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Economic Impact Analysis (EIA): Small Municipal Waste Combustors–Emissions Guidelines and New Source Performance Standards

In 1995, the U.S. Environmental Protection Agency (EPA) promulgated regulations for municipal waste combustion units (MWCs). New Source Performance Standards (NSPS) were adopted for new MWCs (Subpart Eb) and Emission Guidelines (EG) were adopted for existing MWCs (Subpart Cb). Litigation followed the promulgation of these regulations. In 1997, the U.S. Court of Appeals ruled that EPA must develop separate regulations for small and large MWCs. The court indicated that the regulations adopted in 1995 were not consistent with Section 129 of the Clean Air Act. In response to this ruling, EPA published a Direct Final Rule on August 25, 1997, amending the 1995 regulations so that they applied only to large MWCs with an individual unit capacity greater than 250 tons per day (tpd).

As a result of these changes, regulations must be reestablished for small MWCs. Small MWCs are those with an individual unit capacity between 35 and 250 tpd. Different regulations with different subpart designations are being used for the small MWC rules. Subparts Eb and Cb, as revised in 1997, will remain as regulations for the NSPS and EG for large MWCs. Subparts AAAA and BBBB will be used for small MWCs.

This report provides the results of the economic impact analysis (EIA) of the regulation for small MWCs under the new Subparts AAAA and BBBB regulations. This EIA supercedes the March 1999 EIA that supported the August 30, 1999, proposal of Subparts AAAA and BBBB regulations for small MWCs. The principal difference between this EIA and the earlier EIA (March 1999) is that an additional control alternative (Alternative I*) has been considered. This EIA evaluates three control alternatives for existing MWCs (Alternatives I, I*, II), using the same economic impact methodology used in March 1999. This report describes the expected impacts of both the EG requirements on existing facilities (Sections 1 through 5) and the NSPS on new facilities (Section 6).

In these regulatory alternatives for existing MWCs, the small MWC population was subcategorized based on (1) aggregate capacity of the plant where the individual MWC unit is located and, for some alternatives, (2) combustor type. The resulting subcategories are as follows: (1) Class A units are defined as nonrefractory-type small MWCs located at plants

with an aggregate capacity greater than 250 tons of municipal solid waste (MSW) per day; (2) Class B units are refractory-type small MWCs located at plants with an aggregate plant capacity greater than 250 tons of MSW per day; and (3) Class C units are small MWCs located at plants with an aggregate plant capacity less than or equal to 250 tons of MSW per day.

Under Regulatory Alternative I for existing MWCs, different air pollution controls are required for the different MWC unit classes. Class A units would be required to implement a technology with the performance characteristics of a spray dryer (SD)-based control system. MWCs in Classes B and C would be required to implement a technology with the performance characteristics of a dry sorbent injection (DSI)-based control system. All three classes would also be required to install fabric filters (FF) or electrostatic precipitators (ESP) for metal and particulate matter controls, and carbon injection (CI) for mercury control.[1] Class A units would also need to install selective noncatalytic reduction (SNCR) for controlling nitrogen oxides (NO_x).

Under Regulatory Alternative I* for existing MWCs, the stringency of Class B control requirements is increased such that both Class A and B units would be required to implement control technology with the performance characteristics of an SD-based control system. Class C control requirements and CI and SNCR requirements are the same as under Alternative I.

Under Regulatory Alternative II for existing MWCs, the stringency of Class C control requirements is increased such that Class A, B, and C units would be required to implement control technologies with the performance characteristics of an SD-based control system. CI and SNCR requirements are the same as under Alternative I.

New MWCs are subject to the NSPS and will be required to install air pollution control technologies with the performance characteristics of an SD-based control system. Additionally, units located at MWC plants with an aggregate capacity greater than 250 tons of MSW per day would also be required to install NO_x control systems such as SNCR. No other alternative is provided because this is the MACT floor performance level for new MWCs.

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[1]Refuse-derived fuel facilities do not require mercury (Hg) control by carbon injection, because they have sufficient unburned carbon in the fly ash in the flue gases to control Hg and they meet the Hg emission limits.

Estimated total annual costs of the regulatory alternatives are about $50 million for Regulatory Alternative I, $68 million for Regulatory Alternative I*, and $89 million for Regulatory Alternative II. These costs are the worst-case (highest possible) social costs of the regulation. These costs are based on the assumption that the minimum cost response of all small MWC operators is to install the MACT controls. If another option would be less costly, presumably the operator would select that alternative. One alternative is to close down the MWC. This response may be particularly attractive if a small MWC is being used in an application with a very low annual utilization factor (i.e., operates only 1 or 2 days per week). Closing the facility will also have costs associated with it because another method (e.g., landfilling) must be found to manage the solid wastes. However, when the cost of landfilling is less than the cost of MWC operation plus compliance, facility closure is the economic response to these regulations. If a facility closes down, the actual social cost of the regulation will be less than what we estimate here, assuming that landfilling services are appropriately priced. Available data indicate that since 1995 more than 30 percent of all small MWCs have closed and these cities are using alternative disposal methods.

The social costs are distributed across the three ownership categories: business-owned units, government-owned units, and units owned by nonprofit organizations. Under Regulatory Alternative I, business-owned units will incur about $17.1 million, or 34 percent of the total annual cost of the regulation. This cost increase averages $17.97 per ton of waste combusted by the MWCs requiring a retrofit of an air pollution control device (APCD) system. Government-owned units will incur annual incremental costs due to the regulation in the amount of $32.2 million, or 64 percent of the total annual compliance costs. This is an increase of $19.03 per ton of waste combusted for the affected sources. One nonprofit organization owns two MWCs that will be affected by the regulation. These two units will together incur annual incremental costs due to the regulation of approximately $0.7 million, or 1 percent of the total annual compliance costs. This is an increase of $30.49 per ton of waste combusted for these sources.

Under Regulatory Alternative I*, these costs are distributed as follows. Business-owned units incur about $21.3 million, or 32 percent, of the total annual cost of the regulation, representing an increase of $22.35 per ton of waste combusted. Government-owned units will incur annual compliance costs in the amount of $45.5 million, or 67 percent of the total annual compliance costs. This is an increase of $26.89 per ton of waste combusted for the affected sources. The two MWCs owned by a nonprofit organization will together incur annual incremental costs due to the regulation of approximately $0.7 million,

or 1 percent of the total annual compliance costs, representing an increase of $30.49 per ton of waste combusted.

Under Regulatory Alternative II, these costs are distributed as follows. Business-owned units incur about $27.0 million, or 30 percent of the total annual cost of the regulation, representing an increase of $28.30 per ton of waste combusted. Government-owned units will incur annual compliance costs in the amount of $61.0 million, or 69 percent of the total annual compliance costs. This is an increase of $36.04 per ton of waste combusted for the affected sources. The two MWCs owned by a nonprofit organization will together incur annual incremental costs due to the regulation of approximately $0.9 million, or 1 percent of the total annual compliance costs, representing an increase of $41.79 per ton of waste combusted.

