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Economic Impact Analysis For Proposed Emission Standards and Guidelines For Municipal Waste Combustors

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Economic Impact Analysis for Proposed Emission Standards and Guidelines for Municipal Waste Combustors

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A Description of the Basis for, and Impacts of, Proposed Revisions to Air Pollutant Emission Regulations for New and Existing Municipal Waste Combustors Under Clean Air Act Sections 111(b), 111(d), and 129

March 1994

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Air and Radiation
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina

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CONVERSIONS AND DEFINITIONS

This report uses metric units, as well as acronyms and terms that may not be familiar to all readers. Following is a short guide to conversions and definitions for a selection of the units, acronyms, and terms.

CONVERSIONS

To Convert From	To	Multiply by	Examples from Text
Mg (megagram)	Ton (2,000 lb)	1.1025	35 Mg ≈ 39 tons 225 Mg ≈ 250 tons
g/dscm (grams/dry standard cubic meter)	gr/dscf (grains/dry standard cubic foot)	0.44	0.02 g/dscm ≈ 0.01 gr/dscf 0.18 g/dscm ≈ 0.08 gr/dscf
TJ (terajoule)	10^6 Btu (million British Thermal Units)	948	8.54 TJ ≈ 8,100 10^6 Btu 34.2 TJ ≈ 32,400 10^6 Btu
TJ (terajoule)	MWh (megawatt hours	278	4.32 TJ ≈ 1,200 MWh 13 TJ ≈ 3,600 MWh

OTHER MEASURES

ng	Nanogram-one billionth of a gram (10^{-9} gram)
Nm^3	Normal cubic meter (a normal cubic meter is at 0°C, while a standard cubic meter is at 20°C; both at 1 atmosphere of pressure.
mg	Milligram-one thousandth of a gram (10^{-3} gram)
ppmv	Parts per million by volume
10^3; 10^6	Thousands; Millions

POLLUTANTS

CDD/CDF	Polychlorinated dibenzo-p-dioxins and dibenzofurans
CO	Carbon monoxide
HCl	Hydrogen chloride
NO_x	Nitrogen oxides
Pb	Lead
PM	Particulate matter
SO_2	Sulfur dioxide
Cd	Cadmium
Hg	Mercury

GENERAL ACRONYMS

BDT	Best demonstrated technology
MACT	Maximum achievable control technology
APCD	Air pollution control device
MSW	Municipal solid waste
MWC	Municipal waste combustor

ECONOMIC TERMS

MSC	Marginal social cost
MSB	Marginal social benefit
Enterprise cost	The regulatory costs incurred by each MWC, discounted and annualized at real market interest rates
National social cost	The sum of the regulatory costs incurred by each MWC (without accounting for tax effects), discounted and annualized at interest rates reflecting society's real opportunity costs for capital and consumption
$1990	Constant (real) dollars at their mid-year 1990 value
Tipping fee	The charge for incinerating or landfilling MSW, usually $/Mg MSW, imposed by MWCs or landfill operators on MSW collectors. Tipping fees, where they are charged, do not reflect the cost of collecting and transporting MSW to the disposal site and may or may not reflect the full cost of incineration or landfilling.
C/E	Cost-effectiveness

REGULATORY AND LEGISLATIVE TERMS

Baseline	Conditions that would exist were there to be no more emission control than that mandated by regulation in existence before 1991, that is, by 40 CFR Subparts E and Db (but not by EPA's 1987 new source review operational guidance).
EG	Clean Air Act Sections 111(d) and 129 emission guidelines for existing sources
MWC I	Emission Standards and Guidelines promulgated February 11, 1991 for large MWCs

CONVERSIONS AND DEFINITIONS (CONTINUED)

REGULATORY AND LEGISLATIVE TERMS (Continued)

MWC II/III	Revised and expanded Emission Standards and Guidelines to be proposed for large MWCs (MWC II) and small MWCs (MWC II)
NSPS	Clean Air Act Sections 111(b) and 129 new source performance standards
CAA	Clean Air Act (In some references, as amended through 1977; in most references, as amended through 1990)
E.O.	Executive Order
OMB	Office of Management and Budget
RCRA	Resource Conservation and Recovery Act
NAAQS	National Ambient Air Quality Standards
SIP	State Implementation Plan
RFA	Regulatory Flexibility Act
EIA	Economic Impact Analysis

POLLUTION CONTROL TECHNOLOGIES

GCP	Good combustion practices
DSI	Dry sorbent injection
ESP	Electrostatic precipitator
ESP(m)	Enhanced electrostatic precipitator
SD	Spray dryer
FF	Fabric filter
CI	Activated carbon injection (used for mercury control)
SNCR	Selective non-catalytic reduction (ammonia injection for NO_x control)

MODEL PLANTS/COMBUSTION TECHNOLOGIES

Model plant	A hypothetical MWC representative of a class of MWCs; used to analyze impacts of regulation
S	Small (35 to 225 Mg/day capacity)
L	Large (over 225 Mg/day capacity)
BB	Bubbling bed (a type of FBC)
CB	Circulating bed (a type of FBC)
EA	Excess air
FBC	Fluidized-bed combustion
MB	Mass burn
MOD	Modular
RDF	Refuse-derived fuel
REF	Refractory
RG	Rocking grate
RK	Rotary kiln
RWW	Rotary waterwall
SA	Starved air
TG	Travelling grate
TR	Transfer rams
UC	Under construction
WW	Waterwall

CHAPTER 1
INTRODUCTION AND SUMMARY

The Clean Air Act (CAA) of 1990 requires that the U.S. Environmental Protection Agency (EPA) develop, propose, promulgate, and enforce regulations to improve health and welfare by reducing the quantity of air pollutants emitted from sources such as combustors. Sections 111 and 129 of the CAA direct EPA to develop Emission Guidelines (EG) for existing municipal waste combustors (MWCs) and New Source Performance Standards (NSPS) for new MWCs. Municipalities use MWCs to reduce the quantity of municipal solid waste (MSW)[1] that must be landfilled and, frequently, to generate energy.

The EPA projects that, by 1996, the proposed EG will potentially affect approximately 179 MWCs combusting about 32.82 million Mg of waste annually. Furthermore, EPA projects that, by 2000, approximately 70 new plants subject to the NSPS will combust an additional 14.95 million Mg of MSW. Thus, the total 2000 projected waste flow affected by the regulations is 47.77 million Mg/yr.

The regulations are needed because MSW combustion generates unwanted by-products that are discharged into the atmosphere--including criteria pollutants and other organics, metals, and acid gases. Elevated exposures of people, plants,

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[1]MSW is defined as either a mixture or a single item stream of household, commercial, and/or institutional discards. This definition includes refuse-derived fuel (RDF), which is waste that is shredded and classified by size (or pelletized) before combustion to increase the heating value of the waste. Discards from industrial and manufacturing processes are not included in the definition of MSW.

animals, structures, and materials to these pollutants reduce both health and welfare. This combined Economic Impact Analysis (EIA) presents an analysis of the potential economic impacts of the EG and NSPS for MWCs.

1.1 BACKGROUND

Air pollution caused by municipal solid waste combustion in MWCs is a classic example of a "negative externality": costs are imposed on uncompensated parties. Private market systems have failed to make MWC operators consider these costs in their production decisions or to compensate damaged parties for the negative effects associated with pollution. Damaged parties cannot collect compensation because the adverse effects of the pollutants are nonmarket goods--that is, goods that are not explicitly and routinely traded in organized free markets. One way to address the problem of externalities is through Federal regulatory intervention.

Alternatives to Federal intervention addressed in this analysis include State or local regulation and judicial recourse. The EPA believes that relying on State and local action is not a viable substitute for Federal regulatory action in the case of controlling MWC emissions. Federal action is likely to provide a more consistent, efficient, and complete societal response to the problem of MWC emissions. Similarly, litigation, although possible under both the CAA and the Resource Conservation and Recovery Act (RCRA), is expensive and risky in comparison to direct regulation.

Congress decided that Federal regulatory action is necessary, and EPA must decide on a regulatory policy strategy. Several policy options are available to EPA to reduce the pollution from MWCs from an excessive to an optimal level, or to any other desired level. These options include both market-based approaches and regulatory standards.

The market-based approaches considered in this analysis include emission fees and marketable permits. An attractive feature of both of these market-based approaches is that each discharger would independently choose a level of control resulting in equivalent marginal control costs across all polluters. This approach minimizes the cost to achieve a given level of aggregate control.

The government traditionally uses regulatory standards to control pollution. Two broad categories of this regulatory approach include design standards and emission standards. Design standards specify the type of control equipment to be installed by polluters, whereas emission standards specify the maximum quantity of a given pollutant that a polluter may release. The candidate regulatory alternatives analyzed in this report are emission standards based on the requirements in Section 129 of the CAA. For comparison purposes, three candidate regulatory alternatives are examined under the EG and two under the NSPS.

The CAA requires EPA to regulate MWCs based on the maximum achievable control technology (MACT). MACT is the maximum degree of reduction in emissions, taking into consideration the cost of achieving such emission reduction, and any non-air quality health and environmental impacts and energy requirements. Emission standards and guidelines cannot be less stringent than what EPA calls the MACT "floor." Specifically, for new MWCs, the standards must be at least as stringent as the emissions control achieved in practice by the best controlled similar MWC. For existing MWCs, the guidelines can be less stringent than standards for new MWCs in the same category, but must not be less stringent than the average emissions limitation achieved by the best performing 12 percent of MWCs in the same category.

Section 129 of the CAA indicates that EPA should promulgate the Section 111 standards and guidelines that were already in the pipeline in 1990 (when Section 129 was added to the CAA), but that those standards and guidelines subsequently should be revised and expanded to bring them into conformance with the new requirements of Section 129. EPA therefore promulgated the Section 111 standards and guidelines on February 11, 1991. They are referred to as MWC I in this analysis. MWC I requirements have been implemented for new MWCs but not for existing MWCs; they will be expanded and strengthened with more stringent requirements based on MACT. This EIA focuses on these MACT-based requirements, and all reported impacts are incremental to the pre-MWC I baseline.

In this analysis, MWC II refers to the additional MACT-based requirements for MWCs greater than 225 Mg/day (large) capacity. Similarly, MWC III refers to the MACT-based requirements for MWCs between 35 and 225 Mg/day (small) capacity also required in Section 129. These requirements are referred to collectively as MWC II/III throughout the balance of this report.

Table 1-1 reports the emission limits for the MWC II/III EG regulatory alternative that EPA is proposing (Regulatory Alternative II). The proposed limits are different for segments of the regulated population based on plant size classification. Plant size classification is determined by the combustion capacity per day in aggregate for all units at a plant, given in megagrams per day (Mg/day). Plants classified as small have a combustion capacity between 35 and 225 Mg/day, and those classified as large have a capacity of over 225 Mg/day.

Although MWC operators may use any technology that achieves the emission limit to comply with the EG, the impacts of the regulation estimated in this analysis are based on specified demonstrated control technologies that achieve the mandated emission requirements for each plant size.[2] Generally speaking, MWC owners and operators are assumed to choose the minimum-cost control technology that will meet the emission requirements. However, where there is uncertainty

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[2]Section 3.2.2 provides descriptions of the pollution control technologies.

TABLE 1-1. MWC II/III EG: EMISSION LIMIT REQUIREMENTS FOR THE REGULATION THAT EPA IS PROPOSING

	Size Classification (Mg MSW/day)[c]	
Emission Limits[a]	Small (35 to 225)	Large (Over 225)
CO	50-250 ppmv (varies by technology)	50-250 ppmv (varies by technology)
CDD/CDF (Total)	60 ng/dscm[b]	30 ng/dscm[b]
PM	69 mg/dscm	27 mg/dscm
HCl	300 ppmv	35 ppmv
SO_2	80 ppmv	35 ppmv
Pb	1.6 mg/dscm	0.50 mg/dscm
Cd	0.10 mg/dscm	0.04 mg/dscm
Hg	0.10 mg/dscm or 80 percent reduction	0.10 mg/dscm or 80 percent reduction
NO_x	no control	180 ppmv (except REF MWCs)

[a]Emission levels are corrected to 7 percent O_2.

[b]CDD/CDF limits are expressed as total CDD/CDF. On a toxic equivalency (TEQ) basis, 60 ng/dscm (total) ≈ 1.0 ng/dscm (TEQ), and 30 ng/dscm (total) ≈ 0.5 ng/dscm (TEQ).

[c]The control technology bases for large and small plants are provided in Table 1-2.

Note:

1. Definitions are provided on p. x.

regarding the actual emission limit that an existing control technology can be upgraded to, owners may choose a more conservative (or potentially more costly) retrofit strategy to reduce the risk of noncompliance. This is particularly true where the investment decision affects the facility's ability to remain in operation (e.g., noncompliance results in plant shutdown), is a long-term decision, or involves a significant capital outlay. Consequently, this analysis evaluates two compliance scenarios for acid gas controls for existing plants subject to EG.

Table 1-2 describes the control technology bases evaluated under each of the two compliance scenarios included in this analysis. The scenarios illustrate two possible acid gas control compliance strategies MWC owners or operators may take in response to the emission requirements. Note that the compliance strategies are identical under both scenarios for small plants. Consequently, the estimated impacts are identical under both scenarios. However, the compliance strategies modeled for larger plants differ under Scenarios A and B. Thus, the impacts estimated for larger plants differ under the two scenarios.

The compliance scenarios are differentiated based on the projected responses modeled for MWCs with (1) essentially no air pollution control equipment in the baseline, (2) only a minimal level of control equipment in the baseline (ESP), and (3) relatively advanced pollution control equipment in the baseline (SD/ESP or SD/FF).[3] Scenario A assumes that owners whose plants are only minimally equipped with air pollution control equipment in the baseline will attempt to meet the acid gas limitations by adding to and enhancing their existing equipment and by improving their operating practices. Scenario B assumes that these same owners will attempt to meet the acid gas limitations by replacing some of their existing

[3]The control technologies are described in Section 3.

TABLE 1-2. MWC II/III EG: CONTROL TECHNOLOGY BASES FOR THE REGULATION THAT EPA IS PROPOSING[a]

Compliance Scenario and Baseline APCD	Size Classification (Mg MSW/day)	
	Small (35 to 225)	Large (Over 225)
Scenario A		
No Control	GCP+DSI/FF+CI	GCP+SD/FF+CI+SNCR
Minimal Control (ESP)	GCP+DSI/ESP+CI	GCP+SD/ESP(m)+CI+SNCR
Advanced Control (SD/ESP)	GCP+SD/ESP+CI	GCP+SD/ESP(m)+CI+SNCR
Advanced Control (SD/FF)	GCP+SD/FF+CI	GCP+SD/FF+CI+SNCR
Scenario B		
No Control	Same as Scenario A	Same as Scenario A
Minimal Control (ESP)	Same as Scenario A	GCP+SD/FF+CI+SNCR
Advanced Control (SD/ESP)	Same as Scenario A	Same as Scenario A
Advanced Control (SD/FF)	Same as Scenario A	Same as Scenario A

[a]The control technologies are described in Section 3 and definitions are provided on p. x.

equipment with more advanced technology. Under both scenarios, EPA assumes that owners whose plants have advanced acid gas control equipment in the baseline will meet the acid gas limitations without replacing their existing control equipment. However, these owners may have to adjust their operating practices to achieve the acid gas limits. Likewise, under both scenarios, we assume that owners of MWCs that have essentially no air pollution control equipment will respond to the acid gas requirements by installing the most effective equipment available and by improving their operating practices.

Table 1-3 contains the emission limits for the NSPS regulatory alternative that EPA is proposing for new MWCs constructed after the NSPS is proposed (Regulatory Alternative II). The scenario analysis used for the EG is not used to

TABLE 1-3. MWC II/III NSPS: EMISSION LIMIT REQUIREMENTS FOR THE REGULATION THAT EPA IS PROPOSING

	Size Classification (Mg MSW/day)[c]	
Emission Limits[a]	Small (35 to 225)	Large (Over 225)
CO	50-100 ppmv (varies by technology)	50-100 ppmv (varies by technology)
CDD/CDF (Total)	10 ng/dscm[b]	10 ng/dscm[b]
PM	15 mg/dscm	15 mg/dscm
HCl	25 ppmv	25 ppmv
SO_2	26 ppmv	26 ppmv
Pb	0.12 mg/dscm	0.12 mg/dscm
Cd	0.01 mg/dscm	0.01 mg/dscm
Hg	0.10 mg/dscm or 80 percent reduction	0.10 mg/dscm or 80 percent reduction
NO_x	no control	167 ppmv

[a]Emission levels are corrected to 7 percent O_2.

[b]CDD/CDF limits are expressed as total CDD/CDF. On a toxic equivalency (TEQ) basis, 10 ng/dscm (total) ≈ 0.2 ng/dscm (TEQ).

[c]The control technology basis for small plants is GCP+SD/FF+CI and for large plants is GCP+SD/FF+CI+SNCR.

Note:

1. Definitions are provided on p. x.

evaluate impacts for plants subject to the NSPS. Much of the variation in compliance costs for the EG is due to the variable baseline for existing plants--some plants have essentially no baseline control equipment whereas others have advanced pollution control systems in place. The scenario analysis for EG projects responses to the emission limitations that are differentiated based on the level of baseline control. For the NSPS analysis, EPA defines the baseline for new plants based on the 40 CFR Subparts E and Db prior to 1991. Because the baseline for new plants is not variable, a scenario analysis similar to that used for the EG is not relevant for the NSPS.

1.2 ANALYTICAL APPROACH

In this analysis a model plant approach is used to analyze the impacts of the EG and NSPS. Sixteen EG model plant categories and 11 NSPS model plant categories represent the design characteristics of actual existing and planned facilities. These model plants are further subcategorized by size classification and baseline control technology. Weights or scaling factors are computed for each subcategory based on the waste flow of plants assigned to the subcategory. These scaling factors are used to scale the plant-level impacts to national levels.

The choices facing suppliers of MWC services are characterized as either substitution choices or compliance choices. Substitution choices refer to the operating and investment decisions that affect the amount of MSW combusted at existing or planned MWCs. This analysis assumes that the amount of MSW combusted at MWCs, and the mix of combustion technology, will not change in response to the regulation. Compliance choices refer to the decisions regarding the type of control technology selected to comply with the MWC II/III emission standards. Impacts are evaluated based on the assumption that MWC owners and operators will choose the minimum-cost control technology that will meet the emission reduction requirements, subject to some uncertainties regarding the level of control that will actually be achieved by a particular control technology.

In this analysis the increased cost of combustion due to the regulation is estimated for each affected MWC and at the national level. The estimated costs incurred by each affected MWC are called enterprise costs in this analysis. Enterprise costs are computed for publicly owned and privately owned MWCs.[4] The differences in the costs for these two types of ownership reflect differences in assumptions regarding discount rates, as well as the treatment of taxes.

The national-level impacts of the EG and NSPS computed for this analysis include annual social costs, emission reductions, and energy impacts. National social costs refer to the regulatory costs for the nation as a whole and are computed based on a discount rate reflecting society's real opportunity cost of capital. National social costs and emission reductions are used to compute the cost/effectiveness (C/E) of the regulation.

Affordability issues are addressed in a distributional analysis of impacts on governments, businesses, and households affected by the EG and NSPS. Of particular concern are the impacts on small entities affected by the regulation. The Regulatory Flexibility Act (RFA) requires that Federal agencies consider whether regulations they develop will have a significant adverse economic impact on a substantial number of small entities. If more than 20 percent of all small potentially affected entities are likely to incur such an impact, then a regulatory flexibility analysis is required. In the case of the MWC II/III regulations, a regulatory

[4]MWCs owned by government entities are referred to as "publicly owned" MWCs throughout this report. MWCs owned by non-governmental entities are referred to as "privately owned" MWCs throughout this report, regardless of whether the firm is publicly or privately held.

flexibility analysis is not required because the share of small entities likely to incur any economic impacts is less than 20 percent. Even though regulatory flexibility analysis is not required, EPA believes analyzing the impacts of the regulation on affected entities, and on small affected entities in particular, is appropriate.

Distributional impacts are computed using demographic and financial data collected for individual communities and firms identified for this analysis. To evaluate the impacts on publicly owned MWCs, EPA projects the share of government entities with potential difficulty issuing bonds to finance the costs of the regulation. Impacts on firms are measured as a percentage of total annual sales and as projected tipping fee increases at the facility. Household impacts are measured in absolute terms (cost per household per year) and as a percentage of average household income.

Finally, a partial analysis of the benefits of reducing particulate matter (PM) and sulfur dioxide (SO_2) is provided. Specifically, the EIA provides a partial analysis of benefits from reductions in morbidity and mortality. The absence of sufficient exposure-response and valuation information for many of the MWC pollutants precludes a comprehensive benefits analysis.

1.3 SUMMARY OF RESULTS

Tables 1-4 and 1-5 show the estimated costs per megagram of MSW combusted and corresponding tipping fee increases for MWCs under the EG and NSPS that EPA is proposing. These costs are incremental to the pre-MWC I (1991) baseline and include the costs for controlling all pollutants including nitrogen oxides (NO_x) and mercury (Hg). The tipping fee increases are computed based on an average tipping fee of $57/Mg (1990$) (Berenyi and Gould, 1993). Average costs for most publicly owned plants range from about $20 to $34/Mg of MSW combusted for the EG and from $11 to $33/Mg of MSW combusted for the

TABLE 1-4. MWC II/III EG: ENTERPRISE COSTS AND TIPPING FEE INCREASES FOR PUBLICLY AND PRIVATELY OWNED MWCs UNDER THE REGULATION THAT EPA IS PROPOSING[a,b]

	Size Classification (Mg MSW/day)			
	Small (35 to 225)		Large (over 225)	
Type of Ownership and Compliance Scenario	Average Annual Cost ($1990/ Mg MSW)[c]	Tipping Fee Increase (percent)[d]	Average Annual Cost ($1990/ Mg MSW)[c]	Tipping Fee Increase (percent)[d]
Public Entities				
Scenario A	33.65	59	20.24	36
Scenario B	33.65	59	20.25	36
Private Entities				
Scenario A	37.04	65	23.37	41
Scenario B	37.04	65	23.88	42

[a]Costs are computed using the control technology bases reported in Table 1-2.

[b]Costs are annual operating costs plus capital costs, annualized at 4 percent for public MWCs and 8 percent for private MWCs. Annual operating costs include testing, reporting, and recordkeeping costs, some of which are also annualized.

[c]Cost per megagram of MSW is computed by dividing total annual cost of the regulation by the total amount of MSW processed per year at large plants that do not have SD/ESP or SD/FF systems and small plants that do not have DSI/ESP, SD/ESP, or SD/FF systems in the baseline.

[d]Tipping fee increases assume a full cost pass through and are based on an average tipping fee of $57/Mg ($1990).

Notes:

1. MWC capacity utilization is assumed to average 83 to 88 percent for most plants.

2. Definitions are provided on p. x.

TABLE 1-5. MWC II/III NSPS: ENTERPRISE COSTS AND TIPPING FEE INCREASES FOR PUBLICLY AND PRIVATELY OWNED MWCs UNDER THE REGULATION THAT EPA IS PROPOSING[a,b]

	Size Classification (Mg MSW/day)			
	Small (35 to 225)		Large (over 225)	
Type of Ownership	Average Annual Cost ($1990/ Mg MSW)[c]	Tipping Fee Increase (percent)[d]	Average Annual Cost ($1990/ Mg MSW)[c]	Tipping Fee Increase (percent)[d]
Public Entities	33.34	58	11.49	20
Private Entities	38.26	67	12.98	23

[a]Costs are computed using the following control technology bases: GCP+SD/FF+CI for small plants and GCP+SD/FF+CI+SNCR for large plants.

[b]Costs are annual operating costs plus capital costs, annualized at 4 percent for public MWCs and 8 percent for private MWCs. Annual operating costs include testing, reporting, and recordkeeping costs, some of which are also annualized.

[c]Cost per megagram of MSW is computed by dividing total annual cost of the regulation by the total amount of MSW processed per year at all plants affected by the regulation.

[d]Tipping fee increases assume a full cost pass through and are based on an average tipping fee of $57/Mg ($1990).

Notes:

1. MWC capacity utilization is assumed to average 83 to 88 percent for most plants.

2. Definitions are provided on p. x.

NSPS. Average costs for most privately owned plants are slightly higher due to differences in the discount rate and treatment of taxes.

Tables 1-6 and 1-7 show the national annual social costs, the average cost per megagram of MSW combusted, and C/E (relative to the baseline) for the EG and NSPS that EPA is proposing. Costs are projected in this analysis for the year 2000. Costs for existing plants range from a total of $443 million per year under Scenario A to $448 million per year under Scenario B. Costs for new plants total approximately $201 million per year.

TABLE 1-6. MWC II/III EG: NATIONAL SOCIAL COSTS AND COST/EFFECTIVENESS OF THE REGULATION THAT EPA IS PROPOSING ($1990)[a]

Compliance Scenario and Control Cost Category	Annual Social Costs[b] ($10³/yr)	Annual Social Costs[b] ($/Mg MSW)[c]	Social Cost/Effectiveness ($10³/Mg Emissions Reduction)
Scenario A			
Acid Gas/PM/ Metals Control	355,000	21.10	3.02[e]
Hg Control	17,800	0.72	374[f]
NO_x Control	56,300	2.05	2.93[f]
Testing, Reporting, Recordkeeping	13,500	0.41	-
Total	443,000	-[d]	-
Scenario B			
Acid Gas/PM/ Metals Control	366,000	21.70	3.12[e]
Hg Control	13,000	0.53	273[f]
NO_x Control	56,300	2.05	2.93[f]
Testing, Reporting, Recordkeeping	13,500	0.41	-
Total	448,000	-[d]	-

[a]Costs are computed using the control technology bases reported in Table 1-2.

[b]Annual social costs are the sum of capital costs, annualized at 7 percent, and annual operating costs. Annual operating costs include testing, reporting, and recordkeeping costs, some of which are also annualized.

[c]Cost per megagram of MSW is computed by dividing total annual cost of the regulation by the total amount of MSW processed per year at large plants that do not have SD/ESP or SD/FF systems and small plants that do not have DSI/ESP, SD/ESP, or SD/FF systems in the baseline.

[d]The total cost per megagram of MSW is not shown because NO_x control costs are not incurred at the same set of MWC plants that incur costs for controlling other pollutants.

[e]Social cost/effectiveness of acid gas control is [Annual social cost of acid gas control-($17,700 * PM reductions)]/(annual SO_2 + HCl reductions).

[f]Social cost/effectiveness of Hg or NO_x control is (Annual social cost of Hg or NO_x control)/(annual Hg or NO_x reductions).

Notes:

1. MWC capacity utilization is assumed to average 83 to 88 percent for most plants.
2. Definitions are provided on p. x.

TABLE 1-7. MWC II/III NSPS: NATIONAL SOCIAL COSTS AND COST/EFFECTIVENESS OF THE REGULATION THAT EPA IS PROPOSING ($1990)[a]

Control Cost Category	Annual Social Costs[b] ($10^3/yr)	($/Mg MSW)[c]	Social Cost/Effectiveness ($10^3/Mg Emissions Reduction)
Acid Gas/PM/Metals Control	166,000	11.10	0.59[e]
Hg Control	4,500	0.40	167[f]
NO_x Control	25,400	1.80	2.42[f]
Testing, Reporting, Recordkeeping	5,290	0.35	-
Total	201,000	-[d]	-

[a]Costs are computed using GCP+SD/FF+CI as the control technology basis for small plants and GCP+SD/FF+CI+SNCR as the control technology basis for large plants.

[b]Annual social costs are the sum of capital costs, annualized at 7 percent, and annual operating costs. Annual operating costs include testing, reporting, and recordkeeping costs, some of which are also annualized.

[c]Cost per megagram of MSW is computed by dividing total annual cost of the regulation by the total amount of MSW processed per year at all plants affected by the regulation.

[d]The total cost per megagram of MSW is not shown because NO_x control costs are not incurred at small MWC plants, which incur costs for controlling other pollutants.

[e]Social cost/effectiveness of acid gas control is [Annual social cost of acid gas control-($17,700 * PM reductions)]/(annual SO_2 + HCl reductions).

[f]Social cost/effectiveness of Hg or NO_x control is (Annual social cost of Hg or NO_x control)/(annual Hg or NO_x reductions).

Notes:

1. MWC capacity utilization is assumed to average 83 to 88 percent for most plants.

2. Definitions are provided on p. x.

EPA identified 100 potentially affected government entities that own an MWC subject to the EG and another 15 government entities planning to build an MWC that would be subject to the NSPS. The analysis of government impacts indicates that none of the government entities above 50,000 in population are projected to have difficulty issuing revenue bonds as a result of the EG. However, approximately 3 to 5 percent of small affected government entities below 50,000 population are projected to have potentially difficulty issuing revenue bonds under the regulation that EPA is proposing for existing MWCs. None of the government entities potentially affected by the NSPS is projected to experience difficulty issuing revenue bonds.

