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Medical Waste Incinerators - Background Information for Proposed Standards and Guidelines:

Analysis of Economic Impacts for Existing Sources

Office of Air Quality Planning and Standards
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U. S. Environmental Protection Agency
Office of Air and Radiation
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Research Triangle Park, North Carolina

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ANALYSIS OF ECONOMIC IMPACTS FOR EXISTING SOURCES

1.0 INTRODUCTION

1.1 SCOPE

In this report, the economic impacts of the Section 111(d) Emission Guidelines for medical waste incinerators (MWIs) are evaluated. The analysis is conducted by comparing control costs to economic and financial parameters of the regulated industries. Impacts are assessed for four control options defined in Section 4.2 of the "Model Plant Description and Cost Report."[1] These control options are summarized in Table 1. Control Option 1 consists of a secondary chamber with a minimum gas residence time of 1 second at a minimum temperature of 1,700° F. Control Option 1 is evaluated in the current report because existing MWIs are not controlled at this level in the baseline. In contrast, new MWIs are controlled at this level in the baseline. Therefore, Control Option 1 is not evaluated in the report on the economic impacts of the New Source Performance Standards (NSPS) on new sources ("Analysis of Economic Impacts for New Sources").[2] Control Option 2 consists of a secondary chamber with a minimum gas residence time of 2 seconds at a minimum temperature of 1,800° F. Control Option 3 consists of a venturi scrubber/packed bed system and two-second combustion. Control Option 4 consists of a dry injection/fabric filter system with carbon and two-second combustion. Two variants of the latter option -- without carbon and with some carbon -- are also presented in the Model Plant Description and Cost Report. Control costs for these variants are slightly lower than under Control Option 4. In order to avoid a proliferation of calculations, the variants are not assessed in the current report. Instead, they are conservatively represented by Control Option 4.

TABLE 1. CONTROL OPTIONS

Control Option (C.O.)	Description
1*	One-second combustion
2	Two-second combustion
3	Venturi scrubber/packed bed system and two-second combustion
4	Dry injection/fabric filter system with carbon and two-second combustion

*Applies only to existing sources. Does not apply to new sources because they are controlled at this level in the baseline.

The report seeks mainly to determine 1) the average industry-wide price increase necessary to recover control costs; 2) the market response to the industry-wide price increase -- specifically, impacts on output, employment, revenue, and market structure; 3) the extent to which individual establishments can recover control costs by increasing prices; 4) the availability of capital to finance the investment in controls; 5) the extent of economic hardship if control costs cannot be fully recovered or if capital is not readily available; and 6) the extent to which the impacts of control costs can be, and will be, avoided by switching to an alternative medical waste treatment and disposal method. In addition to establishments that operate an MWI, impacts are assessed for establishments that generate medical waste and send it offsite to be incinerated. This recognizes that such establishments will likely pay higher fees for commercial incineration as a result of the Emission Guidelines. An analysis of the potential for significant impacts on small entities (e.g., small businesses) is included.

1.2 ORGANIZATION

In Section 1.3, which follows, the findings of the economic impact analysis are summarized. Background information is provided in Section 2.0. This includes information on the population of existing MWIs (Section 2.1), control costs (Section 2.2), the regulated industries (Section 2.3), and model facilities (Section 2.4). Model facilities and their parameters are presented in Tables 5A, 5B, and 5C. Economic impacts are assessed in Section 3.0. In Section 3.1, the general methodology of the economic impact analysis is outlined and an overview of the findings is presented. The price elasticity of demand -- a measure of the sensitivity of market demand to the price level -- is discussed in Section 3.2. Institutional constraints to increasing prices (in an attempt to recover control costs) are addressed in Section 3.3. In Section 3.4, industry-wide (as opposed to per-facility) impacts are calculated and evaluated. This includes a discussion of impacts on the commercial incineration industry (Section 3.4.3). Per-facility impacts are calculated and assessed for MWI operators in Section 3.5 and for facilities that send their medical waste offsite to be incinerated in Section 3.6. Section 3.5 includes an analysis of the potential to avoid control costs by switching from onsite incineration to an alternative medical waste treatment and disposal method (Section 3.5.5). In Section 3.7, impacts on taxpayers are evaluated. In Section 3.8, the potential for significant impacts on small entities is assessed. References are provided in Section 4.0.

1.3 SUMMARY

No average industry-wide price increase necessary to recover control costs ("market price increase") exceeds one percent under any of the four control options evaluated in this report for the Emission Guidelines. All market price increases are therefore considered to be achievable.

Owing to a small market price increase and/or relatively inelastic demand, all impacts on industry-wide output, employment, and revenue are also insignificant. This implies that no medical waste-generating industry will need to be significantly restructured (e.g., through closures or consolidations).

Individual facilities could be significantly impacted by the Emission Guidelines, however. For MWI operators in the following cases, annualized control costs may not be fully recoverable with a price increase and the resulting impact on earnings may not be sustainable, and/or capital to finance the investment in pollution controls may not be readily available:

- Hospitals with fewer than 50 beds under Control Options 3 and 4
- Hospitals with 50-99 beds under Control Option 4
- Certain categories of hospitals with 100+ beds under Control Option 4
- Nursing homes with 100+ employees under Control Options 3 and 4
- Veterinary facilities with 10-19 employees under Control Options 3 and 4
- Veterinary facilities with 20+ employees under Control Option 4
- Tax-paying commercial research labs with 20-99 employees under Control Options 3 and 4

In these cases, onsite incineration may have to be terminated. In this event, substitution (i.e., switching from onsite incineration to an alternative medical waste treatment method) would be necessary in order to avoid closure -- or at least to avoid the termination of operations that result in, or are dependent on, the generation of medical waste. The two most common alternatives to onsite incineration for the treatment of medical waste are offsite contract disposal (most commonly offsite incineration) and onsite autoclaving.

In general, switching from onsite incineration to one or the other of these alternatives is feasible. For all but two model combustors, there are incremental costs associated with substituting. This is because the costs of the alternative treatment methods are greater on average than the cost of onsite incineration in the baseline. In many cases, incremental substitution costs can be recovered with a price increase. If not, it will, in general, be possible to absorb the costs without compromising competitive position. This is consistent with the fact that in all industries in which medical waste is generated, the majority of facilities already utilize an alternative to onsite incineration.

However, depending on particular conditions in individual market segments, there may, under Control Options 3 and 4, be a few exceptions in which a facility for which annualized control costs or capital control costs are prohibitive would have to shut down. Closure would require that the facility generates a substantial proportion and/or quantity of pathological waste, for which substitution options are limited because it cannot be autoclaved. In addition, the facility would either have to face substantial competition from other MWI operators that are not forced to substitute, or have to pay significantly more than average for offsite contract disposal (because, for example, it is remote from a treatment facility).

In addition to being necessary in some cases in order to avoid closure, substitution will also offer the opportunity in some cases to save costs. This is because relative to the costs of alternative medical waste treatment methods, the cost of onsite incineration increases as a result of the Emission Guidelines, especially as the control options become more stringent. Hence, it can be expected that a major impact of the Emission Guidelines will be to trigger substitution. Substitution would probably escalate under Control Options 3 and 4. While there is a cost-saving alternative to only two model combustors under Control Option 1, there is a cost-saving alternative to three model combustors under Control Option 2, five model combustors under Control Option 3, and six model combustors under Control Option 4.

The Emission Guidelines will directly impact facilities that operate an MWI. It will also indirectly impact facilities that generate medical waste and send it offsite to be incinerated. This is because such facilities are likely to pay higher fees for commercial incineration as a result of the Emission Guidelines (and the NSPS). It is estimated that the cost of offsite incineration will increase on average by $9/ton under Control Option 1, $25/ton under Control Option 2, $86/ton under Control Option 3, and $149/ton under Control Option 4 as a result of the Emission Guidelines (and the NSPS). These impacts assume the same control stringency for new MWIs under the NSPS as for existing MWIs, under the Emission Guidelines.

The great majority of facilities that generate medical waste and send it offsite for incineration are not significantly impacted by the Emission Guidelines. Under certain conditions, facilities of this type could experience similar impacts to MWI operators. On average, however, impacts for this type of facility are lower because commercial MWIs are comparatively large and efficient, and therefore have lower per-ton impacts from the Emission Guidelines.

Substitution will increase the demand for alternative medical waste treatment methods, including offsite incineration. As a result, it is expected that, despite control costs, output at commercial incineration facilities will not be adversely impacted by the Emission Guidelines. This means that commercial incineration facilities will be able to recover control costs by increasing prices.

Impacts of the Emission Guidelines on taxpayers are minimal. In some rare cases -- specifically requiring an MWI to be operated by a facility under the jurisdiction of a government unit with a population of only several thousand -- the impacts of controls might be considered significant. If the impacts are significant, however, they are expected to be avoided by substitution.

An analysis of the potential for significant impacts on small entities is conducted. This involves determining, according to EPA criteria, whether the Emission Guidelines have a "significant economic impact on a substantial number of small entities." Some "small" medical waste generators, as well as "small" commercial incineration facilities and government jurisdictions, may be "significantly" impacted under Control Options 3 and 4. However, because the Emission Guidelines (and the NSPS) will cause the demand for offsite incineration to increase, it is expected that commercial incineration facilities will be able to recoup control costs by passing them along to customers. Furthermore, the number of small medical waste generators and government jurisdictions that will be significantly impacted should not be "substantial." This is in part due to the opportunity that the great majority of facilities will have to avoid the impacts of control costs by substituting. Hence, it is concluded that the Emission Guidelines will not have a significant economic impact on a substantial number of small entities.

2.0 BACKGROUND

2.1 MWI POPULATION

The nationwide distribution of existing MWIs that would be affected by the Emission Guidelines is estimated in Table 2. The distribution is represented by the seven model combustors defined in Section 4.1 of the Model Plant Description and Cost Report. The model combustors are identified by type and lb/day capacity (e.g., the Continuous 36,000 is a continuous MWI with a daily capacity of 36,000 pounds). For the batch unit, the lb/day capacity is equal to the lb/batch design capacity (500 lbs) multiplied by an average of 1/2 batch per day (one batch every other day).

TABLE 2. DISTRIBUTION OF EXISTING MWIs

Industry	Model MWI	Per-unit capacity, tons/yr	Identified population	Projected nationwide population
Hospitals	Inter. 21,000	1,176	50	142
	Cont. 24,000	977	57	161
	Inter. 8,400	470	219	620
	Path. 2,000	172	158	448
	Inter. 2,000	115	513	1,453
	Batch 250	27	115	326
				3,150
Nursing homes	Inter. 8,400	470	2	19
	Path. 2,000	172	14	132
	Inter. 2,000	115	37	349
				500
Veterinary facilities	Path. 2,000	172	86	493
	Inter. 2,000	115	10	57
				550
Research labs	Inter. 21,000	1,176	6	23
	Cont. 24,000	977	4	16
	Inter. 8,400	470	21	83
	Path. 2,000	172	50	197
	Inter. 2,000	115	46	181
				500
Commercial incineration facilities	Cont. 36,000	3,907	39	150
Total			1,427	4,850

Abbreviations: Inter. = Intermittent, Cont. = Continuous, Path. = Pathological.

For all other units, the lb/day capacity is equal to the lb/hr design capacity multiplied by the number of charging hours per day.

Per-unit capacity is reported in Table 2 in terms of tons per year. It is derived from the lb/hr "actual capacity" (usually lower than the design capacity) in the Model Plant Description and Cost Report, considering the number of charging hours per day and the number of operating days per year. Within each industry, the model combustors are listed in descending capacity. The Continuous 36,000 used by commercial incineration facilities is the largest model MWI, while the Batch 250 used at hospitals is the smallest.

The "identified population" in Table 2 is from Table 42 of the Model Plant Description and Cost Report. It represents existing MWIs that were specifically identified for this study. The nationwide distribution in Table 2 is projected from the identified population. Within each industry, the nationwide distribution is proportionate to the identified population distribution, and is constrained to sum to the estimated industry total (e.g., 3,150 for hospitals).

The total number of MWIs in Table 2 is 4,850. The table excludes two categories of MWIs: municipal waste combustors (MWCs) that co-fire medical waste and MWIs that are not attributable to any particular industry (MWIs at "other/unidentified facilities"). These categories are not included in the economic impact analysis. However, impacts on MWCs are likely to be comparable to the impacts that will be measured for facilities that operate a dedicated commercial MWI (commercial incineration facilities), while impacts on MWIs at other/unidentified facilities are likely to be represented by the many industries that are included in the analysis. The estimated number of MWCs co-firing medical waste is 31 and the estimated number of MWIs at other/unidentified facilities is 150. Together, these two categories account for 3.6 percent of the estimated total of 5,031 MWIs (4,850 + 31 + 150).

2.2 CONTROL COSTS

Per-MWI control costs are presented in Table 3. Both capital and total annualized costs are used in the economic impact analysis. Total annualized cost is the sum of annual O&M costs and annualized capital. Capital is annualized using the "capital recovery factor" assuming a discount rate of 10 percent.

2.3 REGULATED INDUSTRIES

The Emission Guidelines will directly impact facilities that operate an MWI. The regulation will also indirectly impact facilities that generate medical waste and send it offsite to be incinerated. This is because it can be expected that increased costs of commercial incineration will be passed along to these facilities. For example, it can be expected that a fire and rescue operation that generates medical waste and sends it to a hospital to be incinerated will have to pay a higher fee for the hospital's increased cost of incineration. Facilities that generate medical waste but do not incinerate it onsite are termed "offsite generators" in this analysis.

With one exception, the economic impact analysis includes all industries in which the average medical waste generation rate per facility exceeds 0.25 tons per year. Information on medical waste generation rates is provided in the "Industry Profile Report For New and Existing Facilities."[3] The exception is residential care facilities (0.38 tons/yr per facility, on average), which are similar to, but offer less comprehensive services than, nursing

TABLE 3. CONTROL COSTS FOR EXISTING MWIs (1989 DOLLARS)

Model MWI		Capital C.O.1	Capital C.O.2	Capital C.O.3	Capital C.O.4	Total annualized C.O.1	Total annualized C.O.2	Total annualized C.O.3	Total annualized C.O.4
Cont.	36,000	5,924	176,206	461,152	901,267	14,064	77,658	238,016	348,973
Inter.	21,000	107,806	176,206	461,152	901,267	36,155	59,643	169,940	270,906
Cont.	24,000	85,047	130,644	362,910	753,211	30,827	46,524	131,290	219,372
Inter.	8,400	66,835	94,183	284,291	634,482	19,665	29,162	93,209	174,288
Path.	2,000	50,017	60,516	211,696	524,410	11,481	14,935	53,404	122,862
Inter.	2,000	48,622	57,722	205,672	515,234	12,684	15,688	56,968	127,270
Batch	250	46,061	52,596	194,619	498,364	13,375	15,268	52,172	120,948

Abbreviations: Cont. = Continuous, Inter. = Intermittent, Path = Pathological.

homes. They are not included in the analysis because their impacts will be conservatively represented by small (0-19 employees) nursing homes, which, using employment as a scale factor, are estimated to generate per facility slightly over one ton of medical waste annually. The selection criterion excludes health units in industry (0.04 tons/yr) and police departments (less than 0.08 tons/yr). These categories are likely to be minimally impacted by the Emission Guidelines because of their low medical waste generation rates.

Table 4 lists the industries generating medical waste that are included in the economic impact analysis. Also included in the analysis are commercial incineration facilities, which are not listed in Table 4 because they do not generate medical waste.

Table 4 highlights that the vast majority of medical waste generators do not operate an MWI. A little less than half of all hospitals operate an MWI. In the other industries in which medical waste is generated, a much lower percentage of facilities operate an MWI. No MWIs have been assigned to ten categories in which medical waste is generated (e.g., physicians' offices, blood banks). In reality, some MWIs may be operated in these categories. However, the number of MWIs in relation to the number of facilities is likely to be insignificant.

2.4 MODEL FACILITIES

The economic impact analysis is conducted by comparing control costs to financial and economic parameters of the regulated industries. At this point, it is necessary to establish model facilities with financial and economic attributes. The model facility data can be used directly to calculate per-facility economic impacts (Sections 3.5 and 3.6), and can be aggregated to calculate industry-wide impacts (Section 3.4).

TABLE 4. SUMMARY OF THE INCIDENCE OF MWIs IN MAJOR INDUSTRIES GENERATING MEDICAL WASTE

Industry[a]	Total no. of facilities[b]	No. with an MWI	Percent of total
Hospitals	6,882	3,150	45.8%
Nursing homes	17,525	500	2.9%
Veterinary facilities	21,496	550	2.6%
Laboratories			
Research	3,826[c]	500	13.1%
Medical	6,871	0	0.0%
Dental	7,970	0	0.0%
Funeral homes	22,000	0	0.0%
Physicians' offices	191,278	0	0.0%
Dentists' offices and clinics	104,213	0	0.0%
Outpatient care			
Physicians' clinics	6,519	0	0.0%
Kidney dialysis facilities	839	0	0.0%
Freestanding blood banks	218	0	0.0%
Fire and rescue operations	29,840	0	0.0%
Correctional facilities	4,288	0	0.0%

[a]Included if the average medical waste generation rate per facility exceeds 0.25 tons per year, with the exception of residential care facilities (0.38 tons per year).

[b]See Section 2.4 for sources.

[c]Commercial facilities only.

Model facilities are defined in Tables 5A, 5B, and 5C. The financial and economic parameters assigned to the model facilities include employment (or full-time-equivalent employment), annual revenue, annual before-tax and after-tax net income, total assets, and net worth (assets minus liabilities). All of the parameters are averages per facility. Therefore, the model facilities represent average or typical establishments. All dollar figures (e.g., revenue, net income) are in 1989 dollars.

To account for heterogeneity, most industry categories are divided into "subcategories," i.e., they are assigned more than one model facility. For example, tax-paying and tax-exempt establishments are distinguished. Subcategories are also created whenever there is significant variation in the size of facilities. This will permit the assessment of differential impacts on different-size facilities. The size dispersion of nursing homes, for example, is accounted for by specifying model facilities with 0-19, 20-99, and 100+ employees.

Table 5A represents hospitals. MWIs are potentially operated in all of the numerous hospital subcategories. Table 5B includes other industries and industry subcategories in which MWIs are potentially operated. Table 5C represents offsite generators. Due mainly to the small amount of medical waste they generate, the model facilities in Table 5C are not likely to operate an MWI. Offsite generators will not directly incur control costs, but will instead be indirectly impacted by the Emission Guidelines by having to pay higher fees for offsite incineration.

The Emission Guidelines will impact establishments that cover the gamut of organizational structures: for-profit, not-for-profit, and public (i.e., government). Often, not-for-profit and public establishments do not earn profits,

TABLE 5A. MODEL FACILITIES: HOSPITALS

Industry subcategory	No. of fac.	Perc. of all in industry	No. of beds	FTE emp. [a]	Annual expenses ($ mm)	Before-tax prof. marg.	After-tax prof. marg.	Annual revenue ($ mm)	Before-tax net income	After-tax net income	Assets/ rev.	Assets ($ mm)	Net worth/ assets	Net worth ($ mm)
			Average per facility											
AHA-registered														
Federal														
Psychiatric	17	0.2%	709	1,119	48.4	3.40%	3.40%	50.1	$1,703,520	$1,703,520	0.863	43.2	0.458	19.8
Other special & general											0.937		0.506	
<50 Beds	97	1.4%	28	225	8.1	2.45%	2.45%	8.3	$203,434	$203,434		7.8		3.9
50-99 Beds	32	0.5%	66	436	17.5	2.45%	2.45%	17.9	$439,518	$439,518		16.8		8.5
100-299 Beds	83	1.2%	186	697	37.6	3.95%	3.95%	39.1	$1,546,278	$1,546,278		36.7		18.6
300+ Beds	111	1.6%	616	1,582	88.3	3.61%	3.61%	91.6	$3,307,013	$3,307,013		85.8		43.4
Non-federal														
Psychiatric											0.863		0.458	
Not-for-profit	127	1.8%	99	229	10.9	3.40%	3.40%	11.3	$383,644	$383,644		9.7		4.5
For-profit	356	5.2%	88	152	8.7	4.86%	3.40%	9.1	$444,144	$310,901		7.9		3.6
State govt.	245	3.6%	459	783	29.1	3.40%	3.40%	30.1	$1,024,224	$1,024,224		26.0		11.9
Local govt.	13	0.2%	367	711	33.3	3.40%	3.40%	34.5	$1,172,050	$1,172,050		29.7		13.6
T.B. & other resp. diseases	4	0.1%	119	241	9.4	N/A	3.50%	9.7	N/A	$340,933	0.94	9.2	0.521	4.8
Long-term other special & gen.											0.937		0.506	
Not-for-profit	63	0.9%	151	352	16.1	3.53%	3.53%	16.7	$589,126	$589,126		15.6		7.9
For-profit	20	0.3%	83	259	12.6	3.81%	2.67%	13.1	$499,658	$349,761		12.3		6.2
State govt.	28	0.4%	227	396	17.2	3.51%	3.51%	17.8	$625,681	$625,681		16.7		8.5
Local govt.	27	0.4%	370	641	27.9	3.51%	3.51%	28.9	$1,014,913	$1,014,913		27.1		13.7
Short-term other special & gen.											0.937		0.506	
Not-for-profit														
<50 Beds	502	7.3%	34	92	4.2	2.41%	2.41%	4.3	$103,720	$103,720		4.0		2.0
50-99 Beds	643	9.3%	72	200	9.7	2.41%	2.41%	9.9	$239,543	$239,543		9.3		4.7
100-299 Beds	1,357	19.7%	185	641	34.7	3.33%	3.33%	35.9	$1,195,314	$1,195,314		33.6		17.0
300+ Beds	731	10.6%	475	1,928	111.5	4.33%	4.33%	116.5	$5,046,462	$5,046,462		109.2		55.3
For-profit														
<50 Beds	107	1.6%	36	86	4.6	-0.18%	-0.18%	4.6	($8,265)	($8,265)		4.3		2.2
50-99 Beds	220	3.2%	74	178	11.0	-0.18%	-0.18%	11.0	($19,764)	($19,764)		10.3		5.2
100-299 Beds	395	5.7%	188	414	27.9	4.64%	3.25%	29.3	$1,358,427	$950,899		27.4		13.9
300+ Beds	47	0.7%	387	1,034	70.3	6.99%	4.89%	75.6	$5,279,788	$3,695,852		70.8		35.8

TABLE 5A. MODEL FACILITIES: HOSPITALS (CONT.)

Industry subcategory	No. of fac.	Perc. of all in industry	No. of beds	FTE[a] emp.	Annual expenses ($ mm)	Before-tax prof. marg.	After-tax prof. marg.	Annual revenue ($ mm)	Before-tax net income	After-tax net income	Assets/ rev.	Assets ($ mm)	Net worth/ assets	Net worth ($ mm)
			Average per facility											
Short-term other special & gen. (continued)														
State govt.														
<50 Beds	23	0.3%	29	64	3.5	2.45%	2.45%	3.6	$87,904	$87,904		3.4		1.7
50-99 Beds	15	0.2%	70	163	8.7	2.45%	2.45%	8.9	$218,503	$218,503		8.4		4.2
100-299 Beds	25	0.4%	177	614	34.2	3.95%	3.95%	35.6	$1,406,455	$1,406,455		33.4		16.9
300+ Beds	36	0.5%	532	2,902	162.8	3.61%	3.61%	168.9	$6,097,189	$6,097,189		158.3		80.1
Local govt.														
<50 Beds	584	8.5%	33	71	2.8	2.45%	2.45%	2.9	$70,323	$70,323		2.7		1.4
50-99 Beds	417	6.1%	71	164	7.0	2.45%	2.45%	7.2	$175,807	$175,807		6.7		3.4
100-299 Beds	302	4.4%	165	490	24.5	3.95%	3.95%	25.5	$1,007,548	$1,007,548		23.9		12.1
300+ Beds	93	1.4%	521	2,262	130.7	3.61%	3.61%	135.6	$4,894,979	$4,894,979		127.1		64.3
Non-AHA-registered														
Non-Federal psychiatric	92	1.3%	81	136	6.4	N/A	3.40%	6.4	N/A	$217,600	0.863	5.5	0.458	2.5
Short-term other special & gen.	58	0.8%	54	121	5.8	N/A	3.44%	6.0	N/A	$206,628	0.937	5.6	0.506	2.8
Other	12	0.2%	124	249	11.7	N/A	3.44%	12.1	N/A	$416,819	0.937	11.4	0.506	5.7
Total	6,882	100.0%	180	575	31.4	N/A	3.44%	32.5	N/A	$1,118,641	0.937	30.5	0.506	15.4
<50 Beds	1,497	21.8%	34	89	3.9	N/A	2.09%	4.0	N/A	$83,250		3.7		1.9
50-99 Beds	1,704	24.8%	72	182	8.9	N/A	2.09%	9.1	N/A	$189,981		8.5		4.3
100-299 Beds	2,457	35.7%	176	551	30.2	N/A	3.42%	31.3	N/A	$1,069,414		29.3		14.8
300+ Beds	1,224	17.8%	516	1,767	98.7	N/A	4.24%	103.1	N/A	$4,370,175		96.6		48.9
Subset:community hosp.	5,455	79.3%	171	605	33.9	N/A	3.44%	35.1	N/A	$1,207,705	0.937	32.9	0.506	16.6
Urban	2,958	43.0%	245	938	54.5	N/A	3.38%	56.4	N/A	$1,906,541		52.9		26.7
<50 Beds	218	3.2%				N/A	1.01%		N/A					
50-99 Beds	448	6.5%				N/A	1.01%		N/A					
100-299 Beds	1,426	20.7%				N/A	2.90%		N/A					
300+ Beds	866	12.6%				N/A	4.16%		N/A					
Rural	2,497	36.3%	83	211	9.5	N/A	3.53%	9.8	N/A	$347,621		9.2		4.7
<50 Beds	970	14.1%				N/A	2.52%		N/A					
50-99 Beds	840	12.2%				N/A	2.52%		N/A					
100-299 Beds	647	9.4%				N/A	4.16%		N/A					
300+ Beds	40	0.6%				N/A	5.28%		N/A					

[a] Full-time-equivalent.

N/A Not available.

Sources: See Section 2.4.

TABLE 5B. MODEL FACILITIES: MWI OPERATORS OTHER THAN HOSPITALS

Industry	No. of fac.	Perc. of all in industry	Average per facility: Emp.	Annual revenue or budget	Before-tax prof. marg.	After-tax prof. marg.	Before-tax net income	After-tax net income	Assets/ rev.	Assets	Net worth/ assets	Net worth
Nursing homes	17,525											
100+ Employees									0.67		0.371	
Tax-paying	3,643	20.8%	141.3	$3,498,600	4.0%	2.8%	$139,944	$97,961		$2,344,062		$869,647
Tax-exempt	1,416	8.1%	187.6	$4,871,800	2.8%	2.8%	$136,410	$136,410		$3,264,106		$1,210,983
Veterinary facilities	21,496								0.316		0.506	
10-19 Employees	2,584	12.0%	12.9	$908,442			$349,750	$244,825		$287,068		$145,256
20+ Employees	595	2.8%	29.3	$1,966,262			$757,011	$529,908		$621,339		$314,397
Commercial research labs	3,826								0.532		0.566	
Tax-paying					6.0%	4.2%						
20-99 Employees	576	15.1%	33.9	$2,800,300			$168,018	$117,613		$1,489,760		$843,204
100+ Employees	169	4.4%	356.9	$30,487,200			$1,829,232	$1,280,462		$16,219,190		$9,180,062
Tax-exempt	304	7.9%	147.7	$13,450,000	4.2%	4.2%	$564,900	$564,900		$7,155,400		$4,049,956
Commercial incineration fac.	75		N/A	$2,000,000			N/A	N/A		N/A		N/A

N/A Not available.

Sources: See Section 2.4, text.

TABLE 5C. MODEL FACILITIES: OFFSITE GENERATORS

Industry	No. of fac.	Perc. of all in industry	Emp.	Annual revenue or budget	Before-tax prof. marg.	After-tax prof. marg.	Before-tax net income	After-tax net income	Assets/ rev.	Assets	Net worth/ assets	Net worth
			Average per facility									
Nursing homes	17,525								0.67		0.371	
0-19 Employees												
Tax-paying	2,099	12.0%	6.9	$189,700	4.0%	2.8%	$7,588	$5,312		$127,099		$47,154
Tax-exempt	1,017	5.8%	8.0	$237,800	2.8%	2.8%	$6,658	$6,658		$159,326		$59,110
20-99 Employees												
Tax-paying	7,673	43.8%	56.3	$1,260,000	4.0%	2.8%	$50,400	$35,280		$844,200		$313,198
Tax-exempt	1,677	9.6%	58.2	$1,302,700	2.8%	2.8%	$36,476	$36,476		$872,809		$323,812
Physicians' offices	191,278		5.4	$498,200			$226,661	$158,663	0.157	$78,217	0.499	$39,030
Dentists' offices & clinics									0.198		0.535	
Offices	103,665	99.5%	4.7	$260,900			$89,166	$62,416		$51,658		$27,637
Clinics												
Tax-paying	486	0.5%	9.5	$538,100			$172,253	$120,577		$106,544		$57,001
Tax-exempt	62	0.1%	14.5	$1,577,100			N/A	N/A		$312,266		$167,062
Outpatient care (clinics)												
Physicians' clinics(amb. care)									0.157		0.499	
Tax-paying	4,224	64.8%	23.8	$1,790,000	4.0%	2.8%	$71,600	$50,120		$281,030		$140,234
Tax-exempt	2,295	35.2%	36.9	$2,736,600	2.8%	2.8%	$76,625	$76,625		$429,646		$214,393
Freestanding kidney dial. fac.									0.647		0.562	
Tax-paying	711	84.7%	18.4	$1,319,300	10.7%	7.5%	$141,165	$98,948		$853,587		$479,716
Tax-exempt	128	15.3%	29.0	$1,785,400	7.5%	7.5%	$133,905	$133,905		$1,155,154		$649,196
Freestanding blood banks	218		61.0	$5,685,000			N/A	N/A		N/A		N/A
Veterinary facilities	21,496								0.316		0.506	
0-9 Employees	18,317	85.2%	2.9	$213,149			$82,063	$57,444		$67,355		$34,082
Laboratories												
Commercial research	3,826								0.532		0.566	
Tax-paying												
0-19 Employees	2,777	72.6%	4.6	$357,600	6.0%	4.2%	$21,456	$15,019		$190,243		$107,678
Other												
Medical	6,871		13.3	$861,300	8.9%	6.2%	$76,287	$53,401	0.47	$404,811	0.462	$187,023
Dental	7,970		5.1	$216,000	9.0%	6.3%	$19,440	$13,608	0.298	$64,368	0.539	$34,694
Funeral homes	22,000		7.0	$450,000	11.4%	8.0%	$51,429	$36,000	0.778	$350,100	0.543	$190,104
Fire & rescue	29,840		9.9	$413,800			N/A	N/A		N/A		N/A
Corrections							N/A	N/A		N/A		N/A
Federal govt.	47	1.1%	276.6	$25,900,000								
State govt.	903	21.1%	292.2	$17,000,000								
Local govt.	3,338	77.8%	44.2	$2,300,000								

N/A Not available.

Sources: See Section 2.4, text.

per se. Rather, they operate at a surplus or deficit. In these cases, net income can be construed as a measure of the surplus or deficit. Also, some not-for-profit and public establishments do not generate revenues (fire departments, for example). Rather, they have a budget to pay for their expenses. Not-for-profit organizations often are underwritten by grants, donations, and fund-raising proceeds, while public establishments typically are appropriated tax revenues. In these cases, revenue and the budget will be treated as synonymous.

The revenue estimates in Tables 5A, 5B, and 5C represent revenues of entire facilities. It is not believed that in any case this will lead to a significant overstatement of the "revenue basis." The revenue basis is the amount of revenue that is dependent on the product or process being regulated, and to which a potential price increase (in order to recover control costs) would be applied. The revenue basis would be overstated if medical waste generation (and the subsequent necessary treatment and disposal) is not a necessary by-product of all operations of the establishment. Most of the regulated industries do not have diverse product lines, however. The generation of medical waste is likely to be a necessary by-product of all operations. Hospitals may be an exception. However, if a hospital department does not generate medical waste, it is probably still interdependent with departments that do. Therefore, total revenue would be representative of the revenue basis.

With the exception of hospitals, uniform after-tax profit rates are specified in each industry category. It is assumed, for example, that profitability does not vary by establishment size. This is similar to an assumption of perfect competition, with every firm earning a normal profit. In reality, profit rates within an industry are not uniform. To the extent profitability is variable, profitability impacts will be overstated for facilities with profit rates above the industry average, and understated for facilities performing below the industry average.

For tax-paying facilities, all before-tax profit margins are calculated from after-tax profit margins, or vice versa, using an average tax rate of 30 percent. The statutory Federal corporate tax rate is 15 percent for the first $50,000 in income, 25 percent for the next $25,000, and 34 percent for all incremental income (i.e., income above $75,000). Because the regulated establishments are predominantly small, most will have effective Federal tax rates significantly below 34 percent. State and local income taxes, which can average around 5 percent, must also be considered. All in all, an average total tax rate of 30 percent is considered appropriate. Before-tax and after-tax net income are calculated by applying the before-tax and after-tax profit margins, respectively, to revenue.

Tax-exempt establishments do not pay income taxes, of course. Public (government) establishments are tax-exempt. So are many not-for-profit establishments, though nonprofit status is only a prerequisite for exemption. Other requirements must be satisfied in order to achieve tax-exempt status.[4] Note in Tables 5A, 5B, and 5C that not-for-profit model facilities are specified only for hospitals (Table 5A). These facilities are assumed to all be tax-exempt. This is because a minimum of 1,145 for-profit hospitals -- which are tax-paying -- are represented in Table 5A. This constitutes 17 percent of the total number of hospitals, 6,882 ("Total" in Table 5A). The 1987 Census of Service Industries, in turn, reports that 19 percent of all hospitals are tax-paying.[5] This suggests that the vast majority of not-for-profit hospitals are tax-exempt.

By definition, tax-exempt establishments have identical before-tax and after-tax profit margins. For industry categories and subcategories consisting of both tax-paying and tax-exempt establishments, it is assumed that tax-exempt establishments have the same after-tax profit margin as tax-paying establishments. This is based on the notion that tax-paying and tax-exempt establishments will tend to have after-tax, rather than before-tax, profit rates that are aligned. If before-tax profit rates were aligned, for-profit establishments would be at an unsustainable competitive disadvantage after paying taxes.