The total cost of the regulatory requirements under the NSPS are estimated to be $8.1 million annually for every new MWC in operation in the fifth year following adoption. This cost averages to $51.66 per ton of waste combusted.

1. Affected Entities

MWCs are used to reduce the volume of MSW that must be transported and landfilled. MWCs typically reduce the volume of waste by 90 percent, thereby extending landfill life by a factor of ten. These combustors are not exclusively "municipal"; other types of organizations might use them, either on a fee-for-service basis or as part of a captively operated waste management activity designed to self-manage the waste generated by some activity. Municipal waste typically refers to the type of waste being combusted and not to the ownership of the MWC.

The small MWCs affected by the regulation are based on the 1998 national inventory of small MWCs (Tucker, 1998). This inventory is an updated version of the 1995 inventory (Cone and Kane, 1997). The update shows that since 1995 the number of small MWCs has decreased by 37 percent (from 143 to 90), the number of plants by 37 percent (from 65 to 41 plants), and aggregate capacity by 38 percent (from 13,774 to 8,551 tpd).[2] Of the 90 remaining units subject to regulation, 29 percent are owned by private businesses,

[2]An MWC plant typically has multiple units to increase operating flexibility. Most plants have two or three units. The units are usually located beside each other and typically share common equipment such as municipal waste pit, fuel feeding system, ash handling system, and stack.

69 percent are owned by government entities, and 2 percent are owned by a nonprofit organization (see Table 1). Government-owned entities include five units owned by the federal government and 57 units owned by city/county governments. Based on the type of combustor, the inventory consists of 31 mass burn units[3] (44 percent of total daily capacity), 51 modular units[4] (38 percent of total daily capacity), and eight refuse-derived fuel units[5] (18 percent of total daily capacity) (Tucker, 1998).

Table 1. Distribution of Small MWCs

	Business	Government	Nonprofit Organization	Total
Number of Plants	11	29	1	41
Number of Plants as a Share of Total (%)	27%	71%	2%	
Number of MWCs at Plants	26	62	2	90
Number of MWCs as a Share of Total (%)	29%	69%	2%	
Total Capacity (TPD)	3,056	5,423	72	8,551
Capacity as a Share of Total (%)	36%	63%	1%	

2. Affected Entities' Potential Responses to Regulation

Owners and operators of small MWCs that do not currently meet the MACT standards must incur additional costs if they elect to continue to use their units. The extra costs will include a one-time outlay for capital items (within 2 or 3 years after the standards are in place) and annual expenditures for equipment operation and maintenance. These costs

[3]These include water wall, refractory, and rotating combustor units.

[4]These include starved and excess air combustor units.

[5]These include all units that use refuse-derived fuel.

can be financed by diverting revenues from other applications, by borrowing, or by raising prices or taxes as appropriate.

Faced with these costs, owners or operators may consider closing the facility. For example, owners of MWCs located near landfills or with opportunities to construct a new landfill may find that landfilling the entire volume of wastes that are now combusted costs less than operating their MWC with the MACT APCD. Or they may institute or increase the scope of recycling programs or source reduction programs to reduce the volume of waste to be managed enough so that the unit can be closed. Several factors may affect these choices:

- institutional constraints, such as steam, electrical, or waste disposal contractual obligations, may require continued operation of the MWC;
- costs of waste transport and disposal to landfills; and
- difficulty siting new waste disposal facilities resulting from "not in my backyard" (NIMBY) attitudes in many communities.

A thorough analysis of the waste management choices would consider the benefits and costs of all the substitute waste management alternatives. However, this requires detailed information on the unique features of each of the facilities and, as such, is beyond the scope of this analysis. Instead, this analysis uses a worst-case cost assumption: all operators not currently in compliance with the standards are assumed to install the technology needed to achieve the MACT requirements. Where substitution is less costly than compliance, the assumption overstates, by an unknown amount, the cost of the standard. Ratios are used to provide some insights regarding the relative cost burden imposed on these operators.

3. Methods for Computing Cost and Emission Impacts

The key assumptions used in this economic impact analysis (EIA) are summarized in Table 2. The no-substitution assumption implies that this analysis was conducted as if no existing MWCs will close because of the regulation—the demand for combustion services provided by these facilities was assumed to be perfectly inelastic (the demand curve was assumed to be vertical; that is, rising cost/price of combustion leads to no change in the quantity of combustion services demanded). The inelasticity could be due to the inelastic

Table 2. Assumptions and Conventions

Affected MWCs: All MWCs with unit capacity between 35 and 250 tpd

Monetary unit: 1997 dollars

Capacity utilization rate: 85.49 percent (based on the average of capacity utilization rates per type of combustor, weighted by the percentage of the total capacity of such units in the inventory)

No substitution in waste management; no facility closures (see text for discussion)

Model plant assignment based on model plant combustion technology as reported in Table 3-4 (EPA, 1994), APCD at baseline as reported in Table 3-6 (EPA, 1994), and capacity as reported in Table 3-4 (EPA, 1994)

Capital costs for each APCD:

- Incurred only at the outset of operation of the APCD
- Amortized over the lifetime of the APCD or the life of the plant, whichever is shorter
- Adjusted for capacity difference between actual and model plants using six-tenths rule

Annual operating costs and revenues for each MWC and APCD:

- Invariant over the lifetime of the MWC or APCD with the exception of some performance, testing, and reporting costs
- Adjusted for capacity difference between actual and model plants
- Proportional to MWC capacity utilization (for analysis purposes if alternative capacity utilization rates are introduced)

Required air pollution controls:

- PM/acid gas/metals (see text for discussion)
- NO_x (see text for discussion)
- Hg (see text for discussion)

Lifetime of physical equipment:

- Existing MWCs: 20 years after compliance costs begin
- APCDs: 20 years after compliance costs begin

Market interest (discount) rate for annualizing capital costs:

- Public and nonprofit organization owners: 4 percent real municipal revenue bond rate
- Private owners: 7 percent real cost of capital rate, as recommended by the Office of Management and Budget (OMB, 1992)

demand for waste management services *per se*,[6] coupled with limited alternatives for waste disposal due to either economic conditions or institutional arrangements that do not allow for substitution in waste management. Thus, this no-substitution assumption is a worst-case cost scenario because it leads to projections of higher national costs of control than are likely to occur if there are less costly alternatives to compliance for some plants. That is, where substitution is less costly than compliance it would be expected to be the MWC operators' response of choice.

Where the baseline existing APCDs for MWCs do not meet the requirements of the compliance alternatives, operators will have to install pollution control equipment for PM, acid gas, metals, and Hg as required. This analysis examines three regulatory alternatives beyond baseline.

Under Regulatory Alternative I, different air pollution controls are required for the different MWC unit classes. Class A units would be required to implement a technology with the performance characteristics of a SD-based control system. MWCs in Classes B and C would be required to implement a technology with the performance characteristics of a DSI-based control system. All three classes would also be required to install ESP or FF for metal and particulate matter controls, and CI for mercury control.[7] Class A units would also need to install SNCR for the control of NO_x.