The EPA identified 39 firms that own one or more MWCs subject to the EG and 5 firms planning to build one or more MWCs subject to the NSPS. Of these, 22 are small firms that own one or more existing MWCs and 4 are small firms planning to build one or more MWCs.[5] Detailed financial data are published for only 17 of the large firms and none of the small firms with MWCs projected to incur costs due to the EG. Total annual costs of the regulation as a percentage of annual sales average less than 1 percent for each of these 17 firms. Detailed financial data are available for only one of the large firms and none of the small firms with MWCs subject to the NSPS. Total costs of the regulation amount to less than one percent of sales for this firm.

Tipping fee increases are also computed for small and large MWCs owned by private entities. As explained in Chapter 7, tipping fee increases at existing MWCs owned by small firms average 18 percent under both Scenario A and Scenario B. The corresponding tipping fee increases at existing MWCs owned by large firms average 14 percent. Under the NSPS, tipping fee increases average 28 percent for small firms and 17 percent for large firms.

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[5]Firms for which financial data were unavailable are assumed to be small (under $6 million in annual sales).

Tables 1-8 and 1-9 report household impacts under the EG and NSPS alternatives that EPA is proposing. Average annual costs per household range from $22 to $30 per household per year for communities affected by the EG and from about $17 to $29 per household per year for communities affected by the NSPS. This amounts to less than one percent of average household income for these communities.

Partial benefits for reduction of PM and SO_2--primarily benefits from reductions in morbidity and mortality--are expected to total about $106 million under the EG and about $160 million under the NSPS annually.

The impacts summarized in this chapter are described in greater detail in the balance of this report. Chapter 2 provides the regulatory background and identifies the basis for Federal regulatory action to control air emissions from MWCs. Chapter 3 contains a description of the demand and supply conditions in the market for waste combustion services. An overview of potential regulatory approaches -- including market-based approaches, design standards, and emission standards -- that can be used to address the air pollution problem is contained in Chapter 4. Chapter 4 also describes the candidate regulatory alternatives examined for this analysis. Chapter 5 describes the methods and assumptions used to compute the economic impacts of each candidate regulatory alternative. The national-level impacts and the enterprise-cost impacts are reported in Chapter 5. Chapter 6 presents a sensitivity analysis to measure the effects of changing certain assumptions used to compute the impacts presented in Chapter 5. The distributional impacts on affected households, government entities, and firms are presented in Chapter 7. Finally, Chapter 8 reports partial benefits quantified for this analysis.

TABLE 1-8. MWC II/III EG: AVERAGE ANNUAL HOUSEHOLD IMPACTS UNDER THE REGULATION THAT EPA IS PROPOSING

Compliance Scenario and Impact Measure	Community Size (Population 10^3) 0 to 50	50 to 100	100 to 250	Over 250
Number of Observations	68	22	37	48
Scenario A				
Cost per Household ($1990/Household/yr)[a]	22	29	24	26
Cost per Household as a Percentage of Household Income (percent)[b]	0.06	0.09	0.07	0.07
Scenario B				
Cost Per Household ($1990/Household)[a]	22	30	24	26
Cost Per Household as a Percentage of Household Income (percent)[b]	0.06	0.09	0.07	0.07

[a]Cost per household is computed by dividing the total annual compliance cost for the MWC by the estimated number of households in the service area. Total annual cost is the sum of capital costs annualized over 20 years (computed using 8 percent for privately owned facilities and 4 percent for publicly owned facilities) and annual operating costs. Annual operating costs include testing, reporting, and recordkeeping costs, some of which are also annualized.

[b]Cost per household as a percentage of household income is computed using the per-capita income and number of persons per household reported in County and City Data Book.

Notes:

1. Where ownership data are unavailable, it is assumed that the facility is publicly owned.

2. For privately owned facilities and facilities for which the type of ownership is not identified, community size is based on the population of the entity identified as the location. For publicly owned facilities, community size is based on the population of the entity that owns the MWC.

3. The number of observations indicates the number of entities for which relevant demographic data are available.

Sources: U.S. Department of Commerce. 1988. County and City Data Book 1988; U.S. Environmental Protection Agency. 1992. Characterization of Municipal Solid Waste in the United States: 1992 Update. Office of Solid Waste and Emergency Response (OS-305). EPA/530-R-92-019; U.S. Department of Commerce. 1991. 1991 Statistical Abstract of the United States.

TABLE 1-9. MWC II/III NSPS: AVERAGE ANNUAL HOUSEHOLD IMPACTS UNDER THE REGULATION THAT EPA IS PROPOSING

	Community Size (Population 10^3)			
Impact Measure	0 to 50	50 to 100	100 to 250	Over 250
Number of Observations	6	4	1	9
Cost per Household ($1990/Household/yr)[a]	27	29	23	17
Cost Per Household as a Percentage of Household Income (percent)[b]	0.07	0.09	0.06	0.04

[a]Cost per household is computed by dividing the total annual compliance cost for the MWC by the estimated number of households in the service area. Total annual cost is the sum of capital costs annualized over 30 years (computed using 8 percent for privately owned facilities and 4 percent for publicly owned facilities) and annual operating costs. Annual operating costs include testing, reporting, and recordkeeping costs, some of which are also annualized.

[b]Cost per household as a percentage of household income is computed using the per-capita income and number of persons per household reported in County and City Data Book.

Notes:

1. Where ownership data are unavailable, it is assumed that the facility is publicly owned.
2. For privately owned facilities and facilities for which the type of ownership is not identified, community size is based on the population of the entity identified as the location. For publicly owned facilities, community size is based on the population of the entity that owns the MWC.
3. The number of observations indicates the number of entities for which relevant demographic data are available.

Sources: U.S. Department of Commerce. 1988. County and City Data Book 1988; U.S. Environmental Protection Agency. 1992. Characterization of Municipal Solid Waste in the United States: 1992 Update. Office of Solid Waste and Emergency Response (OS-305). EPA/530-R-92-019; U.S. Department of Commerce. 1991. 1991 Statistical Abstract of the United States.

CHAPTER 2
REGULATORY BACKGROUND

To reduce the quantity of MSW that must be landfilled and, frequently, to generate energy, many municipalities in the U.S. burn solid waste in MWCs. Combustion of MSW reduces the volume of this waste by 70 to 90 percent. This reduction translates into substantial extensions of the lifetimes of existing and future landfills. Combustion also destroys harmful pathogens present in solid waste and reduces the odors associated with the decay of uncombusted solid waste. The EPA projects an estimated 32.82 million Mg of MSW will be combusted by 1996 in existing MWC plants subject to the EG. The additional MSW combusted in new MWC plants subject to the NSPS is projected to be 14.95 million Mg in 2000.

Unfortunately, this combustion of MSW generates unwanted by-products including criteria pollutants and other organics, metals, and acid gases that are usually discharged to the atmosphere. Elevated exposures of people, plants, animals, structures, and materials to these pollutants reduce health and welfare. In accordance with Sections 111 and 129 of the CAA, EPA is developing EG and NSPS for existing and new MWCs, respectively. The EG and NSPS will improve health and welfare as well as help establish MSW combustion as a viable disposal option for improving environmental quality.

This EIA presents an analysis of the potential economic impacts of the proposed EG and NSPS as well as additional alternatives. This chapter also provides an overview of the needs for Federal regulatory action, alternatives to Federal intervention, and the regulatory background.[1]

2.1 EXECUTIVE ORDER 12866

Under E.O. 12866, EPA must submit to OMB for review regulations that will be "significant." There are several criteria for judging whether a regulation will be significant. The fact that the EG will have an annual effect on the economy exceeding $100 million (beyond the effect of MWC I) triggers one of the criteria, and for that reason EPA classifies the EG as significant. Technically, the NSPS may not qualify as significant. (The annual effect on the economy, incremental to MWC I, will be less than $100 million.) However, for the purposes of this EIA, EPA is analyzing the EG and NSPS together, and therefore is considering both to be significant within the meaning of E.O. 12866.

The Executive Order directs EPA to, among other duties, describe the need for regulation and the alternatives to regulation. In addition, EPA must address the benefits as well as the costs of regulation.

2.2 THE NEED FOR REGULATORY ACTION

Regulation is needed wherever there is a market failure that cannot be resolved be measures other than Federal regulation. Economic theory identifies three sources of market failure:

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[1]For additional information on the regulations, their background, and the general decision making process leading to the EG and NSPS, the reader should see the preamble to the proposed EG and NSPS. The preambles will appear in the Federal Register at the time their regulations are proposed.

- externalities,
- natural monopolies, or
- inadequate information.

The first category of market failure, environmental externality, is the theoretical basis for using government intervention to address the air pollution problem. An externality occurs when one party's actions impose uncompensated benefits or costs on another party outside the marketplace. Air pollution is a classic example of a "negative externality": costs are imposed on uncompensated parties. Indeed, the British economist Pigou (1920), who was the first to identify the market failure created by externalities, used air pollution as an example of such a negative externality. Pigou observed that industrialists had no incentive to install "smoke-preventing appliances" because of the difference between the social costs and the private costs of these devices--they benefit the community but not the industrialist or his customers. Industrialists understandably acted then (and act now) to promote their own welfare and indirectly that of their customers, by producing products, presumably employing minimum-cost combinations of resources, and discarding wastes in the cheapest manner. From the industrialists' viewpoint, the cheapest manner was to discharge them to the environment. The result, according to Pigou (1920), was "a heavy uncharged loss on the community in injury to buildings and vegetables, expenses for washing clothes and cleaning rooms, expenses for the provision of extra artificial light, and in many other ways."

Table 2-1 lists the categories of pollutants emitted from MWCs. Organics include dioxins and furans, labeled CDD/CDF in this report, and other products of incomplete combustion. The metals emitted are mostly trace metals, such as lead (Pb), cadmium (Cd), and mercury (Hg). Acid gases emitted include sulfur dioxide (SO_2), hydrogen chloride (HCl), and, to a

TABLE 2-1. POLLUTANTS EMITTED BY MWCs

Category	Pollutant
Organics	Dioxins and furans[a], which include 2,3,7,8-tetrachlorodibenzo-*p*-dioxin, 2,3,7,8-tetrachlorodibenzofuran, and other tetra through octa chlorodibenzo-*p*-dioxins and chlorodibenzofurans; benzene; chlorinated benzenes; chlorinated phenols; polychlorinated aromatic hydrocarbons (including benzo-a-pyrene)
Metals	Arsenic (As), beryllium (Be), cadmium (Cd), chromium (Cr), copper, lead (Pb)[b], mercury, nickel
Acid Gases	Sulfur dioxide (SO_2)[b], hydrogen chloride (HCR), hydrogen fluoride (HF)
Criteria Pollutants[c]	Particulate matter (PM), carbon monoxide (CO), nitrogen oxides (NO_x), sulfur dioxide (SO_2), lead (Pb)

[a]The family of dioxins and furans is also referred to as CDD/CDFs, which are products of incomplete combustion.

[b]SO_2 and Pb are also criteria pollutants.

[c]Criteria pollutants are those for which National Ambient Air Quality Standards (NAAQS) exist.

lesser extent, hydrogen fluoride (HF). Nitrogen oxides (NO_x) (which are also acid gases), particulate matter (PM), and carbon monoxide (CO) are criteria pollutants (as well as SO_2 and Pb) released by MWCs. Carbon dioxide (CO_2) is emitted, but is not addressed in this report.

As shown in Chapter 8, exposure to these pollutants is known to induce human mortality and morbidity. Exposures to organics can cause cancer; to metals, brain damage, hypertension, central nervous system injury, and renal dysfunction; exposure to acid gases can cause respiratory tract problems and cardiovascular, nervous, and pulmonary systems effects; and exposure to PM can cause eye and throat irritation, bronchitis, and lung damage. Soiling and materials damage, reduced visibility, and greenhouse gas formation are also associated with MWC pollutants.

Private market systems fail to make the generators of air pollution consider these adverse effects in their production decisions or to compensate damaged parties. Because the adverse effects of the pollutants are nonmarket goods--that is, goods that are not explicitly and routinely traded in organized free markets--damaged parties cannot collected compensation.

2.3 ALTERNATIVES TO FEDERAL REGULATION

The existence of market failure does not in and of itself demonstrate the need for regulatory intervention at the Federal level. Other measures may adequately resolve the market failure and should be considered before Federal regulatory action is taken. Alternatives to Federal intervention considered in this analysis include market solutions, State or local regulation, and judicial recourse.

2.3.1 Market Solutions

Coase (1960) argued that, regardless of the distribution of property rights, under some situations private negotiations will "internalize" an externality. In our context, parties damaged by MWC emissions could pay those generators to reduce their discharges to the atmosphere. Alternatively, if property rights to the atmosphere are vested in the damaged parties, they could demand payment from generators for the damages they suffer.

Such markets have not arisen in the case of MWCs for a number of reasons. First, individuals damaged by MWC pollutants may not realize that they are exposed and damaged. For example, a person could suffer a health or welfare effect of elevated atmospheric concentrations of a pollutant and not realize that the source of the effect is exposure to a pollutant or that the source of the pollutant is a specific MWC. No monitoring system is in place that measures the exposure of particular receptors. Such a monitoring system would be expensive, contributing to high "transactions costs" of voluntary exchange, thus undermining the possibility of market development.

Second, emission reductions for one are emission reductions for all. Therefore, even if the damaged parties realized the extent and source of their damage, they would have difficulty organizing to provide the proper amount of payment to emission generators to get them to reduce emissions, given the damaged parties' incentive to "free ride" (i.e., to let others who are damaged pay for emission reductions).

This discussion has explicitly assumed that polluters are vested with ownership of environmental resources although such "ownership" runs contrary to both popular sentiment and most legislative mandates and judicial interpretation. However, similar impediments to private negotiation are present if ownership is explicitly vested in individuals damaged by exposure.

2.3.2 State and Local Regulation

The CAA requires each State to develop and implement measures to attain and maintain EPA's NAAQS. Each State assembles these measures in a document called the State Implementation Plan (SIP). The EPA, which is empowered to compel revision of plans it believes are inadequate, approves SIPs and may assume enforcement authority over air pollution control programs that any State fails to implement. EG and NSPS become part of each State's SIP and enforcement authority is delegated to the States. If EPA were not to promulgate EG or NSPS for MWCs, States could still regulate MWCs in their SIPs. In the past, some CAA regulations that EPA has prepared but not promulgated have subsequently been adopted by some States but usually only for enforcement in nonattainment areas. (Nonattainment areas are regions, designated by EPA, where air quality is below EPA's air quality standards.)

State or local regulation alone is not an attractive solution to the failure of the market to address the externalities caused by MWC emissions discussed above. First, and most importantly, air emissions from MWCs generate damages outside of local or even State jurisdictions. The State or local regulatory approach may, therefore, merely result in the shifting of damages rather than inducing appropriate emission reductions. For example, higher MWC stack heights would reduce damages to local citizens but increase exposure and damages elsewhere.

Second, local "NIMBY" (not in my backyard) politics has forced some State and local governments, on their own initiative, to control MWC emissions, but such efforts have been inconsistent. More often than not, NIMBY politics has forced State and local governments into inaction on MWC siting applications. This attitude can lead to inappropriately <u>low</u> MWC emissions in the sense that social resources, including environmental resources, may be wasted as solid waste is disposed of by other means.

The EPA believes that relying on State and local action alone is not a viable substitute for Federal regulatory action. This belief holds even if EPA were to step up research and technology transfer programs to assist State and local governments. For reasons explained above, Federal action is likely to be a more consistent, efficient, and complete societal response to the problem of MWC emissions. In addition, State and local officials frequently find that EPA regulations give them additional authority in the regulated community.

2.3.3 Judicial Recourse

Citizens may sue State and local governments to force them to control MWC emissions. Litigation under both CAA and RCRA is possible. However, such an approach is piecemeal because it relies on independent action by citizens, public interest groups, States, and local governments. More importantly, litigation is expensive and risky in comparison to regulation.

For a conventional civil damages suit to be successful, the plaintiffs must prove that they have been damaged by MWC emissions. Proving this is very difficult because similar pollutants are emitted by other sources; hence, similar damages can arise from these sources. Identifying MWC emissions, or a particular MWC, as the source of damage is problematic. Furthermore, the court may insist that the damage actually had to occur (i.e., prospective damages may not be an acceptable basis for a suit).

Even assuming that the court does allow prospective damages or the MWC's contribution to damage to be the basis for a suit, identifying the MWC's contribution to damage and valuation of prospective and partial contributions is difficult and controversial. The need to determine the likelihood of the damage event in the absence of the MWC and the possibilities for and costs of averting action, as well as the monetization of the damage itself, places a great burden on the plaintiff and creates great uncertainty regarding the outcome of the case. Under these circumstances, citizens or agencies probably would not press a suit against an MWC; hence the threat of such suits probably would not result in appropriate reductions in MWC emissions.

2.4 REGULATORY BACKGROUND

On December 20, 1989, EPA proposed NSPS for new MWCs and EG for existing MWCs. Eleven months later the 1990 CAA Amendments were signed into law. These amendments add Section 129, a new section addressing emission limits for MWCs. Section 129 indicates that EPA should promulgate the standards and guidelines already in the pipeline under Section 111, but that those standards and guidelines subsequently should be revised and expanded to bring them into conformance with the new requirements of Section 129. EPA therefore promulgated the standards and guidelines on February 11, 1991. They are referred to as MWC I in this analysis.

Section 129 requires EPA to regulate MWCs based on the maximum achievable control technology (MACT). MACT is the maximum degree of reduction in emissions, taking into consideration the cost of achieving such emission reduction, and any non-air quality health and environmental impacts and not energy requirements. Emission standards and guidelines can not be less stringent than what EPA calls the MACT "floor." Specifically, for new MWCs, the standards must be at least as stringent as the emissions control achieved in practice by the best controlled similar MWC. For existing MWCs, the guidelines can be less stringent than standards for new MWCs in the same category, but must not be less stringent than the average emissions limitation achieved by the best performing 12 percent of MWCs in the same category.

Section 129 further directs EPA to propose revised NSPS and EG for MWCs with aggregate plant capacity above 225 Mg/day. These requirements--referred to as MWC II in this analysis--cover additional pollutants, include siting requirements, and are to be based on the MACT. The third phase of requirements described in Section 129 expands the requirements to include MWCs with smaller design capacity. These expanded requirements are referred to as MWC III in this analysis. The MWC II and MWC III requirements are the focus of this EIA and are referred to collectively as MWC II/III throughout this report. The EPA also plans to regulate other types of waste incinerators. However, requirements for these other waste incinerators facilities are not addressed in this EIA.

In this section, a brief review of the MWC I requirements for new and existing MWCs is first presented as background for analyzing the emission limits proposed under MWC II/III. These MWC I requirements have been implemented for new MWCs but not for existing MWCs. Therefore, the impacts of the MWC II/III requirements presented in this report are not incremental to the MWC I requirements, but rather are incremental to the pre-MWC I baseline (December 20, 1989). Thus, the MWC II/III costs and emissions reductions presented in this analysis are not additive to the MWC I costs and emission reductions. An overview of the Section 129 requirements contained in the CAA follows the description of the MWC I requirements. The Section 129 requirements form the basis for the regulatory alternatives proposed under MWC II/III.

2.4.1 MWC I (1991) Emission Guidelines and New Source Performance Standards

MWC I emission limits apply to MWC combustor units with greater than 225 Mg/day capacity. Co-fired combustors burning a fuel feedstream that, in aggregate, comprises 30 percent or less by weight of MSW or RDF are not subject to the MWC I requirements. These combustors are required, however, to submit reports of the amount of MSW and other fuels combusted to document that less than 30 percent MSW is fired on a daily basis.

MWC I emission limits under Section III of the CAA of 1977 are based on the best demonstrated technology (BDT) for MWCs with unit capacity to combust over 225 Mg/day of MSW. The BDT basis is different for new and existing plants. Therefore, MWC I specifies different levels of emission control depending on the MWC's designation as new or existing. Under MWC I, existing plants subject to EG are defined as those MWCs placed under construction on or before December 20, 1989. New plants subject to NSPS are defined as those MWCs placed under construction after that date. Furthermore, BDT for existing plants varies with the size of the plant. Therefore, plant capacity is considered in determining the applicable emission control level for existing plants. New plants subject to the NSPS are not subdivided by plant size.

Table 2-2 presents the MWC I emission requirements and the control technology bases for new and existing MWCs.

2.4.1.1 MWC I EG. MWC I EG require States to develop emission limits for organics, acid gases, and metals. MWC organic emissions are measured as total CDD/CDF, MWC acid gases as SO_2 and HCl emissions, and MWC metals as PM emissions. The MWC I EG also require States to develop emission limits for other pollutants (e.g., CO) not included in these three categories. In addition to requiring States to develop emission limits, the EG include requirements for combustor operating practices, provisions for training and certification of personnel operating the MWC facility, performance testing, monitoring requirements, and reporting and recordkeeping requirements.

Specified emission limits for plants subject to MWC I EG are based on the conclusion that BDT for existing plants is different for MWCs at different plant capacities. MWCs with plant capacities below 1,000 Mg/day are subject to less stringent emission requirements than very large MWCs with capacities greater than 1,000 Mg/day.

Although MWC operators may use any technology to achieve the emission limit to comply with the EG, the impacts of the regulation are estimated here based on specified demonstrated control technologies that achieve the mandated emission requirements for each plant size. For large existing plants, the control technology basis includes good combustion practice (GCP) and dry sorbent injection (DSI) followed by an electrostatic precipitator (ESP). The control technology basis for very large plants includes GCP and a spray dryer (SD) followed by an ESP.[2]

2.4.1.2 MWC I NSPS. New plants must control NO_x emissions in addition to the organics, acid gases, metals, and CO emissions that existing plants must control under MWC I. Again, MWC operators may use any technology that achieves the

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[2]Air pollution control technologies are described in Chapter 3.

TABLE 2-2. MWC I EMISSION REDUCTION REQUIREMENTS FOR PLANTS SUBJECT TO NSPS AND EG[a]

		EG	
	NSPS	Large Plants (225 to 1000 Mg/day)	Very Large Plants (>1000 Mg/day)
Control Technology Basis[b]	GCP SD FF SNCR (NO_x)	GCP DSI ESP	GCP SD ESP
<u>Emission Limits</u>			
CDD/CDF	30 ng/dscm	125 ng/dscm (250 ng/dscm for RDF)	60 ng/dscm
CO	50 to 150 ppmv (Varies by technology)	50 to 250 ppmv (Varies by technology)	50 to 250 ppmv (Varies by technology)
PM	34 mg/dscm	69 mg/dscm	<u>34 mg/dscm</u>
SO_2	80% reduction or 30 ppmv	50% reduction or 30 ppmv	70% reduction or 30 ppmv
HCl	95% reduction or 25 ppmv	50% reduction or 25 ppmv	95% reduction or 25 ppmv
NO_x	180 ppmv	No Guidelines	No Guidelines

[a]Only those MWCs with combustor units designed to combust more than 225 Mg/day are subject to MWC I emission reduction requirements.

[b]The control technologies are described in Section 3.

Note:

1. Conversions and definitions are provided on p. x.

emission limit to comply with the NSPS. However, the impacts of the regulation estimated here are based on specified control technologies demonstrated to achieve NSPS emission requirements. The control technology basis for NSPS plants includes GCP, an SD followed by fabric filter (FF) to achieve additional control of organics as well as metals and acid gases, and the application of selective noncatalytic reduction (SNCR) for NO_x control.

2.4.2 Overview of Section 129

Section 129 of the CAA of 1990 requires EG and NSPS for MWCs to be revised to

> reflect the maximum degree of reduction in emissions of air pollutants listed under Section (a)(4) that [EPA], taking into consideration the cost of achieving such emission reduction, and any non-air quality health and environmental impacts and energy requirements, determines is achievable for new or existing units in each category. (House of Representatives, 1991, p. 126)

Under Section 129, EPA must broaden the control requirements beyond those specified in MWC I. The MWC II/III regulatory alternatives address the additional requirements under Section 129. The following sections describe the categories of emissions and the control technology basis required under Section 129 for new and existing MWCs.

2.4.2.1 Emissions Controlled Under Section 129. Under Section 129, EPA is required to establish emission limits for PM, metals, organics, acid gases, CO, and NO_x. Under MWC II/III, existing plants are required to control the emissions regulated under MWC I (CDD/CDF, SO_2, HCl, PM, CO) plus NO_x, Hg, Pb, Cd, and fly ash/bottom ash fugitive emissions.[3] New plants subject to NSPS under MWC II/III are required to control the emissions regulated under MWC I (CDD/CDF, SO_2,

[3] Fly ash/bottom ash fugitive emission control is not a specific emission requirement of Section 129.

HCl, PM, CO, NO_x) plus Hg, Pb, Cd, and fly ash/bottom ash fugitive emissions. Thus, Section 129 expands the set of regulated pollutants. In addition to controlling for the above-listed pollutants, MWC II/III requires good combustion practices and training and certification of operating personnel, as with MWC I. The performance testing, monitoring, and reporting and recordkeeping requirements are included under MWC II/III, with expanded coverage for the new required pollutants.

2.4.2.2 Control Technology Basis. The control technology basis for establishing NSPS and EG for MWCs under Section 129 is referred to as MACT (maximum achievable control technology). For new MWCs, Section 129 specifies the following: "The degree of reduction in emissions that is deemed achievable for new units in a category shall not be less stringent than the emissions control that is achieved in practice by the best controlled similar unit . . ." (House of Representatives, 1991, p. 126). For each category of MWC, this defines what EPA calls the MACT "floor" for the NSPS.

For existing MWCs, the CAA states that emissions standards for existing units in a category may be no less stringent than, "the average emissions limitation achieved by the best performing 12 percent of units in the category . . ." (House of Representatives, 1991, p. 126). For each category of MWC, this defines what EPA calls the MACT floor for the EG. Control requirements may be more, but not less, stringent than the MACT floors for each category.

Section 129 stipulates that costs may be considered when determining MACT and that the "Administrator may distinguish among classes, types . . . , and sizes of units . . ." (House of Representatives, 1991, p. 126). In other words, technology, plant capacity, age, or other criteria may be used to distinguish existing MWCs for the purpose of developing MACT regulations. Separate emission limits consistent with MACT within each subcategory of existing MWCs could be proposed for each subcategory. Chapter 4 discusses in greater detail the candidate regulatory alternatives considered under MWC II/III.

CHAPTER 3
INDUSTRY PROFILE

Regulating emissions from MWCs will directly affect suppliers of combustion services as well as households, businesses, and institutions located in communities with MWCs. This chapter begins with a discussion of the demand for MSW collection and disposal services. The supply side, discussed next, includes several components: combustion technologies and air pollution control technologies available to MWCs, characteristics of MWCs, and baseline waste flows to MWCs. The chapter concludes by introducing the model plant approach used to assess the various impacts of the MWC II/III regulation.

3.1 DEMAND FOR MWC SERVICES

Because MSW generators require collection and disposal services, they provide most of the demand for MWC services. This demand is a derived demand because the generators generally do not directly purchase MWC services but instead leave the purchase up to the collectors. MSW generators can be partitioned into four broad categories:

- Residential: waste from single- and multiple-family homes.
- Commercial: waste from retail stores, shopping centers, office buildings, restaurants, hotels, airports, wholesalers, auto garages, and other commercial establishments.
- Industrial: waste such as corrugated boxes and other packaging, cafeteria waste, and paper towels from factories or other industrial buildings. Industrial MSW does not include waste from industrial processes, whether hazardous or nonhazardous.

- Other: waste from public works such as street sweepings and tree and brush trimmings, and institutional waste from schools and colleges, hospitals, prisons, and similar public or quasi-public buildings. Infectious and hazardous wastes from these generators are managed separately from MSW.

Households are the primary direct source of MSW, followed by the commercial sector. On average, each U.S. household directly generated 1.16 Mg of solid waste in 1990. This estimate of household waste is based on the average number of persons per household in 1990 (2.63) (U.S. Department of Commerce, 1991), the product of the average annual waste generated per person in 1990 (0.71 Mg), and the estimated share of waste directly generated by households in 1990 (62 percent) (EPA, 1992).

The commercial, industrial, and other sectors each generate smaller portions of MSW than households. Because the industrial sector manages most of its own solid residuals--whether MSW or industrial process wastes--by recycling, reuse, or self disposal, the industry directly contributes only a small share of the MSW flow. Consequently, the analysis of generator behavior in the remainder of this section focuses on households.

Little empirical evidence is available about the factors that affect household waste generation rates. However, without substantial changes in market conditions or policies, increases in economic activity and in the population indicate that MSW generation will increase in the future. Franklin Associates estimates that MSW will increase at an annual rate of approximately 1.2 percent over the 1990-2000 period (EPA, 1992). This growth rate is slightly more than the population growth rate, indicating an increase in expected per-capita waste generation from 0.71 Mg in 1990 to 0.75 Mg in 2000. Regulatory actions may change the conditions under which households make MSW generation and collection choices. Households' responsiveness to these changes is important. A household may be viewed as having a demand for solid waste collection and disposal services just as it has a demand for food and other consumer goods. Household demand for collection and disposal services is a function of household income, the price of waste collection and disposal services, service conditions (e.g., frequency of collection and site of collection, degree of waste separation required, materials accepted), and the cost of self-management (e.g., recycling, incinerating, burying, littering).

