almost $2,088 annually.[27]

3. **Replacement Fuel Costs:** Facilities currently recovering energy from hazardous waste combustion that we expect will send waste offsite for treatment must purchase replacement fuel to offset the lost energy. The 31 boiler systems that we project will close as a result of the proposed HWC MACT replacement standards are all expected to send their waste to cement kilns or LWAKs.[28] Kilns also recover energy during the combustion process, so no net gain or loss of energy will occur beyond the transportation requirements described previously.

Exhibit 7-3 outlines the total changes in energy use that will result from system actions under the market-based scenario. The energy requirements for transportation will result in an increase in energy use of 2,235 gallons of diesel gasoline per year as a result of the proposed HWC MACT replacement standards. The estimated costs of this increase in demand is approximately $2,088. This figure underestimates total energy expenditures resulting from system closures in the market-based scenario because we do not estimate the energy increases and costs associated with upgrading APCDs.

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[26] U.S. Dept. of Transportation, Bureau of Transportation Statistics, "Average Motor Vehicle Miles Per Gallon," July 21, 2003, September 23, 2003 <http://www.bts.gov/products/transportation_indicators.september_2002/ /Environment/excel/Average_Motor_Vehicle_Miles_Per_Gallon.xls>.

[27] Based on average June 2003 spot prices cited by the U.S. Department of Energy, Energy Information Administration, "Table 40: U.S. No. 2 Diesel Fuel Prices by Sales Type, PAD District, and Selected States," *Petroleum Marketing Monthly*, September 2003 <http://www.eia.doe.gov/pub/oil_gas/petroleum/data_publications/_petroleum_petroleum_marketing_monthly/current/pdf/pmmtab16.pdf>.

[28] We do not expect that boilers would accept additional hazardous wastes from offsite because the cost of rerouting the waste would be prohibitively expensive.

Exhibit 7-3

OVERVIEW OF ENERGY IMPACTS RESULTING FROM CLOSURES IN THE MARKET-BASED SCENARIO

Action	Change in Energy Use (Million Btus)	Estimated Costs of Increased Energy
APCDs	Not Calculated	Not Calculated
Transportation of Waste Offsite	205,663	$2,088
Alternative Fuel Purchases	No net gain/loss	$0
Total Impacts:	**205,663**	**$2,088**

Consolidation Analysis

Consolidation of sources has net impacts on energy use if waste previously treated in systems recovering energy is instead treated in incinerators that do not recover energy. Only two of the 13 systems that we project will consolidate in the market-based scenario are boilers, and we expect that this waste will be rerouted to on-site incinerators located at the same facility. The two boilers currently treat over 29,891 tons of hazardous waste annually. Assuming that this waste has an energy value of 13,500 Btu per pound, the boilers will require almost 807,059 million Btus in replacement fuel. One of these boilers, which currently combusts 29,322 tons of hazardous waste and would require 791,683 million Btus of replacement fuel, would use coal costing $1.64 per million Btus, and replacement fuel expenditures would total almost 2002 $1,300,736.[29] The other boiler, which currently combusts 569 tons of hazardous waste and would require 15,376 million Btus of replacement fuel, would use natural gas costing $4.85 per million Btus, and replacement fuel would cost 2002 $74,572.[30] Total replacement fuel costs for boiler systems that consolidate to on-site incinerator systems would equal 2002 $1,375,308. The remaining 11 systems are on-site incinerators that we expect will divert waste to other on-site incinerator systems. This will not affect energy use relative to baseline practices unless consolidation provides a more efficient process and the closure of units reduces energy consumption. However, if consolidation provides a cost-effective alternative to incineration in the market-based scenario, the increase in energy use would be avoided.

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[29] U.S. Department of Energy, Energy Information Administration, "Table 25: Average Price of Coal Receipts at Other Industrial Plants by Census Division and State," *Quarterly Coal Report: October - December 2003*, March 2003, 26.

[30] U.S. Department of Energy, Energy Information Administration, "Table 4: Selected National Average Natural Gas Prices, 1996 - 2002," *Natural Gas Monthly*, March 2003, September 16, 2003 <http://www.eia.doe.gov/pub/oil_gas/natural_gas/data_publications/natural_gas_monthly/historical/2003/2003_03/pdf/table_04.pdf>.

Summary of Energy Use Impacts

According to the market-based scenario, the proposed HWC MACT replacement standards will result in an increased annual use of at least 1,012,722 million Btus of energy at an estimated cost of at least $1,377,396 per year. These energy and cost impacts underestimate total impacts of the proposed standards because we do not include the energy and expenditures associated with APCD upgrades. However, these costs are likely to be relatively modest.