Under Regulatory Alternative I*, the stringency of Class B control requirements are increased such that both Class A and B units would be required to implement control technology with the performance characteristics of a SD based control system. Class C control requirements and CI and SNCR requirements are the same as under Alternative I.

Under Regulatory Alternative II, the stringency of Class C control requirements are increased such that Class A, B, and C units would be required to implement control

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[6]The elasticity of the demand for waste disposal services is not widely explored in the economics literature. Although studies agree that the demand for solid waste disposal is inelastic, they do not agree on the exact magnitude (Goddard, 1975; Hockett, Lober, and Pilgrim, 1995). The assumption of perfectly inelastic demand for combustion services, while not too far from the truth for solid waste in general, simplifies the computations and is a conservative assumption.

[7]Refuse-derived fuel facilities do not require Hg control by carbon injection, because they have sufficient unburned carbon in the fly ash in the flue gases to control Hg and they meet the Hg emission limits.

technology with the performance characteristics of a SD based control system. CI and SNCR requirements are the same as under Alternative I.

This EIA assumes that all capital costs of control for each model plant are incurred on the effective date of compliance and are amortized over the remaining plant life. Annual operating and maintenance expenditures and annual recovery credits stay unchanged over the remaining life of the equipment, and salvage value at the end of the cycle equals the cost of removing the worn-out equipment and restoring the site. This EIA assumes that the remaining plant life on the date of compliance is 20 years for existing plants and that the pollution control equipment life cycle equals remaining plant life. Even though APCDs last on average longer than 20 years, it was assumed that they will not be used beyond the remaining life of the combustor. The cost inputs used in this EIA, reported in Tables 5-1 through 5-8 in *Economic Impact Analysis for Proposed Emission Standards and Guidelines for Municipal Waste Combustors* (EPA, 1994), reflect the assumption of remaining plant and APCD life of 20 years.

The interest rates used to compute the annualized capital costs of the regulation in real terms are 4 percent for units owned by the government and nonprofit organizations and 7 percent for business-owned entities. These rates represent the real cost of borrowing money to acquire financial capital.

3.1 Costs

To calculate the compliance costs of the regulation for individual MWCs, the model plants were first mapped into the 1998 inventory: each actual facility was related to one model plant developed by EPA.[8] Control costs estimates developed for the model plants were then scaled for their corresponding actual facility based on capacity ratios between the two.

Affected entities incur two major types of control costs because of the regulation: capital and operating costs. The capital cost is an initial lump sum associated with purchasing and installing pollution control equipment. Operating costs are the annually recurring costs, including costs associated with operating and maintaining the control equipment, personnel training costs, and emission monitoring costs. Annual control costs

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[8]See Tables 3-4 and 3-6 in *Economic Impact Analysis for Proposed Emission Standards and Guidelines for Municipal Waste Combustors* (EPA, 1994).

consist of capital recovery costs and operating costs. Capital recovery costs are the costs of installing the APCD annualized over the remaining plant life.

Based on *Municipal Waste Combustion Study* (EPA, 1987) and *Municipal Waste Combustors—Background Information for Proposed Standards: Cost Procedures* (EPA, 1989), it was determined that the capital costs should be adjusted for capacity differences between model plant units and real units using the six-tenths rule to reflect that, with increasing capacity, capital costs, K, increase at a slower rate (i.e., economies of scale exist). The six-tenths rule computes the capital cost for a given MWC unit from the appropriate model plant as follows:

$$K_{\text{Actual Facility}} = \left[\frac{\text{Capacity}_{\text{Actual Facility}}}{\text{Capacity}_{\text{Model Plant}}}\right]^{\frac{6}{10}} \bullet K_{\text{Model Plant}}$$

Operating costs include operating, maintenance, and supervision labor; electricity; water and chemicals; waste disposal; overhead; and emissions monitoring costs, as well as taxes, insurance, and general administration costs. Again, based on *Municipal Waste Combustion Study* (EPA, 1987) and *Municipal Waste Combustors—Background Information for Proposed Standards: Cost Procedures* (EPA, 1989), it was determined that operating, maintenance, and supervision labor and overhead, which together account for 30 percent of operating costs, do not vary with changes in capacity. The cost of electricity, chemicals, water, and waste disposal, which together account for 30 percent of operating costs, vary linearly with capacity. The costs of taxes, insurance, and general administration, which together account for 40 percent of operating costs, vary similarly to capital costs except that they follow the seven-tenths rule. The adjusted operating costs, OP, become

$$OP_{\text{Actual Facility}} = 0.30 \bullet OP_{\text{Model Plant}} + 0.30 \bullet OP_{\text{Model Plant}} \bullet \left[\frac{\text{Capacity}_{\text{Actual Facility}}}{\text{Capacity}_{\text{Model Plant}}}\right] +$$

$$0.40 \bullet OP_{\text{Model Plant}} \bullet \left[\frac{\text{Capacity}_{\text{Actual Facility}}}{\text{Capacity}_{\text{Model Plant}}}\right]^{\frac{7}{10}}$$

The total annual compliance costs of the regulation, AC, for a given MWC unit are calculated as follows:

$$AC = \left[\frac{K}{1-(1+r)^{-t}/r}\right] + OP$$

where

AC = annual control cost, including annual capital recovery and annual operating components;

K = capital cost of the required control option, incurred at the beginning of period t;

r = real rate of discount (r = 7 percent for business-owned entities and r = 4 percent for government-owned entities or entities owned by nonprofit organizations) (see text in this section for a discussion of these parameters);

t = estimated remaining life of the plant on the date of compliance (20 years); and

OP = operating costs of the required control option less a credit for any avoided operating costs associated with baseline APCD supplanted by more stringent controls required under the regulation.

The aggregate costs of the regulation were then computed by summing across all the individual affected MWC facilities in the 1998 inventory.

There is a lot of debate in the economics literature on which discount rate to use when analyzing government programs. The general view is that whenever it is believed that the mandated capital outlays displace other productive capital[9] the proper rate of discount is the one reflecting the opportunity cost of capital rather than the cost of consumption (Lind, 1990). Given the uncertainty about whether the required air pollution control equipment will

[9]Implicit in this is the assumption that capital is in fixed supply, so investing in air pollution control equipment crowds out investments in other sectors.

displace capital or consumption expenditures, we assumed that it will displace investment expenditures, which, if anything, will again overestimate the cost of regulation. The private real discount rate of 7 percent was used to annualize the capital cost for private entities. It reflects the real marginal pre-tax rate of return of an average private-sector investment and the private cost of capital. This rate is recommended by OMB in "evaluating federal programs whose benefits and costs are distributed over time" (OMB, 1992). The OMB circular also allows for modification of the 7 percent rate when justified by certain characteristics of the specific industry. Given the lack of data about rates of return on investment in the industries operating MWCs, no such modification was undertaken in this analysis. This rate differs from the one in *Economic Impact Analysis for Proposed Emission Standards and Guidelines for Municipal Waste Combustors* (EPA, 1994), reflecting recent developments in the economics literature discussed above. The public real discount rate of 4 percent reflects the cost of capital to government and nonprofit organizations. It is approximated by the real municipal bond rate. This rate is the same as the one used in *Economic Impact Analysis for Proposed Emission Standards and Guidelines for Municipal Waste Combustors* (EPA, 1994).