Although changes in service conditions and costs of self-management affect the household's demand for MSW collection and disposal services, these factors are not influenced by the MWC regulation. Consequently, for the purposes of analysis, these factors are assumed to remain constant. Household income (after tax) and the price of waste collection disposal, however, may be affected by the regulation.

In most communities today, MSW collection and disposal services are financed by general tax revenues. If increased costs for these services result in increased tax rates, after-tax household income will be reduced. Decreases in the household's income results in decreased consumption spending; however, because of savings, the relationship is not one-for-one. Decreases in consumption include decreases for commodities that generate solid wastes which, in turn, result in a decrease in the demand for MSW disposal services.

Solid waste collection and disposal services are likely a normal good. As income declines, all other arguments in the demand function held constant, the demand for solid waste collection and disposal services declines. Wertz (1976) argues that the income elasticity of demand for collection and disposal services is likely to be positive, but small. Goddard (1975), although noting serious data and methodology problems in a study of demand for waste collection in Chicago, reports an income elasticity of 0.4. A positive income elasticity of demand for waste collection and disposal services indicates that a decrease in household income reduces MSW generation. Because both the income elasticity and the cost of MSW collection and disposal as a share of all taxes are small, however, this effect is unlikely to be significant.

The relationship between quantity demanded and price is an inverse one: increases in the price for MSW collection reduce the quantity demanded of these services. This inverse relationship has been empirically demonstrated for a large variety of commodities; MSW collection and disposal services should not be an exception to these findings. However, demonstrating the responsiveness of MSW collection and disposal services and estimating the numerical relationship are difficult for the following reasons:

- the variety of MSW collection service arrangements,
- the absence of MSW collection pricing on a per-unit-of-service basis, and
- the lack of adequate data on household waste generation rates.

As noted above, most communities today have no price mechanism to provide incentives to households to adjust their use of MSW collection and disposal services because of a change in the cost of these services. When households are not charged, the price of collection and disposal services is zero. In some communities households are charged a flat fee per week or month for a specified service (e.g., solid waste collected from four containers twice weekly). At best, this situation provides a weak link between the fee (or price of service) and the amount of MSW generated because the fee does not vary with the amount of waste generated by any given household.

The MWC II/III regulations will likely result in increased costs of combustion, which may affect household income and/or the price of disposal services. For the reasons cited above, however, it is assumed that generator behavior will not change in response to changes in the costs of combustion services.

3.2 SUPPLY OF MWC SERVICES

MSW combustion is the process of reducing the volume of MSW through incineration. Because combustion reduces waste volume by as much as 70 to 90 percent, this method of waste management has the potential to significantly reduce the need for landfills. Combustion has two principal products, MSW volume reduction and energy generation, along with the residual products of ash and emissions to the ambient air. The inputs are capital services (e.g., combustor unit, land, building, air pollution control devices), operating services (e.g., labor services, maintenance services, fuel for cofiring, utility services), and MSW. The following two sections briefly describe combustion technology and air pollution control technology.

3.2.1 Combustion Technology

MWCs can be classified according to three principal types: mass burn (MB), modular (MOD), and refuse-derived fuel (RDF) combustors. A fourth type, combustors that employ fluidized-bed combustion (FBC), is less common. Variations exist within these categories, and some designs incorporate features of more than one type. Regardless of the technology, each MWC plant site or facility has at least one, and potentially more than one, individual combustor unit.

MB combustors burn waste without any pre-processing other than removal of bulky noncombustible material and items too large to squeeze through the entrance to the combustion chamber. They are large field erected facilities and span a wide size range: individual combustor units range in capacity from 45 to 900 Mg/day. Each site typically has two or three individual units per site, and site or facility capacities range from about 90 to 2,700 Mg/day.

MOD combustors also burn waste without much processing but are usually shop-fabricated units. Components range in capacity from 5 to 110 Mg/day. Typically each facility contains one to four or more individual combustor units, and facility or site capacities typically range from about 15 to 360 Mg/day. Generally, MOD units are dual-chambered combustors. Depending on the design, the volume of combustion air supplied to the primary chamber either is greater than the amount needed for complete combustion (these are called modular excess air MWCs) or less than the amount needed for complete combustion (these are modular starved air MWCs). A secondary combustion chamber is used after the primary chamber to complete the combustion process. Many existing MOD combustors do not have energy recovery, but the majority of planned MOD combustors are expected to incorporate energy recovery.

RDF combustors burn processed and shredded MSW. The degree of processing varies from simple removal of bulky items accompanied by shredding of the remaining waste to removal of most noncombustible material and processing of the residue into fine particles. The sorting and separating typically is accomplished by a process line of shredders, magnets, screens, and air classifiers. The resulting waste stream has a higher energy value and lower ash content than less-processed MSW. Most RDF components range in capacity from 270 to 900 Mg/day. Plants typically have two to four combustors and handle from 550 to 3,600 Mg/day.

The last class of MWCs employs FBC. FBC units have two basic designs: bubbling bed and circulating bed. The former operates with relatively low turbulence to minimize entrapment of solids in the flue gas. The latter operates with relatively high turbulence and employs a cyclone separator to capture and return unburned and inert particles to the bed. By making the waste behave as a liquid or gas, FBC ensures good fuel mixing, good heat transfer, and efficient combustion. At present, however, applying this technology to MWCs is relatively new. Typical component combustor capacities for planned FBC units are 180 to 450 Mg/day, and total facility capacities range from 270 to 900 Mg/day.

3.2.2 Air Pollution Control Technology

Some air pollution control devices (APCDs) control emissions from individual units, while others control emissions from all units on the site. In addition, various types of devices control various types of pollution to a greater or lesser extent.

Good combustion practices (GCP) alter the combustion process to reduce the formation and emissions of MWC organics. Organics can originate in waste feedstreams, combustion reactions, or post-combustion reactions in the flue gas. In broad terms, GCPs include the proper design, construction, operation, and maintenance of an MWC. Specific practices include operator training and certification, CO emissions monitoring, operating load monitoring and control, and APCD inlet temperature control.

MWCs use a variety of control technologies to reduce PM emissions including electrostatic precipitators (ESPs), fabric filters (FFs), electrostatic gravel bed filters, cyclones, and venturi scrubbers. Of these, ESPs and FFs are the most commonly used technologies. When properly designed and operated, ESPs and FFs are capable of achieving high levels of PM control. Data on the control efficiency of the other PM control devices are limited or unavailable. Consequently, the analysis of PM control options is limited to ESPs and FFs.

Spray dryers (SDs) or dry sorbent injection (DSI) systems are generally used to remove acid gases from MWC emissions. Combining a PM control device with an acid gas control device has the potential to significantly reduce the amount of acid gases, CDD/CDF, and metals emitted by MWCs. SD/FF is the most effective APCD combination for controlling acid gases, PM, and metals. An SD used in combination with an ESP is the second-most effective control technology combination. Note, however, that MWC owners can enhance the performance of their SD/ESPs by modifying their operating practices to achieve emission reductions that approach or equal those achieved with an SD/FF for most pollutants except for control of the particulate matter and associated metals (e.g., Pb and Cd). These enhanced SD/ESP systems are referred to as SD/ESP(m) in the remainder of this report.

In addition to the APCDs used to control acid gases, PM, and metals, some MWCs employ control technologies to limit their HG and NO_x emissions. Selective noncatalytic reduction (SNCR) is the control technology generally used to control NO_x emissions from MWCs. Two types of SNCR, ammonia injection and urea injection, are roughly equivalent in their effectiveness for NO_x control. The principal technology currently demonstrated for controlling Hg emissions is activated carbon injection (CI).

3.2.3 Facility Profile

For this EIA, EPA has identified approximately 436 combustor units operating at 179 existing MWC facilities with design capacities above 35 Mg/day. In addition, numerous very small facilities with design capacities below 35 Mg/day are not specifically identified. These very small facilities constitute less than one percent of the total waste flow to MWC facilities and will be exempt from the requirements of MWC II/III. Therefore, the balance of this section focuses on MWCs above 35 Mg/day capacity.

Table 3-1 shows the distribution of the combustion technologies by the number of facilities. The most common types of MWCs are MB, MOD, and RDF. Combined, these three types of plants account for over 98 percent of all facilities and an equal share of combustion capacity.

TABLE 3-1. DISTRIBUTION OF COMBUSTION TECHNOLOGIES ACROSS EXISTING FACILITIES

Combustion Technology	Number of Facilities	Frequency (percent)
Mass Burn	100	55.87
Modular	44	24.58
Refuse-derived fuel	32	17.88
Other[a]	3	1.68
Total	179	100.00

[a]Other includes fluidized-bed combustion and facilities for which information is not available.

Table 3-2 shows the distribution of air pollution control technologies. The most common control technologies among the facilities identified for this analysis are ESP and SD/FF, used at 59 facilities each. SD/ESPs are used at 11 facilities. These three groups account for almost two-thirds of all facilities and over 90 percent of MWC capacity.

3.2.4 Baseline Waste Flow Projections

EPA estimates that 29.35 million Mg of MSW was disposed of through combustion in 1991 (see Table 3-3). To project the 1991 baseline waste flow to MWCs, EPA compiled MSW generation data from several sources and adjusted the data for differences in definitions and coverage. A discussion of the methods and sources used to estimate the amount of MSW disposed of through combustion in 1991 is presented in Economic Impact of Air Pollutant Emission Guidelines for Existing Municipal Waste Combustors (EPA, 1989a). The year 1991 is significant because this is the estimated waste flow used to evaluate the MWC I EG. The baseline waste flow to combustion for 1996 -- 32.82 million Mg -- is based on the

TABLE 3-2. DISTRIBUTION OF AIR POLLUTION CONTROL TECHNOLOGIES ACROSS EXISTING FACILITIES

Air Pollution Control Technology	Number of Facilities	Frequency (percent)
None	14	7.82
ESP	59	32.96
SD/ESP	11	6.15
SD/FF	59	32.96
Other[a]	36	20.11
Total	179	100.00

[a]Other includes cyclones, wet scrubbers, FFs, dry sorbent injection, or some combination of these devices, and facilities for which information is not available.

Note:

1. Definitions are provided on p. x.

TABLE 3-3. MSW DISPOSAL PROJECTIONS (10^6 Mg)

	Year		
Disposal Method	1991	1996	2000
Discards to Landfills and Other Disposal	117.80	106.30	97.92
Recovery for Recycling and Composting	31.33	45.90	62.31
Combustion	29.35	32.82	47.80
Total	178.48	185.03	208.03

Sources: Landfilling and recycling estimates are based on estimates from U.S. Environmental Protection Agency. 1992. Characterization of Municipal Solid Waste in the United States: 1992 Update. Office of Solid Waste and Emergency Response (OS-305). EPA/530-R-92-019.

Combustion estimates are based on estimates from U.S. Environmental Protection Agency. 1989a. Economic Impact of Air Pollutant Emission Guidelines for Existing Municipal Waste Combustors. Office of Air Quality Planning and Standards. EPA-450/3-89-005; and Davis, Lee. 1993. Memorandum to Walter Stevenson, EPA/SDB. Research Triangle Park, NC. November 10.

1991 estimate for MWC I and data compiled by Radian Corporation (Davis, 1993) on the additional MWC capacity projected to come on line by 1996. For this analysis, EPA assumes that MWCs subject to the MWC II/III EG include all facilities that are operational by the year 1996. Thus, the waste flow subject to the MSW II/III EG is 32.82 million Mg per year.

The year 2000 is the year for which NSPS impacts are evaluated in this analysis. EPA estimates that, by 2000, facilities subject to the NSPS will combust 14.95 million Mg of MSW per year. Thus, the total projected annual waste flow to MWCs by the year 2000 is the sum of the annual waste flow to EG facilities (32.82 million Mg) and the annual waste flow to NSPS facilities (14.95 million Mg) or 47.80 million Mg. This represents about a 10 percent annual growth rate in the amount of MSW that will be combusted between 1996 and 2000.

In addition to the MSW flow projections, Table 3-3 also presents the estimated MSW flows to landfills and other disposal and to recovery for recycling and composting.[1] These MSW flows are computed using estimates presented in Appendix C of the Characterization of MSW in the United States: 1992 Update (EPA, 1992). Total MSW flows to combustion are estimated for this analysis as described below.

3.3 MODEL PLANT APPROACH

Analyzing the impacts of alternative regulations and selecting the appropriate level of stringency for regulations requires either collecting or developing large amounts of cost and emissions information. Because of the difficulties

[1]The EPA's goal for the nation as stated in the Agenda for Action (1989f) is to reduce MSW by 25 percent using source reduction and recycling techniques. Table 3-3 shows 31.33 and 45.90 million Mg for recycling in 1991 and 1996, or 18 and 24 percent of the totals, respectively. These baseline projections are only for analytical purposes and should not be interpreted as alternatives to the goals and projections used in the Agenda.

involved in collecting such data, EPA has created "model plants" that are prototypes of the plants or facilities that will be regulated. For the development of the EG, 16 model plants are defined, and for the NSPS 11 model plants are defined. (Plants represented by EG model plant 13 and NSPS model plant 7 in earlier analyses are no longer operating or are now represented in other model plant categories.) The EG model plants are based on the design characteristics of the facilities discussed in Section 3.2.3. Table 3-4 describes the basic characteristics of the EG model plants. The model plants developed to represent NSPS facilities are based on recently built facilities or facilities currently under construction. Table 3-5 shows the characteristics of NSPS model plants.

Tables 3-4 and 3-5 show the model plant number, the type of combustor used at that model plant, plant capacity in megagrams per day, plant annual waste flow in megagrams per day, and the number of hours of operation per year. In addition, the tables also indicate whether the model plant has some form of energy recovery. Model plant waste flow is computed by multiplying the model plant capacity by annual operating hours (converted to hours per day). The annual hours of operation are based on average capacity utilization reported in the <u>1991 Resource Recovery Yearbook</u> (Gould, 1991). In 1990, the averages for capacity utilization, which may be thought of as the percentage of days a plant or combustor operates, were the following:

- Mass burn: 87.5 percent
- Modular: 84.2 percent
- RDF and FBC: 83.3 percent

Tables 3-6 and 3-7 show the size, baseline APCD (EG only), national capacity, national waste flow, and scale factors for each EG and NSPS model plant category and subcategory. Note that model plants are subcategorized by size and APCD (EG only), in addition to type of combustor,

TABLE 3-4. MWC II/III EG: CHARACTERISTICS OF MODEL PLANTS[a]

Model Plant Number[b]	Description	Energy Recovery	Annual Operating Hours[c]	Combustion Capacity (Mg MSW/day)	Annual Waste Flow (Mg/day)
1	MB/REF/TG	none	6,500	680	505
2	MB/REF/RG	none	6,200	218	154
3	MB/REF/RK	none	7,665	816	714
4	MB/WW (large)	electric	7,665	2,041	1,786
5	MB/WW (midsize)	electric	7,665	980	857
6	MB/WW (small)	electric	7,665	181	159
7	RDF (large)	electric	7,297	1,814	1,511
8	RDF (small)	electric	7,297	544	453
9	MOD/SA/TR	steam	4,917	136	76
10	MOD/SA/G	none	6,500	45	34
11	MOD/EA	steam	7,376	181	153
12	MB/RWW	electric	7,665	454	397
14	MB/WW (UC)	electric	7,665	181	159
15	RDF (large) (UC)	electric	7,297	1,814	1,511
16	RDF (small) (UC)	electric	7,297	544	453
17	MB/RWW (UC)	electric	7,665	454	397

[a]Model plants are based on the May 1991 EPA Inventory of Municipal Waste Combustors (Fenn and Nebel, 1992).

[b]Plants assigned to model plant 13 in an earlier analysis are no longer operating.

[c]Annual operating hours are based on the average capacity utilization estimates reported in the 1991 Resource Recovery Yearbook (Gould, 1991). Annual operating hours at model plants 1,2, and 10 reflect the assumption of increased downtime for older plants. Operating hours for model plant 9 reflect a stand-by combustor unit.

Note:

1. Definitions are provided on p. x.

TABLE 3-5. MWC II/III NSPS: CHARACTERISTICS OF MODEL PLANTS[a]

Model Plant Number[b]	Description	Energy Recovery	Annual Operating Hours[c]	Combustion Capacity (Mg MSW/day)	Annual Waste Flow (Mg/day)
1	MB/WW (small)	steam	5,000	181	104
2	MB/WW (midsize)	electric	7,665	726	635
3	MB/WW (large)	electric	7,665	2,041	1,786
4	MB/REF	electric	7,665	454	397
5	MB/REF	electric	7,665	952	833
6	RDF	electric	7,297	1,814	1,511
8	MOD/EA	electric	7,367	218	183
9	MOD/SA (small)	none	5,000	45	26
10	MOD/SA (midsize)	electric	7,367	91	76
11	FBC/BB	electric	7,525	816	701
12	FBC/CB	electric	7,525	816	701

[a]Model plant categories are based on recently built MWCs or MWCs currently under construction as reported in the May 1991 EPA Inventory of Municipal Waste Combustors (Fenn and Nebel, 1992).

[b]Plants assigned to model plant 7 in an earlier analysis were reassigned to model plant 6.

[c]Annual operating hours are based on the average capacity utilization estimates reported in the 1991 Resource Recovery Yearbook (Gould, 1991). Annual operating hours at model plants 1 and 9 reflect the assumption of increased downtime for smaller plants.

Note:

1. Definitions are provided on p. x.

TABLE 3-6. MWC II/III EG: NATIONAL CAPACITY AND WASTE FLOW ESTIMATES FOR EXISTING MWC FACILITIES[a]

Model Plant Number	Baseline Air Pollution Control Device	Size Classification[b]	National Capacity (Mg/Yr)[c]	National Waste Flow (Mg/yr)[d]	Scale Factors[e]
1	ESP	L	1,096,002	813,244	4.41
2	ESP	S	269,317	190,612	3.39
2	ESP	L	1,728,735	1,223,534	21.76
3	ESP	L	1,411,799	1,235,324	4.74
3	SD/FF	L	185,763	162,543	0.62
4	ESP	L	3,209,843	2,808,613	4.31
4	SD/ESP	L	1,894,334	1,657,542	2.54
4	SD/FF	L	6,222,524	5,444,708	8.35
5	ESP	L	2,399,535	2,099,594	3.22
5	SD/ESP	L	835,934	731,442	1.12
5	SD/FF	L	4,169,946	3,648,703	5.60
6	ESP	S	395,537	346,095	5.97
6	ESP	L	226,631	198,302	3.42
6	SD/FF	S	132,900	116,288	2.01
7	ESP	L	2,106,962	1,755,080	3.18
8	ESP	L	2,791,859	2,325,593	14.06
9	ESP (low)	S	627,234	352,067	12.63
9	ESP (low)	L	345,519	193,940	6.96
10	None	S	695,442	516,024	42.01
11	ESP	S	112,508	94,733	1.70
11	ESP	L	356,665	300,315	5.39
12	ESP	S	70,318	61,528	0.42
12	ESP	L	377,471	330,287	2.28
14	ESP	S	152,941	133,823	2.31
14	ESP	L	319,512	279,573	4.83
14	SD/FF	S	42,191	36,917	0.64

(continued)

TABLE 3-6. MWC II/III EG: NATIONAL CAPACITY AND WASTE FLOW ESTIMATES FOR EXISTING MWC FACILITIES[a] (Continued)

Model Plant Number	Baseline Air Pollution Control Device	Size Classification[b]	National Capacity (Mg/Yr)[c]	National Waste Flow (Mg/yr)[d]	Scale Factors[e]
14	SD/FF	L	297,221	260,068	4.49
15	ESP	L	1,157,648	964,310	1.75
15	SD/ESP	L	1,999,574	1,665,627	3.02
15	SD/FF	L	701,605	584,431	1.06
16	ESP	L	526,204	438,323	2.65
16	SD/FF	L	527,567	439,459	2.66
17	ESP	L	192,451	168,394	1.16
17	SD/FF	L	1,416,891	1,239,780	8.56
Total[f]			38,996,582	32,816,816	193.23

[a]Model plants are based on May 1991 EPA Inventory of Municipal Waste Combustors (Fenn and Nebel, 1992).

[b]Small plants (S) have a 35 to 225 Mg/day capacity and large plants (L) have a larger capacity.

[c]National capacity estimates are based on the national waste flow estimates and model plant capacity utilization based on annual operating hours reported in Table 3-4.

[d]National waste flow estimates are based on the share of waste flow assigned to each model plant subcategory and a total waste flow to EG plants of 32.82 million Mg/yr, which includes an estimate of additional capacity to be constructed in 1994.

[e]Scale factors are computed by dividing national capacity reported in this table by model plant combustion capacity reported in Table 3-4.

[f]Details may not sum to totals due to rounding.

Note:

1. Definitions are provided on p. x.

TABLE 3-7. MWC II/III NSPS: NATIONAL CAPACITY AND WASTE FLOW ESTIMATES FOR EXISTING MWC FACILITIES[a]

Model Plant Number	Size Classification[b]	National Capacity (Mg/Yr)[c]	National Waste flow (Mg/yr)[d]	Scale Factors[e]
1	S	333,931	190,600	5.04
1	L	214,333	122,336	3.24
2	L	4,696,042	4,109,037	17.73
3	L	5,375,265	4,703,357	7.22
4	L	342,933	300,067	2.07
5	L	1,194,479	1,045,169	3.44
6	L	4,363,826	3,635,027	6.59
8	S	58,299	49,028	0.73
8	L	205,760	173,040	2.59
9	S	184,755	105,454	11.16
10	S	238,767	200,799	7.21
10	L	135,030	113,558	4.08
11	L	64,300	55,235	0.22
12	L	171,467	147,293	0.58
Total[f]		17,579,188	14,950,000	71.89

[a]Model plant categories are based on recently built MWCs or MWCs currently under construction as reported in the May 1991 EPA Inventory of Municipal Waste Combustors (Fenn and Nebel, 1992).

[b]Small plants (S) have a 35 to 225 Mg/day capacity and large plants (L) have a larger capacity.

[c]National capacity estimates are based on the national waste flow estimates and model plant capacity utilization based on the annual operating hours reported in Table 3-5.

[d]National waste flow estimates are based on the share of waste flow assigned to each model plant subcategory and a total waste flow to NSPS plants of 14.95 million Mg/yr.

[e]Scale factors are computed by dividing national capacity reported in this table by model plant combustion capacity reported in Table 3-5.

[f]Details may not sum to total due to rounding.

Note:

1. Definitions are provided on p. x.

which results in several entries for many of the model plant numbers. Because actual plants do not always fit neatly within a model plant category with respect to the size of the plant (in the case of the NSPS and EG) or baseline APCD (in the case of the EG), subcategories are used to reflect differences in actual plant characteristics.

The national capacity estimates reported in Tables 3-6 and 3-7 are computed by summing the capacity for actual plants assigned to the model plant category. National waste flow estimates are based on the national capacity and the annual hours of operation. Scale factors are computed by dividing national capacity for each model plant category reported in Tables 3-6 and 3-7 by the corresponding model plant capacity reported in Tables 3-4 and 3-5. Note that the scale factors do not equal the number of plants subject to the regulation in each model plant category because of differences in the plant capacity for actual plants versus model plants. The scale factors corresponding to each model plant category are used in the balance of the analysis to compute the national-level impacts of the EG and NSPS.

CHAPTER 4
REGULATORY APPROACHES

The EPA has several policy options to reduce the pollution from MWCs. These options include both market-based approaches and regulatory standards. E.O. 12866 states that EPA shall "assess both the costs and the benefits of the intended regulation and, recognizing that some costs and benefits are difficult to quantify, propose or adopt a regulation only upon a reasoned determination that the benefits of the intended regulation justify its costs" (Federal Register, 1993, p. 51736). In this chapter, several regulatory approaches are considered, including market-based approaches and regulatory standards. This chapter also describes the regulatory approach selected and defines the regulatory alternatives examined for the MWC II/III EG and NSPS. The regulatory alternatives considered incorporate different requirements for different segments of the regulated population.

4.1 BACKGROUND

Public choice theory counsels that, given a criterion of maximizing economic efficiency, an optimum level of environmental quality and, hence, emissions (or emission reduction) exists. This optimum value reflects the recognition that improvements in environmental quality will have both benefits and costs. Ideally, before selecting a regulatory approach, EPA identifies the optimum level of emission reductions. In practice, however, identifying this level is costly and time consuming. Rarely does EPA have all the relevant data to identify the optimal level. In addition, the data may be subjective. Typically, the data available to

EPA comprise totals and averages rather than marginal quantities.

The optimal level of pollution control is the level at which the (declining) marginal social benefit (MSB) of control equals the (rising) marginal social cost (MSC) of control. Up to the optimal level of pollution control (e.g., the point where MSB and MSC are equal), every megagram of emission reduction saves society goods valued more highly than those required to achieve a given reduction. In other words, the benefits of controlling emissions exceed the costs up to the optimal point. Beyond the optimal point, however, the additional costs of pollution abatement outweigh the additional benefits.

When all costs are internalized, the market will frequently equilibrate at the optimal level of pollution. However, where externalities exist, the benefits of abatement do not accrue to the polluter and too little pollution control occurs from a societal perspective. In these cases, public choice theory recognizes that government should address this reallocation of resources by intervening, either directly or indirectly, in the behavior of polluters.

4.2 MARKET-BASED APPROACHES

The primary market-based approaches include emission fees and marketable permits. Emission fees are charges assessed by the government for each unit of pollution discharged to the environment. Marketable permits endow the holder with the right to discharge a given amount of pollution to the environment within a specified period of time. These permits are issued by the government and may be traded freely. Both policies must be enforced through monitoring and assessing monetary sanctions for either underpayment of fees under the emission fee system or overdischarges of pollutants under the permit system.

4.2.1 Emission Fees

Emission fees are designed to internalize the costs of externalities. Costs formerly borne by society are assessed to the owners of MWC facilities in the form of emission fees. In the aggregate, profit-maximizing polluters would reduce emissions to the point where the marginal cost of control is equivalent to the emission fee. Where the marginal cost of control exceeds the emission fee, each owner would opt to pay the fee rather than control emissions. An attractive feature of emission fees is that each discharger would independently choose a level of control resulting in equivalent marginal control costs across all polluters, hence minimizing the cost to achieve the optimal level of emission reductions. Another positive feature of emission charges is that they provide an on-going incentive for polluters to find new, less costly control methods.

This approach poses three problems. First, for reasons discussed previously, the optimal level of emission reduction is difficult to identify. Second, even if some desired level of emission reduction is identified, the appropriate amount for the emission fee is often difficult to estimate because of insufficient data on the marginal costs and benefits of controlling emissions and the baseline level of emissions. Finally, limiting the overall level of pollution to an optimal level does not guarantee that pollution levels within a specific region or other geographic area is optimal.

4.2.2 Marketable Permits

Marketable permits offer a solution to the second problem identified above for emission fees. Like emission fees, marketable permits result in higher costs for MWC owners leading to lower levels of emissions. Permits differ from fees, however, in that the market, not EPA, establishes the price that must be paid for emitting one megagram of a pollutant. Under this approach, EPA would issue permits to emit an amount consistent with the desired level of emission reductions. These permits could be auctioned off to dischargers. Owners with higher marginal control costs would be willing to pay more for the permits than owners with lower marginal control costs.

Another way of implementing this approach would be to give each discharger a specified share of the total permits based on design capacity or some other criterion. Some dischargers would initially have more permits than needed, others fewer permits. Dischargers with an inadequate number could purchase permits from owners with excess permits until an efficient allocation is reached. Under either implementation method, the market equilibrium for an emission permit system would result in a cost-effective allocation.

Under this approach, the lack of accurate control-cost data is not a factor. However, the problem of identifying the optimal level of pollution remains. Furthermore, unless geographic restrictions are imposed, marketable permits also fail to guarantee that pollution levels within a specific region are optimal. In addition, monitoring and enforcement are crucial for the system to work properly. Specifically, sanctions must be imposed on polluters that release emissions without a permit to do so--otherwise the system breaks down.

4.3 REGULATORY STANDARDS

The government traditionally uses the regulatory standards approach to control emissions. The two broad categories of regulatory standards include design standards and emission standards. Design standards specify the type of control equipment polluters must install, whereas emission standards specify the maximum quantity of a given pollutant that any one polluter may release.

Design standards offer the least flexible approach considered in this analysis. Polluters must install the specified control equipment regardless of the additional emission reductions achieved or the relative cost of alternative means of emission reductions. It is conceivable, indeed likely, that some plants could achieve an equivalent level of emission reductions for a lower cost when given the option to do so. Therefore, for a given level of emission reduction, this approach is generally more costly than other approaches. In addition, design standards effectively reduce any motivation for dischargers to develop more efficient control approaches.

Emission standards allow greater flexibility in the methods used to reduce emissions. Firms are free to meet the emission limit in the manner that is least costly to them. Consequently, for a given level of emission reductions, emission standards are generally less costly than design standards. Furthermore, emission standards give dischargers an incentive to develop more effective means of controlling emissions.