Energy Supply and Delivery

United States' industries consumed 32,483 trillion Btus of energy in 2002.[31] The energy impacts of the proposed HWC MACT replacement standards will increase energy use by at least 3.12E-3 percent. This rule is not a "significant energy action" as defined in Executive Order 13211, "Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution, or Use" (66 Fed. Reg. 28355 (May 22, 2001)) because it is not likely to have a significant adverse effect on the supply, distribution, or use of energy. While energy use may increase slightly as a result of the proposed HWC MACT replacement standards, production and supply of fuel will not be affected. The incremental 3.12E-3 percent increase in energy use in the industrial sector estimated by the preceding analysis will have a negligible impact on nationwide fuel prices and supply.

OTHER IMPACTS

While the primary environmental impacts of the proposed HWC MACT replacement standards are improvements in air quality resulting from reduced emissions from combustion facilities, other non-air environmental impacts will also result from the rule.[32] Namely, use of specific air pollution control devices and shifts in hazardous waste burning will result in water and solid waste impacts. Systems that use wet scrubbers to control chlorine emissions will generate an additional 4 billion gallons of wastewater per year. In addition, systems that install dry scrubbers to control chlorine emissions will generate more than 34,000 tons of spent sorbent per year. Facilities using activated carbon to control emissions of dioxins/furans and mercury will generate nearly 11,000 tons of carbon on an annual basis. Controls for other pollutants will increase annual

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[31] U.S. Department of Energy, Energy Information Administration, "Table 2.4: Industrial Sector Energy Consumption (Quadrillion Btu)," *Monthly Energy Review July 2003*, July 28 2003, August 14, 2003 <http://www.eia.doe.gov/emeu/mer/pdf/pages/sec2_9.pdf>.

[32] The water and solid waste impacts described in this paragraph were provided by EERGC, Inc. November 19, 2003.

water consumption by approximately one billion gallons and generate an additional 6,200 tons of solid waste per year. The cost estimates presented in Chapter 4 and Chapter 5 account for the treatment and disposal of all wastewater and solid waste generated as a result of the standards.[33]

[33] Our wet scrubber cost estimates include O&M costs associated with treating wet scrubber wastewater. We anticipate that few, if any, facilities will need to install additional capital equipment to enhance their wastewater treatment capabilities. Personal communication, Bruce Springsteen, EERGC, Inc., November 19, 2003.

COMPARISONS OF COSTS, BENEFITS, AND OTHER IMPACTS

CHAPTER 8

A final component of this assessment for the proposed MACT HWC replacement standards is a comparison of the costs and benefits of the rule. This chapter uses two metrics for this comparison. We first consider cost-effectiveness measures which provide estimates of expenditures per unit reduction of emissions for each air pollutant and estimates of the cost per unit of benefit achieved by the rule. We then compare the total engineering-based compliance costs of the rule with the total monetized benefits of the rule. Cost-benefit analysis is a central feature of virtually all economic assessments and evaluates the economic efficiency of environmental policies by measuring incremental costs and benefits, and hence their net impacts on society. In terms of economic efficiency, if the gainers could compensate the losers and still remain better off, the policy is deemed to be efficiency enhancing and therefore "good" from a policy perspective. Cost-benefit and cost-effectiveness analyses, however, should not be the only tools used in the establishment of any final regulatory action. The HWC MACT standards are expected to provide other benefits that are not expressed in monetary terms. When these benefits are taken into account, along with equity-enhancing effects such as environmental justice and impacts on children's health, the benefit-cost comparison becomes more complex. Consequently, the final regulatory decision becomes a policy judgement which takes into account efficiency as well as equity concerns.

COST-EFFECTIVENESS ANALYSIS

Overview

We developed two types of cost-effectiveness measures that examine:

- cost per unit reduction of emissions for each air pollutant; and

- cost per unit of benefit (e.g., benefits in the form of health and ecological improvements).

The first cost-effectiveness measure is useful for comparisons across various air pollution regulations. Moreover, EPA has typically used this cost-effectiveness measure (defined as "dollar-per-ton-of-pollutant-removed") to assess the decision to go beyond-the-floor (BTF) for MACT standards.[1] The second measure, cost per unit benefit, provides some insight into the rule's relative costs of achieving a given environmental improvement (e.g., cost per avoided premature death). However, because this measure addresses only the portion of benefits that are monetized, it provides an over-estimate of costs per unit benefit and is therefore of value primarily in comparing similar rules.