Some costs were not quantified for this analysis:

- Operator training: Operator training and certification is essential to ensure proper operation of MWCs in accordance with good combustion practices (GCP). The annual cost of operator training is expected to be minor.

- Governmental administration and enforcement: Federal, state, and local governments incur costs to issue permits, monitor performance, and enforce compliance with current environmental regulations for new and existing MWCs. The additional costs associated with administering and enforcing the regulations were not quantified in this EIA but are addressed in the Information Collection Request (ICR) for this rulemaking.

- Adjustment costs for displaced resources: Three types of costs may occur while the economy adjusts to new regulations: underutilization of resources from lost output, resource reallocation costs (such as moving to a new location), and the operation of programs to help the unemployed. These costs were not quantified.

- Paperwork: No paperwork burden costs were estimated in this analysis beyond the testing, reporting, and recordkeeping costs (see Tables 5-7 and 5-8 in *Economic Impact Analysis for Proposed Emission Standards and Guidelines for Municipal Waste Combustors* [EPA, 1994]).

- Costs of controlling fugitive emissions: The costs to control fugitive emissions were not included in this analysis.

3.2 Emissions

Emission factors (EPA, 1995) (expressed as emission per ton of MSW combusted basis) based on the type of combustor, APCD at baseline, and APCD after retrofit were used in conjunction with the annual amount of MSW combusted at each facility to compute the baseline emissions and emission reductions. Aggregate emission reductions were then calculated by summing across all of the facilities in the 1998 inventory.

4. Costs and Emissions Reduction: Emission Guidelines

The number of units, by type of ownership, that will be affected by each type of emission control device is summarized in Table 3 for Regulatory Alternative I, in Table 4 for Regulatory Alternative I*, and in Table 5 for Regulatory Alternative II. The annual control costs for these units were computed using the model plant cost inputs listed in Tables 5-1, 5-3, and 5-4 in the *Economic Impact Analysis for Proposed Emission Standards and Guidelines for Municipal Waste Combustors* (EPA, 1994). These costs are incremental to the baseline levels. Figures 1, 2, and 3 show the distribution of all MWCs in the 1998 inventory based on the increase in the cost per ton of waste combusted under Regulatory Alternatives I, I*, and II, respectively. Table 6 provides the aggregate costs of the standard, about $50 million annually for Regulatory Alternative I. As shown in Table 7, under Regulatory Alternative I* the aggregate costs are $68 million. Table 8 indicates the aggregate costs of Regulatory Alternative II are about $89 million. These costs are presented as the social cost of the regulatory alternatives. However, as explained above, they represent a worst-case (highest-cost) scenario because substitution (facility closure) was not evaluated. These costs are distributed across the three ownership categories: business-owned units, government-owned units, and units owned by nonprofit organizations.

4.1 Impacts on Business-Owned Units

Eleven private entities owning 26 MWCs are subject to regulation. Under Regulatory Alternative I, business-owned units will incur about $17.1 million, or 34 percent, of the total annual cost of the regulation. This cost averages to $17.97 per ton of waste combusted by these sources. Under Regulatory Alternative I*, they will incur $21.3 million, or 32 percent, of the total annual cost of the regulation. This is a cost of $22.35 per ton of waste combusted.

Table 3. Distribution of Affected Units: Regulatory Alternative I (Existing MWCs)

Control System	Business	Government	Nonprofit Organization	Total
Acid Gas/PM/Metals	11	38	2	51
Hg	22	58	2	82
NO_x	6	4	0	10
Total Number of Units	26	62	2	90

Table 4. Distribution of Affected Units: Regulatory Alternative I* (Existing MWCs)

Control System	Business	Government	Nonprofit Organization	Total
Acid Gas/PM/Metals	15	45	2	62
Hg	22	58	2	82
NO_x	6	4	0	10
Total Number of Units	26	62	2	90

Table 5. Distribution of Affected Units: Regulatory Alternative II (Existing MWCs)

Control System	Business	Government	Nonprofit Organization	Total
Acid Gas/PM/Metals	19	50	2	71
Hg	22	58	2	82
NO_x	6	4	0	10
Total Number of Units	26	62	2	90

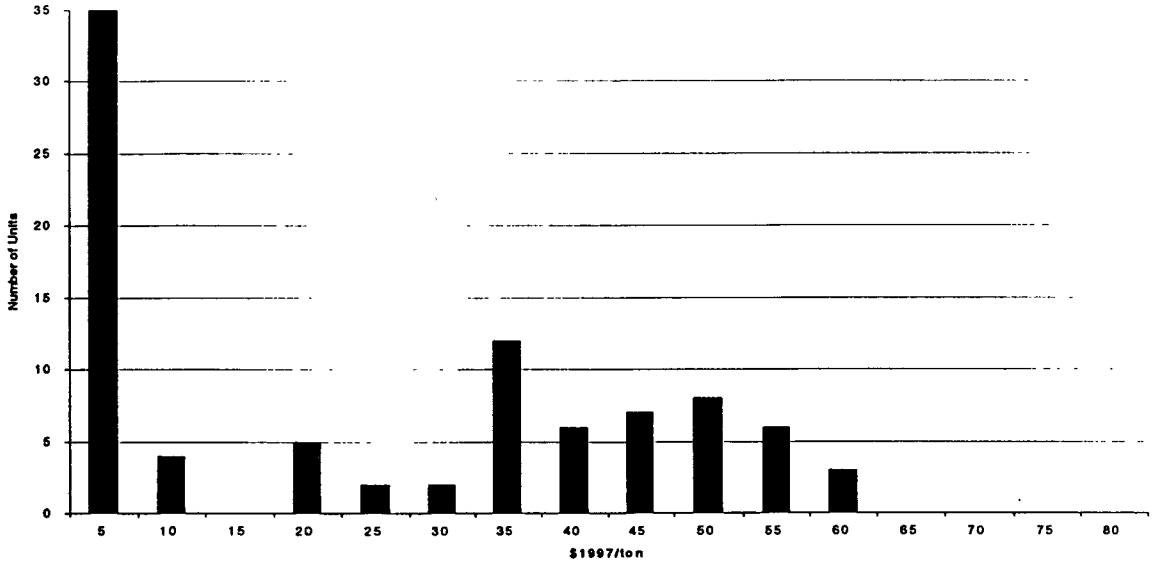

Figure 1. Distribution of Annual Compliance Cost Per Ton of Waste Combusted for Existing Small MWCs: Regulatory Alternative I