Even though emission standards generally result in a more efficient allocation of costs than design standards, uniform emission standards are still potentially more costly than necessary. Uniform emission standards require the same level of emission control of every discharger. Because marginal control costs differ for plants of different sizes, different technologies, different levels of product recovery (i.e., in the chemical industry), and different levels of baseline control, a more cost-effective solution can be reached if standards are carefully tailored to the special characteristics of each discharger. This type of standard is referred to as a differentiated standard.

In formulating its MWC II/III regulatory alternatives, EPA selected candidate regulatory alternatives that contain control limits for MWCs differentiated by general size classification. Small facilities are defined as MWC plants with aggregate plant capacity between 35 and 225 Mg/day. Large facilities are defined as MWCs with aggregate plant capacity over 225 Mg/day.

The MWC II/III regulatory alternatives do not specify a particular control technology; rather, they specify emission limits that facilities must meet. Current practice indicates that the EG limits for acid gases, PM, and metals will likely be met with one of six different types of control technologies, depending on the applicable emission limits. Table 4-1 presents acid gas, PM, and metals control technologies listed in order of increasing efficiency. Current practice also suggests that Hg control will be met with mainly one technology, activated carbon injection (CI), in conjunction with an existing acid gas control device. Post-combustion NO_x control using selective noncatalytic reduction (SNCR) is most commonly used for MWC NO_x control.[1]

In designing MWC regulatory alternatives, EPA considered emission limits consistent with the combinations of the acid gas control technologies listed in Table 4-1. Small plants may be required to meet one control limit and large plants another under a given regulatory alternative. Table 4-2 shows the control technologies projected for the EG regulatory alternatives under two compliance scenarios for acid gas, PM, and metals control. The control technology bases identified in this table are not intended to imply a design standard. Rather, the technology bases are identified only for the purpose of estimating costs and emission reductions.

The regulatory alternatives represent alternative levels of control considered by EPA, whereas the compliance scenarios represent potential alternative responses by the MWC owners and operators to the emission requirements. Generally speaking, we assume that MWC owners and operators will choose the minimum-cost control technology that will meet the emission requirements. However, where there is uncertainty regarding the actual emission limits that a particular control technology will achieve in practice, owners may choose a more

[1]SNCR applicability and performance are problematic with small plants. Therefore, NO_x control is not required at small MWC plants.

TABLE 4-1. CONTROL TECHNOLOGIES ASSOCIATED WITH ACID GAS, PARTICULATE MATTER, AND METALS CONTROL

GCP + ESP
GCP + DSI/ESP
GCP + DSI/FF
GCP + SD/ESP
GCP + SD/ESP(m)
GCP + SD/FF

Note:

1. The control technologies are described in Section 3 and definitions are provided on p. x.

conservative (and potentially more costly) compliance strategy to reduce the risk of noncompliance. A conservative investment decision is particularly likely when the investment decision affects the facility's ability to remain in operation (e.g., noncompliance results in plant shutdown), is a long-term decision, or involves a significant capital outlay. Consequently, we evaluate two compliance scenarios for meeting the acid gas, PM, and metals control requirements for existing plants subject to EG.

The scenarios evaluated in this analysis differ only for large plants with more than 225 Mg/day of capacity. Under Scenario A, we assume that owners of large MWCs with at least a minimal level of air pollution control in the baseline will attempt to meet the acid gas limitations by adding to and enhancing their existing equipment and by improving their operating practices rather than by replacing their existing equipment. In particular, we assume that owners of MWCs with only an ESP will meet the control requirement by retaining and upgrading their ESP and by adding an SD. Under Scenario B, we assume that these same owners will attempt to meet the acid

TABLE 4-2. MWC II/III EG: CONTROL TECHNOLOGY BASES USED TO ESTIMATE THE IMPACTS OF THE REGULATORY ALTERNATIVES

Regulatory Alternative, Compliance Scenario, and Baseline APCD	Size Classification (Mg MSW/day) Small (35 to 225)	Large (Over 225)
Reg. Alt. I-A		
No Control	GCP+ESP	GCP+SD/FF+CI+SNCR
ESP (low)	GCP+ESP	GCP+SD/ESP(m)+CI+SNCR
SD/ESP	GCP+SD/ESP	GCP+SD/ESP(m)+CI+SNCR
SD/FF	GCP+SD/FF	GCP+SD/FF+CI+SNCR
Reg. Alt. I-B		
No Control	Same as Scenario A	Same as Scenario A
ESP (low)	Same as Scenario A	GCP+SD/FF+CI+SNCR
SD/ESP	Same as Scenario A	Same as Scenario A
SD/FF	Same as Scenario A	Same as Scenario A
Reg. Alt. II-A		
No Control	GCP+DSI/FF+CI	GCP+SD/FF+CI+SNCR
ESP (low)	GCP+DSI/ESP+CI	GCP+SD/ESP(m)+CI+SNCR
SD/ESP	GCP+SD/ESP+CI	GCP+SD/ESP(m)+CI+SNCR
SD/FF	GCP+SD/FF+CI	GCP+SD/FF+CI+SNCR
Reg. Alt. II-B		
No Control	Same as Scenario A	Same as Scenario A
ESP (low)	Same as Scenario A	GCP+SD/FF+CI+SNCR
SD/ESP	Same as Scenario A	Same as Scenario A
SD/FF	Same as Scenario A	Same as Scenario A
Reg. Alt. III (A & B)		
No Control	GCP+SD/FF+CI	GCP+SD/FF+CI+SNCR
ESP (low)	GCP+SD/FF+CI	GCP+SD/FF+CI+SNCR
SD/ESP	GCP+SD/FF+CI	GCP+SD/FF+CI+SNCR
SD/FF	GCP+SD/FF+CI	GCP+SD/FF+CI+SNCR

Notes:

1. The MWC II/III regulation does not mandate a specific type of control equipment. The MWC owner/operator may use any control equipment that meets the emission standards. The control technologies are the projected compliance strategies used as the basis for computing costs. If the MWC has equipment that is meeting or exceeding the control requirements, no additional costs are incurred.

2. Section 129 of the CAA specifies that the emission guidelines must include emissions limits for NO_x for all subcategories of MWCs. This holds even if the maximum achievable control technology selected for all subcategories does not include NO_x. Therefore, EPA is proposing a no-control emission limit of 500 ppmv wherever SNCR does not appear in this table. This emission limit is achievable at no cost, and no emission reduction will occur.

3. The control technologies are described in Section 3 and definitions are provided on p. x.

gas limitations by replacing their existing equipment with the SD/FF technology. Under both scenarios, we assume that owners whose plants have fairly advanced acid gas control equipment in the baseline such as SD/ESPs and SD/FFs will be able to meet the acid gas limitations without replacing their control equipment. However, these owners may have to adjust their operating practices to achieve the acid gas limits. Likewise, under both scenarios, we assume that owners of MWCs that have virtually no air pollution control equipment will respond to the acid gas requirements by installing SD/FF systems and by improving their operating practices.

Even though Hg and NO_x controls are included on Table 4-2, compliance with the control requirements for these pollutants is not evaluated using a scenario framework. This is due to the limited number of control technologies currently available to meet the Hg and NO_x limits (see Section 3 for a description of the control technologies) and less variation in the baseline level of control across potentially affected facilities.

Under the EG, Hg control is required whenever acid gas control is required. Consequently, Hg control is required of large plants under all regulatory alternatives and small plants under Regulatory Alternatives II and III. Small plants are not required to control acid gases or Hg above baseline levels under Regulatory Alternative I.

NO_x control is required for large plants under all of the alternatives evaluated. Small plants are not required to control NO_x emissions under any of the regulatory alternatives. Note that in addition to the controls specified for acid gases, metals, PM, Hg, and NO_x, each of the EG regulatory alternatives considered in this analysis also includes testing, reporting, and recordkeeping requirements.

Table 4-3 reports the control technology bases for the MWC II/III NSPS regulatory alternatives. The scenario analysis used for the EG is not used to evaluate impacts for plants subject to the NSPS. Much of the variation in compliance costs for the EG is due to the variable baseline for existing plants--some plants have virtually no baseline control equipment whereas others have advanced pollution control systems in place. The scenario analysis for EG projects responses to the emission limitations that are differentiated based on the level of baseline control. For this analysis, we define the baseline for new plants based on the 40 CFR Subparts E and Db prior to 1991. Thus, the baseline for new plants is not variable and a scenario analysis similar to that used for the EG is not relevant for the NSPS.

The impacts reported in the remainder of this report are computed using the control technology bases described in Tables 4-2 and 4-3.

TABLE 4-3. MWC II/III NSPS: CONTROL TECHNOLOGY BASES USED TO ESTIMATE THE IMPACTS OF THE REGULATORY ALTERNATIVES

	Size Classification (Mg MSW/day)	
Regulatory Alternative	Small (35 to 225)	Large (over 225)
Reg. Alt. I	None Required	GCP+SD/FF+CI+SNCR
Reg. Alt. II	GCP+SD/FF+CI	GCP+SD/FF+CI+SNCR

Notes:

1. The MWC II/III regulation does not mandate a specific type of control equipment. The MWC owner/operator may use any control equipment that meets the emission standards. These control technologies are the projected compliance strategies used as the basis for computing costs. None required means no control required over baseline where baseline is based on 40 CFR subparts E and Db prior to 1991.

2. Section 129 of the Clean Air Act specifies that the emission standards must include emissions limits for NO_x for all subcategories of MWCs. This holds even if the maximum achievable control technology selected for all subcategories does not include NO_x. Therefore, EPA is proposing a no-control emission limit of 500 ppmv wherever SNCR does not appear in this table. This emission limit is achievable at no cost, and no emission reduction will occur.

3. Descriptions of the control technologies are in Section 3 and a list of definitions on p. x.

CHAPTER 5
ECONOMIC IMPACTS

This chapter presents the results of the economic impact analysis for MWC facilities subject to EG and NSPS, and outlines the inputs, methods, and assumptions used in the analysis. Impacts are estimated for each of the model plants and for the nation as a whole. Model plant cost impacts are presented for publicly and privately owned MWCs. National-level impacts reported in this chapter include the annual social costs, emission reductions, and energy impacts. Finally, the cost-effectiveness (C/E) of each regulatory alternative is computed based on the national social cost and national emissions reductions.

5.1 MARKET RESPONSE

The proposed regulations for new and existing MWCs will result in additional costs for many governments and private firms that supply solid waste combustion services. These additional costs will require affected enterprises to make a number of investment and/or operating decisions. The objectives guiding government entities and firms that supply combustion services will determine their response(s) to regulation. In conventional economic analysis, firms are profit maximizers, engaging in behavior that maximizes the net present value of the firm. This condition provides the basis for modeling the behavior of firms in response to governmental regulations.

Governmental decisionmaking is of particular concern because governmental entities play a large role in shaping MSW management systems. Unfortunately, the theoretical and applied literature does not provide much positive guidance on the behavior of governments. However, normative literature on MSW management often assumes that cost minimization is the basis for government decisionmaking (Robinson, 1986).

For the purposes of this EIA, the choices facing suppliers of MWC services are characterized as either substitution choices or compliance choices. Substitution choices refer to the operating and investment decisions that affect the amount of MSW combusted at the existing or planned MWC. For example, communities with nearby landfills may decide to substitute landfilling for combustion when faced with higher combustion costs due to the regulation. Communities with an existing MWC may decide to shut down the existing plant and build a new plant rather than retrofit. Likewise, communities planning to build an MWC may decide to modify the design specifications of the plant or to cancel the MWC project altogether. In addition, communities may decide to institute or increase the scope of recycling programs as the cost of waste disposal increases.

The analysis of substitution choices is complicated by several factors:

- institutional constraints common in MSW management systems (e.g., financial and contractual obligations),
- difficulty siting new waste disposal facilities resulting from "not in my backyard" (NIMBY) attitudes in many communities,
- public perceptions regarding the relative environmental impact of the alternative disposal technologies, and
- uncertainty regarding the objective function of government entities.

In addition, a thorough analysis of substitution choices would consider the net costs and benefits of the substitute waste disposal technologies. Consequently, a quantitative examination of the economic impacts under a substitution scenario is beyond the scope of this analysis.

Suppliers that make the decision to continue operations or to invest in a new plant are faced with compliance decisions. Operators of existing MWCs that do not meet the requirements of the proposed regulations must either take steps to bring the facility into compliance with the regulation or discontinue operations. Likewise entities planning to build an MWC may have to change the design specifications to ensure that the facility is in compliance with the NSPS.

This analysis generally assumes that the MWC owner will choose the minimum-cost control technology that will meet the requirements of the regulation. However, where there is uncertainty regarding the actual emission limits that a particular control technology will achieve in practice, owners may choose a more conservative (and potentially more costly) compliance strategy to reduce the risk of noncompliance. A conservative investment decision is particularly likely when the investment decision affects the facility's ability to remain in operation (e.g., noncompliance results in plant shutdown), is a long-term decision, or involves a significant capital outlay. Consequently, we evaluate two compliance scenarios for existing plants subject to EG. Scenario A assumes that owners select a compliance strategy for acid gas control that has a lower cost and potentially higher level of uncertainty than alternative strategies. Scenario B assumes that MWC owners are slightly more risk averse and choose a higher cost, lower uncertainty strategy.

5.2 ENGINEERING-COST INPUTS

The MWC II/III regulatory alternatives, as discussed in Chapter 4, do not specify a particular control technology; rather, they specify emission limits that facilities must meet. However, current practice indicates that the EG limits for acid gases, PM, and metals will likely be met with one of six different types of control technologies, depending on the applicable emission limits. These control options, listed in order of increasing efficiency, are shown in Table 4-1 of Chapter 4.

Similarly the NSPS limits for acid gases, PM, and metals will be met with one of three types of control technologies (also listed in order of increasing efficiency) depending on the applicable emission limits:

- GCP + ESP
- GCP + DSI/FF
- GCP + SD/FF

Tables 5-1 and 5-2 show the capital and annual operating costs for each acid gas/PM/metals control technology for EG and NSPS model plant categories, respectively.[1] These tables are not designed to show the costs of regulation; rather they are designed to show the variations in capital and operating costs across control options and model plant categories.

The costs reported in Tables 5-1 and 5-2 reflect differing levels of model plant configuration, baseline control, and additional controls. Sixteen existing and 11 new model plants varying by size and technology are examined. In this analysis, baseline refers to the pre-MWC I condition. As mentioned in Section 3.3, the model plant subcategories reflect different-sized facilities within model plant categories and differing levels of baseline control. As shown in Table 5-1, existing plants with baseline controls that exceed the emission requirements of the baseline will experience lower costs of compliance. For example, if a facility already has an SD/FF, it will not incur any acid gas, PM, and metals control costs (beyond monitoring and testing, reporting and recordkeeping costs) under a regulation that

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[1]The cost associated with GCP + DSI/ESP and GCP + DSI/FF are combined in Table 5-1.

TABLE 5-1. MWC II/III EG: MODEL PLANT CAPITAL AND ANNUAL OPERATING COSTS OF ACID GAS, PARTICULATE MATTER, AND METALS CONTROL ($1990 10^3)[a]

		GCP+ESP		GCP+DSI/ESP or FF[b]		GCP+SD/ESP		GCP+SD/ESP(m)		GCP+SD/FF	
Model Plant Number	Baseline APCD	Installed Capital Cost	Annual Operating Cost	Installed Capital Cost	Annual Operating Cost	Installed Capital Cost	Annual Operating Cost	Installed Capital Cost	Annual Operating Cost	Installed Capital Cost	Annual Operating Cost
1	ESP	18,968	-211[c]	21,745	644	36,075	1,712	36,075	1,997	39,077	2,300
2	ESP	6,783	490	8,041	857	12,217	1,094	12,217	1,277	13,602	1,367
3	ESP	1,480	283	10,208	1,810	30,939	3,315	30,939	3,867	34,784	4,130
3	SD/FF	0	0	0	0	0	0	0	0	0	0
4	ESP	96	146	19,172	2,725	33,671	3,597	33,671	4,088	45,625	5,035
4	SD/ESP	0	0	0	0	0	0	0	491	21,987	2,618
4	SD/FF	0	0	0	0	0	0	0	0	0	0
5	ESP	96	146	10,085	1,767	20,433	2,314	20,433	2,528	25,873	3,193
5	SD/ESP	0	0	0	0	0	0	0	214	11,259	1,265
5	SD/FF	0	0	0	0	0	0	0	0	0	0
6	ESP	3,600	341	5,118	894	8,648	1,037	8,648	1,210	9,992	1,292
6	SD/FF	0	0	0	0	0	0	0	0	0	0
7	ESP	13,577	263	20,449	2,219	53,245	3,345	53,245	3,902	64,115	4,814
8	ESP	5,267	187	12,862	1,348	23,720	1,686	23,720	1,879	28,223	2,310
9	none	2,154	234	3,232	536	5,072	517	5,072	604	5,176	708
10	none	1,284	217	1,762	502	4,125	532	4,125	621	3,862	607
11	ESP	1,523	66	2,612	416	4,897	527	4,897	614	5,556	688
12	ESP	3,403	138	5,792	946	11,101	1,176	11,101	1,372	12,969	1,597
14	ESP	2,621	195	4,576	765	8,102	904	8,102	1,054	9,443	1,150
14	SD/FF	0	0	0	0	0	0	0	0	0	0
15	ESP	0	0	6,872	1,942	26,477	3,079	26,477	3,431	33,491	4,357
15	SD/ESP	0	0	0	0	0	0	0	352	23,016	2,568
15	SD/FF	0	0	0	0	0	0	0	0	0	0
16	ESP	0	0	6,992	1,144	14,510	1,499	14,510	1,670	16,980	1,986
16	SD/FF	0	0	0	0	0	0	0	0	0	0
17	ESP	2,824	126	5,213	988	10,774	1,163	10,774	1,357	12,636	1,586
17	SD/FF	0	0	0	0	0	0	0	0	0	0

[a]Costs are incremental to the baseline and include a credit for avoided operating costs of supplanted baseline control equipment.
[b]These costs represent GCP + DSI/ESP costs for most model plant categories. However, costs for small model plants with essentially no baseline controls (model plants 9 and 10) represent GCP + DSI/FF costs.
[c]Negative values represent cost savings.

Note:

1. Definitions are provided on p. x.

Sources: U.S. Environmental Protection Agency. 1989a. Economic Impact of Air Pollutant Emission Guidelines for Existing Municipal Waste Combustors. Office of Air Quality Planning and Standards. EPA-450/3-89-005; Davis, A. Lee. 1991a. Memorandum to Michael G. Johnston, U.S. EPA/ISB. Radian Corporation. Research Triangle Park, NC. April 24; Davis, Lee. 1991c. Memorandum to Walt Stevenson and John Robson, EPA/SDB. Radian Corporation, Research Triangle Park, NC. November 14.

TABLE 5-2. MWC II/III NSPS: MODEL PLANT CAPITAL AND ANNUAL OPERATING COSTS OF ACID GAS, PARTICULATE MATTER, AND METALS CONTROL ($1990 10^3)[a]

	GCP + ESP		GCP + DSI/FF		GCP + SD/FF	
Model Plant Number	Installed Capital Cost	Annual Operating Cost	Installed Capital Cost	Annual Operating Cost	Installed Capital Cost	Annual Operating Cost
1	178	12	1,222	600	4,533	732
2	533	45	3,744	1,446	9,855	1,666
3	1,500	131	8,699	3,314	20,365	3,740
4	689	57	3,089	1,223	9,799	1,504
5	600	40	4,244	1,887	12,743	2,185
6	1,378	122	8,510	3,638	21,842	4,064
8	233	18	1,400	526	3,955	625
9	591	80	1,555	358	3,100	436
10	625	36	1,398	397	3,064	454
11	0	0	500	1,057	9,510	1,542
12	0	0	500	1,746	9,510	1,542

[a]Costs are incremental to the baseline.

Note:

1. Definitions are provided on p. x.

Sources: U.S. Environmental Protection Agency. 1989b. Economic Impact of Air Pollutant Emission Standards for New Municipal Waste Combustors. Office of Air Quality Planning and Standards. EPA-450/3-89-006.

requires all facilities to meet emission limits generally achieved by SD/FFs. Costs reported for NSPS plants (Table 5-2) reflect the assumption that, in the baseline, plants just meet the Federal standards in effect prior to promulgation of MWC I.

In addition to the costs for acid gas/PM/metals control, costs for Hg control and NO_x control are analyzed for each model plant category. Tables 5-3 and 5-4 report the model plant capital and operating costs of these controls for the EG model plants, and Tables 5-5 and 5-6 report these costs for the NSPS model plants. Note that the operating costs of Hg control vary depending on the type of acid gas control

TABLE 5-3. MWC II/III EG: MODEL PLANT CAPITAL AND ANNUAL OPERATING COSTS FOR Hg CONTROL ($1990 10^3)[a]

		Annual Operating Cost by Type of Acid Gas Control[b]		
Model Plant Number	Installed Capital Cost	DSI/ESP or DSI/FF[c]	SD/ESP	SD/FF
1	160	245	156	63
2	81	75	48	19
3	179	346	221	89
4	310	865	553	222
5	310	865	553	222
6	72	77	49	20
7[d]	0	0	0	0
8[d]	0	0	0	0
9	61	37	24	9
10	32	16	10	4
11	72	74	47	19
12	126	192	123	49
14	72	77	49	20
15	0	0	0	0
16	0	0	0	0
17	126	192	123	49

[a]Costs are incremental to acid gas control costs. Costs are estimated based on CI control technology for Hg control applied to facilities with acid gas control systems.

[b]Annual operating costs of Hg control vary by the type of acid gas control used at the MWC. MWCs with SD/FF systems generally incur the lowest operating control cost while MWCs with DSI/ESP systems incur the highest operating control cost.

[c]These costs represent CI operating costs associated with DSI/ESP acid gas control for most model plant categories. However, costs for small model plants with essentially no baseline controls (model plants 9 and 10) represent CI operating costs associated with DSI/FF acid gas controls.

[d]RDF facilities do not incur Hg control costs beyond testing fee costs because these facilities meet the Hg emission limits with acid gas controls.

Note:

1. Definitions are provided on p. x.

Sources: Nebel, Kris. 1993. Memorandum to Walter Stevenson, EPA/SDB. Radian Corporation. Research Triangle Park, NC. November 19; Davis, Lee. 1991b. Memorandum to Glenn Morris, Research Triangle Institute. Radian Corporation. Research Triangle Park, NC. September 5.

TABLE 5-4. MWC II/III EG: MODEL PLANT CAPITAL AND ANNUAL OPERATING COSTS FOR NO_x CONTROL ($1990 10^3)[a]

Model Plant Number	Installed Capital Cost	Annual Operating Cost
1[b]	0	0
2[b]	0	0
3[b]	0	0
4	5,322	781
5	3,271	486
6	1,364	201
7	5,196	711
8	2,599	336
9	1,063	162
10	832	142
11	53	39
12	53	40
14	1,364	201
15	5,196	711
16	2,599	336
17	53	40

[a]Costs are incremental to the baseline.

[b]NO_x control is not required at mass burn refractory plants (model plants 1, 2, and 3).

Note:

1. Definitions are provided on p. x.

Sources: U.S. Environmental Protection Agency. 1989d. Municipal Waste Combustors - Background Information for Proposed Standards: Control of NO_x Emissions. Office of Air Quality Planning and Standards. EPA-450/3-89-27d; Soderberg, Eric, David White, and Kristina Nebel. 1991. Memorandum to Walter Stevenson, U.S. EPA/SDB, and Michael G. Johnston, U.S. EPA/ISB. Radian Corporation. Research Triangle Park, NC. July 17.

TABLE 5-5. MWC II/III NSPS: MODEL PLANT CAPITAL AND ANNUAL OPERATING COSTS FOR Hg CONTROL ($1990 10^3)[a]

Model Plant Number	Installed Capital Cost	Annual Operating Cost by Type of Acid Gas Control[b]	
		DSI/FF	SD/FF
1	72	50	13
2	167	308	79
3	310	865	222
4	126	192	49
5	196	404	104
6[c]	0	0	0
8	81	89	23
9	32	13	3
10	48	37	9
11	179	340	87
12	179	340	87

[a]Costs are incremental to acid gas control costs. Costs are estimated based on CI control technology for Hg control applied to facilities with acid gas control systems.

[b]Annual operating costs of Hg control vary by the type of acid gas control used at the MWC. MWCs with SD/FF systems generally incur the lowest operating control cost while MWCs with DSI/FF systems incur the highest operating control cost.

[c]RDF facilities do not incur Hg control costs beyond testing fee costs because these facilities meet the Hg emission limits with acid gas controls.

Note:

1. Definitions are provided on p. x.

Sources: Nebel, Kris. 1993. Memorandum to Walter Stevenson, EPA/SDB. Radian Corporation. Research Triangle Park, NC. November 19; Davis, Lee. 1991b. Memorandum to Glenn Morris, Research Triangle Institute. Radian Corporation. Research Triangle Park, NC. September 5.

TABLE 5-6. MWC II/III NSPS: MODEL PLANT CAPITAL AND ANNUAL OPERATING COSTS FOR NO_x CONTROL (\$1990 10^3)[a]

Model Plant Number	Installed Capital Cost	Annual Operating Cost
1	1,122	163
2	2,244	337
3	4,155	691
4[b]	0	0
5	80	61
6	3,966	699
8	53	39
9	684	121
10	870	148
11	53	40
12	53	40

[a]Costs are incremental to the baseline.

[b]NO_x control is not required at mass burn refractory plants (model plant 4).

Note:

1. Definitions are provided on p. x.

Sources: U.S. Environmental Protection Agency. 1989d. Municipal Waste Combustors - Background Information for Proposed Standards: Control of NO_x Emissions. Office of Air Quality Planning and Standards. EPA-450/3-89-27d.

equipment that is used. More effective acid gas control generally results in lower Hg operating control costs.

Costs of performance testing, reporting, and recordkeeping for acid gas/PM/metals, mercury, and NO_x control are analyzed for each model plant category.[2] These costs are shown in Table 5-7 for EG and Table 5-8 for NSPS. MWC plants incur a basic one-time cost for notification of construction, anticipated start-up, actual start-up, initial performance testing, and a basic siting analysis. All plants incur annual recordkeeping costs, which include records of employee training and certification; records of start-up malfunction, etc; and mercury sorbent recordkeeping.

Performance testing and reporting are also required annually by all plants. However, if small plants are able to demonstrate compliance with the emission limits for three consecutive years, they will be allowed to test for that particular pollutant every third year instead of annually. If the next test in the third year shows compliance, testing will again be conducted the third year. If a failure occurs for any pollutant, annual testing will resume until the plant establishes three consecutive years of compliance. Small plants that meet the criteria allowing them to perform emission limit testing every third year will be required to submit a simplified annual report for years in which a full compliance test was not required.

The data in Tables 5-1 through 5-8 are used to calculate cost impacts under the regulatory alternatives for each of the model plants. For each model plant, EPA computes the increased cost of combusting under MWC I and MWC II/III. These costs were figured on both an enterprise and social basis. The estimated costs incurred by each affected MWC are called "enterprise costs" in this EIA. In enterprise accounting, the real (constant dollar) municipal bond rate of

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[2]Costs for continuous emissions monitoring are already included in the respective control technology costs (Tables 5-1 through 5-6).

TABLE 5-7. MWC II/III EG: MODEL PLANT TESTING, REPORTING, AND RECORDKEEPING COSTS ($1990 10^3)[a,b]

		Recordkeeping Costs		Performance Testing and Reporting Costs[f]		
Model Plant Number	Basic One-Time Costs[c]	Annual[d]	Mercury Annual[e]	PM/Metals Recurring	Acid Gas Recurring	Mercury Recurring
1	8	6	2	55	6	3
2	8	6	2	55	6	3
3	8	9	4	75	8	4
4	8	9	4	75	8	4
5	8	9	4	75	8	4
6	8	6	2	55	6	3
7	8	6	0	55	6	3
8	8	6	0	55	6	3
9	8	9	4	75	8	4
10	8	6	2	55	6	3
11	8	6	2	55	6	3
12	8	6	2	55	6	3
14	8	6	2	55	6	3
15	8	6	0	55	6	3
16	8	6	0	55	6	3
17	8	6	2	55	6	3

[a]Costs are incremental to the baseline.

[b]Costs for continuous emissions monitoring are included in the respective control technology costs.

[c]Basic one-time costs include initial notifications of construction, anticipated start-up, actual start-up, initial performance testing, and a basic siting analysis.

[d]Annual recordkeeping costs include records of employee training and certification, and records of start-up, malfunction, etc.

[e]Annual mercury recordkeeping costs are for mercury sorbent recordkeeping.

[f]Units at small plants can begin testing every three years for a particular pollutant if they pass their performance test for that pollutant for three consecutive years.

Note:

1. Definitions are on p. x.

Source: Davis, Lee. 1994. Memorandum to Brenda Jellicorse, Research Triangle Institute. Radian Corporation. Research Triangle Park, NC. July 20.