Cost-Effectiveness: Dollar per Unit of Reduced Emission

There are several dimensions a cost-effectiveness analysis can adopt to examine MACT standards. One approach is to estimate the aggregate cost-effectiveness of each MACT standard by summing total costs and dividing by the total emissions reductions across all pollutants. Aggregate cost-effectiveness figures, however, are misleading because the estimates do not account for the types of regulated pollutants, their relative toxicities, and their relative volumes of emissions. A more appropriate analysis requires disaggregating emission reductions and control costs by individual pollutants. Developing cost-effectiveness estimates for individual air pollutants helps EPA compare alternative emission standards for individual pollutants. The two analytic components of the individual cost-effectiveness measures are:

- estimates of emission control expenditures per air pollutant for each regulatory option; and

- estimates of emission reductions under each regulatory option.

Expenditures per air pollutant are based on the engineering costs for various pollution control measures as described in Chapter 4.[2] Within each combustion sector (cement kilns, incinerators, and LWAKs), we sum both the costs of controlling emissions and the reduction in emissions for each pollutant. An additional adjustment is needed for control equipment that simultaneously reduces

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[1] Martineau, Robert J. and David P. Novello, eds. 1998. *The Clean Air Act Handbook*, American Bar Association Publishing, Chicago, as cited in U.S. EPA, *Assessment of the Potential Costs, Benefits, and Other Impacts of the Hazardous Waste Combustion MACT Standards: Final Rule*, Office of Solid Waste, July 1999.

[2] While this presents a high-end estimate of costs, it is consistent with the method used to estimate emissions reductions (e.g., all facilities operate in compliance with the proposed HWC MACT replacement standards). This is a conservative estimate of cost-effectiveness, because it does not take into account either the reduced costs or reduced emissions (e.g., increased benefits) associated with the closure of combustion systems.

emissions for more than one air pollutant. For example, carbon injection or carbon beds can control both mercury and dioxins/furans. In addition, a fabric filter that may be required as part of a carbon injection system will also increase the capture performance of particulate matter, semi-volatile metals, and low-volatility metals. In the case of carbon injection (CI), EPA apportioned costs based on the required emission reduction for each pollutant. For example, if carbon injection (CI) equipment is assigned to a combustion system that requires a dioxin reduction of 40 percent and a mercury reduction of 80 percent, the individual cost calculations for this system are:

Cost for Mercury control = [80/(80+40) x *CI cost*]

Cost for Dioxin control = [40/(80+40) x *CI cost*]

These calculations split the costs of the carbon injection system between dioxin and mercury.

The other component of the individual cost-effectiveness measure is the emission reduction achieved when combustion facilities comply with the standards under any given regulatory option. In the emission reduction calculations, we assume emission reductions consistent with the statistical design level (SDL) outlined in Chapter 1. As a result, combustion systems will not experience emission reductions or incur costs if their emissions are currently below the SDL. However, combustion systems with emissions exceeding the SDL will reduce emissions and incur the associated costs to comply with the proposed HWC MACT replacement standards. In addition, combustion systems that emit above the SDL for just one air pollutant may reduce emissions of other pollutants as they implement pollution control measures for the former. Whether these ancillary reductions are realized depends on which pollution control measure is implemented. To avoid overestimation of emission reductions, we do not attempt to capture these ancillary effects.

The emission reductions for the Option 1 Floor, Option 2 Floor, and Option 3 Floor are calculated as the difference between the baseline emissions (e.g., emissions under the 2002 Interim Standards) and the SDL for each option. Emissions reductions associated with the Agency Preferred Approach, which is a beyond-the-floor version of Option 1, are calculated twice: incremental to baseline emissions and also incremental to the Option 1 Floor.[3] Exhibit 8-1 indicates where incremental emission reductions are expected for each pollutant under the various regulatory options. Where there is no value in the table, no emission reductions are expected. For example, in the baseline all LWAKs and incinerators meet the mercury standards specified under the Option 1 Floor. Since none of the controls these systems are expected to implement for other pollutants under the Option 1 Floor are likely to reduce mercury emissions, incinerators and LWAKs are unlikely to reduce mercury emissions under the Option 1 Floor.

[3] We evaluate the cost effectiveness of the Agency Preferred Approach incremental to the Option 1 Floor to ascertain the marginal cost effectiveness of going beyond the Option 1 Floor.