Following is an industry-by-industry discussion of the sources of data in Tables 5A, 5B, and 5C, and ways in which the data can be interpreted and used.

2.4.1 Hospitals

All information on the number of facilities, the number of beds, full-time-equivalent (FTE) employment, and annual expenses is from the American Hospital Association's (AHA's) "1989 Annual Survey of Hospitals," the results of which were published in the 1990-91 edition of Hospital Statistics.[6] The data therefore pertain to 1989. The total number of hospitals in the U.S. counted by the AHA, 6,882, appears in Table 5A on the line "Total." At the bottom of the table is a subset of all hospitals in the U.S.: community hospitals, distinguished between urban and rural. Urban hospitals are classified as being inside of, and rural hospitals as outside of, Metropolitan Statistical Areas, as defined by the U.S. Office of Management and Budget. Metropolitan Statistical Areas include cities and their environs (e.g., suburbs). Consequently, the urban subcategory includes both urban and suburban hospitals.

With the exception of psychiatric hospitals and the t.b.(tuberculosis) and other respiratory diseases subcategory, after-tax profit margins are from the 1990 edition of The Sourcebook, published by Health Care Investment Analysts, Inc. (HCIA), a research firm in Baltimore, Md.[7] The 1990 edition of The Sourcebook reports results for 1989. HCIA compiles statistical information annually from cost reports filed by the majority of hospitals in the U.S. that participate in Medicare. The statistical measure in The Sourcebook used to measure the after-tax profit margin is the median (50th percentile) "total profit margin" (after taxes). The total profit margin, unlike the "operating profit margin," accounts for revenues from all sources, including sources not related to patient care, such as philanthropic contributions, investment income, and government grants.

The total profit margin is disaggregated by HCIA for hospitals in the following bed-size groupings: 50-99, 100-249, 250-399, and 400 and over. In contrast, as the row headings in Table 5A reveal, the bed-size groupings used to disaggregate hospitals in the economic impact analysis are fewer than 50, 50-99, 100-299, and 300 or more. Although the match is not perfect, the profitability of hospitals with 50-99 beds is used to represent hospitals with fewer than 50 beds and 50-99 beds; the profitability of hospitals with 100-249 beds is used for hospitals with 100-299 beds; and the more conservative, or lesser, of the profitabilities of hospitals with 250-399 and 400 or more beds is used for hospitals with 300 or more beds (in all cases this turned out to be the profitability of hospitals with 250-399 beds).

The overall (nationwide) median total profit margin in 1989 was 3.44 percent. This is applied to "Total" and to several subcategories that are composed of more than one type of hospital. The median margin was 3.53 percent for not-for-profit hospitals, 2.67 percent for investor-owned (for-profit) hospitals, and 3.51 percent for state and local government hospitals. 1989 was the first year in which for-profits were less profitable than the other two categories. In another departure from the past, rural hospitals were more profitable than urban hospitals (3.53% vs. 3.38%, respectively). As mentioned, the urban hospitals subcategory includes both inner-city and suburban hospitals. Inner-city hospitals tend to be far less profitable than suburban hospitals. One subcategory, short-term other special and general for-profit hospitals with fewer than 100 beds, had a negative median total profit margin: -0.18 percent.

The HCIA database does not include psychiatric and tuberculosis hospitals. For psychiatric hospitals, the average after-tax profit margin found for SIC 8063, Psychiatric Hospitals, in a 1990 survey by Dun and Bradstreet, Inc. is used.[8] Dun and Bradstreet's 1990 survey findings for SIC 8069, Specialty Hospitals, Except Psychiatric, are used for the tuberculosis hospitals subcategory. Another subcategory not covered by HCIA is Federal hospitals. This is because they do not have Medicare patients. It is assumed that the profitability of Federal hospitals is the same as that of state and local government hospitals.

Annual revenue in Table 5A is equal to annual expenses divided by one minus the before-tax profit margin. The before-tax profit margin is used in this equation because expenses do not include taxes.

The ratios of assets to revenue and net worth to assets are from the 1990 Dun and Bradstreet survey. SIC 8063, Psychiatric Hospitals, is used for psychiatric hospitals; SIC 8069, Specialty Hospitals, Except Psychiatric, is used for tuberculosis hospitals; and SIC 8062, General Medical and Surgical Hospitals, is used for all else, including "Total." Assets and net worth are then calculated by applying the ratios to revenue.

2.4.2 Nursing Homes

For both tax-paying and tax-exempt nursing homes, three size subcategories are defined: 0-19 employees, 20-99 employees, and 100+ employees. Nursing homes with 100+ employees are classified in Table 5B because they potentially operate an MWI. While it is estimated that 500 MWIs are operated at nursing homes nationwide, there are over 5,000 nursing homes with 100+ employees.[9] The typical nursing home with 0-19 or 20-99 employees, on the other hand, is not likely to operate an MWI and is therefore classified in Table 5C. Nursing homes in the U.S. are estimated to generate 198,000 tons per year of medical waste. Allocating this to the model facilities according to employment, a scale factor, the average nursing home with 20-99 employees is estimated to generate 8.4 tons per year of medical waste. This falls far short of the capacity of the smallest model combustor assigned to nursing homes -- 115 tons/yr for the Intermittent 2,000 -- suggesting that it is not common for a nursing home with 20-99 employees to operate an MWI.

The total number of nursing homes in the U.S., 17,525, and the break-out by employee-size class, are from the 1987 Census. Employment and revenue are also from the 1987 Census. However, revenue from the Census has been inflated by 13.7 percent, the change in the fixed-weighted price index for personal consumption expenditures on medical care from 1987 to 1989.[10] This adjusts revenue to 1989 dollars.

The after-tax profit margin, the ratio of assets to revenue, and the ratio of net worth to assets, are all weighted averages, based on the number of tax-paying establishments nationwide, of SICs 8051, 8052, and 8059 -- the three SICs comprising nursing home care -- in the 1990 Dun and Bradstreet Survey.

2.4.3 Physicians' Offices

Physicians' offices do not in general operate an MWI. Therefore, they are classified as offsite generators in Table 5C. Physicians' Offices are represented by Offices of Physicians, which is set apart by the Bureau of the Census as a subset of SIC 8011, Offices and Clinics of Doctors of Medicine. Actually, this subset does include clinics "owned and operated by physicians associated for the purpose of carrying on their profession."[11] All other clinics are included in the subset Clinics of Physicians, which is assigned to outpatient care in Section 2.4.5. The number of establishments, employment, and revenue are all from the 1987 Census. As with nursing homes, revenue is increased by 13.7 percent so as to be on a 1989 basis. All Offices of Physicians in the 1987 Census are tax-paying.

Before-tax net income is calculated as the product of the average number of non-Federal office-based medical doctors rendering patient care per practice in 1986/1987, 1.71, and the median "take-home" income for office-based physicians in 1989, $132,550.[12,13] Assuming that take-home income consists of wages or earnings from an unincorporated business, personal taxes will have to be paid. To calculate after-tax net income, an average personal tax rate of 30 percent -- the same as the corporate tax rate -- is used.

The ratios of assets to revenue and net worth to assets are from the 1990 Dun and Bradstreet survey of SIC 8011.

2.4.4 Dentists' Offices and Clinics

Like physicians' offices, dentists' offices and clinics generally do not operate an MWI and are therefore included in Table 5C. The number of facilities, employment, and revenue are all from the 1987 Census (SIC 8021, Offices and Clinics of Dentists). Again, revenue is adjusted to 1989 dollars by inflating by 13.7 percent.

Before-tax net income is calculated as the product of average take-home income per practitioner and the average number of dentists per practice. Average take-home income per practitioner in 1983 (the last year for which information was available) was $55,570.[14] This is inflated to 1989 using the change in the GNP implicit price deflator from 1983 to 1989 (+21.6%). The number of dentists per practice is derived by apportioning the total number of active dentists in the U.S. in 1986, 137,900, to offices and clinics according to employment in the 1987 Census.[15] This yields an average of 1.32 dentists per office and 2.55 per clinic. After-tax net income is based on an assumed average personal tax rate of 30 percent. No basis was available for calculating net income at tax-exempt clinics.

The ratios of assets to revenue and net worth to assets are from the 1990 Dun and Bradstreet survey of SIC 8021.

2.4.5 Outpatient Care

Outpatient care facilities are classified as offsite generators in Table 5C. In the "Market Profile Report," ambulatory care centers, managed care organizations, and kidney dialysis facilities represent the outpatient care category.[16] In the economic impact analysis, managed care organizations are excluded because they are not exclusively health care providers. As insurers, they also serve as vehicles for the financing of health care. In fact, many managed care organizations do not provide any health care directly, but rather arrange so that their subscribers receive health care from independent providers. As a result, managed care organizations and some of the industry categories included in the economic impact analysis (e.g., hospitals, physicians' offices) are not mutually exclusive.

The two subcategories representing outpatient care in the economic impact analysis are kidney dialysis facilities and physicians' clinics. Kidney dialysis facilities are classified in SIC 8092. Clinics of Physicians, a subset of SIC 8011, is used to represent ambulatory care centers. Table 5C shows a total of 6,519 physicians' clinics. The estimated total number of ambulatory care centers in the U.S. is fairly close: 1,221 ambulatory surgery centers and 4,000 general ambulatory care centers.[17,18] Therefore, the Clinics of Physicians subset of SIC 8011 is considered to be fairly representative of ambulatory care centers.

Medical waste is generated by outpatient care facilities other than physicians' clinics and kidney dialysis facilities. Other types of outpatient generators include home health care agencies, hospices, and drug treatment centers. However, they tend to generate less medical waste than physician's clinics and kidney dialysis facilities. Therefore, it is assumed that economic impacts for other types of outpatient facilities will be conservatively represented by the impacts calculated for physician's offices and kidney dialysis facilities.

For both physicians' clinics and kidney dialysis facilities, the number of facilities, employment, and revenue are from the 1987 Census. Revenue is increased by 13.7 percent for adjustment to 1989 dollars.

The before-tax profit margin specified for tax-paying physicians' clinics, 4.0 percent, is the average among 180 facilities of multi-unit ambulatory care chains surveyed by Modern Healthcare in 1989.[19] The average after-tax profit margin in the 1990 Dun and Bradstreet survey of SIC 8092, Kidney Dialysis Centers, is used for both tax-paying and tax-exempt kidney dialysis facilities.

The ratios of assets to revenue and net worth to assets are also taken from the 1990 Dun and Bradstreet survey (SIC 8011 for physicians' offices and SIC 8092 for kidney dialysis facilities).

2.4.6 Freestanding Blood Banks

Blood banks are classified as offsite generators in Table 5C. The total number of facilities, 218, reflects the 164 freestanding blood banks that are members of the American Association of Blood Banks, one freestanding facility that is not a member, and the 53 regional Red Cross centers.[20] Employment and revenue were estimated by Jack Faucett Associates in 1987.[21] Revenue has been increased by 13.7 percent for adjustment to 1989 dollars. Profitability data are not available. All freestanding blood banks are not-for-profit.[22]

2.4.7 Veterinary Facilities

Three subcategories of veterinary facilities are defined: 0-9 employees, 10-19 employees, and 20+ employees. As in all other industry categories, MWIs will tend to be located at larger facilities (which may in some cases be better regarded as animal hospitals than as veterinary offices or clinics). Veterinary facilities with 20+ employees potentially operate an MWI and are therefore included in Table 5B. There are 595 such facilities in the U.S.[23,24] The estimated number of MWIs in the industry is 550. Since even among the larger facilities, operating an MWI is not universal, it is likely that in addition to veterinary facilities with 20+ employees, some veterinary facilities with 10-19 employees (of which there are 2,584 in the U.S.) also operate an MWI. Consequently, these facilities are also classified as MWI operators in Table 5B. However, it is possible that relatively few veterinary facilities with 10-19 employees operate an MWI. As a result, the typical veterinary facility with 10-19 employees that operates an MWI is likely to be larger than the average facility in this subcategory, represented by the model parameters in Table 5B. This implies that impacts calculated for veterinary facilities with 10-19 employees will probably be conservative. Based on the average industry ratio of 0.30 tons/yr of medical waste generated per employee (31,000 tons generated, 103,887 employees), the average veterinary facility with 10-19 employees is estimated to generate only 3.8 tons per year.[25] This would not warrant operating even the Intermittent 2,000, which has a capacity of 115 tons per year. Veterinary facilities with 0-9 employees are classified as offsite generators in Table 5C.

The total number of facilities, 21,496, was cited by the Veterinary Medicine Publishing Company in 1989.[26] The disaggregation of the number of facilities and employment are from <u>1988 County Business Patterns</u> (CBP).[27] The total number of establishments reported in CBP is only 16,687. However, CBP does not cover establishments without paid employees. It is conceivable that many veterinary practices do not have any paid employees (e.g., the owner is the only employee, and is not paid wages, but rather is paid from the business's earnings). It is assumed, therefore, that practices without paid employees account for the difference between the two estimates.

Estimated average revenue for a veterinary facility in 1989 is $344,800. This is based on an average of 2.56 veterinarians per practice and <u>Veterinary Economics</u>' estimate of average revenue per veterinarian of $134,704.[28,29] The disaggregated revenues are calculated using the distribution of facility sizes in CBP, and assuming a constant ratio of payroll to revenue (CBP reports payroll, not revenue). It is assumed additionally that revenue is the same for facilities without any paid employees as for facilities with 1-4 employees, the smallest disaggregation in CBP.

Average before-tax net income is equal to the average of 2.56 veterinarians per practice, multiplied by an average take-home income per veterinarian of $51,900.[30] After-tax net income assumes an average personal tax rate of 30 percent. Before-tax and after-tax net income are apportioned to the three subcategories in proportion to the disaggregation of revenue.

The ratios of assets to revenue and net worth to assets are weighted averages, based on the number of respondants, of SICs 0741, Veterinary Services for Livestock, and 0742, Veterinary Services for Animal Specialties, in the 1990 Dun and Bradstreet survey.

2.4.8 <u>Laboratories</u>

Among all types of laboratories, MWIs are found predominantly in research laboratories. Medical and dental laboratories, therefore, are considered to be offsite generators and are classified in Table 5C. Research labs are represented in Tables 5B and 5C by commercial establishments. Tax-paying commercial research labs with 0-19 employees are classified as offsite generators in Table 5C. Tax-paying commercial research labs with 20-99 and 100+ employees, and tax-exempt commercial research labs (147.7 employees per facility, on average), are classified as MWI operators in Table 5B.

In addition to commercial research labs, which are independent and stand-alone, MWIs are also operated by research laboratories that are captive to a larger organization such as a pharmaceutical company or a research university. Captive research labs that are integrated with other operations of an umbrella organization will tend to be impacted less by the Emission Guidelines than independent, stand-alone labs because their revenue basis will be greater. However, impacts measured for commercial research labs will be representative of impacts on captive research labs that are separate profit centers (and therefore are effectively stand-alone).

There are 169 tax-paying commercial research labs with 100+ employees and 304 tax-exempt commercial research labs in the U.S.[31,32] These subcategories do not fully account for the industry's allocation of 500 MWIs. However, as discussed, captive research labs also operate MWIs. Therefore, it is possible that relatively few tax-paying commercial research labs with 20-99 employees (of which there are 576 in the U.S.) operate an MWI. As a result, the typical tax-paying commercial research lab with 20-99 employees that operates an MWI is likely to be larger than the average facility in this subcategory, represented by the model parameters in Table 5B. This implies that impacts calculated for tax-paying commercial research lab with 20-99 employees will probably be conservative. Based on the average industry ratio of 0.40 tons/yr of medical waste generated per employee (55,500 tons generated, 137,517 employees), the average tax-paying commercial research lab with 20-99 employees is estimated to generate only 13.7 tons per year.[33] This would not warrant operating the Intermittent 2,000, which has a capacity of 115 tons per year.

For all categories of labs -- research, medical, and dental -- the number of facilities, employment, and revenue are from the 1987 Census. SIC 8731, Commercial Physical and Biological Research, represents commercial research labs. Medical and dental labs are classified in SICs 8071 and 8072, respectively. In order to adjust to 1989 dollars, revenue is increased by 7.6 percent, the change in the GNP implicit price deflator from 1987 to 1989.

The after-tax profit margin, the ratio of assets to revenue, and the ratio of net worth to assets are from SICs 8071, 8072, and 8731 in the 1990 Dun and Bradstreet survey.

2.4.9 Funeral Homes

As offsite generators, funeral homes are classified in Table 5C. It is estimated that there are 22,000 funeral homes in the U.S.[34] The average revenue of a funeral home is based on an average of 150 funerals per year and $3,000 per funeral.[35] Employment, the after-tax profit margin, the ratio of assets to revenue, and the ratio of net worth to assets are all from the 1990 Dun and Bradstreet survey of SIC 7261, Funeral Service and Crematories. Employment is adjusted, however, to reflect that SIC 7261 is a heterogenous grouping of funeral homes and crematories. Revenue per employee in SIC 7261 is $64,141. Applying this to the estimated revenue per funeral home of $450,000 yields an average of 7.0 employees per funeral home. This exceeds the overall average in SIC 7261 of 5.3 employees per facility, reflecting that funeral homes are larger on average than crematories.

2.4.10 Fire and Rescue

As offsite generators, fire and rescue operations are included in Table 5C. The number of facilities represents the number of public fire departments in the U.S., estimated by Jack Faucett Associates in 1987.[36] This number is composed of 23,157 fire departments that are all-volunteer, 1,999 that have fully career staffs, and 4,684 that are part career, part volunteer. Public fire departments in the U.S. are operated by county governments, municipal governments, township governments, and special-district governments.

Employment is from the 1987 Census of Governments.[37] The average budget is equal to total public (government) spending on fire protection in 1989, $12.35 billion, divided by the number of facilities.[38] Public fire departments are taxpayer-financed. It is not known whether they tend to operate at a surplus or deficit.

2.4.11 Corrections

Correctional facilities are offsite generators and are therefore classified in Table 5C. The 1983 and 1984 Censuses by the Bureau of Justice Statistics reported that there were 47 Federal facilities, 903 state facilities, and 3,338 local jails in the U.S.[39] Local facilities are operated by both county and municipal governments.

Employment is from the 1987 Census of Governments. Revenue is calculated by applying the percentage of total public spending on corrections accounted for by each level of government, reported in the 1987 Census, to total public spending on corrections in 1989, $24.4 billion, and dividing by the number of facilities.[40] Any tendency for correctional facilities to operate at a surplus or deficit is not known.

2.4.12 Commercial Incineration Facilities

By definition, commercial incineration facilities operate an MWI. They are therefore included in Table 5B. The number of facilities, 75, is based on 150 MWIs nationwide, extrapolated from data from 15 states (see the Industry Profile Report, Section 6.3.5); and an estimated two MWIs per facility. Survey responses from 15 commercial incineration facilities were used to calculate average revenue. Data were not available for other economic/ financial parameters.

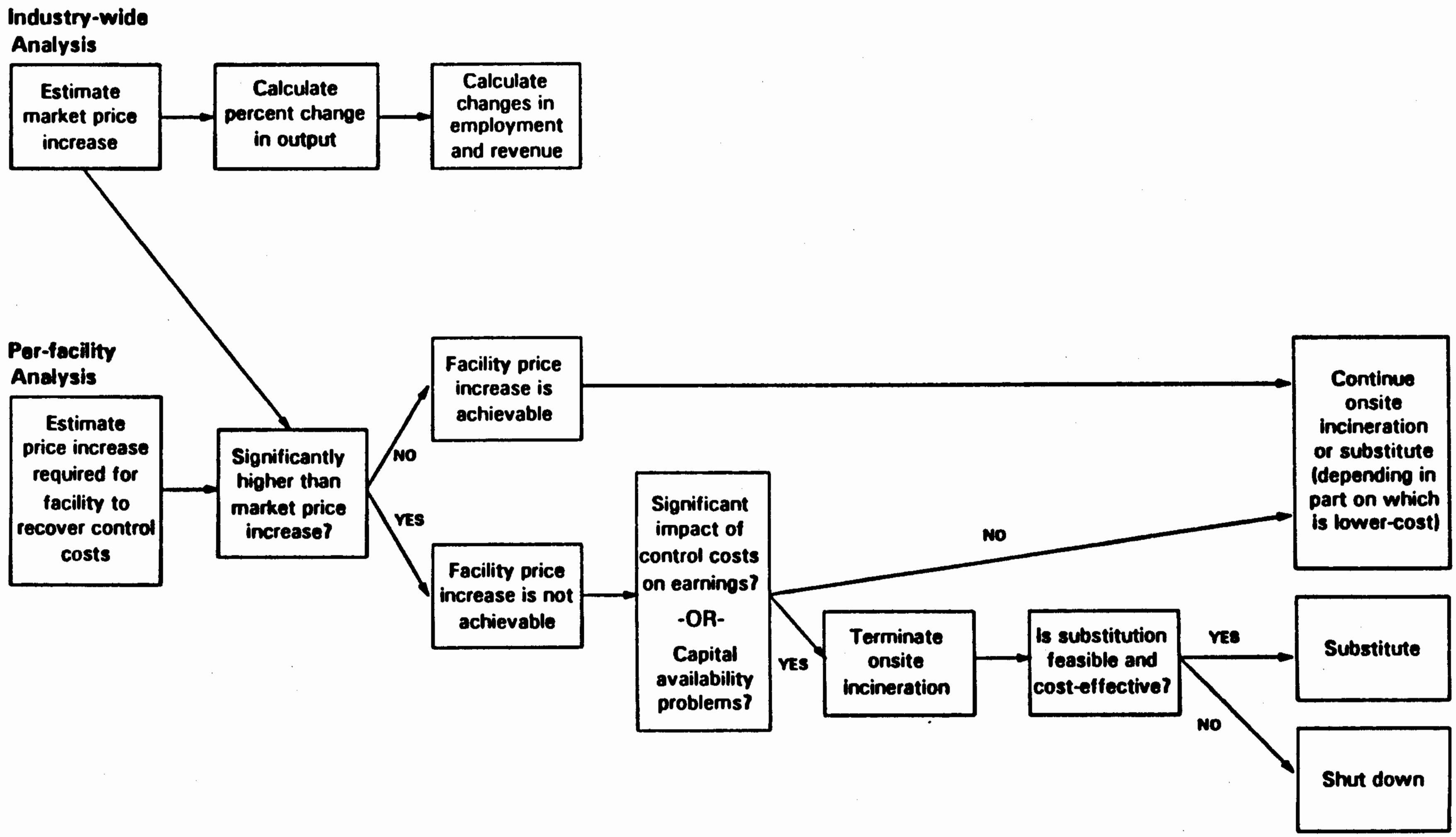
3.0 ECONOMIC IMPACTS

3.1 METHODOLOGY AND OVERVIEW

The general methodology of the economic impact analysis can be understood with the aid of the flow chart in Figure 1. The figure applies specifically to facilities with an onsite MWI.

Two separate impact analyses are conducted: industry-wide and per-facility. The linchpin for the industry-wide analysis (Section 3.4) is calculating the "market price

FIGURE 1. ECONOMIC IMPACT ANALYSIS METHODOLOGY (FOR FACILITIES WITH AN ONSITE MWI)



increase." This represents the average industry-wide price increase necessary to recover control costs. Because most, if not all, of the regulated industries are fragmented, actual price increases will vary from market segment to market segment according to such factors as 1) the number of facilities, 2) the number of facilities operating an MWI, 3) the distribution of MWI types, and 4) market structure and pricing mechanisms. Ideally, the average price increase in each market segment would be measured. However, it is not possible to define and characterize literally hundreds of regional and local market segments. Therefore, the market price increase, which is an average price increase across all market segments, is used to represent the average price increase in each individual market segment. All market price increases in the analysis are under one percent and are therefore considered to be achievable.

Based on the market price increase, the industry-wide change in output is estimated. The change in output is inversely related to the market price increase depending on the price elasticity of demand, which is assessed in Section 3.2. Impacts on industry-wide employment and revenue are, in turn, estimated from the change in output. No impacts on industry-wide output, employment, or revenue are found to be significant in the analysis.

The per-facility analysis (Sections 3.5 and 3.6) is triggered by calculating the "facility price increase," which is the price increase necessary for individual model facilities to recover control costs. The facility price increase is then compared to the market price increase (hence the industry-wide and per-facility analyses are linked). If the facility price increase is not significantly higher than the market price increase, it is judged to be achievable (market structure is also considered in this assessment). This is based on the premise that facilities will be able to implement price increases that are not far out of line with the average industry-wide price increase. Of course, in some market segments, where the average price increase is lower than the average industry-wide price increase (because, for example, a large proportion of facilities do not operate an MWI), it may be more difficult than average to increase prices.

If the facility price increase is achievable, onsite incineration can be continued. This does not rule out substitution from occurring, however. Because the comparative cost of onsite incineration increases as a result of the Emission Guidelines, it may be possible after the regulation to save costs by substituting (though cost is not the only consideration in choosing a medical waste treatment and disposal method).

A number of cases in which the facility price increase may not be achievable are identified in the analysis. These cases include some categories of MWI operators and, because the cost of commercial incineration increases as a result of the Emission Guidelines, possibly also some facilities that send their medical waste offsite to be incinerated. However, on average, impacts are lower for facilities that send their medical offsite to be incinerated than for MWI operators because commercial MWIs are comparatively large and efficient, and therefore have lower per-ton impacts from the regulation.

For facilities that may not be able to achieve the facility price increase, two questions are then asked: 1) will absorbing the portion of control costs that cannot be recovered through a price increase result in an unsustainable decline in earnings?, and 2) will capital generally be available to finance the investment in pollution controls? If neither is a problem, onsite incineration can be continued, though substitution may take place, depending in part on which is lower-cost.

If, on the other hand, earnings will be prohibitively impacted or capital will be difficult to obtain, onsite incineration will have to be terminated. In this event, substitution would be necessary in order to avoid closure -- or at least to avoid the termination of operations that result in, or are dependent on, the generation of medical waste. The analysis finds that, in general, substitution is possible (both feasible and cost-effective) and closure can be avoided. This is consistent with the fact that in all industries in which medical waste is generated, the majority of facilities already utilize an alternative to onsite incineration. Depending on particular conditions in individual market segments, there may be a few exceptions in which a facility would have to shut down, however.

3.2 PRICE ELASTICITY OF DEMAND

A key aim of the economic impacts analysis is to determine the ability of regulated establishments to pass along control costs to their customers by increasing prices. The extent to which this is possible without an attendant decline in output depends greatly on the price elasticity of demand.

The price elasticity of demand measures the percent change in quantity demanded along the demand curve in response to a percent change in price. The more inelastic demand is, the greater is the ability of producers or providers to increase prices without losing output. Conversely, relatively elastic demand restricts the ability to increase prices without losing output. The most important determinants of demand elasticity are 1) the availability and closeness of substitutes, 2) the extent to which the product or service is a necessity, 3) the share of the cost of the product or service in consumers' budgets, and 4) the importance of price versus non-price attributes of the product or service. Products or services without close substitutes, which are relative necessities, which do not constitute a significant share of consumers' budgets, or which have important non-price attributes, all tend to have relatively inelastic demand.

The import elasticity of supply can also be a determinant of domestic price elasticity of demand. It is not a factor in this study, however, because none of the regulated industries face competition from abroad.

The majority of medical waste is generated by industries involved in the provision of health care. In general, the demand for health care is considered to be relatively inelastic. This would be represented by an elasticity estimate between -1 and zero. One recent estimate of the elasticity of demand for health care is -0.47.[41] This was said to fall "within the range of elasticity estimates reported in several previous studies of the demand for medical care."

The demand for health care is relatively inelastic for several reasons. First, other than abstinence, there is no substitute for health care. Secondly, good health is a virtual necessity. As a result of these factors, consumers are relatively captive to providers (e.g., physicians) and often are given little choice in medical decisions. Another factor is that health care providers tend to compete more on quality (a non-price attribute) than price. Finally, and perhaps most importantly, patients are to a great extent insulated from changes in the price of health care because medical bills are commonly paid by third parties such as government programs (e.g., Medicare, Medicaid) and private insurers. In 1987, third parties paid for 72.2 percent of the cost of health care in the U.S.[42]

There are some offsetting factors. For one, co-payments and deductibles on insurance plans still constitute a significant share of consumers' budgets. Further, health care providers have been meeting increased resistance to price increases from third-party payers. Finally, abstaining from health care is apparently an option, as 37 million Americans are presently without health insurance.[43]

Table 6 summarizes the elasticity estimates used in the economic impact analysis. The estimates, which are qualitatively derived, represent ranges, as follows:

	Elasticity Range
Highly inelastic	0 to -0.33
Moderately inelastic	-0.33 to -0.67
Slightly inelastic	-0.67 to -1.00
Slightly elastic	-1.00 to -1.33
Moderately elastic	-1.33 to -1.67
Highly elastic	less than -1.67

The major determinants in Table 6 are labeled "(-)" if they contribute to relative inelasticity and "(+)" if they contribute to relative elasticity.

3.3 INSTITUTIONAL CONSIDERATIONS

The ability of regulated establishments to recover control costs by increasing prices will also be influenced by certain institutional factors.

3.3.1 Health Care Providers Paid In Part By Third Parties

As we have seen, the demand for health care is relatively inelastic, i.e., quantity demanded is not very responsive to a change in price. This would normally imply that prices can easily be raised to pass through a cost increase to consumers (without a significant attendant decline in output). In the health care sector, however,

TABLE 6. ELASTICITY ESTIMATES

	Price elasticity of demand	Major determinants
Hospitals	Highly inelastic	o 90.5 percent third-party-financed (-) o Primary health care a virtual necessity (-) o Compete more on quality than price (-) o Some competition from outpatient facilities (+)
Nursing homes	Moderately inelastic	o No close substitutes (residential facilities provide less/inferior care) (-) o Quality and service, in addition to price, important (-) o 49.3 percent direct payment (+) o For direct-payment residents, significant share of budget (+)
Physicians' offices	Highly inelastic	o Primary health care a virtual necessity (-) o 74.4 percent third-party-financed (-) o Patients very captive (-) o Quality important (-) o Some competition from ambulatory care (+)
Dentists' offices	Moderately inelastic	o No close substitutes (-) o Quality important (-) o Non-preventive care a virtual necessity (-) o 61 percent direct payment (+) o Significant share of budget (+)

TABLE 6. (Continued)

	Price elasticity of demand	Major determinants
Physicians' clinics	Highly inelastic	o Primary health care a virtual necessity (-) o 74.4 percent third-party financed (-) o Patients very captive (-) o Quality important (-) o Some competition from physicians' offices (+)
Kidney dialysis facilities	Highly inelastic	o Necessity (life-saving) (-) o No substitutes (-)
Freestanding blood banks	Highly inelastic	o Necessity (life-saving) (-) o Little latitude for substitution (account for 89% of all blood collected in the U.S.) (-) o Only about 0.3 percent of total health care spending in the U.S. (-)
Veterinary facilities	Slightly inelastic	o No close substitutes (-) o Demand, especially for pets, somewhat discretionary (+) o Significant share of budget (+)
Research laboratories	Slightly elastic	o R&D often discretionary (+)
Medical laboratories	Slightly elastic	o Competition from hospitals, doctors' offices (+)
Dental laboratories	Slightly inelastic	o Face less competition than medical labs (-)

TABLE 6. (Continued)

	Price elasticity of demand	Major determinants
Funeral homes	Highly inelastic	o Compete on reputation, not price (-) o Death disposal an absolute necessity (-) o Competition from crematories (+)
Fire and rescue	Highly inelastic	o Necessary public good (-) o No substitutes (-)
Corrections	Highly inelastic	o Necessary public good (-) o No substitutes (-)

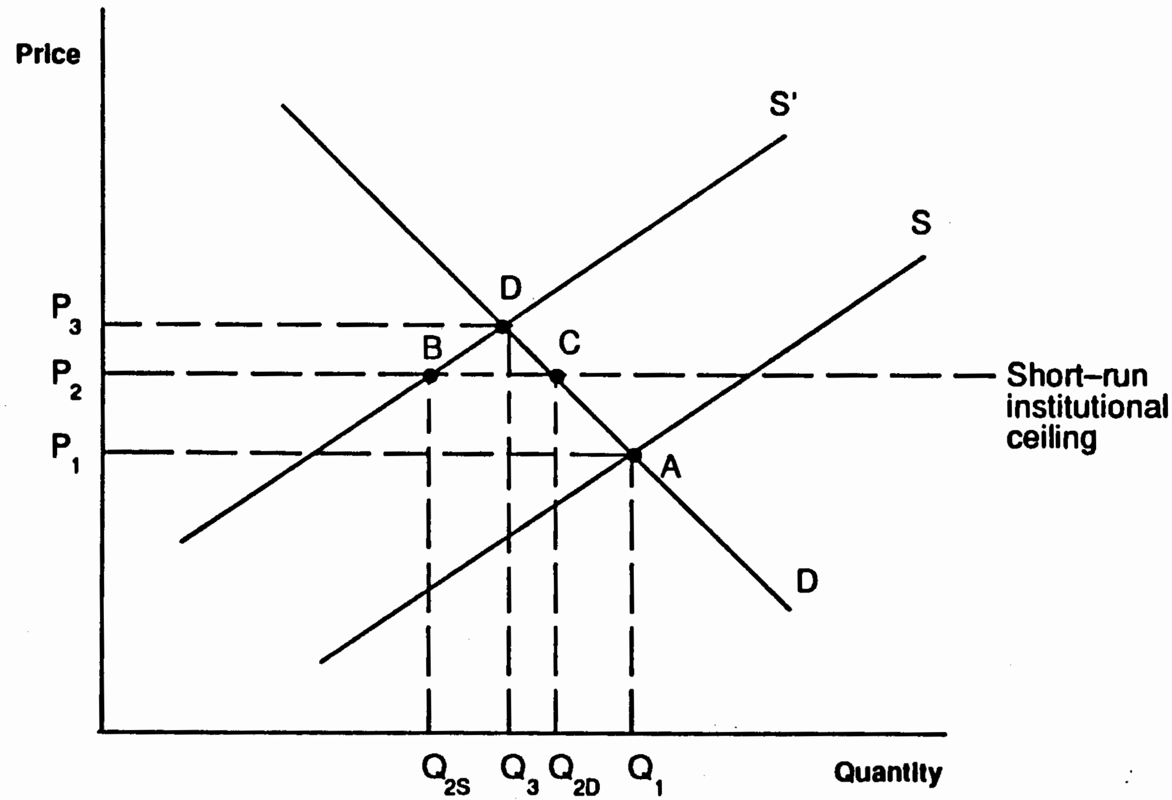
willingness to pay does not always reflect underlying demand. This is due to the role of third-party payers. Since the implementation of the Prospective Payment System (PPS) in 1983, reimbursement rates under Medicare, and even more so under Medicaid, have fallen short of the costs of providing health care. Lately, private third-party payers have also increased their resistance to underwriting increases in the cost of health care. The involvement of third-party payers, therefore, is preventing health care providers from recovering their costs, even though underlying demand is relatively inelastic.