TABLE 5-8. MWC II/III NSPS: MODEL PLANT TESTING, REPORTING, AND RECORDKEEPING COSTS ($1990 10^3)[a,b]

		Recordkeeping Costs		Performance Testing and Reporting Costs[f]		
Model Plant Number	Basic One-Time Costs[c]	Annual[d]	Mercury Annual[e]	PM/Metals Recurring	Acid Gas Recurring	Mercury Recurring
1	8	6	2	55	6	3
2	8	6	2	55	6	3
3	8	9	4	75	8	4
4	8	6	2	55	6	3
5	8	9	4	75	8	4
6	8	12	0	96	9	5
8	8	6	2	55	6	3
9	8	6	2	55	6	3
10	8	6	2	55	6	3
11	8	6	2	55	6	3
12	8	6	2	55	6	3

[a]Costs are incremental to the baseline.

[b]Costs for continuous emissions monitoring are included in the respective control technology costs.

[c]Basic one-time costs include initial notifications of construction, anticipated start-up, actual start-up, initial performance testing, and a basic siting analysis.

[d]Annual recordkeeping costs include records of employee training and certification, and records of start-up, malfunction, etc.

[e]Annual mercury recordkeeping costs are for mercury sorbent recordkeeping.

[f]Units at small plants can begin testing every three years for a particular pollutant if they pass their performance test for that pollutant for three consecutive years.

Note:

1. Definitions are on p. x.

Source: Davis, Lee. 1994. Memorandum to Brenda Jellicorse, Research Triangle Institute. Radian Corporation. Research Triangle Park, NC. July 20.

4 percent is used as the rate for annualizing capital costs of control for publicly owned facilities. A real, after-tax weighted average cost of capital of 8 percent is used for annualizing capital costs of control for privately owned facilities. For a discussion of the methods and assumptions used to compute these discount rates, see Appendix A in Economic Impact of Air Pollutant Emission Guidelines for Existing Municipal Waste Combustors (EPA, 1989a).

The term "social costs" refers to the regulatory costs for the nation as a whole. Largely due to the combined effects of taxes and social discount rates, national social costs are not the sum of costs incurred by each affected MWC. In social accounting, the capital costs of control are annualized at a rate reflecting society's real opportunity cost of capital, which is assumed to be 7 percent.

5.3 ASSUMPTIONS AND CONVENTIONS FOR COMPUTING IMPACTS

Various assumptions underlie the economic impacts estimated to result from MWC II/III EG and NSPS. Table 5-9 summarizes the many assumptions, conventions, and calculated values used in this EIA. The first three entries in the table are self-explanatory. Because it is assumed that no existing MWCs will close due to the EG, the total annual costs for the EG remain constant over the estimated remaining facility life.

The EPA further assumes that model plant capacity utilization and its analytical counterparts--employment, annual emission reductions, and energy usage--remain unchanged over the remaining plant life. This assumption avoids computational complexity as well as controversy relating to the evaluation of an uneven flow of emission reductions over time. The assumption that annual operating costs and revenues vary in proportion to capacity utilization would be needed only for investigating the sensitivity of the economic findings to the assumed model plant capacity utilization rates.

TABLE 5-9. ASSUMPTIONS AND CONVENTIONS

Affected MWCs:

- EG: All MWC units at plants with aggregate plant capacity >35 Mg/day placed under construction on or before the proposal date (expected mid-1994).
- NSPS: All MWC units at plants with aggregate plant capacity >35 Mg/day placed under construction after the proposal date (expected mid-1994).

Monetary unit: Constant (real) June 1990 dollars

Year for which impacts are evaluated: 2000

Percentage utilization of daily capacity (There are some exceptions. These percentages remain constant over time.):

- Mass burn: 87.5 percent
- RDF and FBC: 83.3 percent
- Modular: 84.2 percent

Baseline APCDs:

- EG: Variable (see Table 3-6)
- NSPS: All plants just meet the federal standards in effect prior to MWC I; those regulations (40 CFR Part 60 Subpart E) limit PM emissions to a maximum of 0.18 g/dscm for MWC plants with the exception of plants with design capacity of 45 Mg/day or less.

Capital costs for each Air Pollution Control Device (APCD):

- Incurred only at the outset of operation of the APCD
- Amortized over the lifetime of the APCD

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.
- Proportional to MWC capacity utilization (for analysis purposes when alternative capacity utilization rates are introduced)

Lifetimes of physical facilities:

- Existing MWCs: 20 years after compliance costs begin
- New MWCs: 30 years after compliance costs begin
- APCDs: the shorter of 30 years or remaining plant life

No substitution assumption (See text for discussion.)

Market interest (discount) rate for computing potential tipping fee increases and analyzing the distribution of costs:

- Public owners: 4 percent real municipal revenue bond rate
- Private owners: 8 percent real, after-tax weighted average cost of capital

Social discount rates for computing social costs:

- 7 percent for both capital and operating costs

The next four entries are simplifying assumptions used to compute the annual cost of the regulation. The EPA assumes that all capital costs of control for each model plant are incurred on the effective date of compliance, that annual operating and maintenance expenditures and annual recovery credits are unchanging over the cycle, and that salvage value at the end of the cycle equals the cost of removing the worn-out equipment and restoring the site. As noted in the discussion of testing, reporting, and recordkeeping costs, some of these costs are incurred at 3-year intervals rather than annually.

Based on discussions with MWC industry officials, EPA assumes that the remaining plant life on the date of compliance is, on average, 20 years at EG plants and 30 years at NSPS plants and that the equipment life cycle equals remaining plant life. (The costs reported in Tables 5-1 through 5-8 reflect this assumption.) All of these assumptions and procedures reduce computational complexity. Moreover, the level of detail and uncertainty surrounding the engineering cost data do not justify greater realism or finer distinctions in the economic analysis.

One additional major assumption is not reflected in Table 5-9 because it is not easily described in a few lines. As described in Section 5.1, it is assumed that the amount of waste combusted at planned or existing facilities does not change due to the regulation. The demand for combustion services provided by these facilities is assumed to be perfectly inelastic (i.e., constant in the face of rising costs). The inelasticity could be due to inelastic demand *per se*, or to institutional arrangements that do not allow any increase in costs to be passed on directly to waste generators. Thus, this no-substitution assumption is a reasonably worst-case cost scenario because it leads to projections of higher national costs of control than are likely to occur. The last two entries to Tables 5-9 -- the discount rates used to estimate the enterprise costs and the social costs as well as the approach used to model both costs -- are discussed in the following two sections.

5.4 ENTERPRISE COSTS

Having presented the model inputs and assumptions, the next step is to describe methods by which model plant-level cost impacts are calculated for the MWC II/III EG and NSPS. For each model plant subcategory, the required control option and the installed capital and annual operating costs of the control option are known. The annual enterprise cost of the regulation for a model plant subcategory is calculated in several steps shown in the equations for privately owned and publicly owned MWCs:

Private Annual Control Cost:

$$AC_p = \left[\frac{K-D}{(1-(1+r_p)^{-t})/r_p}\right] + \left[(OP-C)\ (1-X_e)\right] \tag{5-1}$$

Public Annual Control Cost:

$$AC_m = \left[\frac{K}{(1-(1+r_m)^{-t})/r_m}\right] + (OP-C) \tag{5-2}$$

Private Annual Testing, Reporting, and Recordkeeping Costs

$$ATRR_p = \frac{\left[\sum_{n=1}^{t}\frac{TRR_n(1-X_e)}{(1+r_p)^n}\right]}{[(1-(1+r_p)^{-t})/r_p]} \tag{5-3}$$

Public Annual Testing, Reporting, and Recordkeeping Costs

$$ATRR_m = \frac{\left[\sum_{n=1}^{t} \frac{TRR_n}{(1 + r_m)^n}\right]}{[(1 - (1 + r_m)^{-t})/r_m]} \quad (5\text{-}4)$$

Private Total Annual Compliance Cost

$$TAC_p = AC_p + ATTR_p \quad (5\text{-}5)$$

Public Total Annual Compliance Cost

$$TAC_m = AC_m + ATTR_m \quad (5\text{-}6)$$

where

AC_p = Annual control cost at privately owned facilities including annual capital recovery and annual operating components;

AC_m = Annual control cost at publicly owned facilities including annual capital recovery and annual operating components;

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

r_p, r_m = Private and public real rates of discount (r_p=8 percent; r_m=4 percent); (See Appendix A in the Economic Impact of Air Pollutant Emission Guidelines for Existing Municipal Waste Combustors (EPA, 1989a) for a discussion of the estimation of these parameters.)

t = Estimated remaining life of the plant on the date of compliance (20 years for EG plants, 30 years for NSPS plants);

OP = Operating costs of the required control option;

C = Credit for the avoided operating costs associated with baseline control equipment supplanted by more stringent controls required under the regulation;

X_e = Effective tax rate equal to $X_s + (1 - X_s)X_f$, where X_s and X_f are the State and Federal average tax rates (X_s = 7 percent, X_f = 35 percent);

D = The present value of the annual tax savings due to depreciation; (Depreciation of the control equipment is calculated as a straight line over the expected life of the equipment or the remaining life of the plant, whichever is shorter.)

$ATRR_p$ = Annual testing, reporting, and recordkeeping cost at privately owned facilities;

$ATRR_m$ = Annual testing, reporting, and recordkeeping cost at publicly owned facilities;

TRR_n = Testing, reporting, and recordkeeping cost incurred in the nth year; (These include costs incurred every year by large plants and those incurred every third year by small plants.)[3]

TAC_p = Total annual compliance cost at privately owned facilities including annual control cost and annual testing, reporting, and recordkeeping cost; and

TAC_m = Total annual compliance cost at publicly owned facilities including annual control cost and annual testing, reporting, and recordkeeping cost.

The annual enterprise costs of the regulatory alternatives are computed using the cost inputs listed in Tables 5-1 through 5-8 and the control options identified in Tables 4-2 through 4-3 as the technology bases under each regulatory alternative and compliance scenario. Tables 5-10 and 5-11 display the results of these calculations.

The estimated annual enterprise costs per megagram presented in Tables 5-10 through 5-11 differ for private and public entities. Publicly owned entities will be able to meet the financial obligations imposed by the regulation at a lower cost than privately owned entities. The differences in costs are due to differences in the tax obligations and the discount rates faced by public versus private entities.

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[3]Testing, reporting, and recordkeeping costs incurred by plants with less than 35 Mg/day capacity are not reflected in the impacts reported in this EIA.

TABLE 5-10. MWC II/III EG: AVERAGE ANNUAL ENTERPRISE COSTS ($1990/Mg MSW)[a,b,c]

Ownership and Regulatory Alternative	Size Classification (Mg MSW/day)	
	Small (35 to 225)	Large (over 225)
Public Entities		
Reg. Alt. I-A	16.32	20.24
Reg. Alt. II-A	33.65	20.24
Reg. Alt. I-B	16.32	20.25
Reg. Alt. II-B	33.65	20.25
Reg. Alt. III	46.02	17.21
Private Entities		
Reg. Alt. I-A	18.74	23.37
Reg. Alt. II-A	37.04	23.37
Reg. Alt. I-B	18.74	23.88
Reg. Alt. II-B	37.04	23.88
Reg. Alt. III	52.42	20.33

[a]Costs are based on the regulatory alternatives and compliance scenarios described in Table 4-2.

[b]Costs are MWC II/III costs over baseline. Costs are annual operating costs plus capital costs, annualized at 4 percent for public entities and 8 percent for private entities. Annual operating costs include testing, reporting, and recordkeeping costs, some of which are also annualized.

[c]Cost per megagram of MSW is computed by dividing the total annual cost of the regulation by the total amount of MSW processed per year at large plants that do not have SD/ESP or SD/FF systems and small plants that do not have DSI/ESP, SD/ESP, or SD/FF systems in the baseline.

Notes:

1. MWC capacity utilization is assumed to average 83 to 88 percent for most plants.

2. Definitions are provided on p. x.

TABLE 5-11. MWC II/III NSPS: AVERAGE ANNUAL ENTERPRISE COSTS ($1990/Mg MSW)[a,b,c]

Ownership and Regulatory Alternative	Size Classification (Mg MSW/day)	
	Small (35 to 225)	Large (over 225)
Public Entities		
Reg. Alt. I	0	11.49
Reg. Alt. II	33.34	11.49
Private Entities		
Reg. Alt. I	0	12.98
Reg. Alt. II	38.26	12.98

[a]Costs are based on the regulatory alternatives described in Table 4-3.

[b]Costs are MWC II/III costs over baseline. Costs are annual operating costs plus capital costs, annualized at 4 percent for publicly owned MWCs and 8 percent for privately owned MWCs. Annual operating costs include testing, reporting, and recordkeeping costs, some of which are also annualized.

[c]Cost per megagram of MSW is computed by dividing the total annual cost of the regulation by the total amount of MSW processed per year at all plants affected by the regulation.

Notes:

1. MWC capacity utilization is assumed to average 83 to 88 percent for most plants.

2. Definitions are provided on p. x.

An increase in the cost of combustion services for both public and private entities will likely result in increases in the average tipping fee charged. The amount of the cost that is passed along to MWC customers in the form of higher tipping fees is determined by institutional and market conditions prevailing in the MSW area. If, for example, the contracts between collectors and combustors allow combustor owners to pass on pollution control costs to the collectors, or if no viable alternatives to disposal by combustion exist locally and costs are covered by tipping fees, then all or most of the costs will be passed on to MWC customers. Table 5-12 shows the average tipping fee increases for publicly owned and privately owned entities if all of the costs are passed through to the MWC customer.

5.5 NATIONAL-LEVEL IMPACTS

In addition to providing estimates of the enterprise cost of EG and NSPS by model plant category and subcategory, this analysis estimates the national social costs, the national emission reductions, and the increase in energy required by upgraded controls associated with MWC I and the MWC II/III regulatory alternatives. The costs are calculated on an aggregate basis and per megagram of MSW combustion. Emission reductions are calculated for CDD/CDF, CO, PM, SO_2, HCl, Pb, Cd, Hg,and NO_x. Energy impacts are calculated for natural gas and electricity.

5.5.1 National Social Costs

To determine the national social costs for a particular regulatory alternative, the annual costs of that alternative for each model plant subcategory are first computed using the methods outlined above for publicly owned plants. As noted in Section 5.2, the capital costs of control are annualized at a rate reflecting society's real opportunity cost of capital, which is assumed to be 7 percent. These annual model plant

TABLE 5-12. MWC II/III: AVERAGE TIPPING FEE INCREASES PROJECTED FOR MWCs ASSUMING A FULL COST PASS THROUGH (Percent)[a]

Ownership, Regulatory Alternative, and Compliance Scenario	Size Classification (Mg MSW/day Capacity)	
	Small (35 to 225)	Large (over 225)
EG		
Public Entities		
Reg. Alt. I-A	29	36
Reg. Alt. II-A	59	36
Reg. Alt. I-B	29	36
Reg. Alt. II-B	59	36
Reg. Alt. III	81	30
Private Entities		
Reg. Alt. I-A	33	41
Reg. Alt. II-A	65	41
Reg. Alt. I-B	33	42
Reg. Alt. II-B	65	42
Reg. Alt. III	92	36
NSPS		
Public Entities		
Reg. Alt. I	0	20
Reg. Alt. II	58	20
Private Entities		
Reg. Alt. I	0	23
Reg. Alt. II	67	23

[a]Tipping fee increases are computed using the average cost per megagram of MSW reported in Tables 5-10 and 5-11 and an average tipping fee of $57/Mg. The average tipping fee is based on the 1993 average tipping fee for MWCs reported in Waste Age (Berenyi & Gould, 1993) converted to 1990 dollars.

Note:

1. Definitions are provided on p. x.

costs are then multiplied by scale factors (see Tables 3-6 and 3-7) and the products are then summed to compute the national-level social costs.

This method is used to estimate the national social costs of both MWC I and MWC II/III. Table 5-13 reports the national social cost impacts of MWC I. Table 5-14 shows the MWC II/III EG costs broken out by acid gas/PM/metals control; Hg control; testing, reporting, and recordkeeping; and NO_x control. Table 5-15 presents the incremental national social costs for EG. Tables 5-16 and 5-17 report the NSPS national social cost impacts and incremental costs, respectively. Note that the costs of control reported in Tables 5-14 and 5-16 for MWC II/III are incremental to the pre-MWC I baseline and are not additive to MWC I costs. In Tables 5-15 and 5-17, incremental costs are incremental to the previous alternative with the exception of Regulatory Alternative I, which is incremental to the pre-MWC I baseline.

The average annual social costs per megagram of MSW combusted for EG by regulatory alternative and compliance scenario are presented in Table 5-18. Large plants with SD/ESP or SD/FF systems in the baseline or small plants with DSI/ESP, SD/ESP, or SD/FF systems in the baseline will not incur any acid gas capital costs. They would however, have compliance costs for mercury control; NO_x control; and testing, reporting, and recordkeeping. On Table 5-18 a total is given for plants with acid gas capital costs as well as a total for all plants. Table 5-19 presents the average annual social cost per megagram of MSW combusted for NSPS by regulatory alternative.

5.5.2 Miscellaneous Costs

In addition to the costs reported in Section 5.5.1, costs not quantified for this analysis are described below.

TABLE 5-13. MWC I NATIONAL SOCIAL COSTS[a]

Control Cost Category	EG	NSPS
Annual Social Costs ($1990 10^3/yr)		
Acid Gas/PM/Metals Control	168,000	133,652
NO_x Control	0	23,537
Total Annual Social Costs	168,000	157,190
Capital Costs ($1990 10^3)		
Acid Gas/PM/Metals Control	888,000	517,000
NO_x Control	0	96,000
Total Capital Costs	888,000	613,000
Annual Total Costs per Mg MSW Combusted ($1990/Mg MSW)[b]		
Acid Gas/PM/Metals Control	13.68	9.82
NO_x Control	0.0	1.91
Total	13.68	11.73

[a]Costs are based on the requirements described in Table 2-2. Annual social costs are the sum of capital costs annualized at 7 percent, and annual operating costs. Annual operating costs include testing, reporting, and recordkeeping costs, some of which are also annualized. Details may not sum to totals due to rounding.

[b]Cost per megagram of MSW for acid gas/PM metals control is computed by dividing the total annual cost by the total amount of MSW combusted per year at plants that incur costs for acid gas, PM, and metals control. Total cost per megagram of MSW for NO_x control is computed by dividing annual NO_x costs by the total amount of MSW combusted per year at plants required to control NO_x.

Notes:

1. MWC capacity utilization is assumed to average 83 to 88 percent for most plants.

2. Definitions are provided on p. x.

TABLE 5-14. MWC II/III EG: NATIONAL SOCIAL COSTS BY REGULATORY ALTERNATIVE AND COMPLIANCE SCENARIO[a]

Control Cost Category	Reg. Alt. I-A	Reg. Alt. II-A	Reg. Alt. I-B	Reg. Alt. II-B	Reg. Alt. III
Annual Social Costs[b] ($1990 10^3/yr)					
Acid Gas/PM/ Metals Control	327,000	355,000	338,000	366,000	407,000
Hg Control	15,200	17,800	10,300	13,000	10,100
Testing, Reporting, Recordkeeping	13,200	13,500	13,200	13,500	13,500
Subtotal	356,000	386,000	361,000	392,000	431,000
NO_x Control	56,300	56,300	56,300	56,300	56,300
Total Annual Social Costs	**412,000**	**443,000**	**418,000**	**448,000**	**487,000**
Capital Costs ($1990 10^3)					
Acid Gas/PM/ Metals Control[c]	1,674,000	1,730,000	1,940,000	2,000,000	2,320,000
Hg Control	14,500	17,800	14,500	17,800	17,800
Subtotal	1,690,000	1,750,000	1,958,000	2,020,000	2,330,000
NO_x Control	236,000	236,000	236,000	236,000	236,000
Total Capital Costs	**1,930,000**	**1,980,000**	**2,190,000**	**2,250,000**	**2,570,000**

[a]Costs are based on the regulatory alternatives and scenarios described in Table 4-2. Total costs are MWC II/III costs over baseline. Details may not sum to totals due to rounding.

[b]Annual social costs are the sum of capital costs, annualized at 7 percent, and annual operating costs. Annual operating costs include testing, reporting, and recordkeeping costs, some of which are also annualized.

[c]Acid gas/PM/metals capital costs include downtime costs computed using a 1993 average tipping fee of $57 Mg ($1990).

Notes:

1. MWC capacity utilization is assumed to average 83 to 88 percent for most plants.

2. Definitions are provided on p. x.

TABLE 5-15. MWC II/III EG: INCREMENTAL NATIONAL SOCIAL COSTS[a]

	Change in Regulatory Alternative under Compliance Scenario A		
Control Cost Category	Baseline to Reg. Alt. I	Reg. Alt. I to Reg. Alt. II	Reg. Alt. II to Reg. Alt. III
Annual Social Costs ($1990 10^3/yr)			
Acid Gas/PM/Metals Control	327,000	27,800	52,400
Hg Control	15,200	2,620	-7,700
Testing, Reporting, Recordkeeping	13,200	295	0
Subtotal	356,600	30,700	44,700
NO_x Control	56,300	0	0
Total Annual Social Costs	**412,000**	**30,700**	**44,700**
Capital Costs ($1990 10^3)			
Acid Gas/PM/Metals Control	1,670,000	54,400	586,000
Hg Control	14,500	3,340	0
Subtotal	1,690,000	57,700	586,000
NO_x Control	236,000	0	0
Total Capital Costs	**1,930,000**	**57,700**	**586,000**
	Change in Regulatory Alternative under Compliance Scenario B		
	Baseline to Reg. Alt. I	Reg. Alt. I to Reg. Alt. II	Reg. Alt. II to Reg. Alt. III
Annual Social Costs ($1990 10^3/yr)			
Acid Gas/PM/Metals Control	338,000	27,800	41,800
Hg Control	10,300	2,620	-2,890
Testing, Reporting, Recordkeeping	13,200	295	0
Subtotal	361,000	30,700	38,900
NO_x Control	56,300	0	0
Total Annual Social Costs	**418,000**	**30,700**	**38,900**
Capital Costs ($1990 10^3)			
Acid Gas/PM/Metals Control	1,940,000	54,400	318,000
Hg Control	14,500	3,340	0
Subtotal	1,960,000	57,700	318,000
NO_x Control	236,000	0	0
Total Capital Costs	**2,190,000**	**57,700**	**318,000**

[a]The incremental national social costs are derived from the national social costs in Table 5-14. Details may not sum to totals due to rounding.

Note:

1. Definitions are provided on p. x.

TABLE 5-16. MWC II/III NSPS: NATIONAL SOCIAL COSTS BY REGULATORY ALTERNATIVE[a]

Control Cost Category	Reg. Alt. I	Reg. Alt. II
Annual Social Costs[b] ($1990 10^3/yr)		
Acid Gas/PM/Metals Control	147,000	166,000
Hg Control	4,220	4,500
Testing, Reporting, Recordkeeping	5,120	5,290
Subtotal	157,000	176,000
NO_x Control	25,400	25,400
Total Annual Social Costs	**182,000**	**201,000**
Capital Costs ($1990 10^3)		
Acid Gas/PM/Metals	575,000	657,000
Hg Control	6,900	8,020
Subtotal	582,200	665,000
NO_x Control	104,000	104,000
Total Capital Costs	**685,000**	**769,000**

[a]Costs are based on the regulatory alternatives described in Table 4-3. Total costs are MWC II/III costs over baseline. Details may not sum to totals due to rounding.

[b]Annual social costs are the sum of capital costs, annualized at 7 percent, and annual operating costs. Annual operating costs include testing, reporting, and recordkeeping costs, some of which are also annualized.

Notes:

1. MWC capacity utilization is assumed to average 83 to 88 percent for most plants.

2. Definitions are provided on p. x.

TABLE 5-17. MWC II/III NSPS: INCREMENTAL NATIONAL SOCIAL COSTS[a]

Control Cost Category	Change in Regulatory Alternative: Baseline to Reg. Alt. I	Change in Regulatory Alternative: Reg. Alt. I to Reg. Alt. II
Annual Social Costs ($1990 10^3/yr)		
Acid Gas/PM/Metals Control	147,000	18,900
Hg Control	4,220	276
Testing, Reporting, Recordkeeping	5,120	162
Subtotal	157,000	19,400
NO_x Control	25,400	0
Total Annual Social Costs	**182,000**	**19,400**
Capital Costs ($1990 10^3)		
Acid Gas/PM/Metals Control	575,000	82,500
Hg Control	6,900	1,120
Subtotal	582,000	83,600
NO_x Control	104,000	0
Total Capital Costs	**685,000**	**83,600**

[a]The incremental national social costs are derived from the national social costs in Table 5-16. Details may not sum to totals due to rounding.

Note:

1. Definitions are provided on p. x.

TABLE 5-18. MWC II/III EG: AVERAGE ANNUAL SOCIAL COST PER MEGAGRAM OF MSW BY REGULATORY ALTERNATIVE AND COMPLIANCE SCENARIO ($1990/Mg MSW)[a,b]

Control Cost Category	Reg. Alt. I-A	Reg. Alt. II-A	Reg. Alt. I-B	Reg. Alt. II-B	Reg. Alt. III
Acid Gas/ PM/Metals Control	19.45	21.10	20.08	21.72	19.51
Hg Control	0.66	0.72	0.45	0.53	0.41
NO_x Control	2.05	2.05	2.05	2.05	2.05
Testing, Reporting, Recordkeeping	0.40	0.41	0.40	0.41	0.41
Total for plants with acid gas capital costs[c]	22.10	23.91	22.44	24.26	22.04
Total for all plants[d]	12.55	13.49	12.73	13.66	14.85

[a]Costs are based on the regulatory alternatives and scenarios described in Table 4-2.

[b]Average cost per megagram of MSW is computed by dividing the annual compliance cost by the total amount of MSW combusted per year at affected plants.

[c]The total for plants with acid gas capital costs under Regulatory Alternatives I and II exclude large plants with SD/ESP or SD/FF systems and small plants with DSI/ESP, SD/ESP, or SD/FF systems in the baseline. These plants will not incur any acid gas capital costs, but will have the following approximate compliance costs per Mg of MSW combusted: mercury control costs, $0.50-$0.70; NO_x control costs, $2.00; and testing, reporting and recordkeeping, $0.40.

[d]Columns do not add to totals because each individual cost number is an average taken over the particular subset of MWCs that incur the cost. Specifically, small plants do not incur mercury control costs under Alternative I, RDF plants do not incur Mercury control costs under any of the alternatives, and mass burn refractory wall plants do not incur NO_x costs.

Note:

1. Definitions are provided on p. x.

TABLE 5-19. MWC II/III NSPS: AVERAGE ANNUAL SOCIAL COST PER MEGAGRAM OF MSW BY REGULATORY ALTERNATIVE ($/Mg MSW)[a,b]

Control Cost Category	Reg. Alt. I	Reg. Alt. II
Acid Gas/PM/Metals Control	10.23	11.12
Hg Control	0.39	0.40
NO_x Control	1.80	1.80
Testing, Reporting, Recordkeeping	0.34	0.35
Total[c]	12.18	13.47

[a]Costs are based on the regulatory alternatives described in Table 4-3.

[b]Average cost per megagram of MSW is computed by dividing the total annual social cost by the total amount of MSW combusted per year at affected plants.

[c]The cost per Mg values for acid gas/PM/metals; mercury; NO_x; and testing, reporting, and recordkeeping do not sum to the total cost because RDF plants do not incur Hg mercury control costs under any of the alternatives.

Note:

1. Definitions are provided on p. x.

Operator training. Operator training and certification is essential to ensure proper operation of MWCs in accordance with GCP. Operating MWCs and the associated APCDs is complex, requiring qualified operators and supervisors. The MWC I EG requires certification of the shift supervisor and chief plant operator and development of a site-specific training manual for use in training all plant operators. MWC II/III regulations specify only minor additional training requirements necessary to operate and service new APCD equipment. 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 environment regulations for new and existing MWCs. The additional costs associated with administering and enforcing the MWC II/III regulations are not quantified.

Adjustment costs for displaced resources. Three types of costs may occur while the economy adjusts to new regulations: under-utilization 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 are not quantified.

Dead-weight welfare losses. These costs are defined as the net losses in consumers' and producers' surplus that occur when the output of goods and services decreases in response to a regulatory action. Because the method used to estimate costs assumes no reduction in provision of MWC services by existing or planned MWCs, no dead-weight losses are estimated.

Paperwork. No paperwork burden costs have been estimated here for the MWC II/III EG and NSPS beyond the testing, reporting, and recordkeeping costs (see Tables 5-7 and 5-8).

Costs of Controlling Fugitive Emissions. The additional costs to control fugitive emissions are not included in this analysis.