Exhibit 8-1

EXPECTED AGGREGATE ANNUAL EMISSION REDUCTIONS

Source	Options	Pollutant					
		TEQ, g	Hg, Tons	SVM, Tons	LVM, Tons	PM, Tons	TCl, Tons
LWAK	Baseline to Agency Preferred Approach	1.91	-	0.02	0.01	4.65	267.53
	Option 1 Floor to Agency Preferred Approach	1.91	-	-	-	-	267.53
	Baseline to Option 1 Floor	-	-	0.02	0.01	4.65	-
	Baseline to Option 2 Floor	-	0.01	0.01	0.01	4.65	-
	Baseline to Option 3 Floor	-	0.01	0.02	0.01	4.65	-
Incinerators	Baseline to Agency Preferred Approach	0.28	-	0.44	0.12	33.06	286.15
	Option 1 Floor to Agency Preferred Approach	-	-	-	-	-	-
	Baseline to Option 1 Floor	0.28	-	0.44	0.12	33.06	286.15
	Baseline to Option 2 Floor	0.28	-	0.60	0.35	33.06	337.16
	Baseline to Option 3 Floor	0.28	-	0.71	0.44	144.71	337.16
Cement Kilns	Baseline to Agency Preferred Approach	-	0.23	2.01	0.20	588.17	62.01
	Option 1 Floor to Agency Preferred Approach	-	-	-	-	-	-
	Baseline to Option 1 Floor	-	0.23	2.01	0.20	588.17	62.01
	Option 2 Floor	-	0.51	2.52	0.22	588.17	771.59
	Option 3 Floor	-	0.51	3.88	0.21	763.95	771.59
Liquid Boilers	Baseline to Agency Preferred Approach	0.20	0.69	2.42	9.89	1,164.92	640.14
	Option 1 Floor to Agency Preferred Approach	0.06	-	-	-	-	-
	Baseline to Option 1 Floor	0.14	0.69	2.42	9.89	1,164.92	640.14
	Baseline to Option 2 Floor	0.14	0.73	2.42	9.93	1,164.92	1,374.60
	Baseline to Option 3 Floor	0.14	0.75	1.82	12.65	2,306.53	3,173.06

Exhibit 8-1

EXPECTED AGGREGATE ANNUAL EMISSION REDUCTIONS

Source	Options	Pollutant					
		TEQ, g	Hg, Tons	SVM, Tons	LVM, Tons	PM, Tons	TCl, Tons
Coal Boilers	Baseline to Agency Preferred Approach	-	0.02	0.56	0.75	424.68	1,177.31
	Option 1 Floor to Agency Preferred Approach	-	-	0.34	0.30	386.09	767.62
	Baseline to Option 1 Floor	-	0.02	0.22	0.45	38.59	409.69
	Baseline to Option 2 Floor	-	0.02	0.22	0.45	38.59	409.69
	Baseline to Option 3 Floor	-	0.02	0.22	0.45	38.59	409.69
HCl Production Furnaces	Baseline to Agency Preferred Approach	2.29	-	-	-	-	140.64
	Option 1 Floor to Agency Preferred Approach	2.29	-	-	-	-	-
	Baseline to Option 1 Floor	-	-	-	-	-	140.64
	Baseline to Option 2 Floor	-	-	-	-	-	145.28
	Baseline to Option 3 Floor	-	-	-	-	-	145.28

We develop individual cost-effectiveness (CE) measures for each MACT standard as follows:

- **Cost-Effectiveness Measures for Option 1 Floor, Option 2 Floor, and Option 3 Floor —** Costs and emission reductions are incremental to the *baseline* (e.g., compliance with the 2002 Interim Standards).

- **Cost-Effectiveness Measures for Agency Preferred Approach —** Costs and emission reductions are incremental to the baseline and to the *Option 1 MACT Floor.*

Cost-Effectiveness Results

We summarize the cost-effectiveness results in Exhibit 8-2 by pollutant, sector, and proposed

option. Cost-effectiveness results are measured in $1,000 per reduced ton of emissions for all pollutants except dioxins. Cost-effectiveness for dioxins applies the metric of $1,000 per reduced gram of toxicity equivalent. In some cases, we do not present cost-effectiveness figures because there are no associated (incremental) emission reductions. For example, all HCl production furnaces currently meet the Option 1 Floor standards for reducing SVM emissions; thus, we do not report SVM cost-effectiveness results for HCl production furnaces under the Option 1 Floor. Below, we summarize key findings from the results:

Exhibit 8-2

COST-EFFECTIVENESS RESULTS[a]