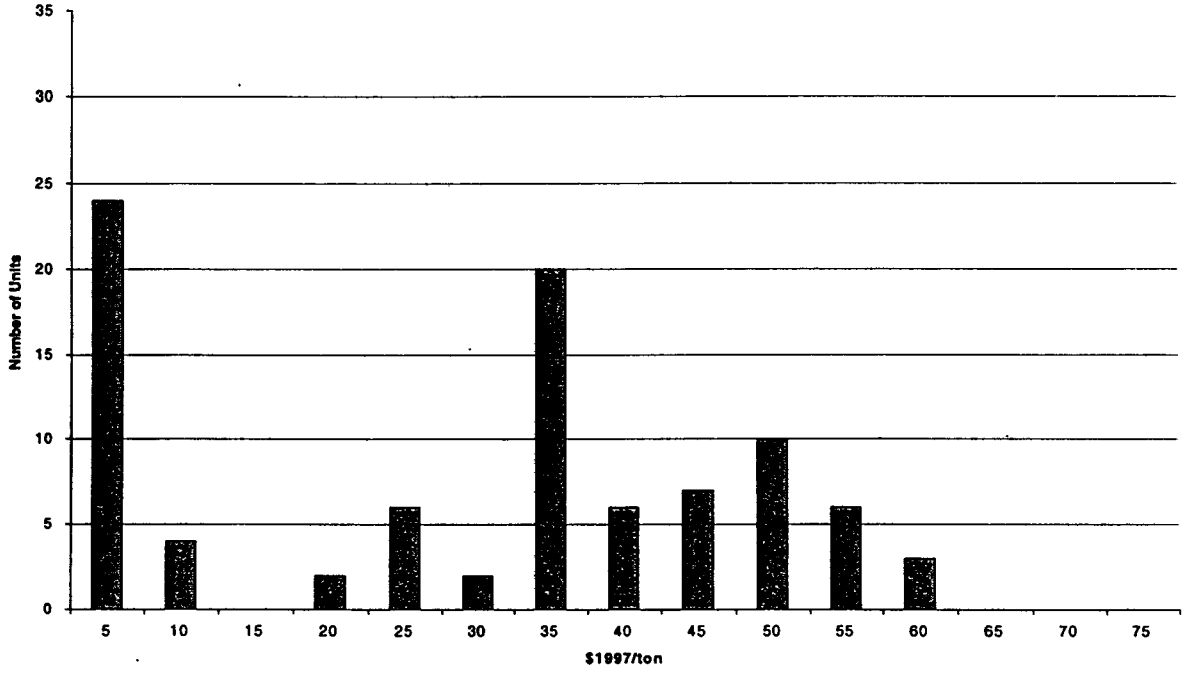

Figure 2. Distribution of Annual Compliance Cost Per Ton of Waste Combusted for Existing Small MWCs: Regulatory Alternative I*

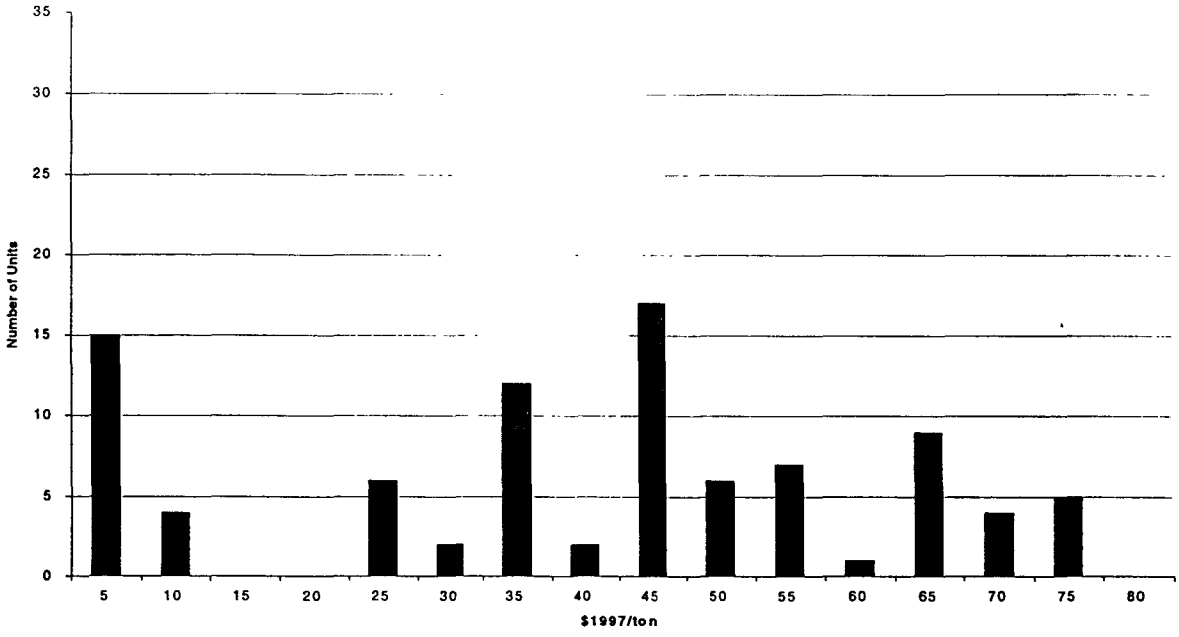

Figure 3. Distribution of Annual Compliance Cost Per Ton of Waste Combusted for Existing Small MWCs: Regulatory Alternative II

Under Regulatory Alternative II, they will incur $27.0 million, or 30 percent of the total annual cost of the regulation. This is $28.30 per ton of waste combusted by these sources.

Two general options are available to the operators of these facilities—pay these costs out of revenues or pass them along to suppliers of inputs or purchasers of the commodity produced at the facility. No formal attempt was made in this analysis to assess whether and to what degree operators may be able to shift costs upstream to suppliers or downstream to consumers. However, costs are expressed as a share of tipping fees. If a facility provides its services for a fee, tipping fees are the price charged. The national average tipping fee is $57 in 1993 dollars (Berenyi and Gould, 1993), or $57.95 when expressed in 1997 dollars. The average control cost represents 31 percent of tipping fees for business-owned units under Regulatory Alternative I, 38 percent under Regulatory Alternative I*, and 49 percent under Regulatory Alternative II. If there were full-cost pass through, which would require a perfectly inelastic demand curve for waste combustion services, this would be the price increase, obviously a very large amount.