5.5.3 National Emissions and Energy Impacts

National-level emission reductions and energy impacts are calculated on a basis similar to national costs. First, the emission reductions for each model plant subcategory are calculated by subtracting the emissions associated with a particular control option from the baseline emissions for that model plant subcategory.[4] Then the emission reduction computed for the model plant is multiplied by the corresponding scale factor (see Tables 3-6 and 3-7). The national emission reductions for a pollutant are equal to the sum of all the emission reductions of a given pollutant for the model plant subcategories multiplied by the corresponding scale factors. Table 5-20 shows the national annual emission reductions attributable to MWC I. The MWC II/III emission reductions are reported in Tables 5-21 and 5-22.

Energy impacts are calculated in the same fashion as emission reductions with the exception that there are no baseline energy estimates. The national energy impacts are calculated for natural gas and electricity. The MWC I national energy impacts are presented in Table 5-23. The MWC II/III national energy impacts and incremental impacts are shown in Tables 5-24 and 5-25 for EG and Tables 5-26 and 5-27 for NSPS. The electricity impacts reported in the tables represent a very small portion of the electricity generated at MWCs -- less than 10 percent. The natural gas impacts are negligible.

5.5.4 Social Cost/Effectiveness of Acid Gas and Mercury Control

C/E is the ratio of cost to effectiveness. In this context "costs" are the costs of acid gas control, Hg control,

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[4] In the baseline, we assume all NSPS plants just meet the Federal standards, which limit PM emissions to a maximum of 0.18 g/dscm for MWC plants with the exception of plants with design capacity of 45 Mg/day or less. EG baseline emissions reflect baseline levels of control characterized in Table 3-6.

TABLE 5-20. MWC I NATIONAL BASELINE EMISSIONS AND EMISSIONS REDUCTIONS (Mg/yr)[a]

	EG		NSPS	
Pollutant Category	Baseline Emissions[e]	Emissions Reductions	Baseline Emissions	Emissions Reductions
CDD/CDF (total)	0.142	0.117	0.030	0.028
CO	21,700	5,890	5,440	0
PM[b]	5,750	1,120	8,040	5,670
SO_2	47,600	25,300	41,900	34,600
HCl	54,300	35,800	51,700	46,000
Pb	99.3	29.7	161	140
Cd	6.71	2.12	10.9	9.00
Hg[c]	54.7	11.4	34.0	9.00
NO_x	53,700	0	29,800	10,300
Total Ash Residual[d]	6,920,000	-84,300	4,090,000	-239,000

[a]Emissions reductions are based on the emissions reduction requirements described in Table 2-2.

[b]PM is total particulate matter and has not been adjusted to exclude Cd, Pb, and Hg.

[c]Hg control is not required under MWC I. However, Hg emissions are reduced at RDF plants under MWC I as a result of acid gas control.

[d]Total ash residual reductions are negative reflecting an increase over baseline levels because of the regulation.

[e]The baseline emissions shown here for the 1991 EG are less than the baseline emissions for the MWC II/III regulatory alternatives shown in accompanying tables because the latter include emissions from MWCs for which construction began in the 1990 through 1994 period.

Notes:

1. MWC capacity utilization is assumed to average 83 to 88 percent for most plants.

2. Definitions are provided on p. x.

Sources: U.S. Environmental Protection Agency. 1989c. Municipal Waste Combustors — Background Information for Proposed Guidelines for Existing Facilities. Office of Air Quality Planning and Standards. EPA-450/3-89-27e; U.S. Environmental Protection Agency. 1989e. Municipal Waste Combustors — Background Information for Proposed Standards: 111(b) Model Plant Description and Cost Report. EPA/450/3-89-27b.

TABLE 5-21. MWC II/III EG: NATIONAL BASELINE EMISSIONS AND EMISSIONS REDUCTIONS BY REGULATORY ALTERNATIVE AND COMPLIANCE SCENARIO (Mg/yr)[a]

Pollutant Category	Baseline Emissions	Reg. Alt. I-A	Reg. Alt. II-A	Reg. Alt. I-B	Reg. Alt. II-B	Reg. Alt. III
CDD/CDF (total)	0.159	0.154	0.156	0.155	0.157	0.158
CO	24,300	8,680	8,680	8,690	8,690	8,690
PM[b]	6,340	3,070	3,070	3,070	3,070	3,240
SO_2	53,100	41,200	43,300	41,200	43,300	45,000
HCl	60,500	51,600	56,300	51,600	56,300	57,300
Pb	109.0	74.8	74.8	91.1	91.1	102.0
Cd	7.37	5.24	5.24	5.56	5.56	6.02
Hg	61.1	44.7	47.5	44.7	47.5	47.5
NO_x	60,100	19,300	19,300	19,300	19,300	19,300
Total Ash Residual[c]	7,730,000	-127,000	-156,000	-184,000	-214,000	-238,000

[a]Emissions reductions are based on regulatory alternatives and scenarios described in Table 4-2. Emissions reductions are MWC II/III reductions over baseline.
[b]PM is total particulate matter and has not been adjusted to exclude Cd, Pb, and Hg.
[c]Total ash residual reductions are negative reflecting an increase over baseline levels because of the regulation.

Notes:

1. MWC capacity utilization is assumed to average 83 to 88 percent for most plants.
2. Definitions are provided on p. x.

Sources: U.S. Environmental Protection Agency. 1989c. Municipal Waste Combustors — Background Information for Proposed Guidelines for Existing Facilities. Office of Air Quality Planning and Standards. EPA-450/3-89-27e; U.S. Environmental Protection Agency. 1989d. Municipal Waste Combustors - Background Information for Proposed Standards: Control of NO_x Emissions. Office of Air Quality Planning and Standards. EPA-450/3-89-27d; Nebel, Kris. 1991. Memorandum to Walt Stevenson, EPA/SDB. Radian Corporation. Research Triangle Park, NC. May 22; Soderberg, Eric. 1990. Memorandum to Brenda Jellicorse, Research Triangle Institute. Radian Corporation. Research Triangle Park, NC. August 31; Davis, A. Lee. 1991a. Memorandum to Michael G. Johnston, U.S. EPA/ISB. Radian Corporation. Research Triangle Park, NC. April 24; Soderberg, Eric, David White, and Kristina Nebel. 1991. Memorandum to Walter Stevenson, U.S. EPA/SDB, and Michael G. Johnston, U.S. EPA/ISB. Radian Corporation. Research Triangle Park, NC. July 17.

TABLE 5-22. MWC II/III NSPS: NATIONAL BASELINE EMISSIONS AND EMISSIONS REDUCTIONS BY REGULATORY ALTERNATIVE (Mg/yr)[a]

Pollutant Category	Baseline Emissions	Reg. Alt. I	Reg. Alt. II
CDD/CDF (total)	0.030	0.029	0.029
CO	5,440	0	0
PM[b]	8,040	6,480	6,480
SO_2	41,900	37,000	37,700
HCl	51,700	49,900	50,200
Pb	161	155	157
Cd	10.9	10.1	10.2
Hg	34	26	27
NO_x	29,800	10,500	10,500
Total Ash Residual[c]	4,090,000	-267,000	-266,000

[a]Emissions reductions are based on regulatory alternatives described in Table 4-3. Emissions reductions are MWC II/III reductions over baseline. In the baseline, EPA assumes all NSPS plants just meet the Federal standards, which limit PM emissions to a maximum of 0.18 g/dscm for MWC plants with the exception of plants with design capacity of 45 Mg/day or less.

[b]PM is total particulate matter and has not been adjusted to exclude Cd, Pb, and Hg.

[c]Total ash residual reductions are negative reflecting an increase over baseline levels because of the regulation.

Notes:

1. MWC capacity utilization is assumed to average 83 to 88 percent for most plants.

2. Definitions are provided on p. x.

Sources: U.S. Environmental Protection Agency. 1989e. Municipal Waste Combustors – Background Information for Proposed Standards: 111(b) Model Plant Description and Cost Report. EPA-450/3-89-27b; U.S. Environmental Protection Agency. 1989d. Municipal Waste Combustors - Background Information for Proposed Standards: Control of NO_x Emissions. Office of Air Quality Planning and Standards. EPA-450/3-89-27d; Nebel, Kris. 1991. Memorandum to Walt Stevenson, EPA/SDB. Radian Corporation. Research Triangle Park, NC. May 22.; Soderberg, Eric. 1990. Memorandum to Brenda Jellicorse, Research Triangle Institute. Radian Corporation. Research Triangle Park, NC. August 31.

TABLE 5-23. MWC I NATIONAL ANNUAL ENERGY IMPACTS (TJ/yr)[a]

	Energy Source[b]	
	Electricity	Gas
EG	481	481
NSPS		
Acid Gas/PM/Metals Control	744	0
NO_x Control	212	0
Total	956	0

[a]Energy impacts are based on the requirements reported in Table 2-2.

[b]Gas impacts result from GCP and electricity impacts result from adding acid gas control for the EG and from adding acid gas and NO_x controls for the NSPS.

Notes:

1. MWC capacity utilization is assumed to average 83 to 88 percent for most plants.

2. Definitions are provided on p. x.

TABLE 5-24. MWC II/III EG: NATIONAL ANNUAL ENERGY IMPACTS (TJ/yr)[a]

Regulatory Alternative and Compliance Scenario	Energy Source[b]	
	Electricity	Gas
Reg. Alt. I-A	1,310	779
Reg. Alt. II-A	1,420	779
Reg. Alt. I-B	1,700	779
Reg. Alt. II-B	1,810	779
Reg. Alt. III	1,960	779

[a]Energy impacts are based on regulatory alternatives and scenarios described in Table 4-2. Energy impacts are MWC II/III impacts over baseline.

[b]Gas impacts result from GCP and electricity impacts result from acid gas controls and NO_x control.

Notes:

1. MWC capacity utilization is assumed to average 83 to 88 percent for most plants.

2. Definitions are provided on p. x.

Sources: Davis, A. Lee. 1991a. Memorandum to Michael G. Johnston, U.S. EPA/ISB. Radian Corporation. Research Triangle Park, NC. April 24; U.S. Environmental Protection Agency. 1989c. Municipal Waste Combustors--Background Information for Proposed Guidelines for Existing Facilities. Office of Air Quality Planning and Standards. EPA-450/3-89-27e.

TABLE 5-25. MWC II/III EG: INCREMENTAL NATIONAL ANNUAL ENERGY IMPACTS (TJ/yr)[a]

Change in Regulatory Alternative and Compliance Scenario	Energy Source	
	Electricity	Gas
Compliance Scenario A		
Baseline to Reg. Alt. I	1,310	779
Reg. Alt. I to Reg. Alt. II	110	0
Reg. Alt. II to Reg. Alt. III	540	0
Compliance Scenario B		
Baseline to Reg. Alt. I	1,700	779
Reg. Alt. I to Reg. Alt. II	110	0
Reg. Alt. II to Reg. Alt. III	150	0

[a]Incremental energy impacts are based on the national annual energy impacts in Table 5-24.

Note:

1. Definitions are provided on p. x.

TABLE 5-26. MWC II/III NSPS: NATIONAL ANNUAL ENERGY IMPACTS (TJ/yr)[a]

Regulatory Alternative	Energy Source[b]	
	Electricity	Gas
Reg. Alt. I	1,050	0
Reg. Alt. II	1,052	0

[a]Emissions reductions are based on regulatory alternatives described in Table 4-3. Energy impacts are MWC II/III impacts over baseline.

[b]Gas impacts result from GCP, and electricity impacts result from acid gas controls and NO_x control. There are no gas costs because GCP is in the baseline.

Notes:

1. MWC capacity utilization is assumed to average 83 to 88 percent for most plants.

2. Definitions are provided on p. x.

Sources: U.S. Environmental Protection Agency. 1989e. Municipal Waste Combustors - Background Information for Proposed Standards: 111(b) Model Plant Description and Cost Report. EPA-450/ 3-89-27b.

TABLE 5-27. MWC II/III NSPS: INCREMENTAL NATIONAL ANNUAL ENERGY IMPACTS (TJ/yr)[a]

Change in Regulatory Alternative	Energy Source	
	Electricity	Gas
Baseline to Reg. Alt. I	1,050	0
Reg. Alt. I to Reg. Alt. II	2	0

[a]Incremental energy impacts are based on the national annual energy impacts in Table 5-26.

Note:

1. Definitions are provided on p. x.

or NO_x control, measured in dollars per year. The "effects" are corresponding reductions in acid gas emissions (SO_2 + HCl), Hg emissions, or NO_x emissions, measured in megagrams per year. Consequently, a low C/E is preferred to a high C/E because the former achieves control at a lower cost per megagram of emissions reduced. Computing the social C/E for Hg control and NO_x control is straightforward because the costs and emission reductions are associated with a single pollutant, assuming acid gas controls are in place. However, the same is not true for acid gas control. A discussion of the methods and assumptions used in computing acid gas C/E follows.

The control systems used to reduce acid gases also reduce emissions of many other pollutants besides those defined as acid gas. To compensate for the omission of these pollutants from the "effectiveness" dimension of the C/E analysis, a credit in the amount of $17,700/Mg of PM emission reduction is applied to the costs. This credit is based on an estimated value of damages caused by the emission of one megagram of PM (see Chapter 8 for further discussion of PM damages). The adjusted total annual cost represents the costs attributable solely to acid gas control. Using this credit for PM reductions implies the following working assumptions:

- PM embraces all pollutants emitted by MWCs except acid gases (SO_2 and HCl), Hg, and NO_x;
- PM from MWCs is similar in composition to those sources used to estimate damages from PM emissions;
- the damage estimates from those other sources transfer to the situations characteristic of MWCs.

Although these assumptions are not expected to hold exactly, they hold closely enough to justify using the current procedures for policy guidance. In addition, the effectiveness measure used here (HCl + SO_2 reductions) does not reflect any differences in the relative benefit of reducing HCl and SO_2. Alternative weights for HCl and SO_2 are explored, however, in the sensitivity analysis that follows in Chapter 6.

The scope of the cost component of a C/E analysis may also be inadequate if the regulation under consideration significantly affects the markets that serve or are served by the regulated activities. If, for example, the demand for a type of control equipment that was in short supply tripled because of the regulation, the price of the equipment would rise, affecting the cost, and perhaps even the effectiveness, of the regulation. Even though most MWCs are operated in a highly regulated market, the cost of operating may increase enough to result in the substitution of some other waste management method for combustion, especially if the cost of the alternative disposal option is significantly less than combustion.

Because of these limitations, EPA supplements C/E results with judgments about which of the regulatory alternatives to consider and about which of these are the most protective of health and welfare, yet affordable and equitable. Despite its shortcomings, C/E analysis does provide a quantifiable, if somewhat narrow, means of comparing regulatory alternatives. Selected C/E measures are discussed below for acid gas, Hg, and NO_x control.

C/E can be measured in either average or incremental terms. Average C/E is computed relative to baseline conditions and is, therefore, the total cost of control divided by the total level of emission reductions. Incremental C/E is calculated relative to the preceding regulatory alternative as measured by the amount of emission reductions. It is found by dividing the difference in cost between the two regulatory alternatives by the difference in emission reductions.

Of the two measures, incremental C/E alone is compatible with "maximization of net benefits" (OMB, 1991) because incremental C/E weighs the additional change in costs against the additional change in benefits. This comparison is necessary to optimize the choice of a regulatory alternative when more than one alternative has positive net benefits. In this analysis, C/E therefore generally means incremental C/E.

Tables 5-28 through 5-31 show C/E measures for EG and NSPS acid gas, Hg, and NO_x control. These values are computed using the national social costs found in Tables 5-14 (EG) and 5-16 (NSPS) and the emissions reductions found in Tables 5-21 (EG) and 5-22 (NSPS). Note that incremental C/E and average C/E are the same for the first alternative considered under each EG scenario and for the NSPS because incremental C/E for the first alternative is relative to the baseline.

TABLE 5-28. MWC II/III EG: AVERAGE NATIONAL SOCIAL COST/EFFECTIVENESS ($1990 10^3/Mg emissions reduction)[a]

Control Category	Reg. Alt I-A	Reg. Alt. II-A	Reg. Alt. I-B	Reg. Alt. II-B	Reg. Alt. III
Acid Gas/PM/ Metals Control[b]	2.94	3.02	3.05	3.12	3.42
Hg Control[c]	339	374	231	273	212
NO_x Control[d]	2.93	2.93	2.93	2.93	2.93

[a]C/E is computed using annual social costs reported in Table 5-14 and emission reductions reported in Table 5-21.

[b]Average C/E of acid gas control is [total cost-(total PM reductions * $17,700)]/total SO_2 + HCl reductions).

[c]Average C/E of Hg control is (total Hg cost)/(total Hg reductions).

[d]Average C/E of NO_x control is (total NO_x cost)/(total NO_x reductions).

Note:

1. Definitions are provided on p. x.

TABLE 5-29. MWC II/III EG: INCREMENTAL NATIONAL SOCIAL COST/EFFECTIVENESS ($1990 10^3/Mg emissions reduction)[a]

Control Category	Baseline to Reg. Alt. I	Reg. Alt. I to Reg. Alt. II	Reg. Alt. II to Reg. Alt. III
	Change in Regulatory Alternative under Compliance Scenario A		
Acid Gas/PM/ Metals Control[b]	2.94	4.11	18.6
Hg Control[c]	339	950	0.00
NO_x Control[d]	2.93	0.00	0.00
	Change in Regulatory Alternative under Compliance Scenario B		
	Baseline to Reg. Alt. I	Reg. Alt. I to Reg. Alt. II	Reg. Alt. II to Reg. Alt. III
Acid Gas/PM/ Metals Control[b]	3.05	4.11	14.6
Hg Control[c]	231	950	0.00
NO_x Control[d]	2.93	0.00	0.00

[a]Incremental C/E is computed using annual incremental social costs reported in Table 5-15 and emission reductions reported in Table 5-21. Data presented in all tables are rounded, but calculations are made with unrounded data.

[b]Incremental C/E of acid gas control is [incremental cost-(incremental PM reductions * $17,700)]/(incremental SO_2 + HCl reductions).

[c]Incremental C/E of Hg control is (incremental Hg cost)/(incremental Hg reductions).

[d]Incremental C/E of NO_x control is (incremental NO_x cost)/(incremental NO_x reductions).

Note:

1. Definitions are provided on p. x.

TABLE 5-30. MWC II/III NSPS: AVERAGE NATIONAL SOCIAL COST/EFFECTIVENESS ($\$10^3$/Mg emissions reduction)[a]

Control Category	Reg. Alt. I	Reg. Alt. II
Acid Gas Control[b]	0.38	0.59
Hg Control[c]	162	167
NO_x Control[d]	2.42	2.42

[a]C/E is computed using annual social costs reported in Table 5-16 and emission reductions reported in 5-22. Data presented in all tables are rounded, but calculations are made with unrounded data.

[b]Average C/E of acid gas control is [total cost-(total PM reductions * $17,700]/(total SO_2 + HCl reductions).

[c]Average C/E of Hg control is (total Hg cost)/(total Hg reductions).

[d]Average C/E of NO_x control is (total NO_x cost)/(total NO_x reductions).

Note:

1. Definitions are provided on p. x.

TABLE 5-31. MWC II/III NSPS: INCREMENTAL NATIONAL SOCIAL COST/EFFECTIVENESS ($$10^3$/Mg emissions reduction)[a]

	Change in Regulatory Alternative	
	Baseline to Reg. Alt. I	Reg. Alt. I to Reg. Alt. II
Acid Gas Control[b]	0.38	19.60
Hg Control[c]	162	313
NO_x Control[d]	2.42	0.0

[a]Incremental C/E is computed using annual incremental social costs reported in Table 5-17 and emission reductions reported in Table 5-22. Data presented in all tables are rounded, but calculations are made with unrounded data.

[b]Incremental C/E of acid gas control is [incremental cost-(incremental PM reductions * $17,700)]/(incremental SO_2 + HCl reductions).

[c]Incremental C/E of Hg control is (incremental Hg cost)/(incremental Hg reductions).

[d]Incremental C/E of NO_x control is (incremental NO_x cost)/(incremental NO_x reductions).

Note:

1. Definitions are provided on p. x.

CHAPTER 6
SENSITIVITY ANALYSIS

This chapter examines the effects of changing certain analytical assumptions on the national impacts estimated for EG and NSPS. In particular, assumptions used to compute C/E values, discount rates, downtime assumptions, and capacity utilization rates are changed. For the EG, sensitivity estimates are computed for Regulatory Alternative II under two compliance scenarios. For the NSPS, sensitivity estimates are computed for Regulatory Alternatives I and II.

Tables 6-1 and 6-2 show the effects on the acid gas C/E estimates of using alternative credits for PM reductions. As described in Chapter 5, acid gas C/E is computed by dividing acid gas costs, net of a $17,700 credit for PM, by acid gas reductions. The first column in each table reports the C/E value with the $17,700/Mg credit for PM, and the second column reports the C/E value with a $0/Mg credit for PM. No change occurs in the incremental C/E value between NSPS Regulatory Alternatives I and II because no incremental PM reductions are associated with this change.

Tables 6-3 and 6-4 also address assumptions regarding C/E for acid gas control. In particular, these tables report the effects of using alternative weights for HCl reductions. In Chapter 5, C/E is computed using SO_2 plus HCl reductions as the estimate of acid gas effectiveness. The first column of Tables 6-3 and 6-4 follows this convention for estimating C/E. In the second column, however, estimates of C/E effectiveness are computed using SO_2 reductions only. Excluding HCl reductions from the estimates of acid gas effectiveness results in significantly higher estimates of C/E because HCl reductions account for at least half of the acid gas reductions in most cases.

TABLE 6-1. MWC II/III EG: NATIONAL SOCIAL COST/EFFECTIVENESS OF ACID GAS CONTROL USING ALTERNATIVE CREDITS FOR PM REDUCTIONS ($1990 10^3/Mg Reductions)[a]

Regulatory Alternative and Compliance Scenario[b]	Credit for PM Reductions	
	$17,700/Mg	$0/Mg
Reg. Alt. II-A	3.02	3.56
Reg. Alt. II-B	3.12	3.67

[a]C/E is reported using annual social costs provided in Table 5-14 and emission reductions provided in Table 5-21. Data presented in all tables are rounded, but calculations are made with unrounded data.

[b]Regulatory Alternative II and Scenarios A and B are described in Table 4-2.

Notes:

1. C/E of acid gas control with a credit for PM reductions is [total acid gas cost - (total PM reductions * $17,700)]/(total SO_2 + HCl reductions).

2. C/E of acid gas control with zero credit for PM reductions is (total acid gas cost)/(total SO_2 + HCl reductions).

3. Definitions are provided on p. x.

TABLE 6-2. MWC II/III NSPS: NATIONAL INCREMENTAL SOCIAL COST/EFFECTIVENESS OF ACID GAS CONTROL USING ALTERNATIVE CREDITS FOR PM REDUCTIONS ($1990 10^3/Mg Reductions)[a]

Change in Regulatory Alternative[b]	Credit for PM Reductions: $17,700/Mg	Credit for PM Reductions: $0/Mg
Baseline to Reg. Alt. I	0.38	1.69
Reg. Alt. I to Reg. Alt. II	19.60	19.60

[a]C/E is reported using annual social costs provided in Table 5-16 and emission reductions provided in Table 5-22. Data presented in all tables are rounded, but calculations are made with unrounded data.

[b]The regulatory alternatives are described in Table 4-3.

Notes:

1. C/E of acid gas control with a credit for PM reductions is [incremental acid gas cost - (incremental PM reductions * $17,700)]/(incremental SO_2 + HCl reductions).
2. C/E of acid gas control with zero credit for PM reductions is (incremental acid gas cost)/ (incremental SO_2 + HCl reductions).
3. Definitions are provided on p. x.

TABLE 6-3. MWC II/III EG: NATIONAL SOCIAL COST/EFFECTIVENESS OF ACID GAS CONTROL USING ALTERNATIVE WEIGHTS FOR HCl REDUCTIONS (\$1990 10^3/Mg Reductions)[a]

Change in Regulatory Alternative and Compliance Scenario[b]	Weights for HCl Reductions	
	\$$10^3$/Mg SO_2 + HCl	\$$10^3$/Mg SO_2 Only
Reg. Alt. II-A	3.02	6.94
Reg. Alt. II-B	3.12	7.19

[a]C/E is reported using annual social costs provided in Table 5-14 and emission reductions provided in Table 5-21. Data presented in all tables are rounded, but calculations are made with unrounded data.

[b]Regulatory Alternative II and Scenarios A and B are described in Table 4-2.

Notes:

1. C/E of acid gas control per megagram SO_2 + HCl is [total acid gas cost - (total PM reductions * \$17,700)]/(total SO_2 + HCl reductions).

2. C/E of acid gas control per megagram SO_2 is [total acid gas cost - (total PM reductions * \$17,700)]/ (total SO_2 reductions).

3. Definitions are provided on p. x.

TABLE 6-4. MWC II/III NSPS: NATIONAL INCREMENTAL SOCIAL COST/EFFECTIVENESS OF ACID GAS CONTROL USING ALTERNATIVE WEIGHTS FOR HCl REDUCTIONS ($1990 10^3/Mg Reductions)[a]

Change in Regulatory Alternative[b]	Weights for HCl Reductions	
	$\$10^3/Mg\ SO_2 + HCl$	$\$10^3/Mg\ SO_2$ Only
Baseline to Reg. Alt. I	0.38	0.88
Reg. Alt. I to Reg. Alt. II	19.55	28.42

[a]C/E is reported using annual social costs provided in Table 5-16 and emission reductions provided in Table 5-22. Data presented in all tables are rounded, but calculations are made with unrounded data.

[b]The regulatory alternatives are described in Table 4-3.

Notes:

1. C/E of acid gas control per megagram SO_2 + HCl is [incremental acid gas cost - (incremental PM reductions * $17,700)]/(incremental SO_2 + HCl reductions).

2. C/E of acid gas control per megagram SO_2 is [incremental acid gas cost - (incremental PM reductions * $17,700)]/(incremental SO_2 reductions).

3. Definitions are provided on p. x.

Tables 6-5 and 6-6 show the effects of changing discount rates on the national annual costs of controlling all emissions. Total annual costs are the sum of annualized capital costs and annual operating costs. The differences in costs by discount rate are due to differences in the estimated annualized capital cost component of total annual costs. (To the extent explained above in Sections 5.4 and 5.5 of Chapter 5, testing, reporting, and recordkeeping costs are also somewhat affected by the discount rate.)

Installing pollution control equipment at existing MWC plants may result in one or more months of downtime that cannot be worked into normal maintenance downtime. This situation is particularly true for GCP. Costs associated with this downtime include lost tipping fees and energy recovery revenues. The installed capital costs used to estimate impacts reported in Chapter 5 include costs associated with less than a month to 6 months of downtime depending on the plant technology and the type of control equipment being installed. Table 6-7 reports the effects of changing these downtime assumptions to reflect a maximum downtime of one month.

Tables 6-8 through 6-11 show the impacts of changing the capacity utilization rates on national costs and emission reductions. The impacts reported in Chapter 5 are based on average capacity utilization reported in the 1991 Resource Recovery Yearbook (Gould, 1991). Average capacity utilization is about 83 to 88 percent for most plants. The first column in Tables 6-8 and 6-9 reports costs based on average capacity utilization. The second column in these tables reports costs based on a capacity utilization rate of 91 percent for most plants. Tables 6-10 and 6-11 show the corresponding emission reductions.

TABLE 6-5. MWC II/III EG: NATIONAL ANNUAL SOCIAL COST USING ALTERNATIVE DISCOUNT RATES ($1990 10^3/yr)[a]

Regulatory Alternative and Compliance Scenario[b]	Discount Rate 7%	3%	10%
Reg. Alt. II-A	443,000	388,000	489,000
Reg. Alt. II-B	448,000	387,000	501,000

[a]Annual costs are MWC II/III costs over baseline. Annual costs are the sum of capital costs, annualized at 7, 3, or 10 percent, and annual operating costs. Annual operating costs include testing, reporting, and recordkeeping costs, some of which also are annualized at 7, 3, or 10 percent.

[b]Regulatory Alternative II and Scenarios A and B are described in Table 4-2.

Note:

1. Definitions are provided on p. x.

TABLE 6-6. MWC II/III NSPS: NATIONAL ANNUAL SOCIAL COST USING ALTERNATIVE DISCOUNT RATES ($1990 10^3/yr)[a]

Regulatory Alternative[b]	Discount Rate 7%	3%	10%
Reg. Alt. I	182,000	162,000	200,000
Reg. Alt. II	201,000	178,000	221,000

[a]Annual costs are MWC II/III costs over baseline. Annual costs are the sum of capital costs, annualized at 7, 3, or 10 percent, and annual operating costs. Annual operating costs include testing, reporting, and recordkeeping costs, some of which also are annualized at 7, 3, or 10 percent.

[b]The regulatory alternatives are described in Table 4-3.

Note:

1. Definitions are provided on p. x.

TABLE 6-7. MWC II/III EG: NATIONAL ANNUAL SOCIAL COST USING ALTERNATIVE DOWNTIME ASSUMPTIONS ($1990 10^3/yr)[a]

Regulatory Alternative and Compliance Scenario[b]	Initial Downtime Assumptions[c]	Maximum Downtime of One Month
Reg. Alt. II-A	443,000	438,000
Reg. Alt. II-B	448,000	444,000

[a]Annual costs are MWC II/III costs over baseline. Annual costs are the sum of capital costs, annualized at 7 percent, and annual operating costs. Annual operating costs include testing, reporting, and recordkeeping costs, some of which are also annualized at 7 percent.