This phenomenon is demonstrated in Figure 2. D is the market demand curve and S is the initial short-run market supply curve. The initial market equilibrium is point A, with output of Q_1 and a price of P_1. As a result of control costs, supply shifts to S'. If it were not for institutional constraints, the new market equilibrium would be point D. However, third-party payers, by limiting reimbursement rates, constrain the price to P_2. This is not a market-clearing price, as the quantity demanded, Q_{2D}, exceeds the quantity that providers are willing to supply, Q_{2S}. This is a case of excess demand, represented by BC. It would probably be evidenced by waiting lists for health care.

One implication of this is that the price increase necessary to recover control costs, no matter how small, may not be achievable in the short run. Price may adjust only to P_2, not P_3, the price level necessary for the market to clear in the short run. Another implication is that the short-run impact of control costs on output may be more pronounced than if the market were allowed to clear. Instead of falling to Q_3, output may fall further to Q_{2S}.

The inability to recover control costs in the short run due to institutional constraints may apply particularly to

FIGURE 2. THE EFFECTS OF INADEQUATE REIMBURSEMENT (e.g., FROM MEDICARE) OF INCREASED COSTS TO HEALTH CARE PROVIDERS



1) nursing homes, which receive almost half of their funding from Medicaid; 2) kidney dialysis facilities, which are almost entirely dependent on Medicare for funding ($4 billion per year); 3) rural hospitals, which tend to have older constituencies and are therefore especially reliant on Medicare; and 4) inner-city hospitals, which serve disproportionately poor populations and are therefore relatively dependent on Medicaid.[44]

In the long run, in theory, excess demand is not sustainable. Eventually, consumers would have to make it clear to third-party payers (e.g., Medicare, Medicaid, private insurers) that accessible health care is imperative. Reimbursement rates would have to be adjusted to allow the market to clear. Considering that since 1983 PPS has consistently under-reimbursed health care providers, however, it is not clear when the "long run" would take effect. Nevertheless, in the long run, price and output adjustments should more closely reflect underlying demand than in the short run. Moreover, the extent to which short-run price and output adjustments are derailed by institutional barriers may not be that great, as third-party reimbursements -- particularly under PPS -- though deficient, still compensate the bulk of health care cost increases.

3.3.2 <u>Public and Not-For-Profit Establishments</u>

Public (government) establishments may also be limited -- regardless of underlying demand -- in their ability to recover a cost increase. Public establishments often produce public goods or provide public services that are valuable socially but for whose production or provision the marketplace would not reward private enterprise. Typically, they are funded at least in part from tax revenues, which, considering current government budget restrictions, may not offer a lot of flexibility for passing along a cost increase.

Not-for-profit establishments may face similar limitations. This applies particularly to establishments that, to meet their budget, are to some degree dependent on such sources of funds as donations, grants, and fund-raising proceeds. For example, the American Red Cross, which collects half of the nation's blood supply, is currently revamping its procedures and controls for collecting and processing blood. It is estimated that this program will cost $100 million. In addition to stepping up fund raising, the Red Cross says it will have to borrow and cut other parts of its budget in order to pay for this.[45] Therefore, despite the underlying relatively inelastic demand for blood (because it is a necessity), it is clear that the Red Cross is restricted, at least in the short run, in its ability to recover a cost increase. It is evidently not a matter of simply increasing prices.

Several regulated industries or industry subcategories may be particularly affected by this type of restriction. These include public hospitals; blood banks, which are not-for-profit; correctional facilities, which are public; and fire and rescue operations, which are public. Public hospitals, for example, typically rely on government subsidies to offset operating deficits.[46] In addition, they tend to be located in areas (e.g., rural) with a high percentage of uninsured patients.[47]

These industries or industry subcategories provide services on which society is reliant. This is reflected in relatively inelastic demand. In the short run, revenues perhaps cannot be increased sufficiently in response to a cost increase to reflect this demand. As a result, normal profits will not be earned. Output will contract and there will be excess demand. In the long run, the public should, in theory, be forthcoming with more generous tax payments, donations, grants, contributions to fund-raising drives, etc. In reality, government budget restrictions and the scarcity of funds for nonprofit uses may make it difficult to fully recover costs even in the longer term. Nevertheless, as in the case of inadequate reimbursement of health care costs, while short-run price and output adjustments may be distorted, in the long run these adjustments should more closely reflect underlying demand.

3.4 INDUSTRY-WIDE IMPACTS

3.4.1 Industry-wide Annualized Control Costs

Net industry-wide annualized control costs, which are needed to calculate industry-wide economic impacts, are estimated in Table 7. Industry-wide annualized control costs, in the first four columns, are calculated by summing for each model combustor the product of the total number of MWIs in the industry (Table 2) and per-MWI annualized control costs (Table 3). Note that there are no such costs for industries in which no MWIs are operated.

Next, Table 7 recognizes that control costs attributable to capacity that is used to incinerate other generators' medical wastes (i.e., used for commercial incineration) will be passed along to these offsite generators. This is accomplished in a two-step process. In the first step, annualized control costs attributable to capacity used for commercial incineration are estimated and aggregated in a "commercial incineration cost pool." In the short run, under perfect competition, only marginal costs would be passed along to offsite generators. In the long run, however, all costs are variable. Therefore, it is assumed that annualized control costs associated with capacity used for commercial incineration are fully passed along to offsite generators. The portion of annualized control costs that is passed along depends on the fraction

TABLE 7. CALCULATION OF NET INDUSTRY-WIDE ANNUALIZED CONTROL COSTS
--EXISTING MWIs--

	Industry-wide annualized control costs ($ thousand)				Portion of costs passed along to off-site generators	Control costs passed along to offsite generators ($ thous.)			
	C.O.1	C.O.2	C.O.3	C.O.4		C.O.1	C.O.2	C.O.3	C.O.4
Hospitals	50,223	68,503	226,766	461,241	10%	5,022	6,850	22,677	46,124
Nursing homes	6,316	8,001	28,702	63,946	10%	632	800	2,870	6,395
Veterinary facilities	6,383	8,257	29,575	67,825	10%	638	826	2,958	6,783
Laboratories									
Commercial research	7,515	10,318	34,577	71,446	10%	752	1,032	3,458	7,145
Medical/dental	0	0	0	0					
Funeral homes	0	0	0	0					
Physicians' offices	0	0	0	0					
Dentists' offices & clinics	0	0	0	0					
Outpatient care	0	0	0	0					
Freestanding blood banks	0	0	0	0					
Fire & rescue operations	0	0	0	0					
Correctional facilities	0	0	0	0					
Commercial incineration fac.	2,110	11,649	35,702	52,346	100%	2,110	11,649	35,702	52,346
Other	0	0	0	0					
Total	72,547	106,728	355,322	716,804		9,154	21,157	67,664	118,792

TABLE 7. CALCULATION OF NET INDUSTRY-WIDE ANNUALIZED CONTROL COSTS (CONT.)
--EXISTING MWIs--

	Share of the commercial incineration cost pool	Incremental offsite incineration costs ($ thousand)				Net industry-wide annualized control costs ($ thousand)			
		C.O.1	C.O.2	C.O.3	C.O.4	C.O.1	C.O.2	C.O.3	C.O.4
Hospitals	57.87%	5,297	12,243	39,157	68,745	50,498	73,896	243,247	483,862
Nursing homes	8.55%	783	1,809	5,785	10,157	6,467	9,010	31,617	67,708
Veterinary facilities	1.34%	123	284	907	1,592	5,867	7,715	27,524	62,634
Laboratories									
Commercial research	2.15%	197	455	1,455	2,554	6,960	9,741	32,574	66,855
Medical/dental	5.23%	479	1,107	3,539	6,213	479	1,107	3,539	6,213
Funeral homes	0.27%	25	57	183	321	25	57	183	321
Physicians' offices	10.45%	957	2,211	7,071	12,414	957	2,211	7,071	12,414
Dentists' offices & clinics	2.58%	236	546	1,746	3,065	236	546	1,746	3,065
Outpatient care	7.78%	712	1,646	5,264	9,242	712	1,646	5,264	9,242
Freestanding blood banks	1.47%	135	311	995	1,746	135	311	995	1,746
Fire & rescue operations	0.49%	45	104	332	582	45	104	332	582
Correctional facilities	0.98%	90	207	663	1,164	90	207	663	1,164
Commercial incineration fac.	0.00%	0	0	0	0	0	0	0	0
Other	0.84%	77	178	568	998	77	178	568	998
Total	100.00%	9,154	21,157	67,664	118,792	72,547	106,728	355,322	716,804

of MWI capacity used to incinerate waste generated offsite. By definition, 100 percent of the MWI capacity of commercial incineration facilities is used by offsite generators. For hospitals, nursing homes, veterinary facilities, and research laboratories, it is assumed that 10 percent of MWI capacity is used by offsite generators. This estimate may be high. However, this is preferred so that impacts calculated for offsite generators will be conservative.

The commercial incineration cost pool is derived by summing annualized control costs passed along to offsite generators in each industry. The result, shown in Table 7, is $9.2 million under Control Option 1, $21.2 million under Control Option 2, $67.7 million under Control Option 3, and $118.8 million under Control Option 4.

The second step is to allocate the commercial incineration cost pool to offsite generators. Ideally, this would be done according to the share of total medical waste incinerated offsite. This information is not available, however. Instead, the share of total medical waste generated <u>and</u> not incinerated onsite is estimated and used as a proxy. This is done assuming that the amount of total industry medical waste generated that is not incinerated onsite is in proportion to the fraction of facilities in the industry that do not operate an MWI. For example, an estimated 54.2 percent of all hospitals do not operate an MWI (see Table 4). Therefore, it is assumed that 54.2 percent of total medical waste generated by hospitals is not incinerated onsite.

This methodology results in the industry shares of the commercial incineration cost pool shown in Table 7. Even though almost half of all hospitals operate an MWI, the hospital category is still estimated to account for over half (57.87%) of all medical waste incinerated offsite. Physicians' offices have the second largest share -- 10.45

percent. Commercial incineration facilities have no share of the commercial incineration cost pool because they do not generate medical waste.

Applying these shares to the commercial incineration cost pool, incremental offsite incineration costs are calculated for each industry in Table 7. Net industry-wide annualized control costs can now be estimated as industry-wide annualized control costs, minus control costs passed along by MWI operators to offsite generators, plus incremental offsite incineration costs incurred by offsite generators. Net industry-wide annualized control costs are shown in the last four columns of Table 7. It is interesting to note that despite the comparative prevalence of MWIs at hospitals, net industry-wide annualized control costs are higher for hospitals than industry-wide annualized control costs. This is because the hospital industry is estimated to generate more medical waste that is incinerated offsite than it incinerates commercially on behalf of offsite generators.

3.4.2 Financial/Economic Inputs

Financial/economic data are also needed for the analysis of industry-wide economic impacts. These inputs are presented in Table 8. Revenue and employment are aggregated from the model facility data in Tables 5A, 5B, and 5C. The price elasticities of demand are from Table 6.

3.4.3 Commercial Incineration

Note in Table 8 that the price elasticity of demand has not been estimated for commercial incineration facilities. Due to the limited number of medical waste treatment and disposal options, the demand for commercial incineration is probably relatively inelastic. However, specifying a price elasticity of demand for commercial incineration will not indicate the impact of the Emission Guidelines on the output of commercial incineration facilities because output will

TABLE 8. FINANCIAL/ECONOMIC INPUTS FOR THE INDUSTRY-WIDE ECONOMIC IMPACT ANALYSIS

	Industry revenue ($ million)	Industry employment	Price elasticity of demand	
			Max.	Min.
Hospitals	223,665	3,957,150[a]	-0.33	0.00
Nursing homes	32,137	1,332,608	-0.67	-0.33
Veterinary facilities	7,422	103,887	-1.00	-0.67
Laboratories				
Commercial research	11,847	137,517	-1.33	-1.00
Medical/dental	7,640	132,031	-1.33	-0.67
Funeral homes	9,900	154,000	-0.33	0.00
Physicians' offices	95,295	1,032,901	-0.33	0.00
Dentists' offices & clinics	27,406	492,742	-0.67	-0.33
Outpatient care	15,008	202,011	-0.33	0.00
Freestanding blood banks	1,239	13,298	-0.33	0.00
Fire & rescue operations	12,348	29,542	-0.33	0.00
Correctional facilities	24,245	424,397	-0.33	0.00
Commercial incineration fac.	150	N/A	N.E.	N.E.
Total	468,302	8,012,084		

[a] Full-time-equivalent

N/A Not available.

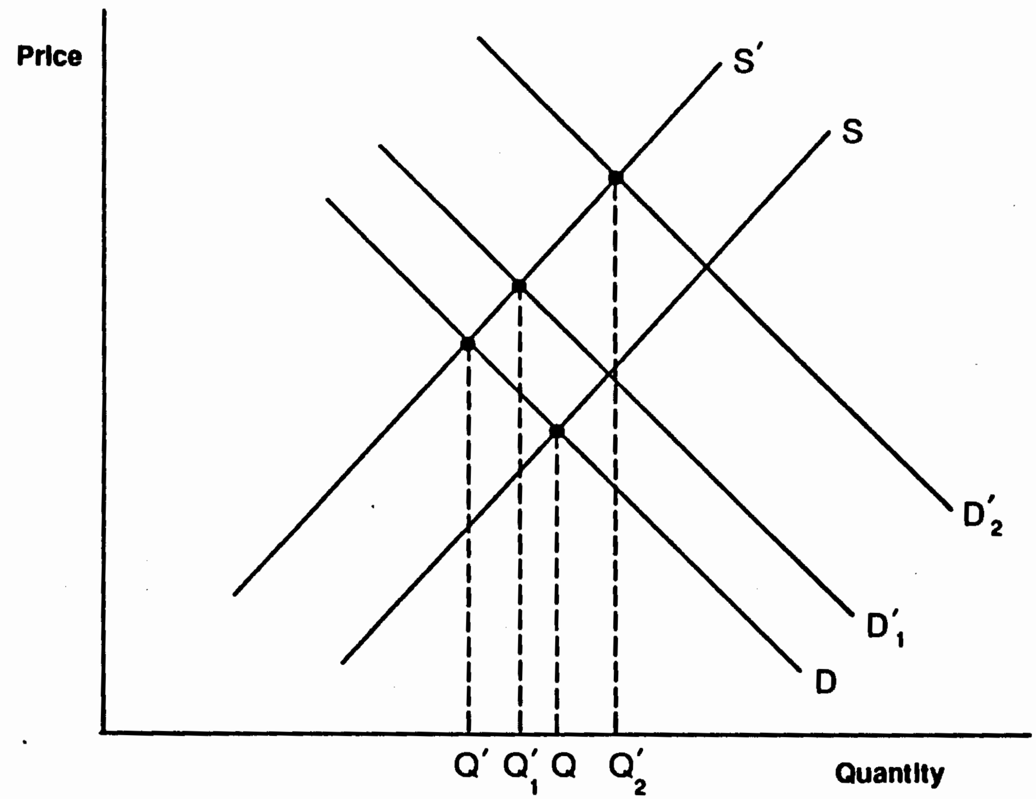
N.E. Not estimated.

also be influenced by the effect of the regulation on the demand for offsite incineration. On the one hand, through a shift in supply, control costs will result in a decrease in quantity demanded and therefore a decrease in output, to the extent that demand is not perfectly inelastic. On the other hand, because offsite incineration is a substitute for onsite incineration, the increase in the cost of onsite incineration resulting from the Emission Guidelines will cause an increase in the demand for offsite incineration. Through a shift in demand, this will produce an increase in quantity supplied and an increase in output, to the extent that supply is not perfectly inelastic.

The countervailing effects that control costs and an increase in the demand for offsite incineration have on commercial incineration output are demonstrated in Figure 3. The initial market supply curve is S and the initial market demand curve is D, with an equilibrium quantity of Q. Control costs cause supply to shift to S′. With no change in demand, this would cause quantity to decrease from Q to Q′. However, demand increases, with a counter effect on quantity. If demand shifts to D'_1, the new equilibrium quantity is Q'_1, which is less than Q. On the other hand, if demand shifts to D'_2, the new equilibrium is Q'_2. In this case, quantity has increased.

The comparative strengths of these countervailing supply and demand effects will determine the impact of the Emission Guidelines on the output of commercial incineration facilities. If the impact is negative, the industry-wide output decline is likely to be shared across the country by a number of commercial incineration facilities because the commercial incineration market is effectively regionalized by transportation cost differentials. In general, to the extent that a market is fragmented (e.g., regionalized), an industry-wide decrease in output will not require

FIGURE 3. ALTERNATIVE QUANTITY IMPACTS FOR COMMERCIAL INCINERATION FACILITIES



restructuring (e.g., closures), but rather will be brought about by a number of marginal facilities reducing their capacity utilization.

This can be understood from the following example. Consider an industry with 100 firms, all of the same size (i.e., all with a 1% market share). If the industry is not fragmented (i.e., the market is nationwide), in theory a one percent decrease in industry-wide output would be brought about by a 100 percent decrease in the output of one firm -- the marginal firm. This implies that the marginal firm would have to shut down. Suppose, in contrast, that the industry is fragmented into 25 market segments -- distinguished by locality or region, for example -- each consisting of four firms. Because these market segments are independent (i.e., firms do not compete with firms in other market segments), a one percent decrease in industry-wide output would be brought about by a one percent decrease in output in each individual market segment. This would require output of the marginal firm in each market segment to decline by only four percent, which does not necessarily imply closure.

Consequently, no commercial incineration facilities would be likely to have to shut down. Another mitigating factor is that if commercial incineration output is negatively impacted by the Emission Guidelines, commercial autoclaving is likely to benefit. Some commercial waste management companies offer both incineration and autoclaving. These types of commercial facilities might only experience a shift in sales from incineration to autoclaving. This may also suggest that commercial facilities dependent on incineration have the flexibility to branch into autoclaving if necessary.

However, the presumption of this analysis is that the demand for commercial incineration will increase to offset the impact on output of control costs. Already, commercial incineration capacity is tight in the face of rapidly growing demand. The Emission Guidelines will give impetus to this demand growth, as onsite incineration becomes more expensive. Given these forces, a contraction of industry output is unlikely.

If the output of commercial incineration facilities is not negatively impacted by the Emission Guidelines, one implication is that prices will be raised to fully recover control costs. This is because profitability will have to be undiminished (implying full recovery of control costs) in order for regulated facilities to have the incentive to maintain their level of output. This can also be understood with reference to Figure 3. If demand shifts to exactly offset the effect on output of the shift in supply, leaving output unchanged, the change in price (per unit of output) will equal the per-unit control cost, represented by the vertical distance between S and S'. Since the per-unit changes in price and cost are the same, control costs are fully recovered.

3.4.4 Market Price Increase

Regulated facilities would ideally like to pass along control costs to their customers by increasing prices. The market price increase is defined as the average industry-wide price increase (i.e., increase in the revenue basis) necessary to recover control costs. It is calculated in Table 9 as the ratio of net industry-wide annualized control costs to revenue.

Because most, if not all, of the regulated industries are fragmented, actual price increases will vary from market segment to market segment according to such factors as 1) the number of facilities, 2) the number of facilities operating an MWI, 3) the distribution of MWI types, and 4) market structure and pricing mechanisms. Ideally, the

TABLE 9. NET INDUSTRY-WIDE ANNUALIZED CONTROL COSTS AS A PERCENT OF REVENUE/BUDGET
--Existing MWIs--

Industry	C.O.1	C.O.2	C.O.3	C.O.4
Hospitals	0.023%	0.033%	0.109%	0.216%
Nursing homes	0.020%	0.028%	0.098%	0.211%
Veterinary facilities	0.079%	0.104%	0.371%	0.844%
Laboratories				
Commercial research	0.059%	0.082%	0.275%	0.564%
Medical/dental	0.006%	0.014%	0.046%	0.081%
Funeral homes	0.000%	0.001%	0.002%	0.003%
Physicians' offices	0.001%	0.002%	0.007%	0.013%
Dentists' offices & clinics	0.001%	0.002%	0.006%	0.011%
Outpatient care	0.005%	0.011%	0.035%	0.062%
Freestanding blood banks	0.011%	0.025%	0.080%	0.141%
Fire & rescue operations	0.000%	0.001%	0.003%	0.005%
Correctional facilities	0.000%	0.001%	0.003%	0.005%

average price increase in each market segment would be measured. However, it is not possible to define and characterize literally hundreds of regional and local market segments. Therefore, the market price increase, which is an average price increase across all market segments, is used to represent the average price increase in each individual market segment.

As an average, the market price increase does not reflect the range of price increases that all facilities in an industry would require to recover control costs. The range of price increases necessary to recover control costs should be particularly wide in industries consisting of both MWI operators and offsite generators. On average, offsite generators will require a lower price increase to recover control costs (passed along from commercial MWIs) than MWI operators. This is because 1) the average offsite generator is less dependent on offsite incineration than the average MWI operator is dependent on onsite incineration; and 2) MWIs used for commercial incineration are larger than average, and therefore have relatively low control costs per ton. Among offsite generators, the price increase necessary to recover control costs will vary with the degree of dependence on offsite incineration.

All market price increases in Table 9 are under one percent and are therefore considered to be achievable. Due to institutional constraints, it may require some time for the price increases to be fully implemented, however. The low values reflect in part that in all industry categories, the majority of facilities do not operate an MWI. Commercial incineration facilities (all of which, by definition, operate an MWI) are not included in Table 9 because they were defined in Table 7 as having no net annualized control costs.

3.4.5 Consequences of the Market Price Increase

The market price increase will result in changes in output, revenue, and employment, depending on demand elasticity. Output will decrease unless demand is perfectly inelastic. (For health care industries, output is the level of service provided, such as the number of patients admitted, or the number of operations performed.) Revenue will change if the demand elasticity is not unitary (i.e., equal to -1). It will increase if demand is relatively inelastic and decrease if demand is relatively elastic. It can be assumed that employment will decrease if output decreases.

3.4.5.1 Output Impacts. Table 10 shows the industry-wide percent change in output in response to the market price increase. The calculations follow from the specification of a constant-elasticity demand function:

$$Q_D = aP^{\epsilon}$$

where,

Q_D = quantity demanded
a = a constant
P = price
ϵ = price elasticity of demand

This function is an arc that is asymptotic to the origin. It assures that elasticity does not change over the range of the market price increase. Alternatively, it can be viewed to allow the elasticities specified in Table 6 to be averages over the range of the market price increase.

The demand function can be used to solve for the percent change in output ($\%\Delta Q$):

TABLE 10. INDUSTRY-WIDE OUTPUT IMPACTS OF THE MARKET PRICE INCREASE
--Existing MWIs--

Industry	Price elasticity of demand		Percent change in output							
			Max. elasticity				Min. elasticity			
	Max.	Min.	C.O.1	C.O.2	C.O.3	C.O.4	C.O.1	C.O.2	C.O.3	C.O.4
Hospitals	-0.33	0.00	-0.007%	-0.011%	-0.036%	-0.071%	0.000%	0.000%	0.000%	0.000%
Nursing homes	-0.67	-0.33	-0.013%	-0.019%	-0.066%	-0.141%	-0.007%	-0.009%	-0.032%	-0.069%
Veterinary facilities	-1.00	-0.67	-0.079%	-0.104%	-0.369%	-0.837%	-0.053%	-0.070%	-0.248%	-0.561%
Laboratories										
Commercial research	-1.33	-1.00	-0.078%	-0.109%	-0.365%	-0.746%	-0.059%	-0.082%	-0.274%	-0.561%
Medical/dental	-1.33	-0.67	-0.008%	-0.019%	-0.062%	-0.108%	-0.004%	-0.010%	-0.031%	-0.054%
Funeral homes	-0.33	0.00	0.000%	0.000%	-0.001%	-0.001%	0.000%	0.000%	0.000%	0.000%
Physicians' offices	-0.33	0.00	0.000%	-0.001%	-0.002%	-0.004%	0.000%	0.000%	0.000%	0.000%
Dentists' offices & clinics	-0.67	-0.33	-0.001%	-0.001%	-0.004%	-0.007%	0.000%	-0.001%	-0.002%	-0.004%
Outpatient care	-0.33	0.00	-0.002%	-0.004%	-0.012%	-0.020%	0.000%	0.000%	0.000%	0.000%
Freestanding blood banks	-0.33	0.00	-0.004%	-0.008%	-0.026%	-0.046%	0.000%	0.000%	0.000%	0.000%
Fire & rescue operations	-0.33	0.00	0.000%	0.000%	-0.001%	-0.002%	0.000%	0.000%	0.000%	0.000%
Correctional facilities	-0.33	0.00	0.000%	0.000%	-0.001%	-0.002%	0.000%	0.000%	0.000%	0.000%

$$\% \Delta Q = \frac{Q_2 - Q_1}{Q_1}$$

$$= \frac{aP_2^{\epsilon} - aP_1^{\epsilon}}{aP_1^{\epsilon}}$$

$$= \frac{P_2^{\epsilon} - P_1^{\epsilon}}{P_1^{\epsilon}}$$

$$= \frac{[P_1(1+\%\Delta P)]^{\epsilon} - P_1^{\epsilon}}{P_1^{\epsilon}}$$

$$= \frac{P_1^{\epsilon}(1+\%\Delta P)^{\epsilon} - P_1^{\epsilon}}{P_1^{\epsilon}}$$

$$= \frac{P_1^{\epsilon}(1+\%\Delta P)^{\epsilon}}{P_1^{\epsilon}} - \frac{P_1^{\epsilon}}{P_1^{\epsilon}}$$

$$= (1+\%\Delta P)^{\epsilon} - 1$$

The output impacts in Table 10 are obtained by setting $\%\Delta P$ equal to the market price increase. The percent change in output and the percent change in price are inversely related because the demand curve is downward-sloping. This inverse relationship is imparted to the equation for $\%\Delta Q$ by ϵ's negative coefficient.

Owing to a small market price increase and/or relatively inelastic demand, none of the impacts in Table 10 are significant. All are less than one percent. The biggest impact is -0.837 percent, registered by veterinary facilities in the case of the maximum elasticity under Control Option 4. The impact on hospitals ranges up to -0.071 percent in the case of the maximum elasticity under Control Option 4.

With the possible exception of commercial research labs, all of the regulated industries are fragmented because they are regionalized or localized. The typical community hospital (that is, one that is not specialized), for example, does not compete with hospitals outside of its locality or region. Consequently, the output impacts in Table 10 will not require any industries to be restructured (e.g., through closures or consolidations), but rather will be brought about by declines in capacity utilization that will be shared by a number of facilities (in theory, the marginal facilities, i.e., the facilities with the highest average costs). The rationale for this was discussed in Section 3.4.3.

Capacity utilization in the U.S. hospital industry is already quite low (the average occupancy rate of hospitals registered with the American Hospital Association declined from 77.7% in 1980 to 69.2% in 1988).[48] But the impact of a 0.071 percent decrease in industry-wide output (Control Option 4, maximum elasticity) on capacity utilization would be insignificant.

Although the industry-wide output impact on commercial research labs -- which may not be a fragmented market -- ranges up to -0.746 percent in the case of the maximum elasticity under Control Option 4, this, too, would not be sufficient to cause the industry to restructure.

3.4.5.2 Employment and Revenue Impacts. The impact of the market price increase on industry-wide employment, assuming that employment is proportionate to output (i.e., fixed labor-output ratio), is calculated in Table 11. The biggest employment decreases are registered by hospitals and nursing homes. As a percent of baseline employment (see Table 8), however, these impacts are small. In the case of the maximum elasticity under Control Option 4, employment declines by 0.071 percent at hospitals and by 0.141 percent at nursing homes (by definition, these are the same as the

TABLE 11. INDUSTRY-WIDE EMPLOYMENT IMPACTS OF THE MARKET PRICE INCREASE
--Existing MWIs--

Industry	Price elasticity of demand		Change in employment							
			Max. elasticity				Min. elasticity			
	Max.	Min.	C.0.1	C.0.2	C.0.3	C.0.4	C.0.1	C.0.2	C.0.3	C.0.4
Hospitals	-0.33	0.00	(295)	(431)	(1,419)	(2,821)	0	0	0	0
Nursing homes	-0.67	-0.33	(180)	(250)	(878)	(1,878)	(88)	(123)	(432)	(925)
Veterinary facilities	-1.00	-0.67	(82)	(108)	(384)	(869)	(55)	(72)	(257)	(583)
Laboratories										
Commercial research	-1.33	-1.00	(107)	(150)	(501)	(1,025)	(81)	(113)	(377)	(772)
Medical/dental	-1.33	-0.67	(11)	(25)	(81)	(143)	(6)	(13)	(41)	(72)
Funeral homes	-0.33	0.00	(0)	(0)	(1)	(2)	0	0	0	0
Physicians' offices	-0.33	0.00	(3)	(8)	(25)	(44)	0	0	0	0
Dentists' offices & clinics	-0.67	-0.33	(3)	(7)	(21)	(37)	(1)	(3)	(10)	(18)
Outpatient care	-0.33	0.00	(3)	(7)	(23)	(41)	0	0	0	0
Freestanding blood banks	-0.33	0.00	(0)	(1)	(4)	(6)	0	0	0	0
Fire & rescue operations	-0.33	0.00	(0)	(0)	(0)	(0)	0	0	0	0
Correctional facilities	-0.33	0.00	(1)	(1)	(4)	(7)	0	0	0	0

output impacts in Table 10). Because all of the regulated industries are geographically dispersed, the employment impacts will not be felt in any one particular region of the country.

Table 11 does not account for some potential employment effects of the regulation that are positive. For example, employment related to the production of pollution control equipment should increase. In addition, additional people will be needed to give training to MWI operators. Further, there should be an increase in employment related to the production and operation of autoclave systems and MWIs used for commercial incineration.

Revenue impacts resulting from the market price increase are stated in Table 12. The percent change in revenue is equal to the sum of the percent change in price (market price increase) and the percent change in output, plus their cross-product. Revenue increases in response to a price increase if demand is relatively inelastic, and decreases if demand is relatively elastic. It does not change if the elasticity is unitary ($\epsilon = -1$).

Revenue decreases only at commercial research labs and medical/dental labs in the case of the maximum elasticity. In all other cases, revenue increases because demand is relatively inelastic or does not change because demand is unitary-elastic. Relative to the baseline, the decrease in revenue in the case of the maximum elasticity under Control Option 4 is only 0.19 percent at commercial research labs and 0.03 percent at medical/dental labs. Not only are these impacts small, but they also will not entirely impact the bottom line (i.e., net income) because they will be at least partially offset by variable costs that decrease along with the decrease in output.

TABLE 12. INDUSTRY-WIDE REVENUE/BUDGET IMPACTS OF THE MARKET PRICE INCREASE
--Existing MWIs--

Industry	Price elasticity of demand		Change in revenue/budget ($ thousand)							
			Max. elasticity				Min. elasticity			
	Max.	Min.	C.O.1	C.O.2	C.O.3	C.O.4	C.O.1	C.O.2	C.O.3	C.O.4
Hospitals	-0.33	0.00	$33,832	$49,508	$162,946	$324,072	$50,498	$73,896	$243,247	$483,862
Nursing homes	-0.67	-0.33	$2,134	$2,973	$10,430	$22,328	$4,333	$6,036	$21,180	$45,349
Veterinary facilities	-1.00	-0.67	$0	$0	($0)	$0	$1,936	$2,545	$9,072	$20,611
Laboratories										
Commercial research	-1.33	-1.00	($2,296)	($3,213)	($10,730)	($21,980)	$0	$0	($0)	$0
Medical/dental	-1.33	-0.67	($158)	($365)	($1,167)	($2,049)	$158	$365	$1,168	$2,050
Funeral homes	-0.33	0.00	$17	$38	$122	$215	$25	$57	$183	$321
Physicians' offices	-0.33	0.00	$641	$1,481	$4,737	$8,317	$957	$2,211	$7,071	$12,414
Dentists' offices & clinics	-0.67	-0.33	$78	$180	$576	$1,011	$158	$366	$1,170	$2,053
Outpatient care	-0.33	0.00	$477	$1,103	$3,527	$6,192	$712	$1,646	$5,264	$9,242
Freestanding blood banks	-0.33	0.00	$90	$208	$666	$1,170	$135	$311	$995	$1,746
Fire & rescue operations	-0.33	0.00	$30	$69	$222	$390	$45	$104	$332	$582
Correctional facilities	-0.33	0.00	$60	$139	$444	$780	$90	$207	$663	$1,164

3.5 PER-FACILITY IMPACTS FOR MWI OPERATORS

3.5.1 Linking Control Costs to Model Facilities

Control costs for the model combustors were presented in Table 3. In order to estimate economic impacts on facilities that operate an MWI, it is necessary to link the control costs to the model facilities defined in Tables 5A and 5B. This is accomplished by assigning model combustors to model facilities.

The assignment scheme reflects that, generally, larger MWIs are expected to be located at larger facilities.

Six model combustors -- the Intermittent 21,000, Continuous 24,000, Intermittent 8,400, Pathological 2,000, Intermittent 2,000, and Batch 250 -- are attributed to hospitals in Table 2. Hospital subcategories in which the average number of beds is 300 or greater are assigned the two largest MWIs, the Intermittent 21,000 and Continuous 24,000. Hospitals with 100-299 beds are assigned the next-largest MWI, the Intermittent 8,400. This includes "Total" and the urban hospitals subcategory. Hospitals with 50-99 beds -- including the rural hospitals subcategory -- are assigned the two next-largest MWIs, the Pathological 2,000 and Intermittent 2,000. Hospitals with fewer than 50 beds are assigned the smallest MWI, the Batch 250.

The Intermittent 8,400, Pathological 2,000, and Intermittent 2,000 are attributed to nursing homes in Table 2. Nursing homes with 100+ employees -- the only subcategory in which MWIs are operated -- are assigned the Pathological 2,000 and a "composite" of the two intermittent MWIs. The composite is a weighted average of the two intermittent MWIs based on their representation in the projected nationwide population of nursing home MWIs (as indicated in Table 2, 19 Intermittent 8,400s and 349 Intermittent 2,000s). The composite is not an actual MWI.