Table 6. Aggregate Costs: Regulatory Alternative I (Existing MWCs)

Ownership/Type of Control	Total Capital Cost ($1997)	Annual Operating Costs ($1997)	Total Annual Costs ($1997)	Annual Average Enterprise Costs ($1997/ton)	Projected Avg. Tipping Fee Increase
Business					
Acid Gas/PM/Metals Control	$70,528,076	$7,334,187	$13,991,539	$14.67	
Hg Control	$1,453,984	$814,417	$951,663	$1.00	
NO_x Control	$9,053,560	$1,333,349	$2,187,941	$2.29	
Total Business	$81,035,620	$9,481,953	$17,131,142	$17.97	30.93%
Percentage of Total Annual Regulatory Costs			34.25%		
Government					
Acid Gas/PM/Metals Control	$110,441,464	$19,708,494	$27,834,970	$16.45	
Hg Control	$3,362,191	$3,108,600	$3,355,996	$1.98	
NO_x Control	$4,360,142	$694,233	$1,015,060	$0.60	
Total Government	$118,163,798	$23,511,327	$32,206,026	$19.03	32.77%
Percentage of Total Annual Regulatory Costs			64.38%		
Nonprofit Organization					
Acid Gas/PM/Metals Control	$2,101,438	$443,966	$598,593	$26.64	
Hg Control	$101,371	$78,975	$86,434	$3.85	
NO_x Control	$0	$0	$0	$0.00	
Total Nonprofit Organization	$2,202,810	$522,941	$685,027	$30.49	52.50%
Percentage of Total Annual Regulatory Costs			1.37%		
Grand Total	**$201,402,227**	**$33,516,221**	**$50,022,196**	**$18.75**	**32.28%**

Table 7. Aggregate Costs: Regulatory Alternative I* (Existing MWCs)

Ownership/Type of Control	Total Capital Cost ($1997)	Annual Operating Costs ($1997)	Total Annual Costs ($1997)	Annual Average Enterprise Costs ($1997/ton)	Projected Avg. Tipping Fee Increase
Business					
Acid Gas/PM/Metals Control	$92,994,827.87	$9,392,894.59	$18,170,948.47	$19.06	
Hg Control	$1,453,984.42	$814,416.78	$951,663	$1.00	
NO_x Control	$9,053,559.78	$1,333,348.61	$2,187,941	$2.29	
Total Business	$103,502,372	$11,540,660	$21,310,552	$22.35	38.48%
Percentage of Total Annual Regulatory Costs			31.57%		
Government					
Acid Gas/PM/Metals Control	$192,124,588	$26,999,548	$41,136,411	$24.31	
Hg Control	$3,362,191	$3,108,600	$3,355,996	$1.98	
NO_x Control	$4,360,142	$694,233	$1,015,060	$0.60	
Total Government	$199,846,922	$30,802,381	$45,507,468	$26.89	46.30%
Percentage of Total Annual Regulatory Costs			67.42%		
Nonprofit Organization					
Acid Gas/PM/Metals Control	$2,101,438	$443,966	$598,593	$26.64	
Hg Control	$101,371	$78,975	$86,434	$3.85	
NO_x Control	$0	$0	$0	$0.00	
Total Nonprofit Organization	$2,202,810	$522,941	$685,027	$30.49	52.50%
Percentage of Total Annual Regulatory Costs			1.01%		
Grand Total	**$305,552,104**	**$42,865,982**	**$67,503,047**	**$25.30**	**43.56%**

Table 8. Aggregate Costs: Regulatory Alternative II (Existing MWCs)

Ownership/Type of Control	Total Capital Cost ($1997)	Annual Operating Costs ($1997)	Total Annual Costs ($1997)	Annual Average Enterprise Costs ($1997/ton)	Projected Avg. Tipping Fee Increase
Business					
Acid Gas/PM/Metals Control	$121,293,761	$12,394,490	$23,843,763	$25.00	
Hg Control	$1,453,984	$814,417	$951,663	$1.00	
NO_x Control	$9,053,560	$1,333,349	$2,187,941	$2.29	
Total Business	$131,801,305	$14,542;255	$26,983,366	$28.30	48.72%
Percentage of Total Annual Regulatory Costs			30.35%		
Government					
Acid Gas/PM/Metals Control	$307,088,205	$34,019,870	$56,615,958	$33.46	
Hg Control	$3,362,191	$3,108,600	$3,355,996	$1.98	
NO_x Control	$4,360,142	$694,233	$1,015,060	$0.60	
Total Government	$314,810,539	$37,822,704	$60,987,014	$36.04	62.05%
Percentage of Total Annual Regulatory Costs			68.59%		
Nonprofit Organization					
Acid Gas/PM/Metals Control	$3,939,795	$562,428	$852,325	$37.94	
Hg Control	$101,371	$78,975	$86,434	$3.85	
NO_x Control	$0	$0	$0	$0.00	
Total Nonprofit Organization	$4,041,166	$641,403	$938,759	$41.79	71.94%
Percentage of Total Annual Regulatory Costs			1.06%		
Grand Total	**$450,653,011**	**$53,006,362**	**$88,909,139**	**$33.32**	**57.37%**

4.2 *Impacts on Government Entities*

Twenty-nine government entities owning 62 MWCs that meet the 35 to 250 tpd size criteria are subject to regulation under both scenarios. Under Regulatory Alternative I, government-owned units will incur annual incremental costs due to the regulation in the amount of $32.2 million, or 64 percent of the total annual compliance costs. This is an increase of $19.03 per ton of waste combusted. Under Regulatory Alternative I*, the cost of compliance for government units is $45.5 million, or 67 percent of the aggregate compliance costs. This represents an increase of $26.89 per ton of waste combusted at these facilities. Under Regulatory Alternative II, the cost of compliance for government units is $61.0 million, or 69 percent of the aggregate compliance costs. This represents an increase of $36.04 per ton of waste combusted at these facilities. The cost increases faced by government units are higher than the increases business-owned MWCs will face because a larger proportion of public MWCs will require a retrofit of their PM/acid gas/metals controls. The tipping fee increase for government MWCs needed to cover these costs, analogous to the one for business-owned units, is 33 percent under Regulatory Alternative I, 46 percent under Regulatory Alternative I*, and 62 percent under Regulatory Alternative II.

Governments may finance regulatory compliance costs by borrowing, rasing taxes, diverting revenue from other services, or, where they exist, raising user fees (i.e., tipping fees). This analysis focuses on the use of revenue bonds as a means of financing MWC retrofits. It estimates the impacts of the regulation on government entities by projecting the government entity's ability to issue revenue bonds to finance the capital control costs imposed by the regulation. Revenue bonds are generally repaid through user fees assessed to individuals that directly benefit from the investment. Thus, the ability to issue revenue bonds depends on the ability of the government entity to increase user charges assessed to households in the service area of the MWC. For this analysis, the ability of government entities to issue revenue bonds was projected based on a threshold criterion established in *Municipalities, Small Businesses, and Agriculture—The Challenge of Meeting Environmental Responsibilities* (EPA, 1988). Specifically, if the annual cost per household due to the regulation exceeds 1 percent of annual household income, then the community is projected to have potential difficulty issuing revenue bonds.