[b]Regulatory Alternative II and Scenarios A and B are described in Table 4-2.

[c]Initial downtime assumptions range from zero to 6 months and are reported in MWCs--Background Information for Proposed Guidelines for Existing Facilities (EPA, 1989c).

Note:

1. Definitions are provided on p. x.

TABLE 6-8. MWC II/III EG: NATIONAL ANNUAL SOCIAL COST USING ALTERNATIVE CAPACITY UTILIZATION RATES ($1990 10^3)[a]

	Average Capacity Utilization[c]		High Capacity Utilization[c]	
Regulatory Alternative and Compliance Scenario[b]	Total Annual Cost ($$10^3$/yr)	Cost per Mg MSW Combusted ($/Mg MSW)[d]	Total Cost ($$10^3$/yr)	Cost per Mg MSW Combusted ($/Mg MSW)[d]
Reg. Alt. II-A	443,000	23.90	454,000	23.20
Reg. Alt. II-B	448,000	24.30	459,000	23.50

[a]Annual costs are MWC II/III costs over baseline. Total annual costs are the sum of capital costs, annualized at 7 percent, and annual operating costs. Annual operating costs include testing, reporting, and record-keeping costs, some of which are also annualized at 7 percent.

[b]Regulatory Alternative II and Scenarios A and B are described in Table 4-2.

[c]Average capacity utilization is assumed to be 83 to 88 percent for most plants. High capacity utilization is assumed to be about 91 percent for most plants.

[d]Costs per megagram of MSW are total costs divided by the amount of MSW combusted at MWCs, excluding large plants with SD/ESP or SD/FF systems and small plants with DSI/ESP, SD/ESP, or SD/FF systems in the baseline.

Note:

1. Definitions are provided on p. x.

TABLE 6-9. MWC II/III NSPS: NATIONAL ANNUAL SOCIAL COST USING ALTERNATIVE CAPACITY UTILIZATION RATES ($1990 10^3)[a]

	Average Capacity Utilization[c]		High Capacity Utilization[c]	
Regulatory Alternative[b]	Total Annual Cost ($$10^3$/yr)	Cost per Mg MSW Combusted ($/Mg MSW)[d]	Total Cost ($$10^3$/yr)	Cost per Mg MSW Combusted ($/Mg MSW)[d]
Reg. Alt. I	182,000	12.20	189,000	12.00
Reg. Alt. II	201,000	13.50	209,000	13.20

[a]Annual costs are MWC II/III costs over baseline. Annual costs are the sum of capital costs, annualized at 7 percent, and annual operating costs. Annual operating costs include testing, reporting, and recordkeeping costs, some of which are also annualized at 7 percent.

[b]The regulatory alternatives are described in Table 4-3.

[c]Average capacity utilization is assumed to be 83 to 88 percent for most plants. High capacity utilization is assumed to be about 91 percent for most plants.

[d]Costs per megagram of MSW are total costs divided by the amount of MSW combusted at planned MWCs subject to the NSPS.

Note:

1. Definitions are provided on p. x.

TABLE 6-10. MWC II/III EG: NATIONAL EMISSION REDUCTIONS USING ALTERNATIVE CAPACITY UTILIZATION RATES (Mg/yr)[a]

Regulatory Alternative[b]	Total CDD/CDF	CO	PM	SO_2	HCl	Pb	Cd	Hg	NO_x	Total Ash Residual[c]
Average Capacity Utilization[d]										
Reg. Alt. I	0.156	8,680	3,070	43,300	56,300	74.8	5.24	47.5	19,300	-156,000
Reg. Alt. II-A	0.157	8,690	3,070	43,300	56,300	91.1	5.56	47.5	19,300	-214,000
High Capacity Utilization[d]										
Reg. Alt. II-A	0.164	8,950	3,140	46,200	59,700	77.2	5.40	50.1	20,500	-178,000
Reg. Alt. II-B	0.165	0.165	3,140	46,200	59,700	94.5	5.74	50.1	20,500	-239,000

[a]Emission reductions MWC II/III reductions over baseline.

[b]Regulatory Alternatives II and Scenarios A and B are described in Table 4-2.

[c]Total ash residual is negative reflecting an increase over baseline levels due to the regulation.

[d]Average capacity utilization is assumed to be 83 to 88 percent for most plants. High capacity utilization is assumed to be about 91 percent for most plants.

Note:

1. Definitions are provided on p. x.

TABLE 6-11. MWC II/III NSPS: NATIONAL EMISSION REDUCTIONS USING ALTERNATIVE CAPACITY UTILIZATION RATES (Mg/yr)[a]

Regulatory Alternative[b]	Total CDD/CDF	CO	PM	SO_2	HCl	Pb	Cd	Hg	NO_x	Total Ash Residual[c]
Average Capacity Utilization[d]										
Reg. Alt. I	0.029	0	6,480	37,000	49,900	155	10.1	26.0	10,500	-267,000
Reg. Alt. II	0.029	0	6,480	37,700	50,200	157	10.2	27.0	10,500	-266,000
High Capacity Utilization[d]										
Reg. Alt. I	0.032	0	6,850	39,400	52,800	164	10.7	27.7	11,100	-283,000
Reg. Alt. II	0.032	0	6,850	40,100	53,100	167	10.8	28.6	11,100	-282,000

[a]Emission reductions MWC II/III reductions over baseline.

[b]Regulatory Alternatives I and II are described in Table 4-3.

[c]Total ash residual is negative reflecting an increase over baseline levels due to the regulation.

[d]Average capacity utilization is assumed to be 83 to 88 percent for most plants. High capacity utilization is assumed to be about 91 percent for most plants.

Note:

1. Definitions are provided on p. x.

Using the higher estimates of capacity utilization results in an increase in national-level costs and emission reductions. Costs per megagram of MSW, however, decline as capacity utilization rates increase. These movements are due to three assumptions used to estimate costs with higher capacity utilization rates. First, total capacity for EG and NSPS plants is held constant. Thus the increase in capacity utilization results in a higher waste flow combusted. Second, operating costs are a function of the amount of waste combusted and increase proportionate to the increase in the waste flow. Finally, capital costs are a function of capacity and do not change as a result of the higher capacity utilization rate or increased waste flow.

The higher emission reductions reflect the increased waste flow to MWCs under the higher capacity utilization rates. Likewise, the total costs of the regulation increase because operating costs increase proportionately to the waste flow. Unlike total costs, however, the cost per megagram of MSW declines as capacity utilization increases. This decline occurs because, although total operating costs rise, the operating costs per megagram do not change as a result of higher capacity utilization. In addition, the annualized capital cost component is spread over a larger waste flow, resulting in a lower total cost per megagram of MSW.

If the total waste flow had been held constant for these calculations, the total costs would have been slightly lower with a higher capacity utilization. Emissions would have remained unchanged under a constant total waste flow. Alternatively, changing the total waste flow to NSPS and EG while keeping the capacity utilization constant would result in a change in total costs, costs per megagram, and emission reductions proportionate to the change in the waste flow.

CHAPTER 7
GOVERNMENT, PRIVATE FIRM, AND HOUSEHOLD IMPACTS

The costs estimated for the MWC II/III regulatory alternatives will affect government entities, firms, and households. This chapter examines how the impacts for existing plants subject to EG and new plants subject to NSPS affect these sectors of the economy. Of particular concern are the impacts on small entities. The regulatory flexibility act (RFA) of 1980 requires that special consideration be given to small entities including businesses, government jurisdictions, and nonprofit organizations potentially affected by Federal regulation. The following sections describe the affected entities, the requirements of the RFA, the distribution of impacts across entities of all sizes, and mitigating measures considered for small entities.

7.1 AFFECTED ENTITIES

The impacts of the regulatory alternatives may be direct or indirect in nature. Directly affected entities may include any entity that disposes of MSW in an MWC as well as any entity that owns an MWC. The extent of the impacts of any one regulatory alternative on a specific generator or owner depends on several factors including the level of pollution control in place at the time of the regulation, local market conditions and contractual arrangements, size and type of the MWC plant, financial status of the owner, and method of financing MSW disposal. In addition, firms that supply services and equipment in the MWC industry but do not own a plant will be indirectly affected. These indirectly affected firms may actually benefit from the regulation as demand for air pollution control technology and equipment increases.

Consequently, this chapter focuses on the impacts on directly affected entities.

Potentially affected waste generators include households, businesses, and institutions located in communities that dispose of waste in an MWC. Households are the primary generators of MSW. Indeed, an argument can be made that many commercial and industrial wastes stem from consumer demand for products. For example, a grocery store may dispose of corrugated containers, but consumers demand the foods that are packaged in these containers. Although commercial and industrial entities generate waste, they have not been incorporated into this analysis.

Owners of MWCs can be public entities or private firms. Some MWCs are jointly owned by public entities and private firms. Ownership impacts are evaluated using the criterion for public entities where this type of joint ownership occurs. Public owners can be a municipality as small as a single village or as large as the Federal government. Private owners may also range from one of the multimillion dollar waste industry giants to very small, single-entity firms.

Public entities that own an MWC can be affected in several ways. Depending on the relative cost of other means of waste disposal, a public entity may decide to substitute alternative waste disposal technologies (such as landfilling or recycling) rather than purchase and operate the required control equipment. However, quantitative examination of a substitution scenario is beyond the scope of this analysis.

Affected entities typically incur two types of costs due to imposed regulation: capital and operating. 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. To raise the money required to cover these costs, the public entity may increase taxes, increase tipping fees, or direct funds away from other services. In any case, the impacts are passed along to households in the affected jurisdictions. Private firms may elect to secure a loan or redirect funds from other uses to cover the initial and recurring costs. Part or all of the increase in costs may be passed along to customers in the form of increased tipping fees.

The impacts on affected entities are not necessarily equitable across entities. Communities have different prevailing economic and financial conditions, which lead to different burdens for different communities. For example, a relatively prosperous community may perceive compliance as less costly than a community faced with difficult economic times. Differences in the size of the service area or in the population represented by the entity that owns the facility can also translate into different degrees of impact for communities. Furthermore, technological differences, both in the type of MWC and the type of APCD, can result in inequities from the proposed regulation. In particular, communities that have recently invested in an APCD would probably be harder hit by a requirement to purchase additional control equipment in a relatively short time. Finally, differences in the time period over which a community chooses to finance the capital costs of control will affect the annualized costs of the regulation.

Similarly, firms can experience different degrees of effects because of differences in their individual situations. Different cost structures, tax rates, technologies, past APCD investments, and size can all result in inequities among firms from the proposed regulation.

7.2 REGULATORY FLEXIBILITY ACT REQUIREMENTS

The RFA requires that Federal agencies consider whether regulations they develop will affect small entities (which may include nonprofit organizations, small governmental jurisdictions, and small businesses) (U.S. Small Business

Administration [SBA], 1982). If the proposed rule is likely to have a significant adverse economic impact on a substantial number of small entities, a regulatory flexibility analysis is required. The Act allows some flexibility in defining small entities and determining what a substantial number and significant impact are.

Using SBA guidelines, EPA has identified small government jurisdictions as those with populations of less than 50,000. Small businesses are identified by SBA general size standard definitions. For SIC code 4953, Refuse Systems, small businesses are those receiving less than $6 million/yr, averaged over the most recent three fiscal years (Code of Federal Regulation, 1991).

The EPA (1982) provides guidelines for determining when a "substantial number" of these small entities have been "significantly affected." The EPA guidance states that a "substantial number" is more than 20 percent of these (small entities) affected for each industry the proposed rule would cover. However, each office may develop its own criterion for defining what is meant by a substantial number.

Under the RFA, for a rule to be proposed, EPA must prepare an initial regulatory flexibility analysis or certify that the proposed rule is not expected to exert "a significant economic impact on a substantial number of small entities." The following steps are used to determine whether a regulatory flexibility analysis is required:

1. Project the total number of small entities potentially affected by the proposed rule.

2. Project the number of small entities likely to incur an economic impact.

3. Compute the share of all small entities potentially affected that are likely to incur an economic impact.

4. Measure the impacts on small entities and identify small entities likely to incur a significant economic impact.

5. Compute the share of all small entities potentially affected that are likely to incur a significant economic impact.

If the share computed in Step 3 is less than 20 percent, then Steps 4 and 5 are unnecessary and a regulatory flexibility analysis is not required. If the share computed in Step 3 is greater than 20 percent, then Steps 4 and 5 are necessary. Finally, if the share computed in Step 5 is greater than 20 percent, a regulatory flexibility analysis must be prepared.

The total number of potentially affected small entities in the United States is difficult to measure because of the wide variation in the size of MWCs. Sizes range from a small portable unit in a 55-gallon drum to very large facilities with a daily capacity of 3,000 Mg. The EPA specifically identified 179 existing MWC facilities and 16 planned MWC facilities for this distributional analysis.[1] These facilities range from 35 Mg/day to over 3,000 Mg/day in design capacity. These facilities are owned by 63 small entities, as defined above, that include the following:

- small government entities that own existing MWCs,
- small government entities planning to build MWCs,
- small firms that own existing MWCs, and
- small firms planning to build MWCs.

Table 7-1 reports the total number and the number of small public and private entities that own an existing or planned MWC over 35 Mg/day capacity. Where population or annual sales data are unavailable, it is assumed that the entity is small. Also note that where ownership data are not available, it is assumed that the government jurisdiction representing the

[1]Six additional planned plants were identified, but were not included in the analysis because capacity data are not available.

TABLE 7-1. NUMBER OF PUBLIC AND PRIVATE ENTITIES THAT OWN AN MWC SUBJECT TO MWC II/III EG OR NSPS[a]

Regulation	Number of MWCs[b]	Number of Owners			Number of Small Owners[c]		
		Public	Private	Total	Public	Private	Total
EG	179	100	39	139	38	22	60
NSPS	16	15	5	20	3	4	7

[a]Excludes entities that own an MWC below 35 Mg/day capacity.

[b]The number of MWCs does not equal the number of owners because some owners own multiple MWCs and some MWCs have more than one owner.

[c]Small public entities are defined as those with a population below 50,000. Small private entities are defined as those receiving less than $6 million in annual sales.

Notes:

1. Where ownership data are unavailable, it is assumed that the community where the facility is located is the owner.

2. Where population or annual sales data are unavailable, it is assumed that the entity is small. Therefore, the number of small entities may be overestimated.

location or the future location of the MWC is also the owner of the MWC.

In addition to the entities identified above, numerous very small facilities below 35 Mg/day capacity are likely owned by small entities that are not specifically identified for this analysis. Many of these small facilities are located in hospitals, apartment buildings, and shopping malls. Other entities such as banks, kennels, stables, resorts, defense contractors, country clubs, marinas, churches, camps, lodges, schools, community buildings, military installations, naval vessels, and law enforcement units also operate very small combustors (Trott, 1991).

In December 1989, EPA proposed a rule that would cover all MWCs with no exemption for size. During the comment period that followed that proposal, EPA received several letters expressing concern about the impacts on small entities that own very small MWCs (from >1 to 35 Mg/day capacity). In addition, several commentors expressed concern that the definition of MSW contained in the December proposed rule would result in restrictions for industrial incinerators and medical waste incinerators.

To address these concerns, EPA introduced a size exemption and a revised (narrower) definition of MSW that excludes industrial incinerators and medical waste incinerators from the requirements. These measures, along with several others designed to mitigate impacts on small entities, are included in the MWC II/III proposed rule. As a result of these measures most of the potentially affected small entities identified above will not incur any economic impacts.

As indicated above, a "substantial number" of small entities is defined as more than 20 percent of all potentially affected small entities -- not just those identified in Table 7-1. Because of the size exemption and the other mitigating measures, thousands of small entities will not incur any economic impact. The share of small entities that are likely to incur impacts comprises less than 20 percent of all potentially affected small entities in the industry. Consequently, a regulatory flexibility analysis is not required.

Even though a regulatory flexibility analysis is not required, EPA believes analyzing the distribution of impacts of the regulation on affected entities and small affected entities in particular is appropriate. The next section examines the distribution of impacts on government entities and firms of all sizes as well as household impacts.

7.3 DISTRIBUTIONAL IMPACTS

This section examines the distribution of impacts on government entities and firms that own MWCs and on households served by MWCs. Specifically, this section first examines government entities' ability to issue bonds to cover the capital costs of the regulation. Next, the financial impacts for firms that own or are planning to build MWCs is examined. This section concludes with a discussion of the burden the regulation imposes on households. Data sources used to compute the distributional impacts on government entities, firms, and households are identified in Table 7-2.

7.3.1 Impacts on Government Entities

An estimated 100 government entities subject to the EG and 15 government entities subject to the NSPS are identified for this analysis (see Table 7-1). Figures 7-1 and 7-2 show the population distribution of government entities that own an existing MWC subject to EG and government entities planning to build an MWC subject to NSPS, respectively.

Approximately 74 communities with an existing MWC larger than 35 Mg/day will likely incur initial capital costs associated with the purchase of control equipment. The MWCs owned by the remaining 26 communities are not projected to incur any capital control costs because these facilities have

TABLE 7-2. DISTRIBUTIONAL ANALYSIS DATA SOURCES

Plant data:	
location, owner, combustor type, pollution control type, capacity	• The National Solid Wastes Management Association. 1992. "The 1992 Municipal Waste Combustion Guide." Waste Age. November. • HCI Publications. 1993. The 1993 Energy-from-Waste Activity Report. Kansas City. • Kiser, Jonathan V.L. 1993. The IWSA Municipal Waste Combustion Directory: 1993 Update of U.S. Plants. Washington, D.C.: Integrated Waste Services Association. (Used for NSPS Plants Only.)
MWC service area population,[a] operating hours per year	• Gould, Robert, M.S., M.P.H., ed. 1991. 1991 Resource Recovery Yearbook, Directory and Guide. Governmental Advisory Associates.
Demographic data:[b]	
1986 population, 1985 per-capita income, 1985 persons per household, 1990 population inflator	• U.S. Department of Commerce. 1988. County and City Data Book 1988. • U.S. Department of Commerce. 1991. 1991 Statistical Abstract of the United States.
Financial data:	
1990 per-capita income inflator	• U.S. Department of Commerce. 1991. 1991 Statistical Abstract of the United States.
1993 tipping fee	• Berenyi, Eileen B. and Robert N. Gould. 1993 "Municipal Waste Combustion in 1993." Waste Age. (November):51-56.

(continued)

TABLE 7-2. DISTRIBUTIONAL ANALYSIS DATA SOURCES (continued)

Financial data (continued)	
firm sales data	• Moody's Bank and Finance Manual. 1992. New York: Moody's Investors Service, Danny A. Zottoli, Jr., publisher.
	• Moody's Industrial Manual. 1992. New York: Moody's Investors Service, Danny A. Zottoli, Jr., publisher.
	• Moody's Public Utility Manual. 1992. New York: Moody's Investors Service, Danny A. Zottoli, Jr., publisher.
	• Ward's Business Directory of U.S. Private and Public Companies. 1993. Washington, DC: Gale Research, Inc.
Other data: average waste generation per person	• U.S. Environmental Protection Agency. 1992. Characterization of Municipal Solid Waste in the United States: 1992 Update. Office of Solid Waste and Emergency Response (OS-305). EPA/530-R-92-019.

[a]Where MWC service area population was not available from the Resource Recovery Yearbook, the figure was estimated using plant waste flow divided by 0.71 Mg/yr/person.

[b]For privately owned plants and plants for which the owner is unknown, these statistics represent the population of the location of the plant; for publicly owned plants they represent the population of the owning community.

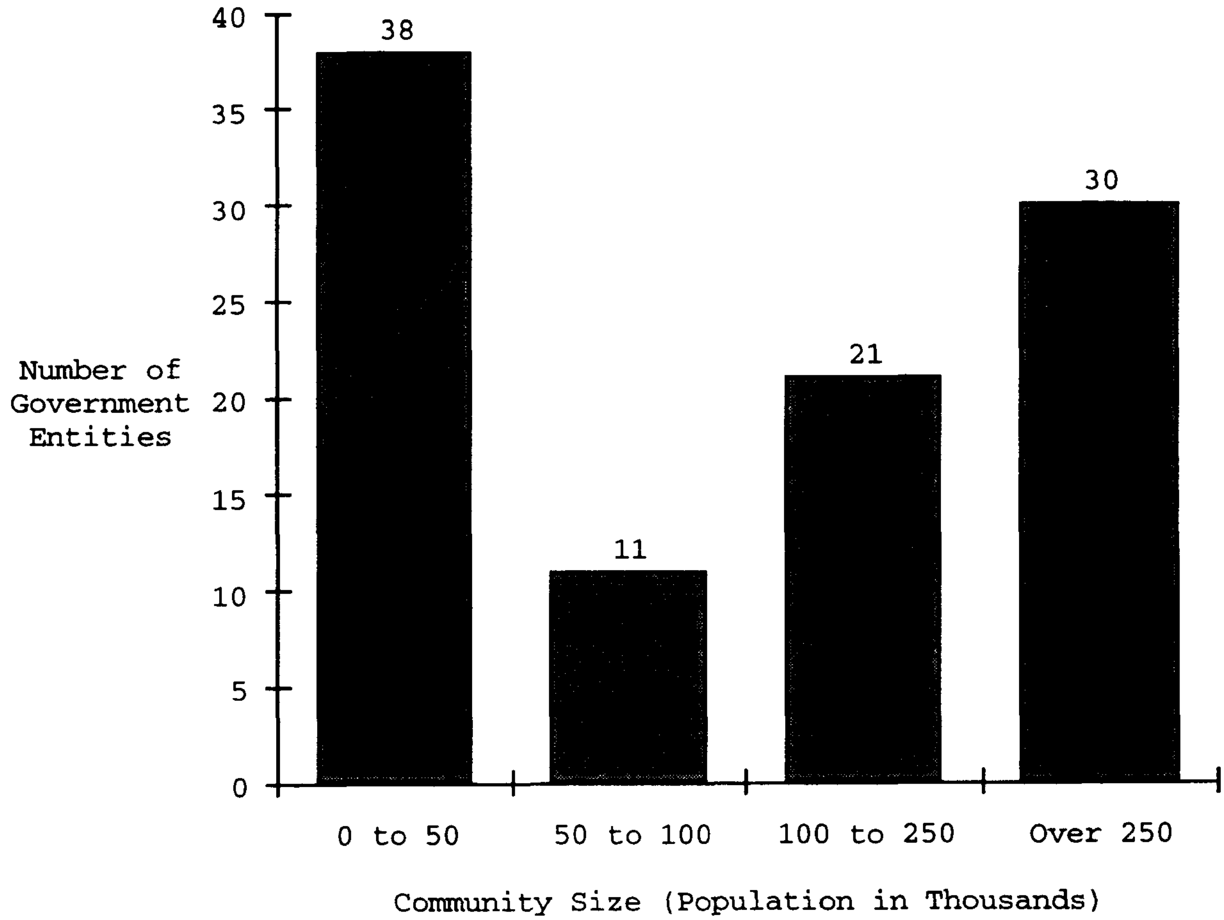

Figure 7-1. MWC II/III EG: Population distribution of government entities that own an MWC

Notes:

1. Population data are unavailable for several municipalities identified as MWC owners. County population is used for these municipalities.

2. Where ownership data are unavailable, it is assumed that the entity identified as the facility location is the owner.

Sources: Sources are identified in Table 7-2.

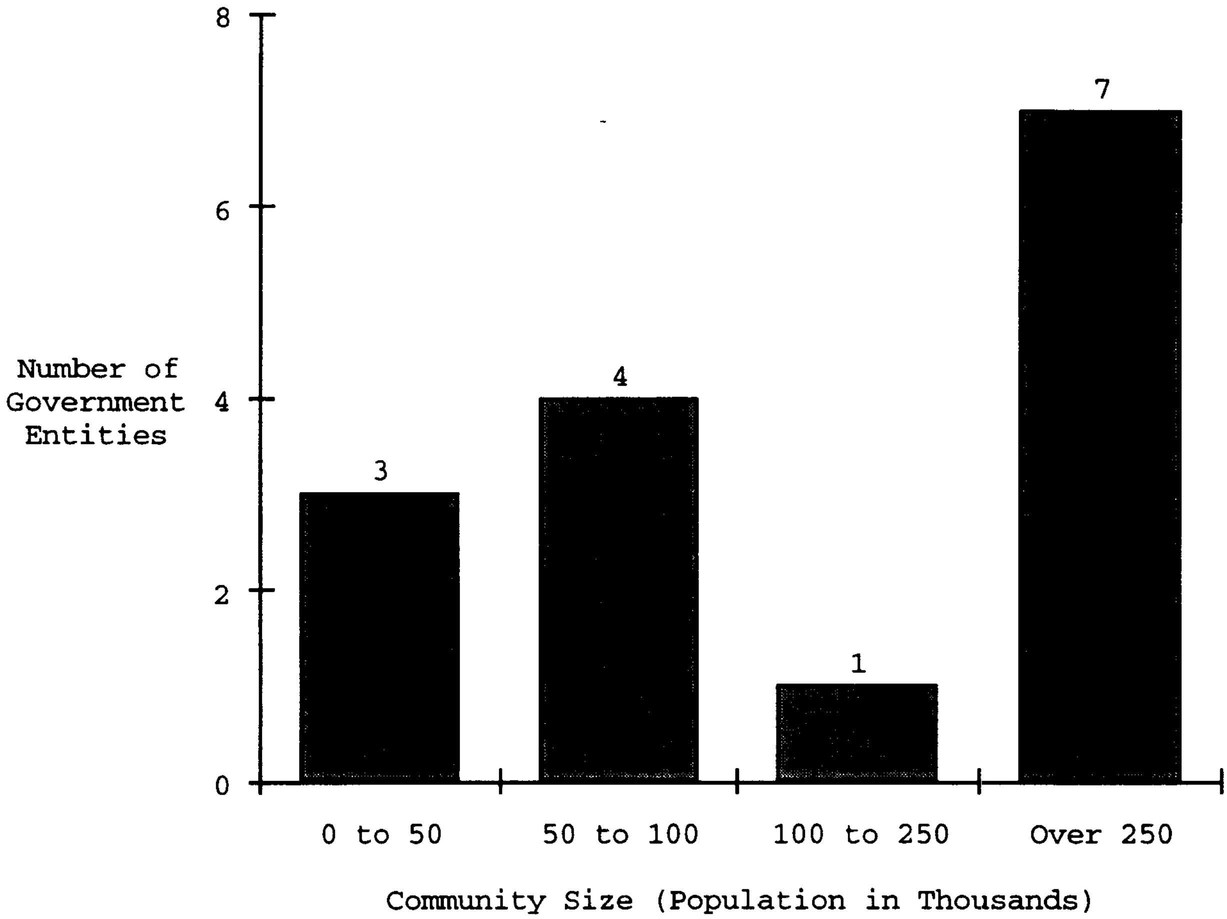

Figure 7-2. MWC II/III NSPS: Population distribution of government entities planning to build an MWC

Note:

1. Where ownership data are unavailable, it is assumed that the entity identified as the facility location is the owner.

Sources: Sources are identified in Table 7-2.

fairly advanced baseline air pollution control equipment. (Note, however, that all facilities are projected to incur operating costs due to the regulation.) Some communities may be able to cover the capital costs of the regulation from their cash reserves. Other communities, however, may not have the necessary cash reserves to cover the initial capital costs of the regulation. These communities must either raise the funds needed for the initial capital investment or shut down their MWCs.

Table 7-3 provides a list of several financing options available to government entities. Revenue bonds are the primary financing mechanism municipalities use to secure funds for MWC plant and equipment (Gould, 1991). Consequently, this analysis measures the impacts of MWC II/III regulations 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 is projected based on a threshold criterion established in Municipalities, Small Businesses, and Agriculture--The Challenge of Meeting Environmental Responsibilities (EPA, 1988). Specifically, if annual cost per household due to the regulation exceeds one percent of average annual household income, then the community is projected to have potential difficulty issuing revenue bonds.

Household costs are computed using the following data:

- per-capita income;
- number of persons per household;
- average waste generation per person;
- service area population; and
- population of the owning entity (see Table 7-2 for a list of data sources).

TABLE 7-3. FINANCING OPTIONS AVAILABLE TO GOVERNMENT ENTITIES

- Operating budget
- Capital improvement fund
- General obligation bonds
- Revenue bonds
- Taxable bonds
- Creative borrowing
  - Floating rate bonds
  - Zero coupon bonds
  - Compound interest bonds
  - Stripped coupon bonds
  - Stepped interest bonds
  - Put bonds
  - Bonds with warrants
- Short-term borrowing
  - Bond anticipation notes
  - Grant anticipation notes
  - Revenue anticipation notes
  - Tax anticipation notes
  - Tax-exempt commercial paper
  - Tax-exempt demand master notes
  - Capital notes
- Multijurisdictional capital pools
- Federal grants
- State grants
- State infrastructure bank
- State revolving load fund
- State bond bank

Source: Matzer, John, Jr. 1989. Capital Projects: New Strategies for Planning, Management, and Finance.