Rather, it is intended to represent a typical intermittent MWI used by nursing homes with 100+ employees.

The two model combustors attributed to veterinary facilities in Table 2, the Pathological 2,000 and Intermittent 2,000, are similar in size. Therefore, both are assigned to the two subcategories of veterinary facilities in which MWIs are operated -- 10-19 employees and 20+ employees.

Tax-paying commercial research labs with 100+ employees (they average 356.9 employees) are assigned the Intermittent 21,000 and Continuous 24,000. Tax-exempt commercial research labs (they average 147.7 employees) are assigned the Intermittent 8,400. Tax-paying commercial research labs with 20-99 employees are assigned the Pathological 2,000 and Intermittent 2,000.

Finally, the only model combustor attributed to commercial incineration facilities in Table 2 is the Continuous 36,000. Survey responses from 15 commercial incineration facilities indicated that the average facility operates about two MWIs. Therefore, commercial incineration facilities are assigned two Continuous 36,000s (alternatively, control costs for the Continuous 36,000 are multiplied by two). In all other industry categories there is typically only one MWI per facility (though there are exceptions), so model combustors are assigned to model facilities on a one-to-one basis.

By linking the control costs in Table 3 directly to model facilities, it is assumed that no portion of control costs is passed along to offsite generators. This deviates from the methodology used to estimate industry-wide control costs in Section 3.4.1. Nevertheless, this approach is taken because many MWI operators, no doubt, do not use any of their capacity to incinerate waste generated offsite.

The impacts of controls on these MWI operators would be lost if control costs were uniformly reduced to reflect commercial incineration cost sharing. Therefore, the per-facility economic impacts on MWI operators should be regarded to apply to facilities that do not incinerate commercially and therefore will not share control costs with offsite generators. Impacts will be overstated (conservative) for facilities that do incinerate commercially and share control costs with offsite generators.

Per-facility control costs are summarized in Tables 13 and 14. Table 13 shows capital control costs and Table 14 shows annualized control costs. These costs are used for the calculation of all impacts in this section. Note that the costs for commercial incineration facilities are double the costs of the Continuous 36,000 in Table 3 because there are two units per facility.

3.5.2 Facility Price Increase

The facility price increase is defined as the price increase necessary for an individual facility to fully recover control costs. It is distinguished from the market price increase, which is the average industry-wide price increase necessary to recover control costs. Because offsite generators are on average impacted less by the Emission Guidelines than MWI operators, the facility price increase calculated for MWI operators in industries in which there are also some offsite generators will exceed the market price increase.

To the extent that an industry is competitive, individual firms are constrained to institute price increases that are not far out of line with the market price increase. Under perfect competition, for example, where all firms are price-takers, an attempt by a firm to increase

TABLE 13. CAPITAL CONTROL COSTS FOR MODEL FACILITIES(1989 DOLLARS)
--EXISTING MWIs--

Industry/subcategory	Intermittent MWI				Batch MWI				Continuous MWI				Pathological MWI			
	C.0.1	C.0.2	C.0.3	C.0.4	C.0.1	C.0.2	C.0.3	C.0.4	C.0.1	C.0.2	C.0.3	C.0.4	C.0.1	C.0.2	C.0.3	C.0.4
Hospitals																
300+ beds	107,806	176,206	461,152	901,267					85,047	130,644	362,910	753,211				
100-299 beds	66,835	94,183	284,291	634,482												
50-99 beds	48,622	57,722	205,672	515,234									50,017	60,516	211,696	524,410
<50 beds					46,061	52,596	194,619	498,364								
Nursing homes	49,562	59,604	209,731	521,391									50,017	60,516	211,696	524,410
Veterinary facilities	48,622	57,722	205,672	515,234									50,017	60,516	211,696	524,410
Commercial research labs																
Tax-paying																
100+ emp.	107,806	176,206	461,152	901,267					85,047	130,644	362,910	753,211				
20-99 emp.	48,622	57,722	205,672	515,234									50,017	60,516	211,696	524,410
Tax-exempt	66,835	94,183	284,291	634,482												
Commercial incineration fac.									11,848	352,412	922,304	1,802,534				

TABLE 14. ANNUALIZED CONTROL COSTS FOR MODEL FACILITIES(1989 DOLLARS)
--EXISTING MWIs--

Industry/subcategory	Intermittent MWI C.0.1	Intermittent MWI C.0.2	Intermittent MWI C.0.3	Intermittent MWI C.0.4	Batch MWI C.0.1	Batch MWI C.0.2	Batch MWI C.0.3	Batch MWI C.0.4	Continuous MWI C.0.1	Continuous MWI C.0.2	Continuous MWI C.0.3	Continuous MWI C.0.4	Pathological MWI C.0.1	Pathological MWI C.0.2	Pathological MWI C.0.3	Pathological MWI C.0.4
Hospitals																
300+ beds	36,155	59,643	169,940	270,906					30,827	46,524	131,290	219,372				
100-299 beds	19,665	29,162	93,209	174,288												
50-99 beds	12,684	15,688	56,968	127,270									11,481	14,935	53,404	122,862
<50 beds					13,375	15,268	52,172	120,948								
Nursing homes	13,044	16,384	58,839	129,698									11,481	14,935	53,404	122,862
Veterinary facilities	12,684	15,688	56,968	127,270									11,481	14,935	53,404	122,862
Commercial research labs																
Tax-paying																
100+ emp.	36,155	59,643	169,940	270,906					30,827	46,524	131,290	219,372				
20-99 emp.	12,684	15,688	56,968	127,270									11,481	14,935	53,404	122,862
Tax-exempt	19,665	29,162	93,209	174,288												
Commercial incineration fac.									28,128	155,316	476,032	697,946				

prices above the prices of its competitors would result in the loss of all output. The achievability of the facility price increase depends on how much it deviates from the market price increase, as well as on market structure.

The facility price increase is calculated as the ratio of annualized control costs to revenue for hospitals in Table 15A and for other MWI operators in Table 15B.

3.5.2.1 Hospitals. The average facility price increase for all hospitals ("Total") is 0.06 percent under Control Option 1, 0.09 percent under Control Option 2, 0.29 percent under Control Option 3, and 0.54 percent under Control Option 4. The latter amount represents only 5.6 percent of the 9.7 percent average annual increase in hospital spending in the U.S. from 1980 to 1987.[49]

Even though model combustors have been assigned to model facilities in relation to size, it is evident that larger facilities have economies of scale. Under Control Option 4, for example, while the average facility price increase for all hospitals with 300+ beds ranges from 0.21 percent (Continuous 24,000) to 0.26 percent (Intermittent 21,000), the average facility price increase for all hospitals with fewer than 50 beds is 3.04 percent (Batch 250). The facility price increase ranges from 0.03 percent under Control Option 1 to 0.31 percent under Control Option 4 for urban hospitals, and from 0.13 percent to 1.29 percent for rural hospitals. The impacts on rural hospitals are higher because rural hospitals are smaller on average than urban hospitals.

All facility price increases under Control Options 1 and 2 are less than one percent. They are therefore considered to be achievable. Institutional constraints may

TABLE 15A. PER-FACILITY ANNUALIZED CONTROL COSTS AS A PERCENT OF REVENUE : HOSPITALS
--EXISTING MWIs--

Industry category	Intermittent MWI C.O.1	C.O.2	C.O.3	C.O.4	Batch, continuous, or pathological MWI[a] C.O.1	C.O.2	C.O.3	C.O.4
AHA-registered								
Federal								
Psychiatric	0.07%	0.12%	0.34%	0.54%	0.06%	0.09%	0.26%	0.44%
Other special & general								
<50 Beds					0.16%	0.18%	0.63%	1.46%
50-99 Beds	0.07%	0.09%	0.32%	0.71%	0.06%	0.08%	0.30%	0.68%
100-299 Beds	0.05%	0.07%	0.24%	0.45%				
300+ Beds	0.04%	0.07%	0.19%	0.30%	0.03%	0.05%	0.14%	0.24%
Non-federal								
Psychiatric								
Not-for-profit	0.11%	0.14%	0.50%	1.13%	0.10%	0.13%	0.47%	1.09%
For-profit	0.14%	0.17%	0.62%	1.39%	0.13%	0.16%	0.58%	1.34%
State govt.	0.12%	0.20%	0.56%	0.90%	0.10%	0.15%	0.44%	0.73%
Local govt.	0.10%	0.17%	0.49%	0.79%	0.09%	0.13%	0.38%	0.64%
T.B. & other resp. diseases	0.20%	0.30%	0.96%	1.79%				
Long-term other special & gen.								
Not-for-profit	0.12%	0.17%	0.56%	1.04%				
For-profit	0.10%	0.12%	0.43%	0.97%	0.09%	0.11%	0.41%	0.94%
State govt.	0.11%	0.16%	0.52%	0.98%				
Local govt.	0.13%	0.21%	0.59%	0.94%	0.11%	0.16%	0.45%	0.76%
Short-term other special & gen.								
Not-for-profit								
<50 Beds					0.31%	0.35%	1.21%	2.81%
50-99 Beds	0.13%	0.16%	0.57%	1.28%	0.12%	0.15%	0.54%	1.24%
100-299 Beds	0.05%	0.08%	0.26%	0.49%				
300+ Beds	0.03%	0.05%	0.15%	0.23%	0.03%	0.04%	0.11%	0.19%
For-profit								
<50 Beds					0.29%	0.33%	1.14%	2.63%
50-99 Beds	0.12%	0.14%	0.52%	1.16%	0.10%	0.14%	0.49%	1.12%
100-299 Beds	0.07%	0.10%	0.32%	0.60%				
300+ Beds	0.05%	0.08%	0.22%	0.36%	0.04%	0.06%	0.17%	0.29%
State govt.								
<50 Beds					0.37%	0.43%	1.45%	3.37%
50-99 Beds	0.14%	0.18%	0.64%	1.43%	0.13%	0.17%	0.60%	1.38%
100-299 Beds	0.06%	0.08%	0.26%	0.49%				
300+ Beds	0.02%	0.04%	0.10%	0.16%	0.02%	0.03%	0.08%	0.13%
Local govt.								
<50 Beds					0.47%	0.53%	1.82%	4.21%
50-99 Beds	0.18%	0.22%	0.79%	1.77%	0.16%	0.21%	0.74%	1.71%
100-299 Beds	0.08%	0.11%	0.37%	0.68%				
300+ Beds	0.03%	0.04%	0.13%	0.20%	0.02%	0.03%	0.10%	0.16%
Non-AHA-registered								
Non-Federal psychiatric	0.20%	0.25%	0.89%	1.99%	0.18%	0.23%	0.83%	1.92%
Short-term other special & gen.	0.21%	0.26%	0.95%	2.12%	0.19%	0.25%	0.89%	2.05%
Other	0.16%	0.24%	0.77%	1.44%				
Total	0.06%	0.09%	0.29%	0.54%				
<50 Beds					0.34%	0.38%	1.31%	3.04%
50-99 Beds	0.14%	0.17%	0.63%	1.40%	0.13%	0.16%	0.59%	1.35%
100-299 Beds	0.06%	0.09%	0.30%	0.56%				
300+ Beds	0.04%	0.06%	0.16%	0.26%	0.03%	0.05%	0.13%	0.21%
Subset:community hosp.								
Urban	0.03%	0.05%	0.17%	0.31%				
<50 Beds								
50-99 Beds								
100-299 Beds								
300+ Beds								
Rural	0.13%	0.16%	0.58%	1.29%	0.12%	0.15%	0.54%	1.25%
<50 Beds								
50-99 Beds								
100-299 Beds								
300+ Beds								

[a] Table 14 indicates which type of MWI -- batch, continuous, or pathological -- is applicable.

TABLE 15B. PER-FACILITY ANNUALIZED CONTROL COSTS AS A PERCENT OF REVENUE/BUDGET : MWI OPERATORS OTHER THAN HOSPITALS --EXISTING MWIs--

Industry	Intermittent MWI				Batch, continuous, or pathological MWI[a]			
	C.O.1	C.O.2	C.O.3	C.O.4	C.O.1	C.O.2	C.O.3	C.O.4
Nursing homes								
100+ Employees								
Tax-paying	0.37%	0.47%	1.68%	3.71%	0.33%	0.43%	1.53%	3.51%
Tax-exempt	0.27%	0.34%	1.21%	2.66%	0.24%	0.31%	1.10%	2.52%
Veterinary facilities								
10-19 Employees	1.40%	1.73%	6.27%	14.01%	1.26%	1.64%	5.88%	13.52%
20+ Employees	0.65%	0.80%	2.90%	6.47%	0.58%	0.76%	2.72%	6.25%
Commercial research labs								
Tax-paying								
20-99 Employees	0.45%	0.56%	2.03%	4.54%	0.41%	0.53%	1.91%	4.39%
100+ Employees	0.12%	0.20%	0.56%	0.89%	0.10%	0.15%	0.43%	0.72%
Tax-exempt	0.15%	0.22%	0.69%	1.30%				
Commercial incineration fac.					1.41%	7.77%	23.80%	34.90%

[a] Table 14 indicates which type of MWI -- batch, continuous, or pathological -- is applicable.

prevent the price increases from being fully achieved in the short run. Still, in the U.S. system of health care financing, hospitals are reimbursed by third parties for the majority of cost increases. In the long run, institutional constraints on the ability of hospitals to fully pass along control costs should be less of a factor.

Under Control Options 3 and 4, hospitals with fewer than 50 beds will need to increase prices by more than one percent in order to recover control costs. The same applies to hospitals with 50-99 beds under Control Option 4. The average facility price increase is 1.31 percent under Control Option 3 and 3.04 percent under Control Option 4 for hospitals with fewer than 50 beds, and ranges up to 1.40 percent under Control Option 4 for hospitals with 50-99 beds. These facility price increases may not be achievable against market price increases of only 0.109 percent under Control Option 3 and 0.216 percent under Control Option 4 (see Table 9).

There are also several subcategories in which the average number of beds per facility is greater than 100 that have a facility price increase exceeding 1 percent under Control Option 4. They are t.b. hospitals (only 4 nationwide), long-term other special and general not-for-profit hospitals, and "other" hospitals not registered with the American Hospital Association.

Small hospitals (e.g., fewer than 100 beds) may not only be prevented from achieving the facility price increase by competition from other hospitals. They also face particular institutional constraints in raising prices (or achieving rate increases). Small hospitals are often located in rural areas, where the population is disproportionately aged and poor. This makes rural hospitals relatively dependent on Medicare and Medicaid. Rural hospitals also have high costs of charity care because rural areas have high concentrations of uninsured people. Moreover, a disproportionate number of small hospitals are public. Many public hospitals rely on government subsidies, which have been cut back in recent years.

3.5.2.2 Other MWI Operators. A number of the facility price increases calculated in Table 15B may not be achievable because they deviate significantly from the market price increase. These include the impacts for both subcategories of nursing homes with 100+ employees under Control Options 3 and 4. For tax-exempt nursing homes with 100+ employees, even a facility price increase of 1.21 percent under Control Option 3 (intermittent MWI) may not be sustainable against a market price increase of only 0.098 percent (see Table 9). Other cases in Table 15B in which the facility price increase may not be achievable include veterinary facilities with 20+ employees under Control Options 3 and 4, veterinary facilities with 10-19 employees under all four control options, and tax-paying commercial research labs with 20-99 employees under Control Options 3 and 4. The 1.30 percent facility price increase for tax-exempt commercial research labs under Control Option 4 is probably achievable because it does not deviate much from the market price increase, 0.564 percent (see Table 9).

In all of these cases, the great majority of facilities do not operate an MWI: 97.1 percent of all nursing homes, 97.4 percent of all veterinary facilities, and, conservatively (because it is assumed that all research labs are commercial facilities), 86.9 percent of all research labs (see Table 4). For this reason, the facility price increase is large in relation to the market price increase.

As discussed in Section 3.4.3, it is expected that due to an increase in the demand for offsite incineration, commercial incineration facilities will be able to fully pass along control costs to their customers. This means that the facility price increases in Table 15B -- 1.41 percent under Control Option 1, 7.77 percent under Control Option 2, 23.80 percent under Control Option 3, and 34.90 percent under Control Option 4 -- are achievable. To be sure, the price increases especially under Control Options 3 and 4 are high. However, as will be seen later in Section 3.5.5, the per-ton cost of commercial incineration does not increase as a result of the Emission Guidelines by as much, on average, as the per-ton cost of onsite incineration. Therefore, despite the price increases of 23.80 percent under Control Option 3 and 34.90 percent under Control Option 4, many MWI operators would be able to save costs by switching to commercial incineration (i.e., their costs of onsite incineration increase by more than 23.80 percent and 34.90 percent, respectively).

3.5.3 Cost Absorption

In the previous section it was seen that it may not be possible in all cases to implement the facility price increase and fully recover control costs. Tables 16A and 16B calculate the impact on net income if control costs are fully absorbed. This represents the extreme case of no price increase. The impact is calculated as the ratio of annualized control costs to before-tax net income. This ratio indicates the percent reduction in earnings if there is no price increase. Before-tax net income is the appropriate measure of earnings because control costs are before taxes and are tax-deductible. For some subcategories of hospitals in Table 16A, after-tax net income is used as a substitute because before-tax net income is not available. This leads to a conservative estimate of impacts because after-tax net income is less than or equal to before-tax net income.

TABLE 16A. PER-FACILITY ANNUALIZED CONTROL COSTS AS A PERCENT OF NET INCOME[a] : HOSPITALS
--EXISTING MWIs--

Industry category	Intermittent MWI C.O.1	Intermittent MWI C.O.2	Intermittent MWI C.O.3	Intermittent MWI C.O.4	Batch, continuous, or pathological MWI[b] C.O.1	Batch, continuous, or pathological MWI[b] C.O.2	Batch, continuous, or pathological MWI[b] C.O.3	Batch, continuous, or pathological MWI[b] C.O.4
AHA-registered								
Federal								
Psychiatric	2.12%	3.50%	9.98%	15.90%	1.81%	2.73%	7.71%	12.88%
Other special & general								
<50 Beds					6.57%	7.51%	25.65%	59.45%
50-99 Beds	2.89%	3.57%	12.96%	28.96%	2.61%	3.40%	12.15%	27.95%
100-299 Beds	1.27%	1.89%	6.03%	11.27%				
300+ Beds	1.09%	1.80%	5.14%	8.19%	0.93%	1.41%	3.97%	6.63%
Non-federal								
Psychiatric								
Not-for-profit	3.31%	4.09%	14.85%	33.17%	2.99%	3.89%	13.92%	32.03%
For-profit	2.86%	3.53%	12.83%	28.66%	2.58%	3.36%	12.02%	27.66%
State govt.	3.53%	5.82%	16.59%	26.45%	3.01%	4.54%	12.82%	21.42%
Local govt.	3.08%	5.09%	14.50%	23.11%	2.63%	3.97%	11.20%	18.72%
T.B. & other resp. diseases	5.77%	8.55%	27.34%	51.12%				
Long-term other special & gen.								
Not-for-profit	3.34%	4.95%	15.82%	29.58%				
For-profit	2.54%	3.14%	11.40%	25.47%	2.30%	2.99%	10.69%	24.59%
State govt.	3.14%	4.66%	14.90%	27.86%				
Local govt.	3.56%	5.88%	16.74%	26.69%	3.04%	4.58%	12.94%	21.61%
Short-term other special & gen.								
Not-for-profit								
<50 Beds					12.90%	14.72%	50.30%	116.61%
50-99 Beds	5.30%	6.55%	23.78%	53.13%	4.79%	6.23%	22.29%	51.29%
100-299 Beds	1.65%	2.44%	7.80%	14.58%				
300+ Beds	0.72%	1.18%	3.37%	5.37%	0.61%	0.92%	2.60%	4.35%
For-profit								
<50 Beds					N.M.	N.M.	N.M.	N.M.
50-99 Beds	N.M.	N.M.	N.M.	N.M.	N.M.	N.M.	N.M.	N.M.
100-299 Beds	1.45%	2.15%	6.86%	12.83%				
300+ Beds	0.68%	1.13%	3.22%	5.13%	0.58%	0.88%	2.49%	4.15%
State govt.								
<50 Beds					15.22%	17.37%	59.35%	137.59%
50-99 Beds	5.80%	7.18%	26.07%	58.25%	5.25%	6.84%	24.44%	56.23%
100-299 Beds	1.40%	2.07%	6.63%	12.39%				
300+ Beds	0.59%	0.98%	2.79%	4.44%	0.51%	0.76%	2.15%	3.60%
Local govt.								
<50 Beds					19.02%	21.71%	74.19%	171.99%
50-99 Beds	7.21%	8.92%	32.40%	72.39%	6.53%	8.50%	30.38%	69.88%
100-299 Beds	1.95%	2.89%	9.25%	17.30%				
300+ Beds	0.74%	1.22%	3.47%	5.53%	0.63%	0.95%	2.68%	4.48%
Non-AHA-registered								
Non-Federal psychiatric	5.83%	7.21%	26.18%	58.49%	5.28%	6.86%	24.54%	56.46%
Short-term other special & gen.	6.14%	7.59%	27.57%	61.59%	5.56%	7.23%	25.85%	59.46%
Other	4.72%	7.00%	22.36%	41.81%				
Total	1.76%	2.61%	8.33%	15.58%				
<50 Beds					16.07%	18.34%	62.67%	145.28%
50-99 Beds	6.68%	8.26%	29.99%	66.99%	6.04%	7.86%	28.11%	64.67%
100-299 Beds	1.84%	2.73%	8.72%	16.30%				
300+ Beds	0.83%	1.36%	3.89%	6.20%	0.71%	1.06%	3.00%	5.02%
Subset:community hosp.								
Urban	1.03%	1.53%	4.89%	9.14%				
<50 Beds								
50-99 Beds								
100-299 Beds								
300+ Beds								
Rural	3.65%	4.51%	16.39%	36.61%	3.30%	4.30%	15.36%	35.34%
<50 Beds								
50-99 Beds								
100-299 Beds								
300+ Beds								

[a] Divisor is before-tax net income except for T.B. hospitals, hospitals not registered with the AHA, "Total" (and subcatgories), and community hospitals, for which only after-tax net income is available.

[b] Table 14 indicates which type of MWI -- batch, continuous, or pathological -- is applicable.

N.M. Not meaningful.

TABLE 16B. PER-FACILITY ANNUALIZED CONTROL COSTS AS A PERCENT OF BEFORE-TAX NET INCOME : MWI OPERATORS OTHER THAN HOSPITALS
--EXISTING MWIs--

	Intermittent MWI				Batch, continuous, or pathological MWI[a]			
Industry	C.O.1	C.O.2	C.O.3	C.O.4	C.O.1	C.O.2	C.O.3	C.O.4
Nursing homes								
100+ employees								
Tax-paying	9.32%	11.71%	42.04%	92.68%	8.20%	10.67%	38.16%	87.79%
Tax-exempt	9.56%	12.01%	43.13%	95.08%	8.42%	10.95%	39.15%	90.07%
Veterinary facilities								
10-19 Employees	3.63%	4.49%	16.29%	36.39%	3.28%	4.27%	15.27%	35.13%
20+ Employees	1.68%	2.07%	7.53%	16.81%	1.52%	1.97%	7.05%	16.23%
Commercial research labs								
Tax-paying								
20-99 Employees	7.55%	9.34%	33.91%	75.75%	6.83%	8.89%	31.78%	73.12%
100+ Employees	1.98%	3.26%	9.29%	14.81%	1.69%	2.54%	7.18%	11.99%
Tax-exempt	3.48%	5.16%	16.50%	30.85%				
Commercial incineration fac.					N/A	N/A	N/A	N/A

[a] Table 14 indicates which type of MWI -- batch, continuous, or pathological -- is applicable.

N/A Not available.

A cost increase is considered sustainable if it does not lead to closure. In the short run, the theoretical closure point is when variable costs, including incremental annualized control costs, exceed revenues. Since some costs are fixed, net income must decline by more than 100 percent for the short-run closure threshold to be surpassed. In the long run, however, a firm is free to redeploy its capital to investments that yield a higher rate of return. In the long run, therefore, the closure point is when the rate of return on capital falls below the opportunity cost of capital.

3.5.3.1 Hospitals. For all of the cases in which hospitals may not be able to achieve the facility price increase, Table 16A shows that the impact on net income would be significant if control costs had to be fully absorbed. Net income would decline at the average hospital with fewer than 50 beds by 62.67 percent under Control Option 3 and by 145.28 percent under Control Option 4. Net income would decline at the average hospital with 50-99 beds by from 64.67 to 66.99 percent under Control Option 4. These impacts are possibly unsustainable -- if not in the short run, then in the long run. The impacts under Control Option 4 for t.b. hospitals, long-term other special and general not-for-profit hospitals, and "other" hospitals not registered with the American Hospital Association are also significant. (The impacts on short-term other special and general for-profit hospitals with fewer than 50 beds and 50-99 beds are "not meaningful" because net income in the baseline is negative).

3.5.3.2 Other MWI Operators. Table 16B points to some additional cases in which control costs may not be sustainable if they cannot be recovered through a price increase. These include nursing homes with 100+ employees under Control Options 3 and 4, veterinary facilities with 10-19 employees under Control Options 3 and 4, veterinary facilities with 20+ employees under Control Option 4, and tax-paying commercial research labs with 20-99 employees under Control Options 3 and 4. In the other cases in which the facility price increase may not be achievable -- veterinary facilities with 10-19 employees under Control Options 1 and 2, and veterinary facilities with 20+ employees under Control Option 3 -- control costs are probably sustainable. The decline in net income is only 3.28-3.63 percent under Control Option 1 and 4.27-4.49 percent under Control Option 2 for veterinary facilities with 10-19 employees, and 7.05-7.53 percent under Control Option 3 for veterinary facilities with 20+ employees.

3.5.4 Capital Availability

Tables 17A, 17B, 18A, and 18B capture some of the impacts of capital control costs on MWI operators. Tables 17A and 17B present the ratio of capital costs to before-tax net income. Before-tax net income is used as a proxy for cash flow before taxes, which can be used to service debt. This assumes a constant asset base (i.e., capital expenditures are offset by depreciation). The ratio in Tables 17A and 17B gives an indication of the extent to which capital costs can be financed from one year's cash flow. Of course, capital costs do not have to be paid from cash flow, but the ability to do so in one year suggests that either external financing is not needed, or it would not be difficult to obtain. If the ratio exceeds 100 percent, it is possible that debt will have to be issued (normally for an investment in pollution controls, it is assumed that equity will not be issued because the investment does not add to the firm's productive capacity).

In Tables 18A and 18B, the ratio of capital costs to total (current and long-term) liabilities is calculated (total liabilities are calculated from Tables 5A, 5B, and 5C

TABLE 17A. PER-FACILITY CAPITAL CONTROL COSTS AS A PERCENT OF NET INCOME[a] : HOSPITALS
--EXISTING MWIs--

Industry category	Intermittent MWI				Batch, continuous, or pathological MWI[b]			
	C.O.1	C.O.2	C.O.3	C.O.4	C.O.1	C.O.2	C.O.3	C.O.4
AHA-registered								
Federal								
Psychiatric	6.33%	10.34%	27.07%	52.91%	4.99%	7.67%	21.30%	44.21%
Other special & general								
<50 Beds					22.64%	25.85%	95.67%	244.98%
50-99 Beds	11.06%	13.13%	46.79%	117.23%	11.38%	13.77%	48.17%	119.31%
100-299 Beds	4.32%	6.09%	18.39%	41.03%				
300+ Beds	3.26%	5.33%	13.94%	27.25%	2.57%	3.95%	10.97%	22.78%
Non-federal								
Psychiatric								
Not-for-profit	12.67%	15.05%	53.61%	134.30%	13.04%	15.77%	55.18%	136.69%
For-profit	10.95%	13.00%	46.31%	116.01%	11.26%	13.63%	47.66%	118.07%
State govt.	10.53%	17.20%	45.02%	88.00%	8.30%	12.76%	35.43%	73.54%
Local govt.	9.20%	15.03%	39.35%	76.90%	7.26%	11.15%	30.96%	64.26%
T.B. & other resp. diseases	19.60%	27.63%	83.39%	186.10%				
Long-term other special & gen.								
Not-for-profit	11.34%	15.99%	48.26%	107.70%				
For-profit	9.73%	11.55%	41.16%	103.12%	10.01%	12.11%	42.37%	104.95%
State govt.	10.68%	15.05%	45.44%	101.41%				
Local govt.	10.62%	17.36%	45.44%	88.80%	8.38%	12.87%	35.76%	74.21%
Short-term other special & gen.								
Not-for-profit								
<50 Beds					44.41%	50.71%	187.64%	480.49%
50-99 Beds	20.30%	24.10%	85.86%	215.09%	20.88%	25.26%	88.37%	218.92%
100-299 Beds	5.59%	7.88%	23.78%	53.08%				
300+ Beds	2.14%	3.49%	9.14%	17.86%	1.69%	2.59%	7.19%	14.93%
For-profit								
<50 Beds					N.M.	N.M.	N.M.	N.M.
50-99 Beds	N.M.	N.M.	N.M.	N.M.	N.M.	N.M.	N.M.	N.M.
100-299 Beds	4.92%	6.93%	20.93%	46.71%				
300+ Beds	2.04%	3.34%	8.73%	17.07%	1.61%	2.47%	6.87%	14.27%
State govt.								
<50 Beds					52.40%	59.83%	221.40%	566.94%
50-99 Beds	22.25%	26.42%	94.13%	235.80%	22.89%	27.70%	96.88%	240.00%
100-299 Beds	4.75%	6.70%	20.21%	45.11%				
300+ Beds	1.77%	2.89%	7.56%	14.78%	1.39%	2.14%	5.95%	12.35%
Local govt.								
<50 Beds					65.50%	74.79%	276.75%	708.68%
50-99 Beds	27.66%	32.83%	116.99%	293.07%	28.45%	34.42%	120.41%	298.29%
100-299 Beds	6.63%	9.35%	28.22%	62.97%				
300+ Beds	2.20%	3.60%	9.42%	18.41%	1.74%	2.67%	7.41%	15.39%
Non-AHA-registered								
Non-federal psychiatric	22.34%	26.53%	94.52%	236.78%	22.99%	27.81%	97.29%	241.00%
Short-term other special & gen.	23.53%	27.94%	99.54%	249.35%	24.21%	29.29%	102.45%	253.79%
Other	16.03%	22.60%	68.20%	152.22%				
Total	5.97%	8.42%	25.41%	56.72%				
<50 Beds					55.33%	63.18%	233.78%	598.64%
50-99 Beds	25.59%	30.38%	108.26%	271.20%	26.33%	31.85%	111.43%	276.03%
100-299 Beds	6.25%	8.81%	26.58%	59.33%				
300+ Beds	2.47%	4.03%	10.55%	20.62%	1.95%	2.99%	8.30%	17.24%
Subset:community hosp.								
Urban	3.51%	4.94%	14.91%	33.28%				
<50 Beds								
50-99 Beds								
100-299 Beds								
300+ Beds								
Rural	13.99%	16.60%	59.17%	148.22%	14.39%	17.41%	60.90%	150.86%
<50 Beds								
50-99 Beds								
100-299 Beds								
300+ Beds								

[a] Divisor is before-tax net income except for T.B. hospitals, hospitals not registered with the AHA, "Total" (and subcatgories), and community hospitals, for which only after-tax net income is available.

[b] Table 13 indicates which type of MWI -- batch, continuous, or pathological -- is applicable.

N.M. Not meaningful.

TABLE 17B. PER-FACILITY CAPITAL CONTROL COSTS AS A PERCENT OF BEFORE-TAX NET INCOME : MWI OPERATORS OTHER THAN HOSPITALS
--EXISTING MWIs--

	Intermittent MWI				Batch, continuous, or pathological MWI[a]			
Industry	C.O.1	C.O.2	C.O.3	C.O.4	C.O.1	C.O.2	C.O.3	C.O.4
Nursing homes								
100+ employees								
Tax-paying	35.42%	42.59%	149.87%	372.57%	35.74%	43.24%	151.27%	374.73%
Tax-exempt	36.33%	43.69%	153.75%	382.22%	36.67%	44.36%	155.19%	384.44%
Veterinary facilities								
10-19 Employees	13.90%	16.50%	58.81%	147.31%	14.30%	17.30%	60.53%	149.94%
20+ Employees	6.42%	7.62%	27.17%	68.06%	6.61%	7.99%	27.96%	69.27%
Commercial research labs								
Tax-paying								
20-99 Employees	28.94%	34.35%	122.41%	306.65%	29.77%	36.02%	126.00%	312.12%
100+ Employees	5.89%	9.63%	25.21%	49.27%	4.65%	7.14%	19.84%	41.18%
Tax-exempt	11.83%	16.67%	50.33%	112.32%				
Commercial incineration fac.					N/A	N/A	N/A	N/A

[a] Table 13 indicates which type of MWI -- batch, continuous, or pathological -- is applicable.

N/A Not available.