Household impacts were computed using the median household income and number of households in the county where the MWC facility is located (Department of Commerce, 1994). Household income was converted to 1997 dollars (Department of Labor, 1998). The

aggregate costs were combined with demographic and income data to compute the cost per household and the cost per household as a percentage of pre-tax household income. The total annual cost (including the annualized capital cost and the annual operating cost) was divided by the number of households to calculate the cost of each regulatory alternative per household.[10] Then the annual cost per household was expressed as a percentage of household income to determine whether the community will have financial difficulty issuing revenue bonds. The results of the analysis were broken down into four groups of facilities based on the size of the population of the county in which they are located.

Tables 9, 10, and 11 show, for Regulatory Alternatives I, I*, and II, respectively, the number of facilities and units, the average cost per household, median household income, average household cost as a percentage of median household income, and the number of government entities whose annual compliance costs exceed the threshold criterion under the regulation, all broken down by population size of the county where the MWC facility is located. No government entities are projected to have difficulty issuing revenue bonds as a result of the regulation under Regulatory Alternative I or Regulatory Alternative I*. Under Regulatory Alternative II, one small government entity exceeds the 1 percent criterion. Government entities that, for some reason, are unable to issue bonds to cover the costs of the regulation may decide to use other financing mechanisms or other waste disposal options.

4.3 Impacts on Nonprofit Organizations

One nonprofit organization owns two MWCs that will be affected by the regulation. These two units will incur annual incremental compliance costs of approximately $0.7 million, or 1 percent of the total annual compliance costs under Regulatory Alternatives I and I*. These costs equate to an annual average cost increase of $30.49 per ton of waste combusted, which is 53 percent of the pre-regulation average fee. Under Regulatory Alternative II, the two units will incur annual incremental compliance costs of $0.9 million, or 1 percent of the total compliance costs of the regulation. Under Regulatory Alternative II, compliance costs result in a cost increase of $41.79 per ton of waste combusted, which is 72 percent of the average tipping fee.

Data were not sufficient to determine the ability of units owned by the nonprofit organization to meet the regulation requirements (e.g., annual operating expenditures or assets).

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[10]The number of households is used as an estimator of the service area population.

Table 9. Impacts on Publicly Owned Units: Regulatory Alternative I (Existing MWCs)

	Country Population Size (in thousands)			
	0 to 50	50 to 100	100 to 250	Over 250
Facilities	8	5	10	6
Units	14	12	23	13
Annual Avg. Compliance Cost Per Household	$58.17	$17.69	$12.29	$1.11
Annual Household Income	$25,551.27	$29,905.72	$37,145.15	$41,030.44
Annual Avg. Compliance Cost Per Household as a Share of Household Income (%)	0.2277%	0.0591%	0.0331%	0.0027%
Government Facilities Projected to Have Difficulty with Financing	0	0	0	0

Table 10. Impacts on Publicly Owned Units: Regulatory Alternative I* (Existing MWCs)

	Country Population Size (in thousands)			
	0 to 50	50 to 100	100 to 250	Over 250
Facilities	8	5	10	6
Units	14	12	23	13
Annual Avg. Compliance Cost Per Household	$58.17	$17.69	$15.55	$6.98
Annual Household Income	$25,551.27	$29,905.72	$37,145.15	$41,030.44
Annual Avg. Compliance Cost Per Household as a Share of Household Income (%)	0.2277%	0.0591%	0.0419%	0.0170%
Government Facilities Projected to Have Difficulty with Financing	0	0	0	0

Table 11. Impacts on Publicly Owned Units: Regulatory Alternative II (Existing MWCs)

	Country Population Size (in thousands)			
	0 to 50	50 to 100	100 to 250	Over 250
Facilities	8	5	10	6
Units	14	12	23	13
Annual Avg. Compliance Cost Per Household	$74.72	$31.21	$18.73	$8.13
Annual Household Income	$25,551.27	$29,905.72	$37,145.15	$41,030.44
Annual Avg. Compliance Cost Per Household as a Share of Household Income (%)	0.2924%	0.1044%	0.0504%	0.0198%
Government Facilities Projected to Have Difficulty with Financing	1	0	0	0

4.4 Household Impacts

If the MWC facilities are not institutional (i.e., they serve customers other than their owners/operators), some or all of the increase in costs will be passed onto their customers. Because household waste comprises the majority of MSW, this analysis estimated the impact of the regulation on households in the facilities' service areas. Household impacts apply to all communities served by MWCs, regardless of their form of ownership. Therefore, the methods used to compute average cost per household and average cost per household as a percentage of income for government-owned MWCs also applies to business-owned MWCs and facilities owned by nonprofit organizations. Community size is based on the population of the county where the facility is located.

Tables 12, 13, and 14 show the average annual compliance cost per household under the regulation and the average annual cost as a percentage of median household income for Regulatory Alternatives I, I*, and II, respectively. They report the average cost increase due

Table 12. Household Impacts: Regulatory Alternative I (Existing MWCs)

	Country Population Size (in thousands)			
	0 to 50	50 to 100	100 to 250	Over 250
Facilities	11	8	14	8
Units	20	18	34	18
Annual Avg. Compliance Cost Per Household	$48.80	$25.72	$9.46	$2.09
Annual Household Income	$29,250.07	$32,928.15	$37,321.44	$40,973.82
Annual Avg. Compliance Cost Per Household as a Share of Household Income (%)	0.17%	0.08%	0.03%	0.01%

Table 13. Household Impacts: Regulatory Alternative I* (Existing MWCs)

	Country Population Size (in thousands)			
	0 to 50	50 to 100	100 to 250	Over 250
Facilities	11	8	14	8
Units	20	18	34	18
Annual Avg. Compliance Cost Per Household	$48.80	$25.72	$13.68	$6.33
Annual Household Income	$29,250.07	$32,928.15	$37;321.44	$40,973.82
Annual Avg. Compliance Cost Per Household as a Share of Household Income (%)	0.17%	0.08%	0.04%	0.02%

to the regulation if all the cost increases are passed on to households in the form of increased user fees or increased taxes. As already discussed, the actual burden on a given household may be larger or smaller depending on the method by which the jurisdiction passes costs along to its customers. The values reported in Tables 12, 13, and 14 indicate that, on

Table 14. Household Impacts: Regulatory Alternative II (Existing MWCs)

	Country Population Size (in thousands)			
	0 to 50	50 to 100	100 to 250	Over 250
Facilities	11	8	14	8
Units	20	18	34	18
Annual Avg. Compliance Cost Per Household	$71.78	$35.75	$17.09	$7.16
Annual Household Income	$29,250.07	$32,928.15	$37,321.44	$40,973.82
Annual Avg. Compliance Cost Per Household as a Share of Household Income (%)	0.25%	0.11%	0.05%	0.02%

average, the cost per household, both as an absolute value and as a share of median household income, is highest for entities with populations below 50,000, and it is inversely related to population size.