		Pollutant					
Source	**Options**	**TEQ, $1,000/ gram**	**Hg, $1,000/ ton**	**SVM, $1,000/ ton**	**LVM, $1,000/ ton**	**PM, $1,000/ ton**	**TCl, $1,000/ ton**
LWAKs	Baseline to Agency Preferred Approach	$767	$117,243	$634	$660	$28.09	$7.01
	Option 1 Floor to Agency Preferred Approach	$767	-	-	-	-	$7.01
	Baseline to Floor Option 1	-	$117,243	$634	$660	$28.09	-
	Baseline to Floor Option 2	-	$119,961	$256	$237	$28.09	-
	Baseline to Floor Option 3	-	$151,504	$2,430	$432	$28.09	-
Incinerators	Baseline to Agency Preferred Approach	$2,627	-	$2,396	$669	$64.75	$44.34
	Option 1 Floor to Agency Preferred Approach	-	-	-	-	-	-
	Baseline to Floor Option 1	$2,627	-	$2,396	$669	$64.75	$44.34
	Baseline to Floor Option 2	$2,627	-	$3,639	$6,100	$63.14	$39.38
	Baseline to Floor Option 3	$2,627	-	$1,901	$2,827	$22.23	$38.74
Cement Kilns	Baseline to Agency Preferred Approach	-	$16,567	$65	$4,558	$5.13	$8.86
	Option 1 Floor to Agency Preferred Approach	-	-	-	-	-	-
	Baseline to Floor Option 1	-	$16,567	$65	$4,558	$5.13	$8.86
	Baseline to Floor Option 2	-	$22,501	$693	$11,270	$5.13	$13.51
	Baseline to Floor Option 3	-	$22,501	$267	$2,456	$5.31	$13.51
Liquid Boilers	Baseline to Agency Preferred Approach	$662	$12,814	$3,032	$704	$9.16	$6.58
	Option 1 Floor to Agency Preferred Approach	$1,312	-	-	-	-	-
	Baseline to Floor Option 1	$373	$12,814	$3,032	$704	$9.16	$6.58

Exhibit 8-2

COST-EFFECTIVENESS RESULTS[a]

		Pollutant					
Source	**Options**	**TEQ, $1,000/ gram**	**Hg, $1,000/ ton**	**SVM, $1,000/ ton**	**LVM, $1,000/ ton**	**PM, $1,000/ ton**	**TCl, $1,000/ ton**
	Baseline to Floor Option 2	$373	$13,537	$3,024	$708	$8.86	$13.90
	Baseline to Floor Option 3	$373	$17,209	$1,215	$262	$9.60	$6.69
Coal Boilers	Baseline to Agency Preferred Approach	-	$23,274	$675[b]	$332[b]	$4.14	$3.59
	Option 1 Floor to Agency Preferred Approach	-	-	-	-	$3.18	$4.87
	Baseline to Floor Option 1	-	$23,274	$675	$332	$5.91	$1.19
	Baseline to Floor Option 2	-	$23,274	$675	$332	$5.91	$1.19
	Baseline to Floor Option 3	-	$23,274	$675	$332	$5.91	$1.19
HCl Production Furnaces	Baseline to Agency Preferred Approach	$823	-	-	-	-	$5.13
	Option 1 Floor to Agency Preferred Approach	$823	-	-	-	-	-
	Baseline to Floor Option 1	-	-	-	-	-	$5.13
	Baseline to Floor Option 2	-	-	-	-	-	$7.53
	Baseline to Floor Option 3	-	-	-	-	-	$7.41

Notes:

a. This table includes pollutants where more than one option was under consideration.

b. Despite higher SVM and LVM emission reductions under the Agency Preferred Approach, cost effectiveness for coal boiler SVM and LVM under the Agency Preferred Approach are equal to cost effectiveness estimates under the Option 1 Floor. Since the incremental reductions under the Agency Preferred Approach are due to tighter PM restrictions, we do not incorporate them into our estimate of the cost effectiveness of the SVM and LVM standards.

- Across options and combustion sectors, cost-effectiveness measures exhibit wide variability. As shown in Exhibit 8-2, the cost-effectiveness of the proposed HWC MACT replacement standard options ranges from $1,200 per ton of reduced total chlorine emissions to $152 million per ton of reduced mercury emissions. Dioxin control ranges from $373,000 to $2.6 million per gram reduced.

- The proposed HWC MACT replacement standards for mercury are less cost effective for LWAKs than for all other sources. Among sources required to implement LVM controls, coal boilers are expected to be the most cost effective at controlling LVM emissions under three of the four versions of the HWC MACT replacement standards.[4]

- In most cases where we have cost effectiveness figures for the Agency Preferred Approach incremental to both the baseline and the Option 1 Floor, cost effectiveness is similar in both cases. However, for liquid boiler emissions of dioxins, the Agency Preferred Approach is nearly twice as cost effective incremental to the baseline as incremental to the Option 1 Floor. This reflects the increasing marginal costs of reducing dioxin emissions. To reduce dioxin emissions, liquid boilers will first implement those measures capable of achieving these reductions at the lowest cost. However, as further reductions are required (e.g., from the Option 1 Floor to the Agency Preferred Approach), facilities must pursue additional, more costly options.

Cost-Effectiveness: Dollar per Health and Ecological Benefits

This section evaluates cost-effectiveness per unit benefit (e.g., cost per health case avoided). EPA developed this second cost-effectiveness analysis to analyze and understand the relative costs of achieving specific benefits as standards become increasingly more stringent. The two components of this benefit cost-effectiveness measure are:

- estimates of specific health and ecological benefits associated with the Recommended Standard; and

- estimates of control expenditures associated with the reduction of emissions for pollutants directly linked to the benefit.

