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ANALYSIS OF THE FINANCIAL IMPACTS TO
THE INDUSTRIAL ENERGY USER OF USING
COAL OR MUNICIPAL SOLID WASTE IN A
NEW PROCESS-STEAM-GENERATING PLANT

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INTRODUCTION

As a result of the variable price and uncertain availability of oil and natural gas, industrial managers are considering the use of solid fuels in new process-steam-generating plants. While many often equate solid fuel with coal, so-called "waste fuels" (e.g., municipal solid waste, industrial solid waste, wood and agricultural wastes) represent another viable solid fuel alternative to oil and natural gas. With communities nationwide facing increasingly severe waste disposal problems, municipal solid waste (MSW) is often available as a fuel for industrial energy production. Moreover, unlike other commodities, this fuel represents an income, rather than an expense, as the community pays a disposal fee to have its waste processed at a resource recovery plant.

This report presents an analysis of the financial impacts to the industrial energy user of using either coal or MSW in a new process-steam-generating plant. The results of the analysis indicate that the use of coal or solid waste, rather than oil, in a new energy production plant represents an attractive investment.

The financial analysis is based on replacing an existing oil-fired plant with a new plant financed via 100-percent debt. While it is obviously not possible to address industry- and site-specific considerations in a study of this nature, the analysis was structured to cover a range of steam demands, different plant ownership and operating structures, and the tax benefits available to these types of plants. Thus, while this report is indicative only, it should be of use to industrial managers who are considering solid fuel options for new energy production plants.

As background to the financial analysis, the report also provides information on the types of technologies that would be appropriate given the assumed steam demands. In addition, information is provided on available tax benefits in light of recent tax law changes.

Nine options for new coal and MSW plants were analyzed, reflecting a matching of technology and energy output to various process steam demands, as well as different ownership and operating structures. Table 1 defines these nine plant options.

The remainder of this report:

- Summarizes the technologies considered and the major performance and operating assumptions.
- Summarizes the methodology and assumptions for calculating operating and maintenance (O&M) cost savings and expenses to the industrial energy user.
- Summarizes available tax benefits.

TABLE 1
DESCRIPTION OF NINE COAL AND
MSW STEAM PLANT OPTIONS

OPTION	PEAK STEAM DEMAND OF INDUSTRIAL ENERGY USER (lbs/hr)	FUEL TYPE/ TECHNOLOGY	OWNERSHIP AND OPERATING STRUCTURE	FINANCING SCENARIO ^a	
1	28,000	Low-Sulfur Coal/Chain- Grate Stoker Package Units	Industry Owns and Operates	Taxable - 17% - 13%	Tax-Exempt - 14% - 10%
2	28,000	MSW/Starved- Air Massburn Units	Industry Owns; Independent Contractor Operates	Tax-Exempt - 14% - 10%	
3	56,000	Low-Sulfur Coal/ Spreader- Stoker Package Units	Industry Owns and Operates	Taxable - 17% - 13%	
4	56,000	MSW/Starved- Air Massburn Units	Industry Owns; Independent Contractor Operates	Tax-Exempt - 14% - 10%	
5	123,000	Low-Sulfur Coal/Pul- verized Coal Unit	Industry Owns and Operates	Taxable - 17% - 13%	
6	123,000	High-Sulfur Coal/Pul- verized Coal Unit	Industry Owns and Operates	Taxable - 17% - 13%	
7	123,000	MSW/Excess- Air Mass- burn Units	Industry Owns; Independent Contractor Operates	Tax-Exempt - 14% - 10%	
8	123,000	High-Sulfur Coal/Pul- verized Coal Unit	Industry is Energy Buyer; Independent Contractor Owns and Operates	N/A	
9	123,000	MSW/Excess- Air Massburn Units	Industry is Energy Buyer; Independent Contractor Owns and Operates	N/A	

a. 100-percent debt financing at two different interest rates
is assumed in all cases.

- Summarizes the methodology and assumptions for calculating returns to the industrial energy user.
- Presents conclusions.

For more information on the financial analysis, the reader is referred to Appendices A through D.

TECHNOLOGY

The nine coal and MSW plant options fall into three categories in terms of peak demand of the industrial energy user:

- 28,000 pounds per hour of 250 psig, 500⁰F steam (process steam) -- e.g., large hospitals, chemical plants, commercial bakeries, large dry-cleaning establishments.
- 56,000 pounds per hour of process steam -- e.g., paper plants, tobacco plants, other small manufacturers.
- 123,000 pounds per hour of process steam -- e.g., breweries, pharmaceutical processes, paper mills, other larger manufacturers.