TABLE 18A. PER-FACILITY CAPITAL CONTROL COSTS AS A PERCENT OF TOTAL LIABILITIES : HOSPITALS
--EXISTING MWIs--

Industry category	Intermittent MWI				Batch, continuous, or pathological MWI[a]			
	C.O.1	C.O.2	C.O.3	C.O.4	C.O.1	C.O.2	C.O.3	C.O.4
AHA-registered								
Federal								
Psychiatric	0.46%	0.75%	1.97%	3.85%	0.36%	0.56%	1.55%	3.21%
Other special & general								
<50 Beds					1.20%	1.37%	5.06%	12.97%
50-99 Beds	0.59%	0.70%	2.48%	6.20%	0.60%	0.73%	2.55%	6.32%
100-299 Beds	0.37%	0.52%	1.57%	3.50%				
300+ Beds	0.25%	0.42%	1.09%	2.13%	0.20%	0.31%	0.86%	1.78%
Non-federal								
Psychiatric								
Not-for-profit	0.92%	1.09%	3.90%	9.76%	0.95%	1.15%	4.01%	9.94%
For-profit	1.14%	1.35%	4.81%	12.05%	1.17%	1.41%	4.95%	12.26%
State govt.	0.77%	1.25%	3.27%	6.40%	0.60%	0.93%	2.58%	5.35%
Local govt.	0.67%	1.09%	2.86%	5.59%	0.53%	0.81%	2.25%	4.67%
T.B. & other resp. diseases	1.52%	2.15%	6.48%	14.47%				
Long-term other special & gen.								
Not-for-profit	0.87%	1.22%	3.68%	8.21%				
For-profit	0.80%	0.95%	3.39%	8.50%	0.82%	1.00%	3.49%	8.65%
State govt.	0.81%	1.14%	3.45%	7.69%				
Local govt.	0.81%	1.32%	3.45%	6.73%	0.64%	0.98%	2.71%	5.63%
Short-term other special & gen.								
Not-for-profit								
<50 Beds					2.31%	2.64%	9.77%	25.02%
50-99 Beds	1.06%	1.25%	4.47%	11.20%	1.09%	1.32%	4.60%	11.40%
100-299 Beds	0.40%	0.57%	1.71%	3.82%				
300+ Beds	0.20%	0.33%	0.85%	1.67%	0.16%	0.24%	0.67%	1.40%
For-profit								
<50 Beds					2.17%	2.47%	9.16%	23.45%
50-99 Beds	0.96%	1.14%	4.05%	10.14%	0.98%	1.19%	4.17%	10.32%
100-299 Beds	0.49%	0.70%	2.10%	4.68%				
300+ Beds	0.31%	0.50%	1.32%	2.58%	0.24%	0.37%	1.04%	2.15%
State govt.								
<50 Beds					2.77%	3.17%	11.72%	30.01%
50-99 Beds	1.18%	1.40%	4.98%	12.48%	1.21%	1.47%	5.13%	12.70%
100-299 Beds	0.41%	0.57%	1.72%	3.85%				
300+ Beds	0.14%	0.23%	0.59%	1.15%	0.11%	0.17%	0.46%	0.96%
Local govt.								
<50 Beds					3.47%	3.96%	14.65%	37.51%
50-99 Beds	1.46%	1.74%	6.19%	15.51%	1.51%	1.82%	6.37%	15.79%
100-299 Beds	0.57%	0.80%	2.41%	5.37%				
300+ Beds	0.17%	0.28%	0.73%	1.44%	0.14%	0.21%	0.58%	1.20%
Non-AHA-registered								
Non-Federal psychiatric	1.62%	1.93%	6.87%	17.21%	1.67%	2.02%	7.07%	17.52%
Short-term other special & gen.	1.75%	2.08%	7.40%	18.53%	1.80%	2.18%	7.61%	18.86%
Other	1.19%	1.68%	5.07%	11.31%				
Total	0.44%	0.63%	1.89%	4.22%				
<50 Beds					2.50%	2.85%	10.56%	27.03%
50-99 Beds	1.16%	1.37%	4.89%	12.25%	1.19%	1.44%	5.03%	12.46%
100-299 Beds	0.46%	0.65%	1.96%	4.38%				
300+ Beds	0.23%	0.37%	0.97%	1.89%	0.18%	0.27%	0.76%	1.58%
Subset:community hosp.								
Urban	0.26%	0.36%	1.09%	2.43%				
<50 Beds								
50-99 Beds								
100-299 Beds								
300+ Beds								
Rural	1.07%	1.27%	4.51%	11.30%	1.10%	1.33%	4.64%	11.50%
<50 Beds								
50-99 Beds								
100-299 Beds								
300+ Beds								

[a] Table 13 indicates which type of MWI -- batch, continuous, or pathological -- is applicable.

TABLE 18B. PER-FACILITY CAPITAL CONTROL COSTS AS A PERCENT OF TOTAL LIABILITIES :
MWI OPERATORS OTHER THAN HOSPITALS
--EXISTING MWIs--

Industry	Intermittent MWI				Batch, continuous, or pathological MWI[a]			
	C.O.1	C.O.2	C.O.3	C.O.4	C.O.1	C.O.2	C.O.3	C.O.4
Nursing homes								
100+ employees								
Tax-paying	3.36%	4.04%	14.22%	35.36%	3.39%	4.10%	14.36%	35.57%
Tax-exempt	2.41%	2.90%	10.22%	25.40%	2.44%	2.95%	10.31%	25.54%
Veterinary facilities								
10-19 Employees	34.29%	40.70%	145.03%	363.32%	35.27%	42.67%	149.28%	369.79%
20+ Employees	15.84%	18.81%	67.01%	167.86%	16.30%	19.72%	68.97%	170.85%
Commercial research labs								
Tax-paying								
20-99 Employees	7.52%	8.93%	31.81%	79.69%	7.74%	9.36%	32.74%	81.11%
100+ Employees	1.53%	2.50%	6.55%	12.80%	1.21%	1.86%	5.16%	10.70%
Tax-exempt	2.15%	3.03%	9.15%	20.43%				
Commercial incineration fac.					N/A	N/A	N/A	N/A

[a] Table 13 indicates which type of MWI -- batch, continuous, or pathological -- is applicable.

N/A Not available.

as the difference between assets and net worth). In the event debt is issued, this gauges the impact on capital structure. Creditors are reluctant to lend to firms with a high degree of financial leverage (i.e., high ratio of debt to net worth) because there is a high risk that debt cannot be repaid. If total liabilities increase by, say, 20 percent, it may be difficult to obtain financing. Take a firm with assets of $100, current liabilities of $20, long-term debt of $30, and net worth of $50. Total liabilities (current liabilities plus debt) are $50. If an increase in debt causes total liabilities to increase by 20 percent, the increase in debt will be from $30 to $40. Meanwhile, assets increase from $100 to $110. Consequently, the ratio of debt to assets (which is scrutinized by lenders) increases from 30 percent to 36.4 percent. However, as pollution-control equipment, the new assets are not income-generating. In relation to productive assets, debt has increased from 30 percent to 40 percent.

An increase in total liabilities of 20 percent is not, to be sure, a definitive threshold beyond which no facilities will be able to obtain external financing. There will always be some facilities that are able to take on debt and, as a result, expand total liabilities by 20 percent, or even much more. Conversely, some facilities will be limited to expanding total liabilities by far less than 20 percent. However, an average increase in total liabilities of 20 percent is likely to make external capital difficult to obtain for at least some facilities. Therefore, with but one exception, a 20 percent increase in total liabilities is used as a guideline for significant impacts. The exception is made for cases in which the facility price increase is achievable (see Section 3.5.2). The facility price increase recovers all annual costs, including the annualized cost of capital (interest and depreciation). Achieving the facility price increase therefore implies that additional cash flow will be generated to pay for the cost of debt (i.e., interest). In theory, the capital markets should recognize this and make financing available, regardless of the impact of additional debt on total liabilities.

The impacts in Tables 17A, 17B, 18A, and 18B are per-facility. They therefore really only apply to stand-alone facilities. For facilities that are affiliated with multi-unit systems, the impacts in these tables are overstated. This is because multi-unit systems have a greater capacity to borrow than stand-alone facilities. Approximately 80 percent of all for-profit hospitals and 33 percent of all not-for-profit hospitals, for example, are affiliated with multi-hospital systems.[50]

3.5.4.1 Hospitals. Table 17A indicates that, on average, hospitals with fewer than 50 beds and with 50-99 beds will require more than one year's cash flow to finance capital costs under Control Options 3 and 4 (the impacts exceed 100%). The ratio of capital costs to net income ranges from 108.26 to 111.43 percent under Control Option 3 and from 271.20 to 276.03 percent under Control Option 4 for the average hospital with 50-99 beds, and is 233.78 percent under Control Option 3 and 598.64 percent under Control Option 4 for the average hospital with fewer than 50 beds. Under Control Option 4, the ratio exceeds 100 percent for rural hospitals (148.22 - 150.86%), but not for urban hospitals (33.28%). The ratio also exceeds 100 percent under Control Option 4 in several subcategories with more than 100 beds per facility: t.b. hospitals, long-term other special and general not-for-profit and state-government hospitals, and "other" hospitals not registered with the American Hospital Association.

The ratio of capital costs to total liabilities in Table 18A exceeds 20 percent only for hospitals with fewer than 50 beds under Control Option 4. Therefore, only hospitals with fewer than 50 beds may in general, under Control Option 4, have difficulty obtaining financing. As 20 percent is not a definitive threshold, this does not preclude other facilities from having difficulty. Rural hospitals, which are predominantly small (Table 5A indicates that 72 percent have fewer than 100 beds), are more likely to have difficulty than urban hospitals. Under Control Option 4, the ratio of capital costs to total liabilities ranges from 11.30 to 11.50 percent for rural hospitals, compared to only 2.43 percent for urban hospitals.

3.5.4.2 Other MWI Operators. Table 17B reveals a number of cases for other MWI operators in which the ratio of capital costs to before-tax net income exceeds 100 percent and therefore external financing may be required. These include nursing homes with 100+ employees under Control Options 3 and 4, veterinary facilities with 10-19 employees under Control Option 4, tax-paying commercial research labs with 20-99 employees under Control Options 3 and 4, and tax-exempt commercial research labs under Control Option 4. Table 18B shows, in turn, that with the exception of nursing homes under Control Option 3, in all of these cases the ratio of capital costs to total liabilities exceeds 20 percent. Except for tax-exempt commercial research labs, this suggests that capital may be difficult to obtain. Despite a ratio of capital costs to total liabilities under Control Option 4 of 20.43 percent, tax-exempt commercial research labs should in general be able to obtain financing because the facility price increase is achievable (See Section 3.5.2.2).

3.5.5 Substitution

Table 4 indicated that over half of all hospitals and an even greater majority of nursing homes, veterinary facilities, and commercial research labs do not operate an

MWI. This suggests that facilities in these industries generally have viable alternatives to onsite incineration for the treatment and disposal of medical waste. The most common alternatives to onsite incineration are onsite autoclaving and offsite contract disposal (most commonly commercial incineration).

The cost to operate an autoclave system including a shredder can vary widely. For example, operated at capacity, a large (1,176 tons/yr) unit is estimated to cost $134 per ton while a small (27 tons/yr) unit is estimated to cost $2,080 per ton. Onsite autoclaving has some limitations. For one, autoclaving is not "suitable" for some components of the medical waste stream, particularly pathological waste. Suitability is determined by both technical and nontechnical factors.[51] The U.S. Congress Office of Technology Assessment (OTA) estimates that approximately 90 percent of all medical waste can be autoclaved.[52] Another limitation is that some landfills (and waste haulers) are not willing to accept autoclaved waste because it cannot easily be identified as having been treated and disinfected. This "recognizability" problem can often be solved, however, by shredding or compacting the waste (either before or after it is autoclaved). Still, some landfills will not accept such waste. Nevertheless, "informal discussions" with a number of hospital officials across the country indicated to OTA that "few refusals (of autoclaved medical waste) occur if a hospital works closely with landfill operators to explain their waste procedures."[53]

To the extent that it has limitations, autoclaving is perhaps better considered as a supplement to incineration than as a substitute for it. Regardless, autoclaving can still be used to treat the great majority of medical waste that is currently incinerated onsite.

The other major alternative to onsite incineration for treating medical waste is offsite contract disposal (most commonly commercial incineration). The average cost of offsite contract disposal is estimated to be $600 per ton. This cost can vary substantially. It can depend, for example, on the hauling distance from the generator to the treatment facility. Also, volume discounts may result in lower fees for large generators than for small generators.

Offsite contract disposal depends highly on the availability of commercial incineration capacity. In some regions of the country (e.g., the Northeast, Illinois, Texas), commercial incineration capacity is tight.[54] In other regions, there may be excess capacity. Building new commercial incineration capacity is persistently hampered by the difficulty of finding a site and the lengthy process of obtaining a permit (up to two years or more, according to OTA).[55] Nevertheless, some regional incinerators (either generator/non-profit or commercial) are currently being planned.[56] OTA concludes that potential short-term shortfalls in commercial incineration capacity can be averted if the "adoption of new regulations is coordinated with careful planning and expedient permitting."[57] Even if commercial incineration capacity in the short term is inadequate (due to imperfect "coordination," for example), the Emission Guidelines should encourage additional capacity to come on stream in the longer term. This is because the regulation will increase the demand for commercial incineration, which will increase the returns that can be earned by commercial MWI operators. The reason the demand for commercial incineration will increase is that regional and dedicated-commercial MWIs are larger and more efficient on average than onsite MWIs. As a result, they will experience lower per-ton impacts from the regulation. This will encourage a shift from onsite MWIs to commercial/

regional MWIs. The model combustors reflect that commercial/regional MWIs tend to achieve economies of scale. While the Continuous 36,000 representing commercial incineration facilities has a capacity of 3,907 tons per year and a baseline operating cost of $75 per ton, the other model combustors range in baseline cost from $92 per ton (Intermittent 21,000, capacity 1,176 tons/year) to $1,137 per ton (Batch 250, capacity 27 tons/year).

Another possibility for accommodating an increase in the demand for offsite contract disposal is an increase in commercial autoclaving capacity. Presently there are believed to be fewer than 24 commercial autoclaving facilities in the U.S.[58] However, autoclaving can be less expensive than incineration.[59] For instance, one commercial facility operating both an autoclave and an incinerator charges less for autoclaving -- $600/ton versus $720/ton for incineration.[60] Consequently, the importance of commercial autoclaving may increase in the future. Already, one large waste management company reports that it is currently siting more autoclaves than incinerators.[61]

Tables 19A, 19B, 19C, and 19D compare the estimated annual costs -- before and after the Emission Guidelines -- of onsite incineration, offsite contract disposal (represented by commercial incineration), and onsite autoclaving. The incremental costs of onsite incineration are derived from the control costs in Table 3. The costs of onsite incineration and onsite autoclaving assume full-capacity utilization (per-ton costs can be much higher if full capacity is not utilized). The cost of onsite autoclaving does not change with the regulation (this disregards the potential increase in cost that could come from an increase in the demand for autoclave systems).

TABLE 19A. COMPARATIVE ANNUAL PER-TON COSTS OF ONSITE MEDICAL WASTE INCINERATION AND ALTERNATIVE TREATMENT METHODS: BASELINE AND CONTROL OPTION 1

--EXISTING MWIs--

Model MWI	Capacity (tons/yr)	Baseline: Onsite incin-eration	Baseline: Offsite contract disposal	Baseline: Onsite auto-claving	Control Option 1: Onsite incin-eration	Control Option 1: Offsite contract disposal[a]	Control Option 1: Onsite auto-claving
Inter. 21,000	1,176	$ 92	$600	$ 134	$ 123	$609	$ 134
Cont. 24,000	977	165	600	160	197	609	160
Inter. 8,400	470	166	600	228	208	609	228
Path. 2,000	172	313	600	N.A.	380	609	N.A.
Inter. 2,000	115	430	600	570	540	609	570
Batch 250	27	1,137	600	2,080	1,632	609	2,080

[a]Assumes the same control stringency for new MWIs under the NSPS as for existing MWIs under the Emission Guidelines. The methodology recognizes that the cost of offsite incineration will be influenced by both the Emission Guidelines and the NSPS.

N.A. Not applicable.

Abbreviations: Cont. = Continuous, Inter. = Intermittent, Path. = Pathological.

TABLE 19B. COMPARATIVE ANNUAL PER-TON COSTS OF ONSITE MEDICAL WASTE INCINERATION AND ALTERNATIVE TREATMENT METHODS: BASELINE AND CONTROL OPTION 2

--EXISTING MWIs--

Model MWI	Capacity (tons/yr)	Baseline: Onsite incin-eration	Baseline: Offsite contract disposal	Baseline: Onsite auto-claving	Control Option 2: Onsite incin-eration	Control Option 2: Offsite contract disposal[a]	Control Option 2: Onsite auto-claving
Inter. 21,000	1,176	$ 92	$600	$ 134	$ 143	$625	$ 134
Cont. 24,000	977	165	600	160	213	625	160
Inter. 8,400	470	166	600	228	228	625	228
Path. 2,000	172	313	600	N.A.	400	625	N.A.
Inter. 2,000	115	430	600	570	566	625	570
Batch 250	27	1,137	600	2,080	1,702	625	2,080

[a]Assumes the same control stringency for new MWIs under the NSPS as for existing MWIs under the Emission Guidelines. The methodology recognizes that the cost of offsite incineration will be influenced by both the Emission Guidelines and the NSPS.

N.A. Not applicable.

Abbreviations: Cont. = Continuous, Inter. = Intermittent, Path. = Pathological.

TABLE 19C. COMPARATIVE ANNUAL PER-TON COSTS OF ONSITE MEDICAL WASTE INCINERATION AND ALTERNATIVE TREATMENT METHODS: BASELINE AND CONTROL OPTION 3

--EXISTING MWIs--

Model MWI		Capacity (tons/yr)	Baseline: Onsite incin- eration	Baseline: Offsite contract disposal	Baseline: Onsite auto- claving	Control Option 3: Onsite incin- eration	Control Option 3: Offsite contract disposal[a]	Control Option 3: Onsite auto- claving
Inter.	21,000	1,176	$ 92	$600	$ 134	$ 237	$686	$ 134
Cont.	24,000	977	165	600	160	299	686	160
Inter.	8,400	470	166	600	228	364	686	228
Path.	2,000	172	313	600	N.A.	624	686	N.A.
Inter.	2,000	115	430	600	570	925	686	570
Batch	250	27	1,137	600	2,080	3,069	686	2,080

[a]Assumes the same control stringency for new MWIs under the NSPS as for existing MWIs under the Emission Guidelines. The methodology recognizes that the cost of offsite incineration will be influenced by both the Emission Guidelines and the NSPS.

N.A. Not applicable.

Abbreviations: Cont. = Continuous, Inter. = Intermittent, Path. = Pathological.

TABLE 19D. COMPARATIVE ANNUAL PER-TON COSTS OF ONSITE MEDICAL WASTE INCINERATION AND ALTERNATIVE TREATMENT METHODS: BASELINE AND CONTROL OPTION 4

--EXISTING MWIs--

		Baseline			Control Option 4		
Model MWI	Capacity (tons/yr)	Onsite incin-eration	Offsite contract disposal	Onsite auto-claving	Onsite incin-eration	Offsite contract disposal[a]	Onsite auto-claving
Inter. 21,000	1,176	$ 92	$600	$ 134	$ 322	$749	$ 134
Cont. 24,000	977	165	600	160	390	749	160
Inter. 8,400	470	166	600	228	537	749	228
Path. 2,000	172	313	600	N.A.	1,027	749	N.A.
Inter. 2,000	115	430	600	570	1,537	749	570
Batch 250	27	1,137	600	2,080	5,617	749	2,080

[a]Assumes the same control stringency for new MWIs under the NSPS as for existing MWIs under the Emission Guidelines. The methodology recognizes that the cost of offsite incineration will be influenced by both the Emission Guidelines and the NSPS.

N.A. Not applicable.

Abbreviations: Cont. = Continuous, Inter. = Intermittent, Path. = Pathological.

Note, however, that the cost of offsite contract disposal increases under each control option: by $9/ton under Control Option 1, $25/ton under Control Option 2, $86/ton under Control Option 3, and $149/ton under Control Option 4. This is because the cost of offsite incineration will increase as a result of the Emission Guidelines (and the NSPS). The incremental cost of offsite incineration is estimated by positing -- as for the calculation of the commercial incineration cost pool in Section 3.4.1 -- that 100 percent of capacity at commercial incineration facilities (by definition) and 10 percent of capacity at hospitals, veterinary facilities, and commercial research labs is used for commercial incineration. As a result, it is estimated that 702,865 tons per year of existing capacity is used for commercial incineration. It is also recognized that in addition to the impact of the Emission Guidelines on existing sources, commercial incineration capacity at new sources will be impacted by the NSPS. Over the next five years, it is estimated that new sources will account for 317,270 tons per year of commercial incineration capacity. The average incremental cost impact of the Emission Guidelines on the commercial incineration capacity of existing sources is calculated to be $13/ton under Control Option 1, $30/ton under Control Option 2, $96/ton under Control Option 3, and $169/ton under Control Option 4. For the commercial incineration capacity of new sources, the average cost impact of the NSPS is $14/ton under Control Option 2, $63/ton under Control Option 3, and $104/ton under Control Option 4. It is assumed that the NSPS will have the same control stringency as the Emission Guidelines. The incremental cost of offsite incineration -- $9/ton under Control Option 1, $25/ton under Control Option 2, $86/ton under Control Option 3, and $149/ton under Control Option 4 -- is then calculated as a weighted average, by capacity, of existing and new sources. It is assumed that this cost will be fully passed along to offsite generators.

Tables 19A, 19B, 19C, and 19D show that the average cost of onsite incineration in the baseline is generally lower than the average cost of onsite autoclaving (autoclaving is not an "applicable" substitute for the Pathological 2,000 because it cannot be used to treat pathological waste). The exception is the Continuous 24,000, which costs more than an autoclave system of the same capacity.

Offsite contract disposal, in the baseline, is more expensive on average than the Intermittent 2,000 and all larger model combustors, but less expensive on average than the smaller Batch 250. Offsite contract disposal is also less expensive on average than an autoclave system of the same capacity as the Batch 250.

With controls, the cost of onsite incineration relative to onsite autoclaving becomes less favorable. Under Control Option 1, the Continuous 24,000 continues to be the only model MWI that is more expensive than onsite autoclaving. Under Control Option 2, the Intermittent 21,000, as well as the Continuous 24,000, is more expensive than onsite autoclaving. Under Control Options 3 and 4, all model MWIs are more expensive than onsite autoclaving (again, excluding the Pathological 2,000, for which autoclaving is not a suitable substitute). The relative cost of onsite incineration increases as the control options become more stringent. For example, the cost advantage of onsite autoclaving over onsite incineration increases from Control Option 3 to Control Option 4. The cost advantage of onsite autoclaving under Control Options 3 and 4 is particularly high in comparison to the smaller model combusters.

The tables also indicate that offsite contract disposal is a cost-saving alternative to the Batch 250 under all four control options, to the Intermittent 2,000 under Control Options 3 and 4, and to the Pathological 2,000 under Control Option 4. The larger model combustors -- the Intermittent 21,000, Continuous 24,000, and Intermittent 8,400 -- remain less expensive than offsite contract disposal under all four control options. Offsite contract disposal continues to be less expensive on average than an autoclave system of the same capacity as the Batch 250. In all other cases, autoclaving is less expensive. Like onsite autoclaving, the cost of offsite contract disposal relative to onsite incineration becomes more favorable as the control options become more stringent.

Estimated capital costs of MWI controls and a new autoclave system are compared in Table 20. Offsite contract disposal is not included because it has the advantage of requiring no capital investment. As stated, autoclaving is not a suitable alternative to the Pathological 2,000. Otherwise, the table shows that the capital cost of a new autoclave system is comparable to the capital cost under Control Option 2, and much lower than capital costs under Control Options 3 and 4. In Section 3.5.4, it was concluded that capital costs under Control Option 2 can be financed. It follows that the capital cost of a new autoclave system can also be financed.

Because the relative cost of onsite incineration increases as a result of the Emission Guidelines, and because capital to invest in an alternative medical waste treatment system should generally be available, it can be expected that a major impact of the Emission Guidelines will be to trigger substitution. The extent of substitution could be expected to vary with the stringency of the control options because relative to the costs of alternative medical waste treatment methods such as onsite autoclaving and

TABLE 20. COMPARATIVE CAPITAL COSTS OF 1) CONTROLS FOR AN EXISTING MWI AND 2) A NEW AUTOCLAVE SYSTEM

Model MWI		Capacity (tons/yr)	Capital cost of MWI controls				Capital cost of a new autoclave system[a]
			C.O.1	C.O.2	C.O.3	C.O.4	
Inter.	21,000	1,176	$107,806	$176,206	$461,152	$901,267	$173,376
Cont.	24,000	977	85,047	130,644	362,910	753,211	136,509
Inter.	8,400	470	66,835	94,183	284,291	634,482	107,015
Path.	2,000	172	50,017	60,516	211,696	524,410	N.A.
Inter.	2,000	115	48,622	57,722	205,672	515,234	77,521
Batch	250	27	46,061	52,596	194,619	498,364	66,406

[a]Includes the cost of a shredder.

N.A. Not applicable.

Abbreviations: Cont. = Continuous, Inter. = Intermittent, Path. = Pathological.

offsite contract disposal, the cost of onsite incineration increases. As the control options increase in stringency, more and more MWI operators would be able to save costs by substituting. Substitution would probably escalate under Control Options 3 and 4. In the baseline and under Control Option 1, there is a cost-saving alternative to two model combustors. Under Control Option 2, there is a cost-saving alternative to three model combustors. Under Control Options 3 and 4, the number of model combustors for which there is a cost-saving alternative escalates to five and six, respectively. A cost-saving alternative is available for the Continuous 24,000 and Batch 250 in the baseline and under all four control options; for the Intermittent 21,000 under Control Options 2, 3, and 4; for the Intermittent 8,400 and Intermittent 2,000 under Control Options 3 and 4; and for the Pathological 2,000 under Control Option 4.

Moreover, under Control Options 3 and 4, it can be expected that there would be more substitution for small MWIs than for larger MWIs (this is not a consideration under Control Options 1 and 2 because only two and three model combustors, respectively, have a lower-cost alternative). This is because small MWIs have comparatively high per-ton cost impacts from the Emission Guidelines. As a result, cost savings from substituting for small MWIs are greater.

While onsite autoclaving is the lower-cost alternative in most cases, offsite contract disposal is the lower-cost alternative to the smallest model combustor, the Batch 250 (capacity 27 tons/year). This suggests that offsite contract disposal would be more cost-effective for small facilities that generate insufficient medical waste to achieve low per-ton costs operating an autoclave system. Offsite contract disposal, which requires no capital investment, may also be more suitable for facilities with limited capital (e.g., small facilities). Further, offsite contract disposal may be necessary if landfills or waste haulers are unwilling to accept autoclaved waste. Finally, offsite contract disposal may be needed as a complement if autoclaving cannot treat the entire medical waste stream.

Assuming profit-maximizing behavior, the opportunity to reduce costs is sufficient for an MWI operator to consider switching to an alternative medical waste treatment method (though, of course, other factors such as reliability, safety, regulatory requirements, and liability exposure must also be considered). However, in addition to being <u>cost-saving</u> in some cases, substitution will also be <u>necessary</u> in order to stay in business if control costs are prohibitive. The operations that would be in jeopardy would be those that result in, or are dependent on, the generation of medical waste. In Sections 3.5.2 and 3.5.3, a number of cases in which annualized control costs may not be fully recoverable with a price increase and the resulting impact on earnings may not be sustainable were identified. In Section 3.5.4, it was seen that capital to finance the investment in pollution controls may not be readily available in some cases.

The impacts of control costs can be avoided by substituting. However, there are also incremental costs associated with substituting. This is because, with two exceptions, the costs of onsite autoclaving and offsite contract disposal are greater on average than the cost of onsite incineration in the baseline. This was seen in Tables 19A, 19B, 19C, and 19D. The two exceptions are the Continuous 24,000, which is more expensive on average in the baseline than onsite autoclaving; and the Batch 250, which is more expensive on average in the baseline than offsite contract disposal.

Table 21 presents incremental annual costs of onsite autoclaving and offsite contract disposal over operating an MWI in the baseline. The table includes all industry categories and subcategories in which, under at least one control option, annualized and/or capital control costs may be prohibitive (and therefore substitution may be necessary). These categories and subcategories were identified in Sections 3.5.2 through 3.5.4. The incremental annual costs -- which are derived from Tables 19A, 19B, 19C, and 19D -- are equal to the per-ton cost differential between the medical waste treatment alternative and onsite incineration in the baseline, multiplied by the number of tons treated per year. The number of tons treated per year is based on full-capacity utilization of the model combustors. The cost of onsite incineration therefore assumes full-capacity utilization. The cost of onsite autoclaving also assumes full capacity utilization. As a result of these assumptions, the incremental annual costs of both onsite autoclaving and offsite contract disposal in Table 21 are conservative, i.e., may be overstated. The incremental annual cost of onsite autoclaving is conservative because the number of tons treated per year may be overstated (no doubt, many MWIs and autoclave systems are not operated at full capacity). The incremental annual cost of offsite contract disposal is conservative not only because the number of tons treated per year may be overstated, but also because the per-ton cost of onsite incineration in the baseline would be understated if full capacity is not utilized. This would lead to an overstatement of the per-ton cost differential between offsite contract disposal and onsite incineration in the baseline.

TABLE 21. INPUTS FOR PER-FACILITY SUBSTITUTION ANALYSIS
--EXISTING MWIs--

Industry/Model MWI	Revenue ($ mil.)	Net income[a]	Onsite auto-claving	Offsite contract disposal: Baseline	C.O.1	C.O.2	C.O.3	C.O.4
			Incremental annual cost of switching to:					
Hospitals								
<50 Beds	4.0	$83,250						
Batch 250			25,461	(14,499)	(14,256)	(13,824)	(12,177)	(10,476)
50-99 Beds	9.1	$189,981						
Inter. 2,000			16,100	19,550	20,585	22,425	29,440	36,685
Path. 2,000			N.A.	49,364	50,912	53,664	64,156	74,992
100-299 Beds								
T.B. & other resp. diseases	9.7	$340,933						
Inter. 8,400			29,140	203,980	208,210	215,730	244,400	274,010
Long-term, not-for-profit	16.7	$589,126						
Inter. 8,400			29,140	203,980	208,210	215,730	244,400	274,010
Non-AHA-registered, other	12.1	$416,819						
Inter. 8,400			29,140	203,980	208,210	215,730	244,400	274,010
Nursing homes								
100+ Employees								
Tax-paying	3.5	$139,944						
Inter. 8,400			29,140	203,980	208,210	215,730	244,400	274,010
Inter. 2,000			16,100	19,550	20,585	22,425	29,440	36,685
Path. 2,000			N.A.	49,364	50,912	53,664	64,156	74,992
Tax-exempt	4.9	$136,410						
Inter. 8,400			29,140	203,980	208,210	215,730	244,400	274,010
Inter. 2,000			16,100	19,550	20,585	22,425	29,440	36,685
Path. 2,000			N.A.	49,364	50,912	53,664	64,156	74,992
Veterinary facilities								
10-19 Employees	0.9	$349,750						
Inter. 2,000			16,100	19,550	20,585	22,425	29,440	36,685
Path. 2,000			N.A.	49,364	50,912	53,664	64,156	74,992
20+ Employees	2.0	$757,011						
Inter. 2,000			16,100	19,550	20,585	22,425	29,440	36,685
Path. 2,000			N.A.	49,364	50,912	53,664	64,156	74,992
Commercial research labs								
Tax-paying								
20-99 Employees	2.8	$168,018						
Inter. 2,000			16,100	19,550	20,585	22,425	29,440	36,685
Path. 2,000			N.A.	49,364	50,912	53,664	64,156	74,992

a After-tax net income for hospitals(because before-tax net income is not available in all cases), before-tax net income for all else.

N.A. Not applicable.

Abbreviations: Inter.=Intermittent, Path.=Pathological.

The table shows that the incremental annual cost of offsite contract disposal increases as the control options become more stringent. This is because the Emission Guidelines (and the NSPS) will cause the cost of offsite incineration to increase. The incremental annual cost of onsite autoclaving, on the other hand, is independent of the control level. The negative incremental annual costs of offsite contract disposal over the Batch 250, which is assigned to hospitals with fewer than 50 beds, indicate that compared to a Batch 250 in the baseline, offsite contract disposal is less expensive in the baseline and under all four control options. Estimates of revenue and net income introduced in Tables 5A and 5B are also included in Table 21.

Based on the inputs in Table 21, the price increase necessary to fully recover incremental substitution costs is calculated in Table 22, and the impact on net income if no price increase is achieved (i.e., incremental substitution costs are fully absorbed) is calculated in Table 23. Only the cases in which control costs may be prohibitive (and therefore substitution may be necessary) are examined. As mentioned, these cases were identified in Sections 3.5.2 through 3.5.4. No cases in which control costs may be prohibitive were identified under Control Options 1 and 2. Therefore, only Control Options 3 and 4 are addressed in Tables 22 and 23. In some cases in Tables 22 and 23, only the impact of incremental substitution costs under Control Option 4 is calculated because control costs under Control Option 3 are not prohibitive.

For all subcategories of hospitals in Table 22, there is at least one medical waste treatment alternative with incremental costs that could be recovered with a price increase of less than one percent. Such a price increase is

TABLE 22. PER-FACILITY ANNUALIZED SUBSTITUTION COSTS AS A PERCENT OF REVENUE (ONLY FOR CASES IN WHICH SUBSTITUTION IS NECESSARY)
--EXISTING MWIs--

Industry/Model MWI	Control Option 3		Control Option 4	
	Onsite auto-claving	Offsite contract disposal	Onsite auto-claving	Offsite contract disposal
Hospitals				
<50 Beds				
Batch 250	0.64%	-0.30%	0.64%	-0.26%
50-99 Beds				
Inter. 2,000			0.18%	0.40%
Path. 2,000			N.A.	0.82%
100-299 Beds				
T.B. & other resp. diseases				
Inter. 8,400			0.30%	2.82%
Long-term, not-for-profit				
Inter. 8,400			0.17%	1.64%
Non-AHA-registered, other				
Inter. 8,400			0.24%	2.26%
Nursing homes				
100+ Employees				
Tax-paying				
Inter. 8,400	0.83%	6.98%	0.83%	7.83%
Inter. 2,000	0.46%	0.84%	0.46%	1.05%
Path. 2,000	N.A.	1.83%	N.A.	2.14%
Tax-exempt				
Inter. 8,400	0.59%	4.99%	0.59%	5.59%
Inter. 2,000	0.33%	0.60%	0.33%	0.75%
Path. 2,000	N.A.	1.31%	N.A.	1.53%
Veterinary facilities				
10-19 Employees				
Inter. 2,000	1.79%	3.27%	1.79%	4.08%
Path. 2,000	N.A.	7.13%	N.A.	8.33%
20+ Employees				
Inter. 2,000			0.81%	1.83%
Path. 2,000			N.A.	3.75%
Commercial research labs				
Tax-paying				
20-99 Employees				
Inter. 2,000	0.58%	1.05%	0.58%	1.31%
Path. 2,000	N.A.	2.29%	N.A.	2.68%

N.A. Not applicable.

Abbreviations: Inter.=Intermittent, Path.=Pathological.