Approach for Calculating Cost-Effectiveness per Unit Benefit

In order to attribute costs to specific benefits, we had to: (i) identify the pollutants associated with specific benefits; (ii) determine the costs of controlling specific pollutants; and (iii) develop a cost allocation approach. For determining control costs, the analysis does not apply social cost estimates. Instead, we apply the same direct compliance (engineering) cost estimates used in constructing the "dollar per unit of reduced pollutant" metric for determination of control costs

[4] "Most cost-effective" means that incremental emission reductions are achieved at the lowest per ton cost among all source categories.

associated with a specific pollutant.[5] We focus on all the HWC MACT Standards in the cost-effectiveness of benefits, because human health and ecological benefits vary significantly across MACT standards.

We use a straightforward cost allocation approach in which the total costs by pollutant are assigned to each health or ecological effect associated with reduction of that pollutant. For example, cost-effectiveness for avoided severe health effects (e.g., premature mortality from exposure to particulates) is calculated as follows:

$$\textit{Cost-Effectiveness} = \frac{\textit{Cost of controlling pollutants associated with mortality risks}}{\textit{Number of avoided premature mortality and cancer cases}}$$

$$= \frac{\textit{Cost of PM control + Cost of D/F control + Cost of metals control}^{6}}{\textit{Number of avoided premature mortality and cancer cases}}$$

$$= \textit{\$47 x } 10^{6} \div \textit{1.8 cases = \$26.5 million per life saved.}$$

We calculate cost-effectiveness benefit figures for morbidity and ecological benefits similarly. That is, we use the total costs of control for each pollutant associated with the health, visibility, or ecological effect. This approach tends to overstate costs for particular benefits. Other cost allocation schemes, however, can underestimate costs if a particular benefit is the only benefit of interest.

Results of Cost-Effectiveness per Unit Benefit Analysis

The primary health and ecological benefits of the HWC MACT standards are avoided premature mortality (cancer and non-cancer), reduced morbidity, increased visibility, and reduced pollution to aquatic and terrestrial ecosystems. We group the benefit cost-effectiveness measures into these categories (as shown in Exhibit 8-3). As explained in the approach section above, in isolation, these cost-effectiveness per unit benefit measures are somewhat deceptive because they apply the full costs of control (by pollutant) to a single type of benefit (e.g., lives saved). The cost

[5] Following this, all caveats regarding the cost methodology discussed in the dollar per unit of reduced pollutant are also relevant to this benefits cost-effectiveness analysis. As stated below, the analysis does not incorporate toxicity metrics into emissions estimates. In addition, the cost-effectiveness analysis assumes that all systems will decide to comply with the standards. Costs may also be overestimated for some pollutants since the feed control cost measures represent an upper bound on costs. Moreover, the analysis does not account for several technological issues, such as the relative ease with which a device can control one pollutant versus another. Finally, the quantified benefits included in this assessment, and therefore the cost effectiveness estimates, do not capture all of the benefits associated with the proposed HWC MACT replacement standards.

[6] The cost of metals control reflects controlling SVM and LVM emissions.

per unit benefit measures are therefore overestimates and should only be used as relative measures for comparison across MACT options. Below, we summarize the results.

- **Dollar per avoided case of premature mortality (cancer and non-cancer)[7]:** The Agency preferred approach result in an estimated cost per life saved of $58.4 million associated with PM emission reductions, in addition, based on the 1999 *Analysis,* less than 0.37 premature deaths are expected to be avoided associated with reduced cancer risks. This is significantly higher than most estimates of the value of a "statistical life" found in the economic valuation literature.[8] The costs associated with mortality benefits reflect control of carcinogenic emissions (dioxin, SVMs, and LVMs) and particulate matter (PM). Benefits are based on the total number of avoided cases of cancer and premature mortality due to moving from the baseline to the Recommended MACT Standard.

- **Dollar per avoided case of morbidity:** Cost-effectiveness for PM control is calculated at $3,187 per benefit case for the Agency preferred approach. For PM, benefits represent the total number of avoided adverse health effects, work loss days, and restricted activity days estimated for the HWC MACT Standards. Cost-effectiveness for lead control is unknown, however, based on the 1999 *Analysis* less than two children are expected to have .blood lead levels reduced to below levels of concern (e.g., below 10µg/dL) as a result of the HWC MACT Standards. Also unknown is the cost-effectiveness for mercury control. Subsistence fishermen will potentially experience reduced risks of having children with developmental abnormalities, but this reduction is likely to be less than the benefits described in the 1999 *Analysis*.