All new plant options replace the user's existing plant as the primary supply of process steam. The user's existing plant is assumed to be oil-fired. While there are several alternatives for ensuring a reliable steam supply,* it is assumed that the user's oil-fired plant is maintained on standby as backup to the new coal or MSW plant. (Depending on the circumstances, it may be appropriate to obtain backup through the industrial energy user's existing plant, as this approach takes advantage of an investment already made.) The oil-fired plant is used only when the new plant is inoperable because of unexpected malfunctions or other difficulties, with routine maintenance of the new plant assumed to coincide with shutdowns at the energy user's manufacturing facility.

All new plant options produce steam only and are sized according to the user's process steam demand, which is assumed to be relatively constant and is based on the actual steam load and operating schedule of a paper plant.**

* Alternatives include installing a package boiler at the new coal or MSW plant, installing more redundancy in the new plant, and altering the production schedule at the industrial energy user's facility.

** There are situations (e.g., the energy user has a highly variable demand) where the cogeneration of electricity and steam may be warranted. However, for purposes of this indicative analysis, it would not be meaningful to address cogeneration.

The coal plant options burn either high-sulfur or low-sulfur coal in chain-grate stokers, spreader-stokers, or pulverized coal units. The MSW plant options burn MSW in starved-air massburn units or excess-air massburn units with waste-heat boilers.* These technology choices reflect current industrial practice within the assumed size ranges. All of these combustion units are now available as shop-fabricated units, which can be assembled on site in the desired configurations.**

All options assume pollution control technology for particulate emissions (electrostatic precipitators). For the high-sulfur pulverized coal options, control for sulfur dioxide emissions was also assumed. (MSW is a relatively low-sulfur fuel.)

Table 2 describes the nine plant options from a technical point of view. As can be seen from this table, within a comparable size, more steam has to be raised from the backup oil plant during the year for the MSW plant options than for the coal plant options. This reflects the fact that an MSW plant typically has a higher forced outage rate than a coal plant. The reason for this is, unlike coal, MSW is a nonspecification, nonhomogeneous fuel that, by its very nature, varies seasonally and daily in terms of its composition and quality. Therefore, it is not as easily handled and processed as is coal. However, MSW plants can be designed to have the same reliability as coal plants.

Because MSW varies greatly in terms of composition and quality among and within regions, the characteristics of the MSW assumed for purposes of this analysis are not necessarily indicative of what would be found in any particular waste generation area. To ascertain fuel characteristics for purposes of plant design, a waste-sampling program can be performed if there has been no previous analysis by the community. Alternatively, if only limited data are available, results of waste-sampling programs from other communities can be adjusted based on these limited data to develop a waste characteristics profile. The coal was assumed to be bituminous eastern coal. In general, in terms of a comparison of MSW and coal characteristics, MSW has a lower heating value than does coal, but, as mentioned previously, is a relatively low-sulfur fuel.

Table 3 summarizes the technical performance of the nine plant options.

* Massburn technology refers to a system wherein, except for the removal of oversized, bulky waste, MSW is burned as-received.

** Pulverized coal units are usually field-erected, but some manufacturers are offering shop-fabricated units with capacities of up to 150,000 pounds per hour.

TABLE 2

DESCRIPTION OF NINE COAL
AND MSW PLANT OPTIONS

OPTION	PEAK STEAM DEMAND OF INDUSTRIAL USER (lbs/hr)	FUEL TYPE/TECHNOLOGY	ANNUAL COAL- OR MSW-FIRED STEAM SUPPLY (klbs/yr)	ANNUAL OIL- FIRED BACKUP STEAM SUPPLY (klbs/yr)	ANNUAL TOTAL ^c STEAM SUPPLY (klbs/yr)
1	23,000	Low-Sulfur Coal/ Chain-Grate Stoker Package Units	177,000	2,700	180,000
2	28,000	MSW/Starved-Air Massburn Units	165,000	14,600	180,000
3	56,000	Low-Sulfur Coal/ Spreader-Stoker Package Units	354,000	5,400	359,000
4	56,000	MSW/Starved-Air Massburn Units	330,000	29,200	359,000
5	123,000	Low-Sulfur Coal/ Pulverized Coal Unit	777,000	12,100	790,000
6&8 ^a	123,000	High-Sulfur Coal/ Pulverized Coal Unit	777,000	12,100	790,000
7&9 ^b	123,000	MSW/Excess-Air Massburn Units	755,000	34,100	790,000

a. Options 6 and 8 only differ in terms of assumed ownership and operating structure.

b. Options 7 and 9 only differ in terms of assumed ownership and operating structure.

c. Sum of components may not equal total because of rounding.