TABLE 23. PER-FACILITY ANNUALIZED SUBSTITUTION COSTS AS A PERCENT OF NET INCOME[a]
(ONLY FOR CASES IN WHICH SUBSTITUTION IS NECESSARY)
--EXISTING MWIs--

Industry/Model MWI	Control Option 3 Onsite auto-claving	Control Option 3 Offsite contract disposal	Control Option 4 Onsite auto-claving	Control Option 4 Offsite contract disposal
Hospitals				
<50 Beds				
Batch 250	30.58%	-14.63%	30.58%	-12.58%
50-99 Beds				
Inter. 2,000			8.47%	19.31%
Path. 2,000			N.A.	39.47%
100-299 Beds				
T.B. & other resp. diseases				
Inter. 8,400			8.55%	80.37%
Long-term, not-for-profit				
Inter. 8,400			4.95%	46.51%
Non-AHA-registered, other				
Inter. 8,400			6.99%	65.74%
Nursing homes				
100+ Employees				
Tax-paying				
Inter. 8,400	20.82%	174.64%	20.82%	195.80%
Inter. 2,000	11.50%	21.04%	11.50%	26.21%
Path. 2,000	N.A.	45.84%	N.A.	53.59%
Tax-exempt				
Inter. 8,400	21.36%	179.17%	21.36%	200.87%
Inter. 2,000	11.80%	21.58%	11.80%	26.89%
Path. 2,000	N.A.	47.03%	N.A.	54.98%
Veterinary facilities				
10-19 Employees				
Inter. 2,000	4.60%	8.42%	4.60%	10.49%
Path. 2,000	N.A.	18.34%	N.A.	21.44%
20+ Employees				
Inter. 2,000			2.13%	4.85%
Path. 2,000			N.A.	9.91%
Commercial research labs				
Tax-paying				
20-99 Employees				
Inter. 2,000	9.58%	17.52%	9.58%	21.83%
Path. 2,000	N.A.	38.18%	N.A.	44.63%

[a] After-tax net income for hospitals(because before-tax net income is not available in all cases), before-tax net income for all else.

N.A. Not applicable.

Abbreviations: Inter.=Intermittent, Path.=Pathological.

considered achievable. It is therefore concluded that, in general, hospitals can substitute. For the three subcategories of hospitals with 100-299 beds included in the table, the price increase necessary to recover incremental offsite contract disposal costs exceeds one percent. However, it is possible to switch instead to onsite autoclaving, which would require at the most a price increase of only 0.30 percent (t.b. hospitals). The negative values associated with switching from the Batch 250 to offsite contract disposal reflect that the cost of offsite contract disposal is lower.

In contrast to hospitals, a number of cases in which the price increase necessary to recover incremental substitution costs may not be achievable can be identified in Table 22 for nursing homes, veterinary facilities, and commercial research labs. Considering, again, only the low-cost (and low-impact) alternative, these cases include:

- Tax-paying and tax-exempt nursing homes with 100+ employees that switch from the Pathological 2,000 to offsite contract disposal under Control Options 3 and 4
- Veterinary facilities with 10-19 employees that switch from the Intermittent 2,000 to onsite autoclaving under Control Options 3 and 4
- Veterinary facilities with 10-19 employees that switch from the Pathological 2,000 to offsite contract disposal under Control Options 3 and 4
- Veterinary facilities with 20+ employees that switch from the Pathological 2,000 to offsite contract disposal under Control Option 4
- Tax-paying commercial research labs with 20-99 employees that switch from the Pathological 2,000

to offsite contract disposal under Control Options 3 and 4

Table 23, in turn, shows that there could be some significant impacts on net income if prices cannot be increased to recover incremental substitution costs. Using a 10 percent decline in net income (in the extreme event of no price increase) as the criterion for a significant impact, the following cases are identified:

- Tax-paying and tax-exempt nursing homes with 100+ employees that switch from the Pathological 2,000 to offsite contract disposal under Control Options 3 and 4
- Veterinary facilities with 10-19 employees that switch from the Pathological 2,000 to offsite contract disposal under Control Options 3 and 4
- Tax-paying commercial research labs with 20-99 employees that switch from the Pathological 2,000 to offsite contract disposal under Control Options 3 and 4

Note that all significant impacts involve switching from the Pathological 2,000 to offsite contract disposal under Control Option 3 and Control Option 4. As a model combustor, the Pathological 2,000 represents MWI operators that generate a substantial proportion and/or quantity of pathological waste ("pathological waste generators"). The significant impacts in Table 23 therefore apply to nursing homes with 100+ employees, veterinary facilities with 10-19 employees, and tax-paying commercial research labs with 20-99 employees that are pathological waste generators. The impacts are significant largely because there are few treatment and disposal options for pathological waste (e.g., autoclaving is not suitable). The question is, do these significant impacts imply closure, or at least the termination of operations that result in, or are dependent on, the generation of medical waste?

The answer in most cases is probably, no. This is based on the realization that 97.1 percent of all nursing homes, 97.4 percent of all veterinary facilities, and, at a minimum, 86.9 percent of all commercial research labs currently survive without operating an MWI onsite. Pathological waste generators that are forced to switch from onsite incineration to offsite contract disposal will simply be joining the majority of facilities in these industries that already utilize this method of medical waste treatment and disposal. It seems paradoxical, then, that net income could decline by as much as the amounts calculated in Table 23. How could a facility that is forced to substitute experience a decline in net income of up to 55 percent (tax-exempt nursing homes with 100+ employees switching from the Pathological 2,000 to offsite contract disposal under Control Option 4) and still be competitive with facilities that do not operate an MWI and do not experience similar impacts? The answer is that, on average, facilities that operate an MWI have a per-ton cost advantage over facilities that do not operate an MWI. This cost advantage, which was evident in the baseline figures in Tables 19A, 19B, 19C, and 19D, reflects economies of scale that facilities generating a sufficient amount of medical waste are able to achieve by operating an MWI. Substituting for onsite incineration simply means that the cost advantage will be lost. Substitution may cause net income to decline significantly, but the decline will be from a level that, in the baseline, is above the industry norm. (The estimates of net income in Tables 5A, 5B, and 5C are only averages. There is, of course, variation around these estimates.) After substitution to offsite contract disposal, profitability will be more in line with the profitabilities of facilities that already utilize offsite contract disposal.

It must also be considered that, as discussed, the incremental costs of offsite contract disposal in Table 21 presume full-capacity utilization of an MWI in the baseline. Many MWIs are not operated at full capacity. The impacts in Tables 22 and 23 are overstated for facilities switching to offsite contract disposal that do not operate an MWI at full capacity in the baseline. This pertains especially to veterinary facilities with 10-19 employees and tax-paying commercial research labs with 20-99 employees. Recall in Sections 2.4.7 and 2.4.8 that classifying these subcategories as MWI operators were said to be conservative measures. It is possible that relatively few facilities in these subcategories operate an MWI. And those that do are likely to be larger than the average facility represented by the model parameters in Table 5B. Based on the model parameters, the average veterinary facility with 10-19 employees was estimated to generate only 3.8 tons per year of medical waste, and the average tax-paying commercial research lab with 20-99 employees only 13.7 tons per year. These rates fall far short of full utilization of a Pathological 2,000 with a capacity of 172 tons per year, suggesting that the impacts in Tables 22 and 23 on veterinary facilities with 10-19 employees and tax-paying commercial research labs with 20-99 employees are overstated.

There may, under Control Options 3 and 4, be a few exceptions in which a nursing home with 100+ employees, a veterinary facility with 10-19 employees, or a tax-paying commercial research lab with 20-99 employees that is a pathological waste generator would have to shut down, however. This will depend on market segmentation, or, specifically, the number and types of medical waste generators found in individual market segments. Recall that most, if not all, of the regulated industries are highly segmented, consisting of regional and local markets (commercial research labs may be an exception). There is no reason to believe that an MWI operator, if forced to switch to offsite contract disposal, would have to shut down if most of its competitors already utilize this method of medical waste treatment and disposal. After substitution, the MWI operator would be on a par with its competitors. Consider, on the other hand, an MWI operator that competes substantially with other MWI operators that are not forced to substitute (because, for example, they are larger and therefore able to operate a larger and more cost-efficient MWI than the Pathological 2,000). The competitive position of this MWI operator, if forced to substitute, could be compromised. Instead of losing a cost advantage, the MWI operator would be losing the means necessary to stay competitive with the other, most likely larger, facilities in its market segment. This situation could exist in some market segments, though it should not be common given the predominance of facilities that do not operate an MWI onsite.

In addition, under Control Options 3 and 4, some MWI operators generating a substantial proportion and/or quantity of pathological waste might have to shut down if they are located in a market segment in which the cost of offsite contract disposal is significantly above average ($600/ton in the baseline). To the extent that the cost of offsite contract disposal is above average, the impacts of switching to offsite contract disposal in Tables 22 and 23 are understated (though not necessarily <u>net</u> of the overstatement that results if the MWI is utilized at less than full capacity in the baseline). This applies to pathological waste generators in all industry categories and subcategories in which control costs are potentially prohibitive, identified in Table 21, not just nursing homes with 100+ employees, veterinary facilities with 10-19 employees, and tax-paying commercial research labs with 20-99 employees. This may even apply to some facilities that are not pathological waste generators -- i.e., to which the Pathological 2,000 has not been assigned. Such facilities are said to be able to switch to onsite autoclaving, for which none of the impacts in Tables 22 and 23 are significant. However, it must be recalled that, on average, 10 percent of the medical waste stream cannot be autoclaved. Therefore, even MWI operators that switch to onsite autoclaving may have to utilize offsite contract disposal for a small portion of their medical waste stream.

Medical waste generators that are remote from a treatment facility are likeliest to pay more than average for offsite contract disposal. Often such medical waste generators are located in sparsely populated areas. A mitigating factor is that medical waste generators located in sparsely populated areas are likely to face little competition. Such facilities probably have above-average pricing power and may be able to exceed the market price increase. This would reduce the portion of incremental substitution costs that could not be recovered with a price increase and therefore would have to be absorbed.

Medical waste generators in populous areas may be remote from a treatment facility with available capacity if local or regional offsite treatment capacity is tight. A mitigating factor in this case is that a shortage of medical waste treatment capacity is probably more likely to elicit the construction of new capacity for a populous area than for a relatively unpopulated area because the market in the populous area is larger.

3.6 PER-FACILITY IMPACTS FOR OFFSITE GENERATORS

The Emission Guidelines will not only impact facilities that operate an MWI, but also facilities that generate medical waste and send it offsite to be incinerated. Such facilities are likely to pay higher fees for commercial incineration as a result of the Emission Guidelines (and the NSPS).

In Section 3.5, per-facility impacts were calculated for MWI operators. In all of the industries in which MWIs are operated, with the exception of commercial incineration facilities, MWI operators and offsite generators coexist. In fact, offsite generators comprise the majority of facilities in all of these industries. Average impacts on offsite generators in industry categories and subcategories defined to consist of both MWI operators and offsite generators (specified in Tables 5A and 5B) cannot be measured because comparative scale parameters (e.g., medical waste generated) for MWI operators and offsite generators are not known. For example, it is likely that the average hospital that is an offsite generator is smaller than the average hospital that operates an MWI. How much smaller is not known.

However, some conclusions can be made about the impacts of the Emission Guidelines on this type of offsite generator -- that is, offsite generators that coexist in industry categories or subcategories with MWI operators: (1) There will be no direct impact on offsite generators with no dependence on offsite incineration (though there may be indirect impacts if the demand for, and therefore the price of, alternative medical waste treatment methods increases). (2) The cost impact will vary with the degree of dependence on offsite incineration. (3) On average, offsite generators with 100 percent dependence on offsite incineration will be impacted less by the Emission Guidelines than MWI operators in the same industry. This is because MWIs used for commercial incineration are larger than average and therefore have comparatively low control costs per ton. In Section 3.5.5 it was revealed that the average joint impact of the Emission Guidelines and NSPS on the cost of commercial incineration is $9/ton under Control Option 1, $25/ton under Control Option 2, $86/ton under Control Option 3, and $149/ton under Control Option 4. Of all the model combustors, only the Continuous 36,000, which is attributed exclusively to commercial incineration facilities, is impacted less by the Emission Guidelines: $4/ton under Control Option 1, $20/ton under Control Option 2, $61/ton under Control Option 3, and $89/ton under Control Option 4. (4) In some situations, an offsite generator could experience cost impacts similar to an MWI operator of the same size (e.g., generating the same amount of medical waste) in the same industry. The offsite generator would have to be as dependent on offsite incineration as the MWI operator is dependent on onsite incineration (normally 100%), and would have to rely on incineration by a commercial MWI that is comparable in size and efficiency to the MWI used by the onsite operator. That the impacts would be comparable follows from the premise that commercial incineration costs are fully passed along to customers. In Section 3.5.5, it was seen that under Control Options 3 and 4, some nursing homes with 100+ employees, veterinary facilities with 10-19 employees, and tax-paying commercial research labs with 20-99 employees that operate an MWI and generate a substantial proportion and/or quantity of pathological waste may have to shut down. It follows that some offsite generators generating a substantial proportion and/or quantity of pathological waste in these subcategories may also have to shut down. However, closure should be even more of an exception for offsite generators than for MWI operators. For offsite generators, not only will closure require, as for MWI operators, the particular conditions in individual market segments discussed in Section 3.5.5, but the population of facilities that are potentially affected will be limited to those that are substantially dependent on offsite incineration by an MWI that is smaller and less efficient than the average commercial MWI.

It is possible, on the other hand, to estimate average impacts for offsite generators in industry categories and subcategories defined to consist exclusively of offsite generators. These industry categories and subcategories were specified in Table 5C. In Table 24, incremental annual costs due to the Emission Guidelines are estimated for facilities in these industry categories and subcategories that send 100 percent of their medical waste offsite to be incinerated. The costs are estimated by apportioning total industry medical waste generated to subcategories according to their share of total industry employment. This uses employment as a scale factor, and assumes a constant ratio of medical waste generated to employment. In reality, the relationship of medical waste generated to employment may vary somewhat, especially in the two groupings that are of heterogenous composition: 1) outpatient care, which consists of physicians' clinics and kidney dialysis facilities; and 2) "other" laboratories, comprising medical and dental labs.

In Table 24, after disaggregating total medical waste generated by employment, average waste per facility is calculated. Then, based on the estimated average joint impact of the Emission Guidelines and NSPS on the cost of offsite incineration, estimated in Section 3.5.5 -- $9/ton under Control Option 1, $25/ton under Control Option 2, $86/ton under Control Option 3, and $149/ton under Control

TABLE 24. ESTIMATED INCREMENTAL ANNUAL COSTS FOR FACILITIES THAT SEND ALL OF THEIR MEDICAL WASTE OFFSITE TO BE INCINERATED
--EXISTING MWIs--

	Medical waste generated annually (tons)	Share of industry employment	Estimated share of industry medical waste(tons)	No. of facilities	Medical waste per facility (tons)	Incremental annual cost per facility[a] C.O.1	C.O.2	C.O.3	C.O.4
Nursing homes	198,000								
0-19 Employees									
Tax-paying		1.09%	2,158	2,099	1.03	$9	$26	$88	$153
Tax-exempt		0.61%	1,208	1,017	1.19	$11	$30	$102	$177
20-99 Employees									
Tax-paying		32.42%	64,192	7,673	8.37	$75	$209	$719	$1,247
Tax-exempt		7.32%	14,494	1,677	8.64	$78	$216	$743	$1,288
Physicians' offices	235,000	100.00%	235,000	191,278	1.23	$11	$31	$106	$183
Dentists' offices & clinics	58,000								
Offices		99.88%	57,350	103,665	0.55	$5	$14	$48	$82
Clinics									
Tax-paying		0.94%	545	486	1.12	$10	$28	$96	$167
Tax-exempt		0.18%	104	62	1.68	$15	$42	$145	$251
Outpatient care (clinics)	175,000								
Physicians' clinics (amb. care)									
Tax-paying		49.77%	87,098	4,224	20.62	$186	$515	$1,773	$3,072
Tax-exempt		41.92%	73,360	2,295	31.97	$288	$799	$2,749	$4,763
Freestanding kidney dial. fac.									
Tax-paying		6.48%	11,340	711	15.95	$144	$399	$1,372	$2,376
Tax-exempt		1.84%	3,220	128	25.16	$226	$629	$2,163	$3,748
Freestanding blood banks	33,000	100.00%	33,000	218	151.38	$1,362	$3,784	$13,018	$22,555
Veterinary facilities	31,000								
0-9 employees		51.13%	15,850	18,317	0.87	$8	$22	$74	$129
Laboratories									
Commercial research	55,500								
Tax-paying									
0-19 Employees		9.29%	5,156	2,777	1.86	$17	$46	$160	$277
Other	117,500								
Medical		69.21%	81,322	6,871	11.84	$107	$296	$1,018	$1,763
Dental		30.79%	36,178	7,970	4.54	$41	$113	$390	$676
Funeral homes	6,000	100.00%	6,000	22,000	0.27	$2	$7	$23	$41
Fire & rescue	11,000	100.00%	11,000	29,840	0.37	$3	$9	$32	$55
Corrections	22,000								
Federal govt.		3.06%	673	47	14.32	$129	$358	$1,232	$2,134
State govt.		62.17%	13,677	903	15.15	$136	$379	$1,303	$2,257
Local govt.		34.76%	7,647	3,338	2.29	$21	$57	$197	$341

[a] Based on $9/ton under Control Option 1, $25/ton under Control Option 2, $86/ton under Control Option 3, and $149/ton under Control Option 4.

Option 4 -- the incremental annual cost per facility is calculated. This cost is the average increase in the cost of commercial incineration to an offsite generator that sends 100 percent of its medical waste offsite to be incinerated. Offsite generators that are less dependent on offsite incineration will be impacted less by the regulation.

The facility price increase is calculated in Table 25. For nursing homes with 0-19 and 20-99 employees, veterinary facilities with 0-9 employees, and tax-paying commercial research laboratories with 0-19 employees, the facility price increase is less than the market price increase (see Table 9) because of the influence on the market price increase of MWI operators in other subcategories of the industry (MWI operators have relatively high control costs and therefore drive up the market price increase). These facility price increases are achievable because the market price increases were deemed achievable (see Section 3.4.4).

All other offsite generators in Table 25 are in industries in which there are no MWI operators. In these cases, the facility price increase exceeds the market price increase because offsite generators with less than 100 percent dependence on offsite incineration are included in the revenue basis for the market price increase. All of these facility price increases are considered achievable, however. All are less than 0.4 percent (the highest is 0.397% for blood banks under Control Option 4) and none deviate significantly from the market price increase.

The impact on earnings of full absorption of control costs is measured in Table 26. Since all facility price

TABLE 25. PER-FACILITY ANNUALIZED CONTROL COSTS AS A PERCENT OF REVENUE/BUDGET: OFFSITE GENERATORS
--EXISTING MWIs--

Industry	C.O.1	C.O.2	C.O.3	C.O.4
Nursing homes				
0-19 Employees				
Tax-paying	0.005%	0.014%	0.047%	0.081%
Tax-exempt	0.004%	0.012%	0.043%	0.074%
20-99 Employees				
Tax-paying	0.006%	0.017%	0.057%	0.099%
Tax-exempt	0.006%	0.017%	0.057%	0.099%
Physicians' offices	0.002%	0.006%	0.021%	0.037%
Dentists' offices & clinics				
Offices	0.002%	0.005%	0.018%	0.032%
Clinics				
Tax-paying	0.002%	0.005%	0.018%	0.031%
Tax-exempt	0.001%	0.003%	0.009%	0.016%
Outpatient care (clinics)				
Physicians' clinics(amb. care)				
Tax-paying	0.010%	0.029%	0.099%	0.172%
Tax-exempt	0.011%	0.029%	0.100%	0.174%
Freestanding kidney dial. fac.				
Tax-paying	0.011%	0.030%	0.104%	0.180%
Tax-exempt	0.013%	0.035%	0.121%	0.210%
Freestanding blood banks	0.024%	0.067%	0.229%	0.397%
Veterinary facilities				
0-9 Employees	0.004%	0.010%	0.035%	0.060%
Laboratories				
Commercial research				
Tax-paying				
0-19 Employees	0.005%	0.013%	0.045%	0.077%
Other				
Medical	0.012%	0.034%	0.118%	0.205%
Dental	0.019%	0.053%	0.181%	0.313%
Funeral homes	0.001%	0.002%	0.005%	0.009%
Fire & rescue	0.001%	0.002%	0.008%	0.013%
Corrections				
Federal govt.	0.000%	0.001%	0.005%	0.008%
State govt.	0.001%	0.002%	0.008%	0.013%
Local govt.	0.001%	0.002%	0.009%	0.015%

TABLE 26. PER-FACILITY ANNUALIZED CONTROL COSTS AS A PERCENT OF BEFORE-TAX NET INCOME : OFFSITE GENERATORS
--EXISTING MWIs--

Industry	C.O.1	C.O.2	C.O.3	C.O.4
Nursing homes				
0-19 Employees				
Tax-paying	0.122%	0.339%	1.165%	2.019%
Tax-exempt	0.161%	0.446%	1.534%	2.658%
20-99 Employees				
Tax-paying	0.149%	0.415%	1.428%	2.473%
Tax-exempt	0.213%	0.592%	2.038%	3.530%
Physicians' offices	0.005%	0.014%	0.047%	0.081%
Dentists' offices & clinics				
Offices	0.006%	0.016%	0.053%	0.092%
Clinics				
Tax-paying	0.006%	0.016%	0.056%	0.097%
Tax-exempt	N/A	N/A	N/A	N/A
Outpatient care (clinics)				
Physicians' clinics(amb. care)				
Tax-paying	0.259%	0.720%	2.477%	4.291%
Tax-exempt	0.375%	1.043%	3.588%	6.216%
Freestanding kidney dial. fac.				
Tax-paying	0.102%	0.282%	0.972%	1.683%
Tax-exempt	0.169%	0.470%	1.616%	2.799%
Freestanding blood banks	N/A	N/A	N/A	N/A
Veterinary facilities				
0-9 Employees	0.009%	0.026%	0.091%	0.157%
Laboratories				
Commercial research				
Tax-paying				
0-19 Employees	0.078%	0.216%	0.744%	1.289%
Other				
Medical	0.140%	0.388%	1.334%	2.312%
Dental	0.210%	0.584%	2.008%	3.479%
Funeral homes	0.005%	0.013%	0.046%	0.079%
Fire & rescue	N/A	N/A	N/A	N/A
Corrections				
Federal govt.	N/A	N/A	N/A	N/A
State govt.	N/A	N/A	N/A	N/A
Local govt.	N/A	N/A	N/A	N/A

N/A Not available.

increases in Table 25 can be achieved, however, these impacts will not come into effect.

Offsite generators will have no capital control costs. Hence no impacts indicating the availability of capital are calculated.

3.7 IMPACTS ON TAXPAYERS

There are three primary ways in which the Emission Guidelines will impact taxpayers. First, taxpayers will indirectly subsidize tax-exempt debt issued by public and some not-for-profit institutions. This is because tax-exempt debt results in a tax-revenue shortfall for the government that must ultimately be made up for by other taxes. Measuring this impact is beyond the scope of this analysis. Secondly, taxpayers will underwrite the costs to government programs that finance health care. This impact can be grasped from the facility price increases calculated in Tables 15A, 15B, and 25. In the long run, it can be expected that, on average, about 35 percent of the price increases achieved by health care providers will be passed on to taxpayers (in the form of higher taxes). This is because government programs pay for about 35 percent of health care in the U.S. (in 1987, Medicare 16.2%, Medicaid 9.9%, other government programs 8.9%).[62] Thirdly, taxpayers will have to pay for the costs to public institutions. Medical waste generators that are exclusively government-owned include correctional facilities and fire departments. Many hospitals are also public. In addition, it is possible that some tax-exempt nursing homes, laboratories, outpatient clinics, and dentists' clinics are government-owned.

Assuming control costs are passed along to taxpayers, Table 27 estimates per-capita impacts of the Emission Guidelines for three of the above categories of public establishments: public hospitals, fire and rescue

TABLE 27. PER-CAPITA IMPACTS OF ANNUAL COSTS TO PUBLIC FACILITIES
--Existing MWIs--

Industry/ government unit	Number of facilities	Annual cost per facility (intermittent MWI for hospitals; all else offsite contract disposal) C.0.1	C.0.2	C.0.3	C.0.4	No. of govt. units, 1986	Average population per govt. unit, 1986	Per-capita cost of per-facility annual cost C.0.1	C.0.2	C.0.3	C.0.4
Hospitals											
Federal	N/A (a)	$19,665	$29,162	$93,209	$174,288	1	241,625,000	$0.00	$0.00	$0.00	$0.00
State	N/A (b)	$36,155	$59,643	$169,940	$270,906	50	4,832,500	$0.01	$0.01	$0.04	$0.06
Local	N/A (c)	$19,665	$29,162	$93,209	$174,288						
County						3,042	71,465	$0.28	$0.41	$1.30	$2.44
Municipal						19,200	7,805	$2.52	$3.74	$11.94	$22.33
Township						16,691	3,119	$6.30	$9.35	$29.88	$55.88
Special district						783	N/A	N/A	N/A	N/A	N/A
Fire and rescue	29,840 (d)	$3	$9	$32	$55						
County						3,042	71,465	$0.00	$0.00	$0.00	$0.00
Municipal						19,200	7,805	$0.00	$0.00	$0.00	$0.01
Township						16,691	3,119	$0.00	$0.00	$0.01	$0.02
Special district						5,070	N/A	N/A	N/A	N/A	N/A
Corrections											
Federal	47	$129	$358	$1,232	$2,134	1	241,625,000	$0.00	$0.00	$0.00	$0.00
State	903	$136	$379	$1,303	$2,257	50	4,832,500	$0.00	$0.00	$0.00	$0.00
Local	3,338	$21	$57	$197	$341						
County						3,042	71,465	$0.00	$0.00	$0.00	$0.00
Municipal						19,200	7,805	$0.00	$0.01	$0.03	$0.04

(a) The total number of Federal hospitals equals 340 (Table 4A). However, the number with and the number without an MWI is not known.

(b) The total number of state hospitals equals 372 (Table 4A). However, the number with and the number without an MWI is not known.

(c) The total number of local government hospitals equals 1,436 (Table 4A). However, the number with and the number without an MWI is not known.

(d) The distribution of fire and rescue operations by type of government unit is not known. However, municipal governments accounted for the majority -- 74.9 percent -- of total public spending on fire and rescue in 1986, according to the 1986/87 Census.

N/A Not available.

operations, and correctional facilities. Necessary government data were not available to measure impacts for the other categories. However, public hospitals are certain to account for most of the costs of the regulation to public establishments.

In the U.S., six types of government units operate public hospitals: Federal, state, county, municipal, township, and special district. Fire departments are operated by county, municipal, township, and special district governments. Correctional facilities are operated by Federal, state, county, and municipal governments. These government units are all specified as subcategories in Table 27.

Annual control costs for hospitals in Table 27 are taken from Table 14. State hospitals have on average 387 beds (calculated from Table 5A). In Table 14, hospitals with 300+ beds are assigned both the Intermittent 21,000 and the Continuous 24,000. Only the Intermittent 21,000 is applied in Table 27. This is sufficient for the purpose of estimating conservative impacts because its control costs are higher. Federal and local government hospitals have on average 296 and 113 beds, respectively, so they are assigned the annual control costs in Table 14 applying to hospitals with 100-299 beds (represented by the Intermittent 8,400).

Fire and rescue operations and correctional facilities are offsite generators. The incremental annual costs of offsite incineration estimated in Table 24 are used in Table 27. These costs reflect the impacts of both the Emission Guidelines and the NSPS on offsite incineration. In addition, the costs assume that the facility sends all of its medical waste offsite to be incinerated. Per-capita impacts will be lower for facilities that send less than 100 percent of their medical waste offsite to be incinerated.

Dividing per-facility costs (1989 dollars) by the average population in 1986 of the relevant government unit in Table 27 yields the per-capita cost of the annual cost per facility. The number of government units is from the 1986/87 Census of Governments. The total population is used as a substitute for the total number of taxpayers per government unit, which is not known. Since not all residents are taxpayers, per-capita impacts underestimate impacts per taxpayer.

The per-capita impacts in Table 27 for Federal and state hospitals are insignificant. However, for local hospitals, the impacts range up to $6.30 under Control Option 1, $9.35 under Control Option 2, $29.88 under Control Option 3, and $55.88 under Control Option 4. In each case, the highest cost is accounted for by township hospitals. This is because townships are the government unit with the lowest average population (3,119). The interpretation of, for example, the $6.30 per-capita cost for township hospitals under Control Option 1 is as follows: if a hospital -- or any other type of facility, for that matter -- operating an Intermittent 8,400 is under the jurisdiction of a township of average size (population 3,119), the average annual per-capita cost is $6.30.

Some of the impacts for local hospitals under Control Options 3 and 4, particularly those for township hospitals, can perhaps be considered significant. However, under these control options, the impacts of switching from an Intermittent 8,400 to onsite autoclaving -- which should occur if control costs are prohibitive -- are substantially lower (see Tables 19C and 19D). In addition, it is not clear whether a hospital operating an Intermittent 8,400 -- which is likely to be a hospital of above-average size -- is likely to be under the jurisdiction of a township as small as the average-sized township (population 3,119).

The per-capita costs for fire and rescue operations and correctional facilities are negligible. At the most they are only 4 cents.

3.8 IMPACTS ON SMALL ENTITIES

In accordance with the Regulatory Flexibility Act of 1980, it is necessary to determine if the Emission Guidelines will have a "significant economic impact on a substantial number of small entities." Small entities affected by the regulation include small businesses, small not-for-profit organizations, and small government jurisdictions.

The Small Business Administration (SBA) standard for a small business is 500 employees or fewer for SIC 8731, Commercial Physical and Biological Research (research labs), and annual sales of $3.5 million or less for all other industries impacted by the Emission Guidelines. The EPA "Guidelines for Implementing the Regulatory Flexibility Act" (February 9, 1982) suggest that not-for-profit organizations are small if they are not dominant in their field, and government jurisdictions are small if they have a population of 50,000 or less.

According to the EPA "Guidelines," the criterion for a "substantial number" is 20 percent or more of all small entities impacted by a regulation.

Impacts on government units, some of which have an average population less than 50,000 and are therefore "small," were measured in Table 27. The only potentially significant impacts are represented by local hospitals, especially township hospitals, operating an Intermittent 8,400. In an average-sized township with 3,119 residents, the per-capita impacts are $6.30 under Control Option 1, $9.35 under Control Option 2, $29.88 under Control Option 3, and $55.88 under Control Option 4. These impacts apply not only to hospitals, but to any facility operating an

Intermittent 8,400 in an average-sized township. The impacts under Control Options 3 and 4 can perhaps be regarded as significant, especially considering that taxpayers in government units that are larger on average (e.g., municipalities) are not similarly burdened. The per-capita impact would be compounded if other public facilities operating an MWI are located in the same township.

However, under Control Options 3 and 4, the impacts of switching from an Intermittent 8,400 to onsite autoclaving -- which should occur if control costs are prohibitive -- are substantially lower (see Tables 19C and 19D). Additionally, it is not clear whether a facility operating an Intermittent 8,400 is likely to be under the jurisdiction of a township as small as the average-sized township (population 3,119). In any event, if there are significant impacts, they should not apply to a "substantial number" of small government units. This would probably be true even if the only small government units impacted by the Emission Guidelines were those in which an MWI is operated. However, small government units in which there are offsite generators -- which will pay more for offsite incineration as a result of the Emission Guidelines (and the NSPS) -- will also be impacted. Therefore, the number of government units that are significantly impacted should represent only a small percentage -- far less than 20 percent -- of all small government units impacted by the Emission Guidelines.

Many small businesses and small not-for-profit organizations are represented in Tables 5A, 5B, and 5C. The tables confirm that, with the exception of hospitals, all industries impacted by the Emission Guidelines consist predominantly of small entities, according to the criteria above. It should be noted, though, that the data in these tables represent establishments, not firms or organizations.

For purposes of defining small businesses, for example, the firm, or the ultimate company affiliation, is of the essence. Therefore, Tables 5A, 5B, and 5C overstate the incidence of small entities in the regulated industries.

The EPA "Guidelines" define a significant impact on a small entity as any one of the following:

(1) Annual compliance costs increase total costs of production by more than 5 percent.

(2) Compliance costs (annualized, presumably) as a percent of sales are at least 10 percent higher than for large entities.

(3) Capital costs of compliance represent a significant portion of capital available.

(4) The requirements of the regulation are likely to result in closures.

Let's examine each of these four criteria.

Criterion 1: Since revenue differs from costs only by accounting profits, a facility price increase greater than five percent approximately indicates that annual control costs would cause total production costs to increase by more than five percent. No such cases can be identified for hospitals in Table 15A. Table 15B indicates, on the other hand, that production costs would likely increase by more than five percent at MWI-operating veterinary facilities with 10-19 employees under Control Options 3 and 4, veterinary facilities with 20+ employees under Control Option 4, and commercial incineration facilities under Control Options 2, 3, and 4. In general, veterinary facilities with 10-19 employees, veterinary facilities with 20+ employees, and commercial incineration facilities are "small" because they average less than $3.5 million in sales (See Table 5B).

However, a 5%+ increase in production costs at commercial incineration facilities is not taken to be significant. This is because the demand for commercial incineration will increase as a result of the Emission Guidelines (and the NSPS), and, as discussed in Section 3.4.3, it is presumed that the increase in demand will be sufficient to permit full recovery of control costs.

All veterinary facilities that would experience a 5%+ increase in production costs from controls are expected to avoid control costs by substituting. In Table 22, the price increase necessary to fully recover incremental substitution costs is less than 5 percent for veterinary facilities with 10-19 employees switching from the Intermittent 2,000 and for veterinary facilities with 20+ employees switching from both the Intermittent 2,000 and the Pathological 2,000. This implies that production costs would not increase by 5 percent. On the other hand, under both Control Option 3 and Control Option 4, the price increase necessary to fully recover incremental substitution costs is greater than 5 percent for veterinary facilities with 10-19 employees switching from the Pathological 2,000. This is a significant impact. However, as explained in Section 3.5.5, it is believed that this impact is overstated because veterinary facilities with 10-19 employees that operate an MWI are likely to be larger than the average facility in this subcategory represented by the model parameters in Table 5B. Anyway, a "substantial number" of facilities will not be impacted. There are a total of 21,496 veterinary facilities in the U.S. Considering that average sales per facility in even the largest subcategory, 20+ employees, are only $2.0 million, it is clear that the vast majority of veterinary facilities in the U.S. are "small." Meanwhile, 493 Pathological 2,000s were attributed to veterinary facilities in Table 2 (these MWIs were later assigned both to veterinary facilities with 10-19 employees and to veterinary facilities with 20+ employees). Considering that both veterinary facilities that operate an MWI and veterinary facilities that send their medical waste offsite to be incinerated will be impacted by the Emission Guidelines, it is clear that the total number of veterinary facilities for which production costs increase by 5%+ as a result of the Emission Guidelines will not be close to 20 percent of the total number of "small" veterinary facilities impacted by the regulation.