- **Dollars per visibility benefit:** Cost-effectiveness for visibility benefits is unknown but visibility benefits are expected as a result of the HWC MACT Standards. Visibility benefits are monetized in Chapter 6 by comparing impacts of the HWC MACT Standards to impacts of the Clean Air Act Amendments. Visibility benefits are not quantified, to do this we would need to model the change in average annual visual range resulting from the HWC MACT Standards.

[7] Although cancer may not be fatal in all cases, for the purposes of this assessment, we apply the value of statistical life estimates to avoided cancer cases.

[8] For more information on the value of a statistical life, see Chapter 6.

Exhibit 8-3

COST-EFFECTIVENESS PER UNIT HEALTH AND ECOLOGICAL IMPROVEMENT[a,b]
(using unadjusted, maximum cost of control, 2002$)

Benefit Type	Pollutant(s)	Agency Preferred Approach			Floor Option 1			Floor Option 2			Floor Option 3		
		Cost of Control[a]	Benefit	Cost-Effectiveness[b]	Cost of Control[a]	Benefit	Cost-Effectiveness[b]	Cost of Control[a]	Benefit	Cost-Effectiveness[b]	Cost of Control[a]	Benefit	Cost-Effectiveness[b]
Health Benefits													
Avoided Premature Mortality Cases[c,d]	PM	$17.5 million	0.3 cases	$58.4 million per life saved	$16.2 million	0.3 cases	$54.0 million per life saved	$15.8 million	0.3 cases	$52.6 million per life saved	$29.8 million	0.6 cases	$49.6 million per life saved
Avoided Morbidity (PM)	PM	$17.5 million	5,500.5 cases	$3,187 per case	$16.2 million	5,454.1 cases	$2,969 per case	$15.8 million	5,454.1 cases	$2,895 per case	$29.8 million	10,666.3	$2,792 per case
Avoided Morbidity (lead)[e]	SVM	$8.5 million	less than 2 cases	Unknown	$8.7 million	less than 2 cases	Unknown	$11.4 million	less than 2 cases	Unknown	$4.8 million	less than 2 cases	Unknown
Ecological Benefits													
Reduction in area of Land and Water Impacted	dioxin, mercury, lead	$26.5 million	less than 185 km^2	Unknown	$22.9 million	less than 185 km^2	Unknown	$36.5 million	less than 185 km^2	Unknown	$31.3 million	less than 185 km^2	Unknown

Notes:
[a] Engineering costs.
[b] Dollar per unit benefit.
[c] These cost-effectiveness per unit benefit measures are upper bound estimates that apply the full costs of control (by pollutant) to a single type of benefit (e.g., lives saved). The cost per unit benefit measures should not be reported in isolation from other benefit estimates; they should only be used as relative measures to compare across MACT standards.
[d] All figures are incremental from the baseline to the HWC MACT standards.
[e] Mortality cases comprise fatal cancers and fatalities from exposure to particulate matter.
[f] PM morbidity cases comprise hospital admissions from respiratory diseases, cases of chronic bronchitis and asthma, work loss days, and mild restricted activity days.
[G] Morbidity cases associated with exposure to lead are cases in which children have blood lead levels above 10µg/dL.

- **Dollars per ecological benefit:** Cost-effectiveness for ecological benefits is unknown. Based on the 1999 *Analysis*, less than 185 kilometers of land and surface water are expected to experience reductions in ecological hazard quotients to levels below concern (e.g., HQ<1). Other unquantified benefits that may be experienced due to the HWC MACT Standards include improvements of forest health and aesthetics and increased productivity of agricultural land. These benefits are not quantified in this analysis due to a lack of measurable impacts associated with the pollutants of concern in this analysis.

Caveats and Limitations

Our method for calculating cost-effectiveness makes several simplifying assumptions. The two most important address the metrics employed for measuring cost-effectiveness and the actual methodology used to estimate the cost and emission reduction figures. The analysis used two separate metrics. For the majority of pollutants, the metric applied was a dollars per metric ton of emissions reduced.[9] With the exception of dioxins/furans, the cost-effectiveness metrics do not incorporate any measure of relative toxicity or scaling to adjust to relative emissions levels. Consequently, comparisons of cost effectiveness across pollutants are somewhat misleading. For example, cost-effectiveness values for dioxins/furans average more than one million dollars per gram reduced. In contrast, cost-effectiveness values for total chlorine (TCl) average $9,400 per metric ton reduced. The stark differences in cost-effectiveness performance would suggest that it is not cost-effective to regulate dioxins/furans. However, required emission reductions for dioxins/furans range between 0.42 and 4.69 grams, while TCl reductions range roughly between 1,539 and 4,837 metric tons. The differences in relative scale of reductions account for the differences in cost-effectiveness. Moreover, the relative toxicity of dioxins/furans to total chlorine is not reflected.