TABLE 3
TECHNICAL PERFORMANCE SUMMARY FOR
THE NINE COAL AND MSW OPTIONS

	OPTION						
	1	2	3	4	5	6&8	7&9
Fuel Type	Low-Sulfur Coal	MSW	Low-Sulfur Coal	MSW	Low-Sulfur Coal	High-Sulfur Coal	MSW
Technology	Chain-Grate Stoker	Starved-Air	Spreader-Stoker	Starved-Air	Pulverized Coal	Pulverized Coal	Excess-Air
Industrial Energy User Peak Steam Demand (lbs/hr)	28,000	28,000	56,000	56,000	123,000	123,000	123,000
Total Annual Steam Production (klbs/yr) ^a	180,000	180,000	359,000	359,000	790,000	790,000	790,000
Steam Raising Rate (lbs/ton)	17,600	4,470	17,900	4,470	18,400	18,900	4,920
Annual Steam Production from Coal or MSW (klbs/yr)	177,000	165,000	354,000	330,000	777,000	777,000	755,000
Coal Burned (tons/yr)	10,100	N/A	19,900	N/A	42,200	41,100	N/A
MSW Burned (tons/yr)	N/A	36,900	N/A	73,800	N/A	N/A	154,000
In-Plant Power Use (MWh/yr)	382	1,290	756	2,580	4,510	5,220	5,370
Ash Produced (tons/yr)	1,100	11,200	2,170	22,400	4,590	14,700	46,500
Water Use (klbs/yr)	158,000	148,000	249,000	232,000	465,000	467,000	452,000
Soda Ash Use (tons/yr)	N/A	N/A	N/A	N/A	N/A	185	N/A
Lime Use (tons/yr)	N/A	N/A	N/A	N/A	N/A	2,060	N/A

a. Includes backup oil-fired steam supply and equals industrial energy user's total annual steam demand.

PRE-TAX SAVINGS AND EXPENSES

In general, pre-tax savings are derived by subtracting from gross O&M cost savings, the O&M expenses incurred by the industrial energy user.

Under all options, the industrial energy user's gross savings include the O&M cost savings that result from retiring the existing oil-fired plant,* and his expenses include the O&M costs related to maintaining and using the oil-fired plant as backup to the new plant.

Within each option, the form and allocation of other savings and expense items depend on which of the following ownership and operating structures was assumed:

1. The industrial energy user owns and operates the new plant.
2. The industrial energy user owns the new plant, which is operated by an independent contractor.
3. The industrial energy user buys steam from the new plant, which is owned and operated by an independent contractor.

The first structure was assumed for most of the coal plant options. The second structure was assumed for most of the MSW plant options, and reflects current practice in the United States, whereby operation of an MSW plant is usually performed by an independent contractor who designs and constructs the plant. The independent contractor (or system vendor) is experienced in handling and processing the nonhomogeneous MSW fuel. The third structure was assumed for a large coal plant option and a large MSW plant option and allows for comparison of the plant ownership role with the steam purchase role.

Table 4 indicates the form and allocation of the O&M savings and expenses to the industrial energy user under each option.

As can be seen from the table, when the industrial energy user owns the coal plant, his other O&M expenses are the coal plant O&M costs (including fuel).

* This analysis does not consider the potential savings from avoided capital costs associated with renovating the existing oil-fired plant or constructing a new oil-fired plant. If the industrial energy user were contemplating renovation or new construction, these avoided capital costs would significantly increase the savings to the industrial energy user from using either coal or MSW as an alternative fuel.