<u>Criterion 2</u>: There are two countervailing differential impacts of the Emission Guidelines. On the one hand, due to economies of scale, the relative impact of the regulation is less for large facilities that operate an MWI than for small facilities that operate an MWI. For example, under Control Option 1, the average ratio of annualized control costs to revenue is 0.34 percent for hospitals with fewer than 50 beds, and, in the high-cost case of the Intermittent 21,000, 0.04 percent for hospitals with 300 or more beds (see Table 15A). The ratios differ by 850 percent, easily exceeding the 10 percent criterion. On the other hand, offsite generators -- especially to the extent that they do not utilize offsite incineration -- are on average impacted less by the Emission Guidelines than MWI operators. And MWIs tend to be located at large facilities as opposed to small facilities. This results in differential impacts favoring small offsite generators. The net differential impacts will depend on the comparative strengths of the two countervailing trends. Since the majority of facilities in all industries in which medical waste is generated are offsite generators, the net differential impacts will most likely favor small facilities. The exception is commercial incineration facilities, none of which, by definition, are offsite generators. Although the relative impact of control

costs is likely to be greater for small commercial incineration facilities than for large ones, facilities of all sizes are expected to be able to pass along control costs to their customers.

Criterion 3: For MWI operators, there are a number of cases in which capital costs might be difficult to finance under Control Options 3 and 4. These impacts can be avoided, however, by substituting, for which financing should generally be available. Offsite generators do not have any capital control costs.

Criterion 4: For the cases in which control costs are prohibitive, the opportunity to substitute will, for the most part, allow closure to be prevented. Depending on particular conditions in individual market segments, there may, under Control Options 3 and 4, be a few exceptions in which a facility would have to shut down. Closure would require that the facility generates a substantial proportion and/or quantity of pathological waste, for which substitution options are limited because it cannot be autoclaved. In addition, the facility would either have to face substantial competition from other MWI operators that are not forced to substitute, or have to pay significantly more than average for offsite contract disposal (because, for example, it is remote from a treatment facility). In no industry, however, should the closure exceptions come close to representing a "substantial" portion -- i.e., 20 percent -- of all small entities impacted by the Emission Guidelines.

In summary, some "small" medical waste generators, as well as "small" commercial incineration facilities and government jurisdictions, may be "significantly" impacted by the Emission Guidelines under Control Options 3 and 4. However, because the Emission Guidelines (and the NSPS) will cause the demand for offsite incineration to increase, it is expected that commercial incineration facilities will be able to recoup control costs by passing them along to customers. Furthermore, the number of small medical waste generators and government jurisdictions that will be significantly impacted should not be "substantial." This is in part due to the opportunity that the great majority of facilities will have to avoid the impacts of control costs by substituting. Hence, it is concluded that the Emission Guidelines will not have a "significant economic impact on a substantial number of small entities."

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ADDENDUM TO THE ANALYSIS OF
ECONOMIC IMPACTS FOR EXISTING SOURCES

1.0 INTRODUCTION

Four control options were assessed in the Analysis of Economic Impacts for Existing Sources. The most stringent, "Control Option 4," consisted of a dry injection/fabric filter system with carbon injection and two-second combustion. In this addendum to the Analysis of Economic Impacts for Existing Sources, a fifth, more-stringent control option — "Control Option 5" — is evaluated. Control Option 5 has the same requirements as Control Option 4, but also requires continuous emissions monitoring (CEM).

This addendum is organized to facilitate comparison with the Analysis of Economic Impacts for Existing Sources, and particularly to facilitate analysis of the incremental impacts of Control Option 5 over Control Option 4. Many of the tables in the Analysis of Economic Impacts for Existing Sources are employed. They differ in this addendum only in that they present Control Options 4 and 5, rather than Control Options 1 through 4. Otherwise they are the same (same table numbers, titles, headings, etc.). The tables in this addendum do not run in consecutive numbers because, for purposes of evaluating Control Option 5, it is not necessary to reproduce all of the tables in the Analysis of Economic Impacts for Existing Sources. One table in this addendum is new: Table 19E.

2.0 SUMMARY OF ECONOMIC IMPACTS UNDER CONTROL OPTION 5

Nationwide total annualized control costs slightly more than double from $716.8 million under Control Option 4 to $1,451.6 million under Control Option 5. The primary impact of Control Option 5 will be to prompt substitution. Already under Control Option 4, it is estimated that there is a cheaper alternative (either onsite autoclaving or offsite contract disposal) to 100 percent of onsite MWI capacity.

While substitution may already be the accepted practice under Control Option 4, it is even more likely to take place under Control Option 5.

While substitution will be prompted because it is <u>cost-saving</u>, it will also be <u>necessary</u> for many MWI operators because control costs are prohibitive. This applies under Control Option 5 to the same cases identified under Control Option 4 — hospitals with fewer than 50 beds, hospitals with 50-99 beds, certain categories of hospitals with 100+ beds, nursing homes with 100+ employees, veterinary facilities with 10-19 employees, veterinary facilities with 20+ employees, and tax-paying commercial research labs with 20-99 employees — as well as to a new case: tax-exempt commercial research labs. These cases represent all but the largest medical waste generators.

For the most part, substitution will avoid these significant impacts. Still, the incremental cost of substitution is significant for facilities switching from a pathological MWI (represented by the Pathological 2,000) to offsite contract disposal in several cases: nursing homes with 100+ employees (Control Options 3, 4, and 5), veterinary facilities with 10-19 employees (Control Options 3, 4, and 5), tax-paying commercial research labs with 20-99 employees (Control Options 3, 4, and 5), and veterinary facilities with 20+ employees (Control Option 5). Though significant, these impacts are not taken to, in general, imply closure. Already in these industries, the great majority of facilities have demonstrated that they can survive without onsite incineration (97.1% of all nursing homes, 97.4% of all veterinary facilities, a minimum of 86.9% of all commercial research labs).

However, a few of these facilities, as exceptions, may find substitution costs prohibitive and therefore would have to close. Closure would require that the facility generates a substantial proportion and/or quantity of pathological waste, for which substitution options are limited because it cannot be autoclaved. In addition, the facility would either have to face substantial competition in its market segment from other MWI operators that are not forced to substitute (because, for example, they operate larger, more cost-effective MWIs), or have to pay significantly more than average for offsite contract disposal (because, for example, it is remote from a treatment facility). The number of exceptions is sure to be higher under Control Option 5 than under the less-stringent Control Option 4.

Substitution will also avoid some industry-wide impacts found to be significant under Control Option 5 but not under Control Option 4. Under Control Option 5, in the case of maximum demand elasticities, industry-wide output and employment would decline by 1.8 percent at veterinary facilities and by 1.5 percent at commercial research labs. With substitution, the impacts are less than -1 percent.

The vast majority of medical waste generators do not operate an onsite MWI. Those that send their waste offsite to be incinerated are estimated to see an increase in cost of $149/ton under Control Option 4 and $259/ton under Control Option 5. For all industry categories and subcategories defined to consist exclusively of medical waste generators that do not operate an MWI, both cost increases can be recovered with a price increase under one percent even if all medical waste generated is incinerated offsite.

Finally, the Emission Guidelines continue under Control Option 5 to not have a "significant economic impact on a substantial number of small entities." A good number of small entities are significantly impacted by controls, but most significant impacts can be avoided by substituting. While some small facilities will continue to have significant impacts, in no case will the number of significantly impacted facilities be close to "substantial" (i.e., 20% or more of all small entities impacted).

3.0 CONTROL COSTS

Per-MWI control costs under Control Options 4 and 5 are presented in Table 3. The increase in capital control costs from Control Option 4 to Control Option 5 ranges from 19.7 percent for the Continuous 36,000 and Intermittent 21,000, to 35.5 percent for the Batch 250. The increase in total annualized control costs is likewise inversely related to MWI size — while total annualized control costs for the Continuous 36,000 increase by 38.7 percent, they more than double for the three smallest MWIs, the Pathological 2,000, Intermittent 2,000, and Batch 250.

4.0 INDUSTRY-WIDE IMPACTS OF CONTROLS

4.1 INDUSTRY-WIDE ANNUALIZED CONTROL COSTS

The first two columns of Table 7 show that nationwide total annualized control costs slightly more than double from $716.8 million under Control Option 4 to 1,451.6 million under Control Option 5.

The commercial incineration cost pool (i.e., total annualized control costs that will be passed along to offsite generators) increases from $118.8 million under Control Option 4 to $210.5 million under Control Option 5. Considering that an estimated 702,865 tons of capacity at existing MWIs is used for commercial incineration, this comes to $169/ton under Control Option 4 and $300/ton under Control Option 5. These are the per-ton increases in offsite incineration costs at existing commercial MWIs under Control Options 4 and 5.

Net (of commercial incineration) industry-wide annualized control costs are shown in the last two columns of the table.

TABLE 3. CONTROL COSTS FOR EXISTING MWIS (1989 DOLLARS)

Model MWI		Capital C.O.4	Capital C.O.5	Total annualized C.O.4	Total annualized C.O.5
Cont.	36,000	901,267	1,078,373	348,973	484,083
Inter.	21,000	901,267	1,078,373	270,906	424,513
Cont.	24,000	753,211	930,317	219,372	354,482
Inter.	8,400	634,482	811,588	174,288	327,214
Path.	2,000	524,410	701,516	122,862	275,333
Inter.	2,000	515,234	692,340	127,270	279,893
Batch	250	498,364	675,470	120,948	273,948

Abbreviations: Cont. = Continuous, Inter. = Intermittent, Path. = Pathological.

TABLE 7. CALCULATION OF NET INDUSTRY-WIDE ANNUALIZED CONTROL COSTS
--EXISTING MWIs--

	Industry-wide annualized control costs ($ thousand)		Portion of costs passed along to off-site generators	Control costs passed along to offsite generators ($ thous.)	
	C.O.4	C.O.5		C.O.4	C.O.5
Hospitals	461,241	939,566	10%	46,124	93,957
Nursing homes	63,946	140,244	10%	6,395	14,024
Veterinary facilities	67,825	151,693	10%	6,783	15,169
Laboratories					
Commercial research	71,446	147,496	10%	7,145	14,750
Medical/dental	0	0			
Funeral homes	0	0			
Physicians' offices	0	0			
Dentists' offices & clinics	0	0			
Outpatient care	0	0			
Freestanding blood banks	0	0			
Fire & rescue operations	0	0			
Correctional facilities	0	0			
Commercial incineration fac.	52,346	72,612	100%	52,346	72,612
Other	0	0			
Total	716,804	1,451,611		118,792	210,512

TABLE 7. CALCULATION OF NET INDUSTRY-WIDE ANNUALIZED CONTROL COSTS (CONT.)
--EXISTING MWIs--

	Share of the commercial incineration cost pool	Incremental offsite incineration costs ($ thousand)		Net industry-wide annualized control costs ($ thousand)	
		C.0.4	C.0.5	C.0.4	C.0.5
Hospitals	57.87%	68,745	121,823	483,862	967,433
Nursing homes	8.55%	10,157	17,999	67,708	144,218
Veterinary facilities	1.34%	1,592	2,821	62,634	139,345
Laboratories					
Commercial research	2.15%	2,554	4,526	66,855	137,272
Medical/dental	5.23%	6,213	11,010	6,213	11,010
Funeral homes	0.27%	321	568	321	568
Physicians' offices	10.45%	12,414	21,999	12,414	21,999
Dentists' offices & clinics	2.58%	3,065	5,431	3,065	5,431
Outpatient care	7.78%	9,242	16,378	9,242	16,378
Freestanding blood banks	1.47%	1,746	3,095	1,746	3,095
Fire & rescue operations	0.49%	582	1,032	582	1,032
Correctional facilities	0.98%	1,164	2,063	1,164	2,063
Commercial incineration fac.	0.00%	0	0	0	0
Other	0.84%	998	1,768	998	1,768
Total	100.00%	118,792	210,512	716,804	1,451,611

4.2 MARKET PRICE INCREASE

Market price increases under Control Options 4 and 5 are calculated in Table 9. In the Analysis of Economic Impacts for Existing Sources, all market prices under Control Option 4 were considered achievable because they are less than one percent. Under Control Option 5, two (veterinary facilities, commercial research labs) exceed one percent. However, at less than two percent, they are also considered achievable.

4.3 CONSEQUENCES OF THE MARKET PRICE INCREASE

4.3.1 Output Impacts

Table 10 shows the impact of the market price increase on industry-wide output. While all impacts under Control Option 4 are less than -1 percent and were (in the Analysis of Economic Impacts for Existing Sources) considered insignificant, two impacts under Control Option 5 exceed -1 percent: industry-wide output could fall by up to 1.8 percent at veterinary facilities and 1.5 percent at commercial research labs (maximum elasticities). While these impacts are not likely to require industry restructurings, they could be considered significant. However, later, in Section 6.2, it will be seen that these impacts can be avoided by switching to an alternative medical waste treatment and disposal method.

4.3.2 Employment and Revenue Impacts

Table 11 shows that the estimated employment impacts of a loss of 1.8 percent of industry-wide output at veterinary facilities and 1.5 percent of industry-wide output at commercial research labs are -1,914 and -2,091, respectively. They represent, by definition, -1.8 percent and -1.5 percent, respectively, of baseline industry-wide employment. Again, however, it will be seen in Section 6.2 that these impacts can be avoided by substituting. All other employment impacts under Control Option 5 are small in relation to baseline employment.

TABLE 9. NET INDUSTRY-WIDE ANNUALIZED CONTROL COSTS AS A PERCENT OF REVENUE/BUDGET
--Existing MWIs--

Industry	C.O.4	C.O.5
Hospitals	0.216%	0.433%
Nursing homes	0.211%	0.449%
Veterinary facilities	0.844%	1.877%
Laboratories		
Commercial research	0.564%	1.159%
Medical/dental	0.081%	0.144%
Funeral homes	0.003%	0.006%
Physicians' offices	0.013%	0.023%
Dentists' offices & clinics	0.011%	0.020%
Outpatient care	0.062%	0.109%
Freestanding blood banks	0.141%	0.250%
Fire & rescue operations	0.005%	0.008%
Correctional facilities	0.005%	0.009%

TABLE 10. INDUSTRY-WIDE OUTPUT IMPACTS OF THE MARKET PRICE INCREASE
--Existing MWIs--

Industry	Price elasticity of demand		Percent change in output			
			Max. elasticity		Min. elasticity	
	Max.	Min.	C.0.4	C.0.5	C.0.4	C.0.5
Hospitals	-0.33	0.00	-0.071%	-0.142%	0.000%	0.000%
Nursing homes	-0.67	-0.33	-0.141%	-0.300%	-0.069%	-0.148%
Veterinary facilities	-1.00	-0.67	-0.837%	-1.843%	-0.561%	-1.238%
Laboratories						
Commercial research	-1.33	-1.00	-0.746%	-1.521%	-0.561%	-1.145%
Medical/dental	-1.33	-0.67	-0.108%	-0.191%	-0.054%	-0.096%
Funeral homes	-0.33	0.00	-0.001%	-0.002%	0.000%	0.000%
Physicians' offices	-0.33	0.00	-0.004%	-0.008%	0.000%	0.000%
Dentists' offices & clinics	-0.67	-0.33	-0.007%	-0.013%	-0.004%	-0.007%
Outpatient care	-0.33	0.00	-0.020%	-0.036%	0.000%	0.000%
Freestanding blood banks	-0.33	0.00	-0.046%	-0.082%	0.000%	0.000%
Fire & rescue operations	-0.33	0.00	-0.002%	-0.003%	0.000%	0.000%
Correctional facilities	-0.33	0.00	-0.002%	-0.003%	0.000%	0.000%

TABLE 11. INDUSTRY-WIDE EMPLOYMENT IMPACTS OF THE MARKET PRICE INCREASE
--Existing MWIs--

Industry	Price elasticity of demand		Change in employment: Max. elasticity		Change in employment: Min. elasticity	
	Max.	Min.	C.0.4	C.0.5	C.0.4	C.0.5
Hospitals	-0.33	0.00	(2,821)	(5,632)	0	0
Nursing homes	-0.67	-0.33	(1,878)	(3,992)	(925)	(1,968)
Veterinary facilities	-1.00	-0.67	(869)	(1,914)	(583)	(1,287)
Laboratories						
Commercial research	-1.33	-1.00	(1,025)	(2,091)	(772)	(1,575)
Medical/dental	-1.33	-0.67	(143)	(253)	(72)	(127)
Funeral homes	-0.33	0.00	(2)	(3)	0	0
Physicians' offices	-0.33	0.00	(44)	(79)	0	0
Dentists' offices & clinics	-0.67	-0.33	(37)	(65)	(18)	(32)
Outpatient care	-0.33	0.00	(41)	(73)	0	0
Freestanding blood banks	-0.33	0.00	(6)	(11)	0	0
Fire & rescue operations	-0.33	0.00	(5)	(8)	0	0
Correctional facilities	-0.33	0.00	(7)	(12)	0	0

As under Control Option 4, under Control Option 5, industry-wide revenue decreases only for commercial research labs and medical/dental labs in the case of the maximum elasticity (Table 12). The decreases are insignificant in relation to baseline industry-wide revenue.

5.0 PER-FACILITY IMPACTS OF CONTROLS FOR MWI OPERATORS

5.1 PER-FACILITY CONTROL COSTS

Per-MWI control costs were presented in Table 3. Using the scheme developed in the Analysis of Economic Impacts for Existing Sources to link per-MWI control costs to model facilities, per-facility control costs for MWI operators under Control Options 4 and 5 are presented in Tables 13 and 14.

5.2 FACILITY PRICE INCREASE

The facility price increase is calculated for hospitals in Table 15A and for other MWI operators in Table 15B. Under Control Option 5, it becomes even more likely than under Control Option 4 that hospitals with fewer than 100 beds will not be able to achieve the facility price increase. For hospitals with fewer than 50 beds, the average facility price increase under Control Option 5 is 6.88 percent. For hospitals with 50-99 beds, it ranges from 3.03 to 3.08 percent. In general, hospitals with 100 or more beds should still be able to achieve the facility price increase, considering that it averages 1.05 percent, which is less than one percentage point greater than the market price increase (0.433% — see Table 9). As under Control Option 4, there are some subcategories of hospitals with 100 or more beds that are exceptions, however (e.g., t.b. hospitals).

Under Control Option 5, the facility price increase for both subcategories of nursing homes with 100+ employees, veterinary facilities with 10-19 and 20+ employees, and tax-paying commercial research labs with 20-99 employees continues to exceed the market price increase by more than

TABLE 12. INDUSTRY-WIDE REVENUE/BUDGET IMPACTS OF THE MARKET PRICE INCREASE
--Existing MWIs--

Industry	Price elasticity of demand		Change in revenue/budget ($ thousand)			
			Max. elasticity		Min. elasticity	
	Max.	Min.	C.0.4	C.0.5	C.0.4	C.0.5
Hospitals	-0.33	0.00	$324,072	$647,718	$483,862	$967,433
Nursing homes	-0.67	-0.33	$22,328	$47,521	$45,349	$96,555
Veterinary facilities	-1.00	-0.67	($0)	$0	$20,611	$45,697
Laboratories						
Commercial research	-1.33	-1.00	($21,980)	($44,954)	$0	($0)
Medical/dental	-1.33	-0.67	($2,049)	($3,630)	$2,050	$3,631
Funeral homes	-0.33	0.00	$215	$381	$321	$568
Physicians' offices	-0.33	0.00	$8,317	$14,738	$12,414	$21,999
Dentists' offices & clinics	-0.67	-0.33	$1,011	$1,792	$2,053	$3,639
Outpatient care	-0.33	0.00	$6,192	$10,971	$9,242	$16,378
Freestanding blood banks	-0.33	0.00	$1,170	$2,072	$1,746	$3,095
Fire & rescue operations	-0.33	0.00	$390	$691	$582	$1,032
Correctional facilities	-0.33	0.00	$780	$1,382	$1,164	$2,063

TABLE 13. CAPITAL CONTROL COSTS FOR MODEL FACILITIES(1989 DOLLARS)
--EXISTING MWIs--

Industry/subcategory	Intermittent MWI C.O.4	Intermittent MWI C.O.5	Batch MWI C.O.4	Batch MWI C.O.5	Continuous MWI C.O.4	Continuous MWI C.O.5	Pathological MWI C.O.4	Pathological MWI C.O.5
Hospitals								
300+ beds	901,267	1,078,373			753,211	930,317		
100-299 beds	634,482	811,588						
50-99 beds	515,234	692,340					524,410	701,516
<50 beds			498,364	675,470				
Nursing homes	521,391	698,497					524,410	701,516
Veterinary facilities	515,234	692,340					524,410	701,516
Commercial research labs								
Tax-paying								
100+ emp.	901,267	1,078,373			753,211	930,317		
20-99 emp.	515,234	692,340					524,410	701,516
Tax-exempt	634,482	811,588						
Commercial incineration fac.					1,802,534	2,156,746		

TABLE 14. ANNUALIZED CONTROL COSTS FOR MODEL FACILITIES(1989 DOLLARS)
--EXISTING MWIs--

Industry/subcategory	Intermittent MWI		Batch MWI		Continuous MWI		Pathological MWI	
	C.0.4	C.0.5	C.0.4	C.0.5	C.0.4	C.0.5	C.0.4	C.0.5
Hospitals								
300+ beds	270,906	424,513			219,372	354,482		
100-299 beds	174,288	327,214						
50-99 beds	127,270	279,893					122,862	275,333
<50 beds			120,948	273,948				
Nursing homes	129,698	282,335					122,862	275,333
Veterinary facilities	127,270	279,893					122,862	275,333
Commercial research labs								
Tax-paying								
100+ emp.	270,906	424,513			219,372	354,482		
20-99 emp.	127,270	279,893					122,862	275,333
Tax-exempt	174,288	327,214						
Commercial incineration fac.					697,946	968,166		

TABLE 15A. PER-FACILITY ANNUALIZED CONTROL COSTS AS A PERCENT OF REVENUE : HOSPITALS
--EXISTING MWIs--

Industry category	Intermittent MWI C.O.4	Intermittent MWI C.O.5	Batch, continuous, or pathological MWI[a] C.O.4	Batch, continuous, or pathological MWI[a] C.O.5
AHA-registered				
Federal				
Psychiatric	0.54%	0.85%	0.44%	0.71%
Other special & general				
<50 Beds			1.46%	3.30%
50-99 Beds	0.71%	1.56%	0.68%	1.53%
100-299 Beds	0.45%	0.84%		
300+ Beds	0.30%	0.46%	0.24%	0.39%
Non-federal				
Psychiatric				
Not-for-profit	1.13%	2.48%	1.09%	2.44%
For-profit	1.39%	3.06%	1.34%	3.01%
State govt.	0.90%	1.41%	0.73%	1.18%
Local govt.	0.79%	1.23%	0.64%	1.03%
T.B. & other resp. diseases	1.79%	3.36%		
Long-term other special & gen.				
Not-for-profit	1.04%	1.96%		
For-profit	0.97%	2.14%	0.94%	2.10%
State govt.	0.98%	1.84%		
Local govt.	0.94%	1.47%	0.76%	1.23%
Short-term other special & gen.				
Not-for-profit				
<50 Beds			2.81%	6.37%
50-99 Beds	1.28%	2.82%	1.24%	2.77%
100-299 Beds	0.49%	0.91%		
300+ Beds	0.23%	0.36%	0.19%	0.30%
For-profit				
<50 Beds			2.63%	5.97%
50-99 Beds	1.16%	2.55%	1.12%	2.51%
100-299 Beds	0.60%	1.12%		
300+ Beds	0.36%	0.56%	0.29%	0.47%
State govt.				
<50 Beds			3.37%	7.64%
50-99 Beds	1.43%	3.14%	1.38%	3.09%
100-299 Beds	0.49%	0.92%		
300+ Beds	0.16%	0.25%	0.13%	0.21%
Local govt.				
<50 Beds			4.21%	9.54%
50-99 Beds	1.77%	3.90%	1.71%	3.84%
100-299 Beds	0.68%	1.28%		
300+ Beds	0.20%	0.31%	0.16%	0.26%
Non-AHA-registered				
Non-Federal psychiatric	1.99%	4.37%	1.92%	4.30%
Short-term other special & gen.	2.12%	4.66%	2.05%	4.58%
Other	1.44%	2.70%		
Total	0.54%	1.01%		
<50 Beds			3.04%	6.88%
50-99 Beds	1.40%	3.08%	1.35%	3.03%
100-299 Beds	0.56%	1.05%		
300+ Beds	0.26%	0.41%	0.21%	0.34%
Subset:community hosp.				
Urban	0.31%	0.58%		
<50 Beds				
50-99 Beds				
100-299 Beds				
300+ Beds				
Rural	1.29%	2.84%	1.25%	2.80%
<50 Beds				
50-99 Beds				
100-299 Beds				
300+ Beds				

[a] Table 14 indicates which type of MWI -- batch, continuous, or pathological -- is applicable.

TABLE 15B. PER-FACILITY ANNUALIZED CONTROL COSTS AS A PERCENT OF REVENUE/BUDGET : MWI OPERATORS OTHER THAN HOSPITALS

--EXISTING MWIs--

	Intermittent MWI		Batch, continuous, or pathological MWI [a]	
Industry	C.O.4	C.O.5	C.O.4	C.O.5
Nursing homes				
100+ Employees				
Tax-paying	3.71%	8.07%	3.51%	7.87%
Tax-exempt	2.66%	5.80%	2.52%	5.65%
Veterinary facilities				
10-19 Employees	14.01%	30.81%	13.52%	30.31%
20+ Employees	6.47%	14.23%	6.25%	14.00%
Commercial research labs				
Tax-paying				
20-99 Employees	4.54%	10.00%	4.39%	9.83%
100+ Employees	0.89%	1.39%	0.72%	1.16%
Tax-exempt	1.30%	2.43%		
Commercial incineration fac.			34.90%	48.41%

[a] Table 14 indicates which type of MWI -- batch, continuous, or pathological -- is applicable.

one percentage point and therefore may not be achievable. The exceedances are greater than under Control Option 4, indicating that it is even more likely that the facility price increase cannot be achieved. Control Option 5 introduces a new subcategory (i.e., it isn't similarly impacted under Control Option 4) for which the facility price increase exceeds the market price increase by more than one percentage point: tax-exempt commercial research labs (facility price increase = 2.43%, market price increase = 1.159%).

5.3 COST ABSORPTION

Tables 16A and 16B demonstrate that the impact on net income of full control cost absorption is significant for all of the identified cases in which the facility price increase may not be achievable. This includes the new subcategory under Control Option 5: tax-exempt commercial research labs. For this subcategory, net income would decline by 57.92 percent in the absence of a price increase.

5.4 CAPITAL AVAILABILITY

Tables 17A, 17B, 18A, and 18B capture some of the impacts of capital control costs on MWI operators. Table 17A shows that it is even more likely under Control Option 5 than under Control Option 4 that hospitals with fewer than 100 beds will need external financing (the ratio of capital control costs to net income exceeds 100%). While in general this is still not the case for hospitals with 100+ beds (the average ratio under Control Option 5 is 75.89% for hospitals with 100-299 beds, and ranges from 21.29% to 24.68% for hospitals with 300+ beds), there are some subcategories of hospitals with 100+ beds that do have ratios exceeding 100 percent (e.g., t.b. hospitals).

Table 18A shows, in turn, that, in general, only hospitals with fewer than 50 beds may, under both Control Options 4 and 5, have difficulty obtaining financing (the ratio of capital control costs to total liabilities exceeds

TABLE 16A. PER-FACILITY ANNUALIZED CONTROL COSTS AS A PERCENT OF NET INCOME[a]: HOSPITALS
--EXISTING MWIs--

Industry category	Intermittent MWI C.O.4	Intermittent MWI C.O.5	Batch, continuous, or pathological MWI[b] C.O.4	Batch, continuous, or pathological MWI[b] C.O.5
AHA-registered				
Federal				
Psychiatric	15.90%	24.92%	12.88%	20.81%
Other special & general				
<50 Beds			59.45%	134.66%
50-99 Beds	28.96%	63.68%	27.95%	62.64%
100-299 Beds	11.27%	21.16%		
300+ Beds	8.19%	12.84%	6.63%	10.72%
Non-federal				
Psychiatric				
Not-for-profit	33.17%	72.96%	32.03%	71.77%
For-profit	28.66%	63.02%	27.66%	61.99%
State govt.	26.45%	41.45%	21.42%	34.61%
Local govt.	23.11%	36.22%	18.72%	30.24%
T.B. & other resp. diseases	51.12%	95.98%		
Long-term other special & gen.				
Not-for-profit	29.58%	55.54%		
For-profit	25.47%	56.02%	24.59%	55.10%
State govt.	27.86%	52.30%		
Local govt.	26.69%	41.83%	21.61%	34.93%
Short-term other special & gen.				
Not-for-profit				
<50 Beds			116.61%	264.12%
50-99 Beds	53.13%	116.84%	51.29%	114.94%
100-299 Beds	14.58%	27.37%		
300+ Beds	5.37%	8.41%	4.35%	7.02%
For-profit				
<50 Beds			N.M.	N.M.
50-99 Beds	N.M.	N.M.	N.M.	N.M.
100-299 Beds	12.83%	24.09%		
300+ Beds	5.13%	8.04%	4.15%	6.71%
State govt.				
<50 Beds			137.59%	311.65%
50-99 Beds	58.25%	128.10%	56.23%	126.01%
100-299 Beds	12.39%	23.27%		
300+ Beds	4.44%	6.96%	3.60%	5.81%
Local govt.				
<50 Beds			171.99%	389.56%
50-99 Beds	72.39%	159.20%	69.88%	156.61%
100-299 Beds	17.30%	32.48%		
300+ Beds	5.53%	8.67%	4.48%	7.24%
Non-AHA-registered				
Non-Federal psychiatric	58.49%	128.63%	56.46%	126.53%
Short-term other special & gen.	61.59%	135.46%	59.46%	133.25%
Other	41.81%	78.50%		
Total	15.58%	29.25%		
<50 Beds			145.28%	329.07%
50-99 Beds	66.99%	147.33%	64.67%	144.93%
100-299 Beds	16.30%	30.60%		
300+ Beds	6.20%	9.71%	5.02%	8.11%
Subset:community hosp.				
Urban	9.14%	17.16%		
<50 Beds				
50-99 Beds				
100-299 Beds				
300+ Beds				
Rural	36.61%	80.52%	35.34%	79.20%
<50 Beds				
50-99 Beds				
100-299 Beds				
300+ Beds				

[a] Divisor is before-tax net income except for T.B. hospitals, hospitals not registered with the AHA, "Total" (and subcatgories), and community hospitals, for which only after-tax net income is available.

[b] Table 14 indicates which type of MWI -- batch, continuous, or pathological -- is applicable.

N.M. Not meaningful.

TABLE 16B. PER-FACILITY ANNUALIZED CONTROL COSTS AS A PERCENT OF BEFORE-TAX NET INCOME : MWI OPERATORS OTHER THAN HOSPITALS

--EXISTING MWIs--

Industry	Intermittent MWI C.O.4	Intermittent MWI C.O.5	Batch, continuous, or pathological MWI[a] C.O.4	Batch, continuous, or pathological MWI[a] C.O.5
Nursing homes				
100+ employees				
Tax-paying	92.68%	201.75%	87.79%	196.75%
Tax-exempt	95.08%	206.97%	90.07%	201.84%
Veterinary facilities				
10-19 Employees	36.39%	80.03%	35.13%	78.72%
20+ Employees	16.81%	36.97%	16.23%	36.37%
Commercial research labs				
Tax-paying				
20-99 Employees	75.75%	166.59%	73.12%	163.87%
100+ Employees	14.81%	23.21%	11.99%	19.38%
Tax-exempt	30.85%	57.92%		
Commercial incineration fac.			N/A	N/A

[a] Table 14 indicates which type of MWI -- batch, continuous, or pathological -- is applicable.

N/A Not available.

TABLE 17A. PER-FACILITY CAPITAL CONTROL COSTS AS A PERCENT OF NET INCOME[a] : HOSPITALS
--EXISTING MWIs--

Industry category	Intermittent MWI C.O.4	Intermittent MWI C.O.5	Batch, continuous, or pathological MWI[b] C.O.4	Batch, continuous, or pathological MWI[b] C.O.5
AHA-registered				
Federal				
Psychiatric	52.91%	63.30%	44.21%	54.61%
Other special & general				
<50 Beds			244.98%	332.03%
50-99 Beds	117.23%	157.52%	119.31%	159.61%
100-299 Beds	41.03%	52.49%		
300+ Beds	27.25%	32.61%	22.78%	28.13%
Non-federal				
Psychiatric				
Not-for-profit	134.30%	180.46%	136.69%	182.86%
For-profit	116.01%	155.88%	118.07%	157.95%
State govt.	88.00%	105.29%	73.54%	90.83%
Local govt.	76.90%	92.01%	64.26%	79.38%
T.B. & other resp. diseases	186.10%	238.05%		
Long-term other special & gen.				
Not-for-profit	107.70%	137.76%		
For-profit	103.12%	138.56%	104.95%	140.40%
State govt.	101.41%	129.71%		
Local govt.	88.80%	106.25%	74.21%	91.66%
Short-term other special & gen.				
Not-for-profit				
<50 Beds			480.49%	651.25%
50-99 Beds	215.09%	289.03%	218.92%	292.86%
100-299 Beds	53.08%	67.90%		
300+ Beds	17.86%	21.37%	14.93%	18.44%
For-profit				
<50 Beds			N.M.	N.M.
50-99 Beds	N.M.	N.M.	N.M.	N.M.
100-299 Beds	46.71%	59.74%		
300+ Beds	17.07%	20.42%	14.27%	17.62%
State govt.				
<50 Beds			566.94%	768.42%
50-99 Beds	235.80%	316.86%	240.00%	321.06%
100-299 Beds	45.11%	57.70%		
300+ Beds	14.78%	17.69%	12.35%	15.26%
Local govt.				
<50 Beds			708.68%	960.53%
50-99 Beds	293.07%	393.81%	298.29%	399.03%
100-299 Beds	62.97%	80.55%		
300+ Beds	18.41%	22.03%	15.39%	19.01%
Non-AHA-registered				
Non-Federal psychiatric	236.78%	318.17%	241.00%	322.39%
Short-term other special & gen.	249.35%	335.07%	253.79%	339.51%
Other	152.22%	194.71%		
Total	56.72%	72.55%		
<50 Beds			598.64%	811.38%
50-99 Beds	271.20%	364.43%	276.03%	369.26%
100-299 Beds	59.33%	75.89%		
300+ Beds	20.62%	24.68%	17.24%	21.29%
Subset:community hosp.				
Urban	33.28%	42.57%		
<50 Beds				
50-99 Beds				
100-299 Beds				
300+ Beds				
Rural	148.22%	199.17%	150.86%	201.80%
<50 Beds				
50-99 Beds				
100-299 Beds				
300+ Beds				

[a] Divisor is before-tax net income except for T.B. hospitals, hospitals not registered with the AHA, "Total" (and subcatgories), and community hospitals, for which only after-tax net income is available.