The second caveat to the cost-effectiveness analysis concerns the methodology for estimating cost and emission reductions for individual pollutants. The method assumes that all facilities continue operating and install pollution control equipment and/or implement feed control to comply with the MACT standards. As discussed in earlier chapters of this *Assessment,* 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 pollutant or on total emissions of each pollutant. Beyond this broad caveat, other factors influence the cost-effectiveness estimates:

[9] The one exception being dioxins/furans (TEQ), which was measured in dollars per gram of emissions reduced.

- The feed control costing approach may lead us to overstate expenditures per pollutant. Feed control costs are upper-bound costs based on pollution control equipment and/or design, operation, and maintenance of existing pollution control equipment. Combustion facilities may in fact be able to implement waste feed control at lower cost.

- Costs are currently apportioned according to the percentage reduction required to meet the standard for each pollutant controlled by the device. While the approach chosen is reasonable, it does not take engineering/technological issues such as the relative ease with which a device can control one pollutant versus another into account.

The third caveat to the cost-effective analysis is that the health, visibility, and ecological benefits estimated in this *Assessment* do not represent the total benefits expected from the HWC MACT Standards. The benefits analysis relies on comparisons to the benefits estimated in the 1999 *Analysis* for the 1999 Standards. Although the incremental benefits resulting from the HWC MACT Standards are expected to be less than the benefits estimated for the 1999 standards, they represent real improvements that are not reflected in the analysis. In addition, those benefits not estimated in the 1999 *Analysis*, such as visibility, are expected to be significant.

COST-BENEFIT COMPARISON

A comparison of the costs and benefits of the rule provides an assessment of its overall efficiency and impact on society. In this section, we compare the total social costs of the rule with the total monetized and non-monetized benefits of the rule. The total monetized benefits of the final standards and each option analyzed are summarized in Exhibit 8-4. As discussed in Chapter 6, monetized benefits represent only a subset of potential avoided health effects, both cancer and non-cancer cases. In comparison, the total social costs of the rule are provided in Exhibit 8-5. These cost ranges represent market- and non-market adjusted scenarios to bound the costs of the rule. Social costs also include government administrative costs.

Across all MACT regulatory scenarios, monetized costs significantly exceed monetized benefits. However, the proposed HWC MACT standards are expected to provide other benefits that are not expressed in monetary terms. These benefits include health benefits of reduced emissions of HAPs such as dioxins, lead, mercury, arsenic, cadmium, etc., including benefits to sensitive sub-populations such as subsistence anglers and improvements to terrestrial, and aquatic ecological systems. When these benefits are taken into account, along with equity-enhancing effects such as environmental justice and impacts on children's health, the benefit-cost comparison becomes more complex. Consequently, the final regulatory decision becomes a policy judgment which takes into account efficiency as well as equity concerns.

Exhibit 8-4

TOTAL MONETIZED HUMAN HEALTH BENEFIT
(millions of dollars)

Facility Type	Agency Preferred Approach	Floor Option 1	Floor Option 2	Floor Option 3
LWAK	$0.03	$0.03	$0.03	$0.03
Cement Kilns	$0.03	$0.03	$0.03	$0.05
All Incinerators	$0.25	$0.25	$0.25	$0.45
Coal Boilers	$0.04	$0.00	$0.00	$0.00
HCl Production Furnaces	$0.00	$0.00	$0.00	$0.00
Liquid Boilers	$3.81	$3.81	$3.81	$7.54
Total[a,b]	**$4.16**	**$4.12**	**$4.12**	**$8.08**

Notes:
a. Totals may not add due to rounding.
b. A portion of benefits (i.e., avoided mortality) is expressed in 1999 dollars; other health benefits (i.e., reduced morbidity effects) are in 2002 dollars. Total benefit estimates, therefore, are not comparable to estimated costs, which are expressed in 2002 dollars.

Exhibit 8-5

TOTAL SOCIAL COSTS
(millions of 2002 dollars)

MACT STANDARD

	Agency Preferred Approach	Option 1 Floor	Option 2 Floor	Option 3 Floor
Private Costs	$57.1	$48.0	$80.3	$88.4
Government Costs	$0.45	$0.45	$0.42	$0.43
Total Social Costs[a]	**$57.6**	**$48.5**	**$80.7**	**$88.9**

Notes:
a. Figures may not add due to rounding.

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Note: Toxicity risk factors presented in this document do not reflect EPA's official estimate of dioxin toxicity, but reflect EPA's ongoing effort to re-evaluate dioxin toxicity.