5. National Emissions Reductions (Emission Guidelines)

Tables 15, 16, and 17 describe expected national aggregate emissions and emissions reductions for dioxins (CDD/CDF), cadmium (Cd), Hg, lead (Pb), PM, sulfur dioxide (SO_2), hydrogen chloride, and NO_x under Regulatory Alternatives I, I*, and II, respectively. The tables also report the expected percentage change in the emissions of each pollutant.

6. Cost and Emissions Reductions: NSPS

The proposed regulation of MWCs includes New Source Performance Standards (NSPS) to be imposed on new facilities. New MWCs subject to the NSPS will be required to install air pollution control technologies with the performance characteristics of an SD-based control system. Additionally, units located at MWC plants with an aggregate capacity greater than 250 tons of MSW per day would also be required to install NO_x control systems with the performance characteristics of SNCR.

Table 15. Aggregate Emissions Reductions: Regulatory Alternative I (Existing MWCs)

	Baseline Emissions (lbs per year)	Emissions Reductions (lbs per year)	Percent Reduction (%)
PM	1,058,149	771,878	73%
Cd	806	680	84%
Hg	9,427	8,987	95%
Pb	30,909	28,044	91%
SO_2	5,347,111	2,630,931	49%
HCl	6,167,873	5,258,472	85%
CDD/CDF	6	6	97%
NO_x	9,042,433	845,717	9%
CO*	1,958,682	0	0%

Table 16. Aggregate Emissions Reductions: Regulatory Alternative I* (Existing MWCs)

	Baseline Emissions (lbs per year)	Emissions Reductions (lbs per year)	Percent Reduction (%)
PM	1,058,149	812,958	77%
Cd	806	683	85%
Hg	9,427	8,998	95%
Pb	30,909	28,503	92%
SO_2	5,347,111	3,014,954	56%
HCl	6,167,873	5,414,007	88%
CDD/CDF	6	6	97%
NO_x	9,042,433	845,717	9%
CO*	1,958,682	0	0%

Table 17. Aggregate Emissions Reductions: Regulatory Alternative II (Existing MWCs)

	Baseline Emissions* (lbs per year)	Emissions Reductions (lbs per year)	Percent Reduction (%)
PM	1,058,149	862,110	81%
Cd	806	689	85%
Hg	9,427	9,023	96%
Pb	30,909	29,512	95%
SO_2	5,347,111	3,576,606	67%
HCl	6,167,873	5,522,556	90%
CDD/CDF	6	6	98%
NO_x	9,042,433	845,717	9%
CO*	1,958,682	0	0%

It is projected that, in the absence of the NSPS, five new small MWC plants will be constructed over the next 5 years, averaging one per year (Leatherwood, 1998). Furthermore, it is projected that each of these new plants will have two combustor units each with capacity of 50 tpd, for a total plant capacity of 100 tpd. For the new NSPS, the baseline performance is assumed to be the 1971 NSPS for MWCs (Subpart E) (40 CFR Part 60), which only regulates PM emissions. The model plant for the NSPS analysis would be required to implement air pollution controls with the performance characteristics of SD/FF control systems for PM, acid gas, and metals and of CI for Hg. NO_x controls will not be required for the projected model units, because the projected total capacity of each new facility is less than 250 tpd.

The aggregate costs and emissions reductions at new MWCs were computed based on the same assumptions and methodology as the ones for existing small MWCs. The only difference is that the useful life of new small MWCs is assumed to be 30 years,[11] and the cost data used were extracted from Tables 5-2, 5-5, and 5-6 in *Economic Impact Analysis for Proposed Emission Standards and Guidelines for Municipal Waste Combustors* (EPA, 1994).

[11]This assumption is consistent with *Economic Impact Analysis for Proposed Emission Standards and Guidelines for Municipal Waste Combustors* (EPA, 1994).

Table 18. Aggregate Costs (New MWCs)[a]

Type of Control	Total Capital Cost ($1997)	Annual Operating Costs ($1997)	Total Annual Costs ($1997)	Annual Average Enterprise Costs ($1997/ton)
Acid Gas/PM/ Metals Controls	$34,600,503	$5,126,064	$7,914,394	$50.73
Hg Control	$542,044	$101,618	$145,299	$0.93
NO_x Control	$0	$0	$0	$0.00
Total	**$35,142,547**	**$5,227,682**	**$8,059,693**	**$51.66**

[a] Fifth-year impacts.

6.1 Cost Impact

The costs of the NSPS in the fifth year after the regulation is imposed are expected to be $8.1 million in the worst case, as shown in Table 18. These costs are taken to be the social cost of the regulation. One projected small MWC plant, consisting of two units, will incur additional costs due to the regulation in the amount of $1.6 million. In the fifth year, it is projected that there will be five such new facilities in operation. The cost of the regulation averages to about $51.66 per ton of waste combusted. These costs are relative to the 1971 NSPS for MWCs (Subpart E).

As explained in the EG analysis, the costs presented in Table 18 represent a worst-case (highest-costs) scenario because substitution was not evaluated. If we did consider landfilling as a substitution option for institutions planning to purchase a small MWC, we would expect the number of new MWCs to be lower than in our worst-case scenario. This results because, as the new standards require additional pollution control equipment to be installed with the combustors, the cost of combustion increases. As the cost of combustion increases, institutions that plan to use combustion as a method of waste disposal will consume less of it. This effect will be even more pronounced further into the future, as the institutions planning to purchase combustors will have more flexibility in choosing their method of waste disposal.

6.2 *Emissions Reductions*

In the fifth year after the NSPS are put into effect, the standards are expected to result in a reduction of pollutants, as shown in Table 19. The table also reports the expected percentage change in the emissions of each pollutant. These reductions are relative to the 1971 HSPS for MWCs (Subpart E).

Table 19. Emissions Reductions (New MWCs)[a]

	Baseline Emissions[b] (lbs per year)	Emissions Reductions (lbs per year)	Percent Reduction (%)
CDD/CDF	0.459	0.452	99%
Cd	376	372	99%
Hg	874	850	97%
Pb	33,231	33,191	99%
PM	535,134	525,461	98%
SO_2	503,931	417,498	83%
HCl	335,434	302,514	90%
NO_x	493,010	(c)	0%

[a] Fifth-year impacts.
[b] Baseline emissions assume new MWCs are subject to 1971 NSPS (Subpart E).
[c] The model plant for new NSPS units was a unit of a plant with capacity less than 250 tpd and no NO_x control would be required. If the model plant had been a unit of a plant with capacity larger than 250 tpd, NO_x control would have been required. The projected NO_x emissions reduction for such units is approximately 40 percent.

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16. ABSTRACT

This report describes the expected impacts of EPA's Emission Guidelines (EGs) on existing small municipal waste combustion units (SMWCs) and the New Source Performance Standards on new SMWCs. The report compares three different regulatory alternatives for existing facilities and reports the overall distribution of costs, the distribution of costs across ownership structures, and the variation of costs across communities of different sizes. The report presents projected emissions reductions associated with each of the regulatory alternatives. The report also describes expected fifth-year impacts of the NSPS.

17. MACT Rule Support

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