[b] Table 13 indicates which type of MWI -- batch, continuous, or pathological -- is applicable.

N.M. Not meaningful.

TABLE 17B. PER-FACILITY CAPITAL CONTROL COSTS AS A PERCENT OF BEFORE-TAX NET INCOME : MWI OPERATORS OTHER THAN HOSPITALS

--EXISTING MWIs--

Industry	Intermittent MWI C.O.4	Intermittent MWI C.O.5	Batch, continuous, or pathological MWI[a] C.O.4	Batch, continuous, or pathological MWI[a] C.O.5
Nursing homes				
100+ employees				
Tax-paying	372.57%	499.13%	374.73%	501.28%
Tax-exempt	382.22%	512.06%	384.44%	514.27%
Veterinary facilities				
10-19 Employees	147.31%	197.95%	149.94%	200.58%
20+ Employees	68.06%	91.46%	69.27%	92.67%
Commercial research labs				
Tax-paying				
20-99 Employees	306.65%	412.06%	312.12%	417.52%
100+ Employees	49.27%	58.95%	41.18%	50.86%
Tax-exempt	112.32%	143.67%		
Commercial incineration fac.			N/A	N/A

[a] Table 13 indicates which type of MWI -- batch, continuous, or pathological -- is applicable.

N/A Not available.

TABLE 18A. PER-FACILITY CAPITAL CONTROL COSTS AS A PERCENT OF TOTAL LIABILITIES : HOSPITALS
--EXISTING MWIs--

	Intermittent MWI		Batch, continuous, or pathological MWI [a]	
Industry category	C.O.4	C.O.5	C.O.4	C.O.5
AHA-registered				
Federal				
Psychiatric	3.85%	4.60%	3.21%	3.97%
Other special & general				
<50 Beds			12.97%	17.57%
50-99 Beds	6.20%	8.34%	6.32%	8.45%
100-299 Beds	3.50%	4.48%		
300+ Beds	2.13%	2.54%	1.78%	2.19%
Non-federal				
Psychiatric				
Not-for-profit	9.76%	13.12%	9.94%	13.29%
For-profit	12.05%	16.19%	12.26%	16.40%
State govt.	6.40%	7.65%	5.35%	6.60%
Local govt.	5.59%	6.69%	4.67%	5.77%
T.B. & other resp. diseases	14.47%	18.50%		
Long-term other special & gen.				
Not-for-profit	8.21%	10.51%		
For-profit	8.50%	11.42%	8.65%	11.57%
State govt.	7.69%	9.84%		
Local govt.	6.73%	8.06%	5.63%	6.95%
Short-term other special & gen.				
Not-for-profit				
<50 Beds			25.02%	33.91%
50-99 Beds	11.20%	15.05%	11.40%	15.25%
100-299 Beds	3.82%	4.88%		
300+ Beds	1.67%	2.00%	1.40%	1.72%
For-profit				
<50 Beds			23.45%	31.78%
50-99 Beds	10.14%	13.62%	10.32%	13.80%
100-299 Beds	4.68%	5.99%		
300+ Beds	2.58%	3.08%	2.15%	2.66%
State govt.				
<50 Beds			30.01%	40.67%
50-99 Beds	12.48%	16.77%	12.70%	16.99%
100-299 Beds	3.85%	4.92%		
300+ Beds	1.15%	1.38%	0.96%	1.19%
Local govt.				
<50 Beds			37.51%	50.84%
50-99 Beds	15.51%	20.84%	15.79%	21.12%
100-299 Beds	5.37%	6.87%		
300+ Beds	1.44%	1.72%	1.20%	1.48%
Non-AHA-registered				
Non-Federal psychiatric	17.21%	23.13%	17.52%	23.43%
Short-term other special & gen.	18.53%	24.90%	18.86%	25.23%
Other	11.31%	14.47%		
Total	4.22%	5.39%		
<50 Beds			27.03%	36.64%
50-99 Beds	12.25%	16.45%	12.46%	16.67%
100-299 Beds	4.38%	5.61%		
300+ Beds	1.89%	2.26%	1.58%	1.95%
Subset:community hosp.				
Urban	2.43%	3.11%		
<50 Beds				
50-99 Beds				
100-299 Beds				
300+ Beds				
Rural	11.30%	15.19%	11.50%	15.39%
<50 Beds				
50-99 Beds				
100-299 Beds				
300+ Beds				

[a] Table 13 indicates which type of MWI -- batch, continuous, or pathological -- is applicable.

TABLE 18B. PER-FACILITY CAPITAL CONTROL COSTS AS A PERCENT OF TOTAL LIABILITIES :
MWI OPERATORS OTHER THAN HOSPITALS
--EXISTING MWIs--

Industry	Intermittent MWI C.O.4	Intermittent MWI C.O.5	Batch, continuous, or pathological MWI[a] C.O.4	Batch, continuous, or pathological MWI[a] C.O.5
Nursing homes				
100+ employees				
Tax-paying	35.36%	47.37%	35.57%	47.58%
Tax-exempt	25.40%	34.02%	25.54%	34.17%
Veterinary facilities				
10-19 Employees	363.32%	488.21%	369.79%	494.68%
20+ Employees	167.86%	225.56%	170.85%	228.55%
Commercial research labs				
Tax-paying				
20-99 Employees	79.69%	107.08%	81.11%	108.50%
100+ Employees	12.80%	15.32%	10.70%	13.22%
Tax-exempt	20.43%	26.13%		
Commercial incineration fac.			N/A	N/A

[a] Table 13 indicates which type of MWI -- batch, continuous, or pathological -- is applicable.

N/A Not available.

20%). However, three subcategories of hospitals with 50-99 beds also have ratios over 20 percent under Control Option 5: local government hospitals, non-Federal psychiatric hospitals not registered with the AHA, and short-term other special and general hospitals not registered with the AHA. So, some hospitals with 50-99 beds may have difficulty obtaining financing.

Table 17B shows that, as under Control Option 4, nursing homes with 100+ employees, veterinary facilities with 10-19 employees, tax-paying commercial research labs with 20-99 employees, and tax-exempt commercial research labs may require external financing under Control Option 5 (and the likelihood of requiring it is greater than under Control Option 4).

Table 18B shows, in turn, that in all of these cases under Control Option 5, external financing may be difficult to obtain (because the ratio of capital control costs to total liabilities exceeds 20%). This includes tax-exempt commercial research labs, which were deemed to be able to obtain external financing under Control Option 4 despite a ratio of 20.43 percent because the facility price increase is achievable. Under Control Option 5, however, the facility price increase is not achievable (see Section 5.2).

6.0 SUBSTITUTION

In the Analysis of Economic Impacts for Existing Sources, it was seen that there is a cost-saving alternative (either offsite contract disposal or onsite autoclaving) to onsite incineration for two model MWIs in the baseline and under Control Option 1, three model MWIs under Control Option 2, five model MWIs under Control Option 3, and all six model MWIs (excluding the Continuous 36,000, which by definition, as a commercial MWI, is an alternative to onsite incineration) under Control Option 4.

Let's look at this in another way. Nationwide capacity of these six model MWIs is 1,168,151 tons per year. Of this, the Intermittent 21,000 accounts for 16.6 percent, the Continuous 24,000 for 14.8 percent, the Intermittent 8,400 for 29.0 percent, the Pathological 2,000 for 18.7 percent, the Intermittent 2,000 for 20.1 percent, and the Batch 250 for 0.8 percent. Meanwhile, the Intermittent 21,000 has a cheaper alternative beginning under Control Option 2, the Continuous 24,000 beginning in the baseline, the Intermittent 8,400 beginning under Control Option 3, the Pathological 2,000 beginning under Control Option 4, the Intermittent 2,000 beginning under Control Option 3, and the Batch 250 beginning in the baseline. Therefore, based only on estimated average costs (other factors would also have to be considered), 15.6 percent of nationwide onsite MWI capacity would substitute in the baseline and under Control Option 1, 32.2 percent would substitute under Control Option 2, 81.3 percent would substitute under Control Option 3, and 100 percent would substitute under Control Option 4.

Table 19D confirms that there is a cheaper alternative to onsite incineration for all six model MWIs under Control Option 4. Table 19E shows that the same is true under Control Option 5. In fact, the cost advantage of one or the other alternative over onsite incineration is greater for all six model MWIs under Control Option 5, indicating that substitution is even more likely to occur than under Control Option 4. Based solely on estimated average costs, 100 percent of nationwide onsite MWI capacity would substitute under Control Option 5, as under Control Option 4.

The offsite contract disposal cost under Control Option 5, $859/ton, reflects an increase of $259/ton over the estimated baseline of $600/ton. This is calculated as a weighted (by commercial incineration capacity) average of $300/ton for the average incremental cost impact of the Emission Guidelines on the commercial incineration capacity of existing sources (see Section 4.1) and $167/ton for the average incremental cost impact of the NSPS on the

TABLE 19D. COMPARATIVE ANNUAL PER-TON COSTS OF ONSITE MEDICAL WASTE INCINERATION AND ALTERNATIVE TREATMENT METHODS: BASELINE AND CONTROL OPTION 4

--EXISTING MWIs--

Model MWI		Capacity (tons/yr)	Baseline: Onsite incin-eration	Baseline: Offsite contract disposal	Baseline: Onsite auto-claving	Control Option 4: Onsite incin-eration	Control Option 4: Offsite contract disposal[a]	Control Option 4: Onsite auto-claving
Inter.	21,000	1,176	$ 92	$600	$ 134	$ 322	$749	$ 134
Cont.	24,000	977	165	600	160	390	749	160
Inter.	8,400	470	166	600	228	537	749	228
Path.	2,000	172	313	600	N.A.	1,027	749	N.A.
Inter.	2,000	115	430	600	570	1,537	749	570
Batch	250	27	1,137	600	2,080	5,617	749	2,080

[a]Assumes the same control stringency for new MWIs under the NSPS as for existing MWIs under the Emission Guidelines. The methodology recognizes that the cost of offsite incineration will be influenced by both the Emission Guidelines and the NSPS.

N.A. Not applicable.

Abbreviations: Cont. = Continuous, Inter. = Intermittent, Path. = Pathological.

TABLE 19E. COMPARATIVE ANNUAL PER-TON COSTS OF ONSITE MEDICAL WASTE INCINERATION AND ALTERNATIVE TREATMENT METHODS: BASELINE AND CONTROL OPTION 5

--EXISTING MWIs--

Model MWI		Capacity (tons/yr)	Baseline			Control Option 5		
			Onsite incin-eration	Offsite contract disposal	Onsite auto-claving	Onsite incin-eration	Offsite contract disposal[a]	Onsite auto-claving
Inter.	21,000	1,176	$ 92	$600	$ 134	$ 453	$859	$ 134
Cont.	24,000	977	165	600	160	528	859	160
Inter.	8,400	470	166	600	228	862	859	228
Path.	2,000	172	313	600	N.A.	1,914	859	N.A.
Inter.	2,000	115	430	600	570	2,864	859	570
Batch	250	27	1,137	600	2,080	11,283	859	2,080

[a]Assumes the same control stringency for new MWIs under the NSPS as for existing MWIs under the Emission Guidelines. The methodology recognizes that the cost of offsite incineration will be influenced by both the Emission Guidelines and the NSPS.

N.A. Not applicable.

Abbreviations: Cont. = Continuous, Inter. = Intermittent, Path. = Pathological.

commercial incineration capacity of new sources (see Section 4.1 of the Addendum to the Analysis of Economic Impacts for New Sources), assuming the same control stringency for the NSPS as for the Emission Guidelines.

6.1 PER-FACILITY IMPACTS OF SUBSTITUTION

In addition to being cost-saving in some cases, substitution will also be necessary in order to stay in business if control costs are prohibitive. The Analysis of Economic Impacts for Existing Sources identified the following cases under Control Option 4 in which substitution may be necessary because annualized control costs may not be recoverable with a price increase, and the resulting impact on earnings may not be sustainable and/or capital to finance the up-front investment may not be available:

1) Hospitals with fewer than 50 beds
2) Hospitals with 50-99 beds
3) Several subcategories of hospitals with 100+ beds
4) Nursing homes with 100+ beds
5) Veterinary facilities with 10-19 employees
6) Veterinary facilities with 20+ employees
7) Tax-paying commercial research labs with 20-99 employees

In Sections 5.2 through 5.4 it was seen that these same cases apply under Control Option 5, with the addition of an eighth case: tax-exempt commercial research labs.

The question is: Is substitution economically feasible in these cases? Table 21 presents the incremental annual costs of substitution (unlike Table 21 in the Analysis of Economic Impacts for Existing Sources, the current Table 21 includes tax-exempt commercial research labs). The price increase necessary to recover incremental substitution costs is calculated in Table 22, and the impact on net income if no price increase is achieved is calculated in Table 23.

TABLE 21. INPUTS FOR PER-FACILITY SUBSTITUTION ANALYSIS
--EXISTING MWIs--

			Incremental annual cost of switching to:			
			Onsite	Offsite contract disposal		
Industry/Model MWI	Revenue ($ mil.)	Net income[a]	auto-claving	Baseline	C.O.4	C.O.5
Hospitals						
<50 Beds	4.0	$83,250				
Batch 250			25,461	(14,499)	(10,476)	(7,506)
50-99 Beds	9.1	$189,981				
Inter. 2,000			16,100	19,550	36,685	49,335
Path. 2,000			N.A.	49,364	74,992	93,912
100-299 Beds						
T.B. & other resp. diseases	9.7	$340,933				
Inter. 8,400			29,140	203,980	274,010	325,710
Long-term, not-for-profit	16.7	$589,126				
Inter. 8,400			29,140	203,980	274,010	325,710
Non-AHA-registered, other	12.1	$416,819				
Inter. 8,400			29,140	203,980	274,010	325,710
Nursing homes						
100+ Employees						
Tax-paying	3.5	$139,944				
Inter. 8,400			29,140	203,980	274,010	325,710
Inter. 2,000			16,100	19,550	36,685	49,335
Path. 2,000			N.A.	49,364	74,992	93,912
Tax-exempt	4.9	$136,410				
Inter. 8,400			29,140	203,980	274,010	325,710
Inter. 2,000			16,100	19,550	36,685	49,335
Path. 2,000			N.A.	49,364	74,992	93,912
Veterinary facilities						
10-19 Employees	0.9	$349,750				
Inter. 2,000			16,100	19,550	36,685	49,335
Path. 2,000			N.A.	49,364	74,992	93,912
20+ Employees	2.0	$757,011				
Inter. 2,000			16,100	19,550	36,685	49,335
Path. 2,000			N.A.	49,364	74,992	93,912
Commercial research labs						
Tax-paying						
20-99 Employees	2.8	$168,018				
Inter. 2,000			16,100	19,550	36,685	49,335
Path. 2,000			N.A.	49,364	74,992	93,912
Tax-exempt	13.5	$564,900				
Inter. 8,400			29,140	203,980	274,010	325,710

a
After-tax net income for hospitals(because before-tax net income is not available in all cases), before-tax net income for all else.

N.A. Not applicable.

Abbreviations: Inter.=Intermittent, Path.=Pathological.

TABLE 22. PER-FACILITY ANNUALIZED SUBSTITUTION COSTS AS A PERCENT OF REVENUE (ONLY FOR CASES IN WHICH SUBSTITUTION IS NECESSARY) --EXISTING MWIs--

Industry/Model MWI	Control Option 4: Onsite auto-claving	Control Option 4: Offsite contract disposal	Control Option 5: Onsite auto-claving	Control Option 5: Offsite contract disposal
Hospitals				
<50 Beds				
Batch 250	0.64%	-0.26%	0.64%	-0.19%
50-99 Beds				
Inter. 2,000	0.18%	0.40%	0.18%	0.54%
Path. 2,000	N.A.	0.82%	N.A.	1.03%
100-299 Beds				
T.B. & other resp. diseases				
Inter. 8,400	0.30%	2.82%	0.30%	3.36%
Long-term, not-for-profit				
Inter. 8,400	0.17%	1.64%	0.17%	1.95%
Non-AHA-registered, other				
Inter. 8,400	0.24%	2.26%	0.24%	2.69%
Nursing homes				
100+ Employees				
Tax-paying				
Inter. 8,400	0.83%	7.83%	0.83%	9.31%
Inter. 2,000	0.46%	1.05%	0.46%	1.41%
Path. 2,000	N.A.	2.14%	N.A.	2.68%
Tax-exempt				
Inter. 8,400	0.59%	5.59%	0.59%	6.65%
Inter. 2,000	0.33%	0.75%	0.33%	1.01%
Path. 2,000	N.A.	1.53%	N.A.	1.92%
Veterinary facilities				
10-19 Employees				
Inter. 2,000	1.79%	4.08%	1.79%	5.48%
Path. 2,000	N.A.	8.33%	N.A.	10.43%
20+ Employees				
Inter. 2,000	0.81%	1.83%	0.81%	2.47%
Path. 2,000	N.A.	3.75%	N.A.	4.70%
Commercial research labs				
Tax-paying				
20-99 Employees				
Inter. 2,000	0.58%	1.31%	0.58%	1.76%
Path. 2,000	N.A.	2.68%	N.A.	3.35%
Tax-exempt				
Inter. 8,400			0.22%	2.41%

N.A. Not applicable.

Abbreviations: Inter.=Intermittent, Path.=Pathological.

TABLE 23. PER-FACILITY ANNUALIZED SUBSTITUTION COSTS AS A PERCENT OF NET INCOME
(ONLY FOR CASES IN WHICH SUBSTITUTION IS NECESSARY)
--EXISTING MWIs--

Industry/Model MWI	Control Option 4: Onsite auto-claving	Control Option 4: Offsite contract disposal	Control Option 5: Onsite auto-claving	Control Option 5: Offsite contract disposal
Hospitals				
<50 Beds				
Batch 250	30.58%	-12.58%	30.58%	-9.02%
50-99 Beds				
Inter. 2,000	8.47%	19.31%	8.47%	25.97%
Path. 2,000	N.A.	39.47%	N.A.	49.43%
100-299 Beds				
T.B. & other resp. diseases				
Inter. 8,400	8.55%	80.37%	8.55%	95.53%
Long-term, not-for-profit				
Inter. 8,400	4.95%	46.51%	4.95%	55.29%
Non-AHA-registered, other				
Inter. 8,400	6.99%	65.74%	6.99%	78.14%
Nursing homes				
100+ Employees				
Tax-paying				
Inter. 8,400	20.82%	195.80%	20.82%	232.74%
Inter. 2,000	11.50%	26.21%	11.50%	35.25%
Path. 2,000	N.A.	53.59%	N.A.	67.11%
Tax-exempt				
Inter. 8,400	21.36%	200.87%	21.36%	238.77%
Inter. 2,000	11.80%	26.89%	11.80%	36.17%
Path. 2,000	N.A.	54.98%	N.A.	68.85%
Veterinary facilities				
10-19 Employees				
Inter. 2,000	4.60%	10.49%	4.60%	14.11%
Path. 2,000	N.A.	21.44%	N.A.	26.85%
20+ Employees				
Inter. 2,000	2.13%	4.85%	2.13%	6.52%
Path. 2,000	N.A.	9.91%	N.A.	12.41%
Commercial research labs				
Tax-paying				
20-99 Employees				
Inter. 2,000	9.58%	21.83%	9.58%	29.36%
Path. 2,000	N.A.	44.63%	N.A.	55.89%
Tax-exempt				
Inter. 8,400			5.16%	57.66%

a After-tax net income for hospitals(because before-tax net income is not available in all cases), before-tax net income for all else.

N.A. Not applicable.

Abbreviations: Inter.=Intermittent, Path.=Pathological.

In Table 22, the cases under Control Option 5 in which it may not be possible to recover substitution costs with a price increase are the same as under Control Option 4 (nursing homes with 100+ employees switching from the Pathological 2,000 to offsite contract disposal, veterinary facilities with 10-19 employees switching from the Intermittent 2,000 to onsite autoclaving and from the Pathological 2,000 to offsite contract disposal, veterinary facilities with 20+ employees switching from the Pathological 2,000 to offsite contract disposal, and tax-paying commercial research labs with 20-99 employees switching from the Pathological 2,000 to offsite contract disposal). The price increase for hospitals with 50-99 beds switching from the Pathological 2,000 to offsite contract disposal now also exceeds one percent (it is 1.03%), but it should be achievable because it does not greatly exceed the market price increase (0.433%).

Table 23 shows, in turn, that net income would decline significantly — i.e., by 10 percent or more — in the absence of a price increase in the same cases under Control Option 5 as under Control Option 4 (and under Control Option 3, as well): nursing homes with 100+ employees, veterinary facilities with 10-19 employees, and tax-paying commercial research labs with 20-99 employees, all switching from the Pathological 2,000 to offsite contract disposal. In addition, there is one new case under Control Option 5 in which net income would decline by more than 10 percent if no price increase is achieved: veterinary facilities with 20+ employees switching from the Pathological 2,000 to offsite contract disposal. Like the cases common to Control Options 3, 4, and 5, this case involves the Pathological 2,000, representative of "pathological waste generators" (i.e., facilities that generate a substantial proportion and/or quantity of pathological waste). As under Control Options 3 and 4, the significant substitution impacts under Control

Option 5 do not in general imply closure. In general, it should be possible to absorb substitution costs without compromising competitive position. This is consistent with the fact that in each of the affected industries, the great majority of facilities already utilize an alternative to onsite incineration (97.1% of all nursing homes, 97.4% of all veterinary facilities, a minimum of 86.9% of all commercial research labs). However, as under Control Option 4, there may be a few facilities that, as exceptions, would not be able to absorb substitution costs (and therefore would have to close). The exceptions will require the particular conditions in individual market segments as explained in Section 3.5.5 of the Analysis of Economic Impacts for Existing Sources. The number of exceptions is sure to be higher under Control Option 5 than under the less-stringent Control Option 4.

6.2 INDUSTRY-WIDE IMPACTS OF SUBSTITUTION

It remains to follow up on the findings in Sections 4.3.1 and 4.3.2 that the impacts under Control Option 5 on industry-wide output and employment for veterinary facilities and commercial research labs could be considered significant. Substitution would avoid significant impacts. The industry-wide annual cost under Control Option 5 for veterinary facilities to switch from 493 Pathological 2,000s to offsite contract disposal and from 57 Intermittent 2,000s to onsite autoclaving would be $47.2 million. In comparison, net industry-wide annualized control costs under Control Option 5 are $139.3 million (see Table 7). The market price increase to recover substitution costs is only 0.64 percent, compared to 1.877 percent for controls. The impacts of substitution costs on industry-wide output and employment are, in turn, also not significant (less than a 1% decline).

Substitution also renders insignificant the industry-wide impacts on commercial research labs under Control

Option 5. The industry-wide annual cost under Control Option 5 of switching from 23 Intermittent 21,000s to onsite autoclaving, from 16 Continuous 24,000s to onsite autoclaving, from 83 Intermittent 8,400s to onsite autoclaving, from 197 Pathological 2,000s to offsite contract disposal, and from 181 Intermittent 2,000s to onsite autoclaving would be $24.9 million. This compares to $137.3 million for net industry-wide annualized control costs. The market price increase to recover substitution costs is only 0.21 percent, compared to 1.159 percent for controls. As a result, industry-wide output and employment impacts are not significant (less than a 1% decline).

7.0 PER-FACILITY IMPACTS FOR OFFSITE GENERATORS

Incremental annual costs for offsite generators in industry categories and subcategories defined to consist exclusively of offsite generators are presented in Table 24. As explained in Section 6.0, the incremental annual cost per ton under Control Option 5 is $259.

The facility price increase is calculated in Table 25. All facility price increases are less than one percent and none deviate significantly from the market price increase. Therefore, all facility price increases are considered achievable. Since they are achievable, the impact of full-cost absorption, measured in Table 26, will not come to pass.

8.0 IMPACTS ON TAXPAYERS

Per-capita impacts of annual control costs to public facilities are shown in Table 27. For the average-sized township (population 3,119) with jurisdiction over a hospital (or any other type of medical waste generator) operating an Intermittent 8,400, the per-capita annual control cost rises from $55.88 under Control Option 4 to $104.91 under Control Option 5. However, these per-capita impacts can be greatly reduced by switching to onsite autoclaving. In addition, it is not clear that an

TABLE 24. ESTIMATED INCREMENTAL ANNUAL COSTS FOR FACILITIES THAT SEND ALL OF THEIR MEDICAL WASTE OFFSITE TO BE INCINERATED
--EXISTING MWIs--

	Medical waste generated annually (tons)	Share of industry employment	Estimated share of industry medical waste(tons)	No. of facilities	Medical waste per facility (tons)	Incremental annual cost per facility[a] C.O.4	C.O.5
Nursing homes	198,000						
0-19 Employees							
Tax-paying		1.09%	2,158	2,099	1.03	$153	$266
Tax-exempt		0.61%	1,208	1,017	1.19	$177	$308
20-99 Employees							
Tax-paying		32.42%	64,192	7,673	8.37	$1,247	$2,167
Tax-exempt		7.32%	14,494	1,677	8.64	$1,288	$2,238
Physicians' offices	235,000	100.00%	235,000	191,278	1.23	$183	$318
Dentists' offices & clinics	58,000						
Offices		99.88%	57,350	103,665	0.55	$82	$143
Clinics							
Tax-paying		0.94%	545	486	1.12	$167	$291
Tax-exempt		0.18%	104	62	1.68	$251	$436
Outpatient care (clinics)	175,000						
Physicians' clinics (amb. care)							
Tax-paying		49.77%	87,098	4,224	20.62	$3,072	$5,340
Tax-exempt		41.92%	73,360	2,295	31.97	$4,763	$8,279
Freestanding kidney dial. fac.							
Tax-paying		6.48%	11,340	711	15.95	$2,376	$4,131
Tax-exempt		1.84%	3,220	128	25.16	$3,748	$6,515
Freestanding blood banks	33,000	100.00%	33,000	218	151.38	$22,555	$39,206
Veterinary facilities	31,000						
0-9 employees		51.13%	15,850	18,317	0.87	$129	$224
Laboratories							
Commercial research	55,500						
Tax-paying							
0-19 Employees		9.29%	5,156	2,777	1.86	$277	$481
Other	117,500						
Medical		69.21%	81,322	6,871	11.84	$1,763	$3,065
Dental		30.79%	36,178	7,970	4.54	$676	$1,176
Funeral homes	6,000	100.00%	6,000	22,000	0.27	$41	$71
Fire & rescue	11,000	100.00%	11,000	29,840	0.37	$55	$95
Corrections	22,000						
Federal govt.		3.06%	673	47	14.32	$2,134	$3,710
State govt.		62.17%	13,677	903	15.15	$2,257	$3,923
Local govt.		34.76%	7,647	3,338	2.29	$341	$593

[a] Based on $149/ton under Control Option 4, $259/ton under Control Option 5.

TABLE 25. PER-FACILITY ANNUALIZED CONTROL COSTS AS A PERCENT OF REVENUE/BUDGET: OFFSITE GENERATORS
--EXISTING MWIs--

Industry	C.O.4	C.O.5
Nursing homes		
0-19 Employees		
Tax-paying	0.081%	0.140%
Tax-exempt	0.074%	0.129%
20-99 Employees		
Tax-paying	0.099%	0.172%
Tax-exempt	0.099%	0.172%
Physicians' offices	0.037%	0.064%
Dentists' offices & clinics		
Offices	0.032%	0.055%
Clinics		
Tax-paying	0.031%	0.054%
Tax-exempt	0.016%	0.028%
Outpatient care (clinics)		
Physicians' clinics(amb. care)		
Tax-paying	0.172%	0.298%
Tax-exempt	0.174%	0.303%
Freestanding kidney dial. fac.		
Tax-paying	0.180%	0.313%
Tax-exempt	0.210%	0.365%
Freestanding blood banks	0.397%	0.690%
Veterinary facilities		
0-9 Employees	0.060%	0.105%
Laboratories		
Commercial research		
Tax-paying		
0-19 Employees	0.077%	0.134%
Other		
Medical	0.205%	0.356%
Dental	0.313%	0.544%
Funeral homes	0.009%	0.016%
Fire & rescue	0.013%	0.023%
Corrections		
Federal govt.	0.008%	0.014%
State govt.	0.013%	0.023%
Local govt.	0.015%	0.026%

TABLE 26. PER-FACILITY ANNUALIZED CONTROL COSTS AS A PERCENT OF BEFORE-TAX NET INCOME : OFFSITE GENERATORS
--EXISTING MWIs--

Industry	C.O.4	C.O.5
Nursing homes		
0-19 Employees		
Tax-paying	2.019%	3.510%
Tax-exempt	2.658%	4.620%
20-99 Employees		
Tax-paying	2.473%	4.299%
Tax-exempt	3.530%	6.137%
Physicians' offices	0.081%	0.140%
Dentists' offices & clinics		
Offices	0.092%	0.161%
Clinics		
Tax-paying	0.097%	0.169%
Tax-exempt	N/A	N/A
Outpatient care (clinics)		
Physicians' clinics(amb. care)		
Tax-paying	4.291%	7.459%
Tax-exempt	6.216%	10.805%
Freestanding kidney dial. fac.		
Tax-paying	1.683%	2.926%
Tax-exempt	2.799%	4.866%
Freestanding blood banks	N/A	N/A
Veterinary facilities		
0-9 Employees	0.157%	0.273%
Laboratories		
Commercial research		
Tax-paying		
0-19 Employees	1.289%	2.241%
Other		
Medical	2.312%	4.018%
Dental	3.479%	6.048%
Funeral homes	0.079%	0.137%
Fire & rescue	N/A	N/A
Corrections		
Federal govt.	N/A	N/A
State govt.	N/A	N/A
Local govt.	N/A	N/A

N/A Not available.

TABLE 27. PER-CAPITA IMPACTS OF ANNUAL COSTS TO PUBLIC FACILITIES
--Existing MWIs--

Industry/ government unit	Number of facilities	Annual cost per facility (intermittent MWI for hospitals; all else offsite contract disposal) C.O.4	C.O.5	No. of govt. units, 1986	Average population per govt. unit, 1986	Per-capita cost of per-facility annual cost C.O.4	C.O.5
Hospitals							
Federal	N/A (a)	$174,288	$327,214	1	241,625,000	$0.00	$0.00
State	N/A (b)	$270,906	$424,513	50	4,832,500	$0.06	$0.09
Local	N/A (c)	$174,288	$327,214				
County				3,042	71,465	$2.44	$4.58
Municipal				19,200	7,805	$22.33	$41.92
Township				16,691	3,119	$55.88	$104.91
Special district				783	N/A	N/A	N/A
Fire and rescue	29,840 (d)	$55	$95				
County				3,042	71,465	$0.00	$0.00
Municipal				19,200	7,805	$0.01	$0.01
Township				16,691	3,119	$0.02	$0.03
Special district				5,070	N/A	N/A	N/A
Corrections							
Federal	47	$2,134	$3,710	1	241,625,000	$0.00	$0.00
State	903	$2,257	$3,923	50	4,832,500	$0.00	$0.00
Local	3,338	$341	$593				
County				3,042	71,465	$0.00	$0.01
Municipal				19,200	7,805	$0.04	$0.08

(a) The total number of Federal hospitals equals 340 (Table 4A). However, the number with and the number without an MWI is not known.
(b) The total number of state hospitals equals 372 (Table 4A). However, the number with and the number without an MWI is not known.
(c) The total number of local government hospitals equals 1,436 (Table 4A). However, the number with and the number without an MWI is not known.
(d) The distribution of fire and rescue operations by type of government unit is not known. However, municipal governments accounted for the majority -- 74.9 percent -- of total public spending on fire and rescue in 1986, according to the 1986/87 Census.

N/A Not available.

Intermittent 8,400 would be under the jurisdiction of a government unit with a population of only 3,119.

The per-capita impacts for fire and rescue operations and correctional facilities continue to be less than 10 cents.

9.0 IMPACTS ON SMALL ENTITIES

Under Control Option 5, the Emission Guidelines will continue to not have a "significant economic impact on a substantial number of small entities."

Some "small" government jurisdictions may be significantly impacted, but the number would not be close to being "substantial" — i.e., 20 percent or more of all small government jurisdictions impacted.

Some "small" medical waste generators would be significantly impacted by controls. Under Control Option 4, production costs at commercial incineration facilities and at MWI-operating veterinary facilities with 10-19 and 20+ employees would increase on average by more than five percent (a "significant" impact). Production costs would increase on average by more than five percent in these same cases under Control Option 5, as well as in the cases of MWI-operating hospitals with less than 50 beds, nursing homes with 100+ employees, and tax-paying commercial research labs with 20-99 beds.

However, commercial incineration facilities are expected to recover their cost increases with price increases. And, with the exception of veterinary facilities with 10-19 employees operating the Pathological 2,000, significant impacts can be avoided by substituting. The incremental cost of substituting is less than five percent for all but veterinary facilities with 10-19 employees operating the Pathological 2,000, for which the cost of switching to offsite contract disposal exceeds five percent under both Control Option 4 and Control Option 5. But considering that there are 21,496 veterinary facilities in the U.S., the vast majority of which are "small," and that the industry is posited to operate only 493 pathological MWIs (only some of which are operated by facilities with 10-19 employees), it is clear that the number of facilities that are significantly impacted will not be "substantial" — i.e., 20 percent or more of all small entities impacted.

In Section 6.1 it was seen that a few pathological waste generators may have to close as a result of the Emission Guidelines, even more so under Control Option 5 than under Control Option 4. These cases are exceptions, however, and the number will not come close to being "substantial."

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(Please read Instructions on reverse before completing)

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16. ABSTRACT
The economic impact analysis uses annualized control costs in conjunction with economic and financial parameters to estimate potential economic impacts that may be experienced by existing facilities in industries that generate medical waste. Economic impacts such as price, output, and employment changes are examined for industries such as hospitals, nursing homes, and veterinary facilities. This is one in a series of reports used as background information in developing air emission standards and guidelines for new and existing MWI's.

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