Per-capita income is converted to 1990 dollars using the 1990 per-capita income inflator. The population data (except persons per household for each entity) are projected to 1990 using the 1990 population inflator for the U.S. The above data are combined with cost data to compute two ratios used to measure the cost per household and the cost per household as a percentage of pre-tax household income.

To project whether a community is expected to have potential difficulty issuing revenue bonds, the annual cost of the regulation computed for the analysis of household costs is used for each government entity that owns one or more MWCs. The total annual cost of the regulation for a given community that owns one or more MWCs is based on the annualized capital cost and the annual operating cost estimated for the model plant(s) representing the actual plant (or plants) owned by the community.[2] Where the actual plant differs from the model plant in the amount of waste combusted per year, the model plant annual operating costs are scaled up or down to conform to the waste flow at the actual plant. Unlike operating costs, however, small differences in capacity or waste flow generally do not result in different capital costs. Consequently, no adjustment is made to the capital cost component.

The EG capital cost portion of total annual costs is annualized using an estimated real discount rate of 4 percent (EPA, 1989a) over a 20-year time period. This annualization period for existing facilities implies that owners of these facilities will pay off the capital costs of the regulation over a 20-year period. However, some communities that own an existing facility may decide to finance the capital costs of the regulation over a shorter time period due to bond covenants and other institutional constraints. Consequently, the impacts of the EG are also evaluated based on the

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[2]Annual operating costs include testing, reporting, and recordkeeping costs, some of which are also annualized.

assumption that owners of existing MWCs finance the capital costs of the regulation over a 10-year period. Impacts of the NSPS are computed based on a real discount rate of 4 percent and a 30-year annualization period.

After computing the annual compliance costs for each government entity as described above, the average cost per household is computed for each affected community as follows. The Resource Recovery Yearbook (Gould, 1991) reports the service area population for many of the MWCs included in this distributional analysis. For those MWCs not included in the Resource Recovery Yearbook database, the service area population is estimated by dividing the amount of MSW combusted by the MWC annually by the average waste generated per person annually (0.71 Mg/person/year) (EPA, 1992). To compute the number of households served by the MWC, service area population is divided by the average number of persons per household for the government entity that owns the MWC. Next, total compliance cost for the government entity is divided by the average number of households served to compute the average annual cost per household.[3] Finally, the estimated average annual cost per household is compared to the average annual household income for the community. As noted above, if the cost per household exceeds one percent of average annual household income, then the community is projected to have potential difficulty issuing revenue bonds.

Table 7-4 shows the share of government entities whose compliance costs (annualized over 20 years) exceed the threshold criterion under the EG. No government entities with a population above 50,000 are projected to have difficulty issuing revenue bonds as a result of the EG. However, approximately 3 percent of small affected entities (population below 50,000) are projected to have potential difficulty

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[3]Where a community owns more than one MWC, costs are summed for all plants owned to get the total costs of the regulation for the owning entity.

TABLE 7-4. MWC II/III EG: SHARE OF GOVERNMENT ENTITIES WITH POTENTIAL DIFFICULTY ISSUING REVENUE BONDS (Percent)[a]

Regulatory Alternative and Compliance Scenario	Community Size (Population 10^3)			
	0 to 50	50 to 100	100 to 250	Over 250
Number of Observations	38	11	22	35
Reg. Alt. I-A	0	0	0	0
Reg. Alt. II-A	3	0	0	0
Reg. Alt. I-B	0	0	0	0
Reg. Alt. II-B	3	0	0	0
Reg. Alt. III	8	0	0	0

[a]Communities are assumed to have difficulty issuing revenue bonds if the following threshold criterion is exceeded: [(total annual cost of the regulation/number of households in the service area)/average household income] > 1 percent. Total annual cost includes the annualized capital cost and the annual operating cost. Annual operating costs include testing, reporting, and recordkeeping costs, some of which are also annualized.

Sources: Sources are identified in Table 7-2.

issuing revenue bonds under Regulatory Alternative II. This share increases to 8 percent under Regulatory Alternative III. None of the government entities planning to build an MWC are projected to have difficulty issuing revenue bonds due to the NSPS.

The share of government entities with potential difficulty issuing revenue bonds due to the EG is also projected using a 10-year annualization period. When the costs of the EG are annualized over 10 years, still no government entities with a population above 50,000 are projected to have difficulty issuing revenue bonds. However, under Regulatory Alternative II, 5 percent of small affected entities are projected to have difficulty issuing revenue bonds (compared to the projected 3 percent when a 20-year annualization period is used). Under Regulatory Alternative III, 8 percent of the small affected entities are projected to have difficulty issuing revenue bonds (under both annualization period assumptions).

Government entities that are unable to issue a bond to cover the costs of the regulation may decide to use other financing mechanisms (see Table 7-3) or other waste disposal options. Entities that are able to--and choose to--issue a bond to finance the costs of the regulation face the possibility that the additional debt burden will adversely affect their financial health. If the impact is severe enough, the government entity's bond rating may fall. Examining the effect that additional costs due to the regulation would have on municipality bond ratings is beyond the scope of this analysis.

7.3.2 <u>Firm Impacts</u>

This analysis identifies 39 firms that own MWCs subject to EG and 5 firms that own MWCs subject to NSPS. These firms include private entities that own or are planning to build an MWC over 35 Mg/day capacity. In several cases, especially for the EG, a single firm owns multiple MWCs.

As mentioned in Section 7.2, small entities are defined as those receiving less than $6 million in annual sales. Using this definition, 22 firms that own one or more existing MWCs are small and 4 firms planning to build one or more MWCs are small. Note that firms for which annual sales data are not available are assumed to be small.

Detailed financial data are published for 17 of the large firms and none of the small firms that own MWCs likely to incur impacts under the EG. Total annual costs of the regulation as a percentage of sales average less than 1 percent and range from less than 1 up to 80 percent for each of these 17 firms. The total annual costs for firms that own multiple MWCs are computed by summing the total estimated annual costs for all plants owned by the firm.

Table 7-5 shows average tipping fee increases at privately owned MWCs subject to EG and NSPS. These increases are based on an average tipping fee of $57/Mg and the assumption of a full cost pass through. The tipping fee increase at each MWC owned by small firms averages from approximately 17 percent under the least stringent regulatory alternative to almost 21 percent under the most stringent one. The tipping fee increase at each MWC owned by large firms averages from approximately 14 percent under the least stringent regulatory alternative to 15 percent under the most stringent one.

Detailed financial data are published for only one of the large firms and none of the small firms planning to build MWCs subject to NSPS. Total annual costs of the regulation amount to less than one percent of total annual sales for this firm. Tipping fee increases average from 26 percent under Regulatory Alternative I to 28 percent under Regulatory Alternative II for MWCs owned by small firms. Tipping fee increases average about 17 percent (under both alternatives) for MWCs owned by large firms.

TABLE 7-5. MWC II/III: AVERAGE TIPPING FEE INCREASES AT PRIVATELY OWNED MWCs BY SIZE OF FIRM (Percent)[a]

Regulatory Alternative and Compliance Scenario	Size of the Firm (Annual Sales)	
	Small ($0 to $6 Million)	Large (Over $6 Million)
EG		
Reg. Alt. I-A	16.6	13.7
Reg. Alt. II-A	18.1	13.9
Reg. Alt. I-B	16.6	14.0
Reg. Alt. II-B	18.1	14.2
Reg. Alt. III	20.7	15.3
NSPS		
Reg. Alt. I	25.9	17.2
Reg. Alt. II	27.7	17.2

[a]Tipping fee increases are total annual costs per megagram of MSW divided by an average tipping fee of $57/Mg of MSW. Costs are MSW II/III total annual costs. Total annual cost per megagram of MSW is the sum of capital costs and the annualized portion of testing costs, annualized at 8 percent over 20 years, and annual operating costs divided by the total annual waste flow at the facility.

Sources: Sources are identified in Table 7-2.

7.3.3 Household Impacts

Regardless of the methods used to finance the costs of the regulation, the government entity will pass these costs along to households in the form of higher taxes, higher user fees, or reduced services. Household impacts are computed based on the methods discussed in Section 7.3.1. Household impacts apply to communities served by MWCs owned by both public and private entities. Therefore, the description in Setion 7.3.1 of the methods used to compute average cost per household and average cost per household as a percentage of income for publicly owned MWCs also applies to privately owned MWCs. Community size is based on the population of the government entity that owns the MWC (in the case of publicly owned facilities) or the population of the community where the MWC is located (in the case of privately owned facilities).

Tables 7-6 and 7-7 show the average annual cost per household under the EG and NSPS, respectively. These tables report the average cost increase due to the regulation that is directly assessed to households in the form of increased user fees or increased taxes. 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 Table 7-6 indicate that, on average, the EG costs per household are generally higher for entities with a population between 50,000 and 100,000. The values reported in Table 7-8 indicate that, on average, NSPS costs per household are generally higher for communities with a population less than 100,000.

Tables 7-8 and 7-9 report the average annual cost per household as a percentage of average pre-tax household income under the EG and NSPS, respectively. Because of higher costs per household population coupled with lower average household income levels, affected entities with a population ranging from 50,000 to 100,000 will pay a larger portion of their income to comply with the regulation. The EPA is aware of the potential differential burden on households in small

TABLE 7-6. MWC II/III EG: AVERAGE ANNUAL COST PER HOUSEHOLD ($1990/household/year)[a]

Regulatory Alternative and Compliance Scenario	Community Size (Population 10^3)[b]			
	0 to 50	50 to 100	100 to 250	Over 250
Number of Observations[c]	68	22	37	48
Reg. Alt. I-A	18	28	22	22
Reg. Alt. II-A	22	29	24	26
Reg. Alt. I-B	18	29	22	22
Reg. Alt. II-B	22	30	24	26
Reg. Alt. III	26	33	25	28

[a]Cost per household is computed by dividing the total annual compliance cost for the MWC by the estimated number of households in the service area. Costs are MWC II/III total annual costs. Total annual cost is the sum of capital costs and the annualized portion of testing costs annualized over 20 years (computed using 8 percent for privately owned facilities and 4 percent for publicly owned facilities) and annual operating costs.

[b]For privately owned facilities and facilities for which the type of ownership is not identified, community size is based on the population of the entity identified as the location. For publicly owned facilities community size is based on the population of the entity that owns the MWC.

[c]The number of observations indicates the number of entities for which relevant demographic data are available.

Note:

1. These estimates are based on the assumption that essentially all the community's waste goes to the incinerator, and therefore are upper bound estimates. They would overestimate the costs for communities that are also served by landfills.

Sources: Sources are identified in Table 7-2.

TABLE 7-7. MWC II/III NSPS: AVERAGE ANNUAL COST PER HOUSEHOLD ($1990/household/year)[a]

Regulatory Alternative	Community Size (Population 10^3)[b] 0 to 50	50 to 100	100 to 250	Over 250
Number of Observations[c]	6	4	1	9
Reg. Alt. I	26	26	23	17
Reg. Alt. II	27	29	23	17

[a]Cost per household is computed by dividing the total annual compliance cost for the MWC by the estimated number of households in the service area. Costs are MWC II/III total annual costs. Total annual cost is the sum of capital costs and the annualized portion of testing costs annualized over 30 years (computed using 8 percent for privately owned facilities and 4 percent for publicly owned facilities) and annual operating costs.

[b]For privately owned facilities and facilities for which the type of ownership is not identified, community size is based on the population of the entity identified as the location. For publicly owned facilities community size is based on the population of the entity that owns the MWC.

[c]The number of observations indicates the number of entities for which relevant demographic data are available.

Note:

1. These estimates are based on the assumption that essentially all the community's waste goes to the incinerator, and therefore are upper bound estimates. They would overestimate the costs for communities that are also served by landfills.

Sources: Sources are identified in Table 7-2.

TABLE 7-8. MWC II/III EG: AVERAGE ANNUAL COST PER HOUSEHOLD AS A PERCENTAGE OF HOUSEHOLD INCOME (Percent)[a]

Regulatory Alternative and Compliance Scenario	Community Size (Population 10^3)[b]			
	0 to 50	50 to 100	100 to 250	Over 250
Number of Observations[c]	68	22	37	48
Reg. Alt. I-A	0.05	0.08	0.06	0.06
Reg. Alt. II-A	0.06	0.09	0.07	0.07
Reg. Alt. I-B	0.05	0.09	0.06	0.06
Reg. Alt. II-B	0.06	0.09	0.07	0.07
Reg. Alt. III	0.07	0.10	0.07	0.07

[a]Costs per household as a percentage of household income is based on the cost computed for Table 7-6 and the per-capita income and number of persons per household. Costs are MWC II/III total annual costs. Total annual cost is the sum of capital costs and the annualized portion of testing costs annualized over 20 years (computed using 8 percent for privately owned facilities and 4 percent for publicly owned facilities) and annual operating costs.

[b]For privately owned facilities and facilities for which the type of ownership is not identified, community size is based on the population of the entity identified as the location. For publicly owned facilities community size is based on the population of the entity that owns the MWC.

[c]The number of observations indicates the number of entities for which relevant demographic data are available.

Note:

1. These estimates are based on the assumption that essentially all the community's waste goes to the incinerator, and therefore are upper bound estimates. They would overestimate the costs for communities that are also served by landfills.

Source: Sources are identified in Table 7-2.

TABLE 7-9. MWC II/III NSPS: AVERAGE ANNUAL COST PER HOUSEHOLD AS A PERCENTAGE OF HOUSEHOLD INCOME ($1990/household/year)[a]

Regulatory Alternative	Community Size (Population 10^3)[b]			
	0 to 50	50 to 100	100 to 250	Over 250
Number of Observations[c]	6	4	1	9
Reg. Alt. I	0.07	0.08	0.06	0.04
Reg. Alt. II	0.07	0.09	0.06	0.04

[a]Costs per household as a percentage of household income is based on the cost computed for Table 7-7 and the per-capita income and number of persons per household. Costs are MWC II/III total annual costs. Total annual cost is the sum of capital costs and the annualized portion of testing costs annualized over 30 years (computed using 8 percent for privately owned facilities and 4 percent for publicly owned facilities) and annual operating costs.

[b]For privately owned facilities and facilities for which the type of ownership is not identified, community size is based on the population of the entity identified as the location. For publicly owned facilities community size is based on the population of the entity that owns the MWC.

[c]The number of observations indicates the number of entities for which relevant demographic data are available.

Note:

1. These estimates are based on the assumption that essentially all the community's waste goes to the incinerator, and therefore are upper bound estimates. They would overestimate the costs for communities that are also served by landfills.

Sources: Sources are identified in Table 7-2.

communities. As a result, several mitigating measures have been considered and are discussed in the next section.

7.4 MITIGATING MEASURES

The impacts reported in the previous sections for government entities, firms, and households indicate that entities of all sizes will experience impacts because of the regulation. However, the impacts on small entities are frequently relatively greater than the impacts on larger entities. The EPA is particularly concerned about these impacts on small entities. To address these concerns, several measures designed to mitigate the impacts on small entities were considered. The following measures are incorporated in the regulatory alternatives:

- emission standards rather than design, equipment, work practice, or operational standards;
- flexibility for States to make case-by-case judgments under the EG;
- a size cutoff for all facilities below 35 Mg/day capacity;
- less stringent emission standards for small facilities; and
- reduced reporting requirements for small facilities.

The first measure reduces impacts by giving the MWC owner/operator the freedom to use the least costly control equipment that will satisfy the requirements of the regulation. The second measure allows States the freedom to review the EG requirements and make case-by-case judgments where special considerations are warranted.

The last three measures are designed to mitigate impacts at small facilities in particular. The size cutoff exempts very small facilities below 35 Mg/day. In addition, requirements for facilities between 35 and 225 Mg/day capacity are less stringent than those for larger plants under both the NSPS and EG.

In designing the measures to mitigate impacts at small facilities, EPA assumes that a correlation exists between the size of the facility and the size of the entity that owns the facility. This assumption generally holds true, especially for publicly owned facilities. Consequently, measures aimed at reducing impacts at small facilities also reduce impacts for small entities.

CHAPTER 8
BENEFITS AND NET BENEFITS

This chapter presents incremental benefit estimates for the regulatory alternatives proposed for EG and NSPS. Because of limitations on concentration-response functions and the valuation of these functions, benefits are not quantified for all pollutants.

Benefit estimates are quantified for the emission reductions of PM and SO_2 that are expected to result from these regulations. Benefit estimates for Pb are not available yet but are in the process of being finalized. This chapter presents the estimates for PM and SO_2 and a discussion of benefits predicted from additional pollutant reductions. By combining the benefit estimates for PM and SO_2, a net benefit estimate is calculated. However, because benefit estimates are not complete for all pollutants, the net benefits (i.e., benefits minus costs) results cannot be used to make conclusions regarding the total net benefits of EG and NSPS for MWC II/III.

8.1 BENEFITS

8.1.1 Particulate Matter Benefits

The valuation range used to calculate PM benefits is derived using the same methodology employed in the analysis of MWC I. In that methodology, the PM reductions are valued using a synthesis of estimates for the following effects categories: mortality risk, morbidity, and household soiling and materials damage.

To value reductions in mortality risk, a range of $1.6 to $8.5 million (1986 dollars) per statistical life saved is taken from Fisher, Chestnut, and Violette (1989). The median estimate of this range is $4.4 million per statistical life, derived by averaging estimates from the 13 studies used by Fisher, Chestnut, and Violette (1989).

Morbidity is valued using the cost-of-illness approach, which includes such costs as work-loss days (valued at the wage rate), reduced-activity days (valued at half the wage rate), and direct medical expenditures. Because reductions in residual pain and suffering are not valued, the cost-of-illness approach tends to underestimate benefits. Lastly, soiling and materials damage is valued using a supply and demand model for goods purchased to maintain a desired level of cleanliness. The model compares expenditures for laundry and cleaning products, as well as gas and electricity, both before and after PM controls.

Considering the sum of these three functions, the estimated range of values for benefits per megagram of PM reduced is $6,100 to $42,400/Mg in 1990 dollars with a best point estimate of $17,700/Mg. To compute the national benefits of reduced PM, the range of values per megagram has been multiplied by the total emission reductions of PM resulting from the regulation. Tables 8-1 and 8-2 present the benefit estimates.

8.1.2 Sulfur Dioxide Benefits

As in the MWC I analysis, the estimated benefits per megagram of SO_2 reduced that are used in this analysis come from the Industrial Boiler-SO_2 RIA (EPA, 1987). These estimates include direct SO_2 effects (morbidity, reduced agricultural yield, and soiling and materials damage) and indirect SO_4 effects (morbidity, visibility impairment, and soiling and materials damage). The SO_2 benefit estimates reported in that analysis range from $560 to $780/Mg (1983 dollars).

These estimates are adjusted to reflect the lack of chronic morbidity effects and potential mortality effects and are inflated to 1990 dollars. The final range of estimates is

$1,000 to $1,300/Mg, with a best point estimate of $1,200/Mg. National benefits are then computed by multiplying this range of estimates by the total emission reductions from SO_2 control. Tables 8-1 and 8-2 present the benefit estimates.

8.1.3 Lead Benefits

Benefits will occur from reduced concentrations of Pb; however, these benefit values are not available yet. Although everyone is susceptible to toxic effects from Pb, the following major subgroups of the population are particularly sensitive: young children, middle-aged men, and pregnant women and their fetuses. Pb seems to affect the biological system directly rather than through metabolic transformations. Moreover, effects of Pb ions at the subcellular or cellular levels may have no biological threshold. Many of the biochemical changes or mechanisms that appear to underlie Pb toxicity (e.g., altered enzyme activity, membrane receptors, and calcium homeostasis) have been observed at the lowest exposure dosage.

8.1.4 Unquantified Benefits

Table 8-3 presents a summary of health and welfare effects of MWC emissions. Emission reductions have been calculated for Hg; however, benefits from these reductions have not been valued. Likewise, emission reductions of HCl, NO_x, CO, Cd, and CDD/CDFs are also expected as a result of controls imposed on MWCs. No valuation for reductions of these pollutants exists at this time. However, extensive research on probable health effects suggests that risk of adverse health effects will increase commensurately at higher ambient concentrations.

TABLE 8-1. MWC II/III EG: PARTIAL NATIONAL BENEFIT ESTIMATES FOR SULFUR DIOXIDE AND PARTICULATE MATTER EMISSION REDUCTIONS ($1990 10^3/yr)

Regulatory Alternative and Compliance Scenario	PM	SO_2	Total
Reg. Alt. I-A	54,300	49,500	104,000
Reg. Alt. II-A	54,300	52,000	106,000
Reg. Alt. I-B	54,300	49,500	104,000
Reg. Alt. II-B	54,300	52,000	106,000
Reg. Alt. III	57,300	54,000	111,000

Notes:

1. Benefits are calculated by multiplying the benefit estimate per megagram reduction (in 1990 dollars) by the emission reductions given in Table 5-21.
2. The benefit estimate for PM is $17,700/Mg reduced.
3. The benefit estimate for SO_2 is $1,200/Mg reduced.
4. Numbers may not add due to rounding.
5. Definitions are provided on p. x.

TABLE 8-2. MWC II/III NSPS: PARTIAL NATIONAL BENEFIT ESTIMATES FOR SULFUR DIOXIDE AND PARTICULATE MATTER EMISSION REDUCTIONS ($1990 10^3/yr)

Regulatory Alternative	PM	SO_2	Total
Reg. Alt. I	115,000	44,400	159,000
Reg. Alt. II	115,000	45,200	160,000

Notes:

1. Benefits are calculated by multiplying the benefit estimate per megagram reduction (in 1990 dollars) by the emission reductions given in Table 5-22.
2. The benefit estimate for PM is $17,700/Mg reduced.
3. The benefit estimate for SO_2 is $1,200/Mg reduced.
4. Numbers may not add due to rounding.
5. Definitions are provided on p. x.

TABLE 8-3. SOME HEALTH AND WELFARE EFFECTS OF MWC EMISSIONS

Pollutant Category[a]	Health and/or Welfare Effects
Organics	• Mortality, morbidity • Carcinogenicity
Metals	• Retardation and brain damage, especially in children • Hypertension • Central nervous system injury • Renal dysfunction
Acid Gases	• Mortality, morbidity • Cardiovascular, nervous, and pulmonary systems effects • Respiratory tract problems, lung disease • Reduced exercise capacity • Dental erosion • Ozone formation • Acid rain • Reduced agricultural yield • Soiling and materials damage
Particulate Matter	• Mortality, morbidity • Eye and throat irritation, bronchitis, lung damage • Impaired visibility • Soiling and materials damage

[a]See Table 2-1 for a list of pollutants in each pollutant category.

Note:

1. The following MWC emissions are carcinogens: Arsenic, beryllium, cadmium, chromium^{+6}, nickel, 2,3,7,8-tetrachloro-dibenzo-p-dioxin, benzene, benzo-a-pyrene, hexachlorobenzene, trichlorophenol, polychlorinated biphenyls, and formaldehyde.

HCl emissions are significant corrosive and toxic emissions from MWCs. The health effects associated with HCl emissions include corrosion of the respiratory tract and dental erosion. Environmentally, HCl is a minor contributor to acid rain. HCl is generated from chlorides and chlorinated organics in the MWC waste stream. The major sources of chlorine are paper and chlorinated plastics (e.g., polyvinyl chloride and polyvinylidene chloride). Chlorine is used in paper production mainly during the bleaching processes. Aggressive recycling and precombustion or pollution prevention techniques can lead to substantial reductions in emissions of HCl and chlorinated hydrocarbons. Further prudent combustion measures also reduce toxic HCl emissions.

NAAQS exist for NO_x and CO to mitigate the health effects associated with these pollutants. NO_x is irritating to the lungs and lowers resistance to respiratory infections. CO reduces the amount of oxygen available to body tissue, impairing the function of nerves and muscles.

Cd is a demonstrated carcinogen that causes kidney damage and cancer. Long-term exposure also bioaccumulates, leading to anemia, chronic fatigue, and loss of smell. Inhalation exposure, specifically from occupational exposure, can cause systemic effects in the respiratory area ranging from slight toxicity of lung epithelial cells to severe effects such as decreased lung function and emphysema, but the kidney is the main target organ for Cd toxicity, regardless of route of exposure. Chronic exposure to Cd may lead to proteinuria and, with continued exposure, to more severe renal dysfunction such as mineral metabolism disturbances, kidney stones, mild tubular lesions, and widespread necrosis. Exposure to Cd emissions can induce alterations of vitamin D metabolism, which causes musculoskeletal effects. These effects suggest that either Cd has a direct effect on bone at levels lower than those causing kidney damage or that interference with vitamin D metabolism in the proximal tubule of the kidney is a sensitive indicator of kidney damage. Because the target tissue for inhalation exposure is the lung and because the unit risk estimate makes Cd one of the more potent verified carcinogens on the CAA list of hazardous air pollutants, Cd presents a significant risk to human health.

CDD/CDFs have become a considerable health concern because of their widespread occurrence and persistence in the environment. Health effects associated with these pollutants include an enlarged and impaired liver, neuromuscular symptoms, abnormalities of the endocrine and immune systems, altered metabolism, and general weakness and weight loss.

Occupational studies have shown that chronic exposure to Hg can cause irreversible damage to the brain, kidneys, or developing fetuses. Effects associated with the lowest exposure levels produce nonspecific symptoms such as insomnia, introversion, and anxiety. Biochemical alterations have been observed in enzymes of plasma and red blood cells, and increases in urinary excretion of specific proteins and enzymes are also known to occur. Higher chronic exposures produce more pronounced effects in cognitive function, such as short-term memory loss and changes in personality, as well as motor dysfunction and associated body tremors. The form of Hg, the route of exposure, and the concentration influence which of the above effects are most severe. For example, organic Hg (i.e., methylmercury) ingested through contaminated fish can readily cross the blood-brain and placental barriers and will therefore tend to cause greater damage to the brain and developing fetus, whereas inorganic Hg that is ingested will tend to cause greater harm to the kidneys.

Because of Hg's potential to cause adverse health effects, the Occupational Safety and Health Administration, the National Institute of Occupational Safety and Health, the Food and Drug Administration, and EPA have all set concentration levels in various media that, if exceeded, may not properly protect human health and the environment. Hg is also included in the list of 189 hazardous air pollutants to be regulated under Title III of the CAA.

8.1.5 Conclusion

Tables 8-1 and 8-2 present a partial analysis of the benefits associated with MWC II/III controls. In these tables, benefits have been estimated for PM and SO_2. This analysis may be considered low end because of the unquantified benefits mentioned in the previous section.

8.2 NET BENEFITS

8.2.1 Evaluation Criterion

Benefit-cost analysis provides a framework for assessing the potential changes in society's well-being from the adoption of any given regulatory alternative. Using the Hicks-Kaldor compensation principle, society is judged to be better off if potential net benefits (benefits minus costs) are positive and potential gainers are able to compensate potential losers. Applying this principle to environmental regulations, however, is often complicated by the difficulty of quantifying all the potential benefits from such regulations.

8.2.2 Qualifications

Because of a lack of data, applying the benefit-cost methodology to evaluating the regulatory alternatives examined in this analysis is limited to comparing some of the benefits with most of the costs. Consequently, drawing conclusions about the net value to society of this regulation is difficult. The fact that quantified potential benefits do not exceed quantified potential costs does not necessary guarantee that society's well-being is worsened.

Another limitation of this analysis concerns the degree of accuracy in the cost and benefit estimates. Data limitations, as well as time and resource constraints on the analysis, seriously limit the degree of accuracy achievable at this time.

8.2.3 Results

Table 8-4 summarizes the monetized estimates of some of the potential benefits and most of the costs for the MWC II/III EG and NSPS. Even the high estimate of quantified benefits falls well short of quantified costs. The EPA cannot, however, conclude that potential net benefits from the MWC II/III EG and NSPS would be negative because only PM and SO_2 emission reductions can be valued at this time. However, neither can EPA assert that society would be better off in a Hicks-Kaldor compensation principle sense if EPA adopted EG and NSPS for MWC II/III. Because of data paucities, the allocation efficiency aspects of these rules remain ambiguous.

TABLE 8-4. MWC II/III: NATIONAL SOCIAL COSTS AND PARTIAL NATIONAL BENEFITS FROM REDUCING MWC EMISSIONS ($1990 10^3/yr)

Regulatory Alternative and Compliance Scenario	Annual Costs[a]	Partial Annual Benefits[b]
EG		
Reg. Alt. I-A	412,000	104,000
Reg. Alt. II-A	443,000	106,000
Reg. Alt. I-B	418,000	104,000
Reg. Alt. II-B	448,000	106,000
Reg. Alt. III	487,000	111,000
NSPS		
Reg. Alt. I	177,000	159,000
Reg. Alt. II	184,000	160,000

[a]Annual costs are taken from Table 5-14 (EG) and Table 5-16 (NSPS).

[b]Benefits include only partial benefits for PM and SO_2 reductions and are taken from Tables 8-1 and 8-2.

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