TABLE 4

DEFINITION OF GROSS O&M SAVINGS AND
EXPENSES TO INDUSTRIAL ENERGY USERS
UNDER EACH COAL AND MSW PLANT OPTION

OPTION	GROSS SAVINGS				EXPENSES					
	Gross Oil Plant O&M Savings			MSW Disposal Fee Revenues	Coal Plant O&M Costs			Operating Fee	Steam Purchase Payment	Oil-Fired Backup O&M Costs
	Gross Oil Savings	Gross Oil Plant Non- Energy O&M Savings	Gross Oil Plant Electric Savings		Coal Plant Fuel Costs	Coal Plant Non-Energy O&M Costs	Coal Plant Electric Costs			
1, 3, 5, & 6 (coal; industrial energy user owns & operates)	•	•	•		•	•	•			•
2, 4, & 7 (MSW; industrial energy user owns, independent contractor operates)	•	•	•	•				•		•
8 (coal; industrial energy user buys energy, indepen- dent contractor owns & operates)	•	•	•						•	•
9 (MSW; industrial energy user buys energy, indepen- dent contractor owns & operates)	•	•	•						•	•

When the industrial energy user owns the MSW plant, his fuel "costs" are really a revenue, as he is paid by the MSW suppliers to dispose of their solid waste. Hence, disposal fee revenues appear on the savings side of the general equation. However, in order to obtain MSW, he must be able to offer a disposal fee to the communities that is competitive with the cost to them of continued landfilling. Landfill disposal costs vary greatly across the country and within regions -- they can be as high as \$40 per ton and as low as \$5 per ton. Obviously, prevailing landfill disposal costs are a critical consideration in planning an MSW plant. On the expenses side of the equation, because the industrial energy user does not operate the MSW plant, he does not directly incur the MSW plant O&M costs. Instead, he pays an operating fee to the independent contractor. This operating fee includes plant O&M costs plus a profit to the contractor.*

When the industrial energy user is the steam buyer, whether it be steam from a coal or MSW plant, his interest in plant O&M costs is limited to seeking assurance that the independent contractor will be able to run the plant profitably, and thereby provide the steam supply service over the contracted period. The industrial energy user's steam price, including any escalation provisions, as well as other terms and conditions for the steam purchase agreement, will be negotiated as part of his contract with the independent contractor. The steam price will, however, have to be able to support a profitable plant.

Table 5 provides key pricing assumptions used in the analysis.

* If the industrial energy user desired to operate the MSW plant itself, the industrial energy user's expenses could be reduced by avoiding paying profit to an independent operator.

TABLE 5

PRICE DATA USED TO CALCULATE
SAVINGS AND EXPENSES (\$ 1982
IN NEW ENGLAND AREA)

ITEM	PRICE
Electricity	\$0.0700/kwh
Distillate Fuel Oil	\$42.4/barrel (\$6.78/MBtu)
Low-Sulfur Coal (0.7% sulfur)	\$65.0/ton (\$2.51/MBtu)
High-Sulfur Coal (2.7% sulfur)	\$51.9/ton (\$1.99/MBtu)
MSW Disposal Fee ^a	\$15.0/ton (paid by MSW suppliers)
Landfill Haul and Disposal Cost ^b (Coal and MSW Ash)	\$20.0/ton
Water	\$0.50/klbs
Lime	\$61.2/ton
Soda Ash	\$136/ton

- a. MSW disposal fees (i.e., the fee paid to the MSW plant owner by the MSW supplier) are dependent on the hauling and landfilling costs prevalent in the particular area; accordingly, this fee will vary both across the country and within regions. The \$15/ton assumed for purposes of this study does not, therefore, necessarily reflect prevailing MSW disposal costs in New England or other areas of the country.
- b. Assumes: \$15/ton disposal fee, and \$5/ton haul cost [landfill is 15 miles (one-way) from the plant and haul costs are \$0.017/ton-mile]. The fee paid by the coal or MSW plant owner for the disposal of coal or MSW processing ash in a landfill will likely be the same per-ton fee as can be expected to be received for the MSW delivered [the MSW disposal fee at the plant must be competitive with the cost to the supplier of alternative disposal (i.e., straight landfilling of MSW)]. Again, the ash disposal fee does not necessarily reflect prevailing landfill disposal costs in New England or other areas of the country.

AVAILABLE TAX BENEFITS

Available benefits include the use of tax-exempt financing, depreciation write-offs, and tax credits. When investing in a new coal or MSW plant, tax counsel should be consulted to ensure that all available tax benefits are considered.

Unlike coal plants, MSW plants qualify for both the use of tax-exempt financing for up to 100 percent of the capital cost of the plant and other available tax benefits. The use of tax-exempt financing when coupled with other tax benefits can provide significant economic advantages. Tax-exempt bonds can only be issued to finance a coal plant meeting certain capital cost limitations. This latter use is referred to as a "small-issue" industrial development bond and will only be available up to December 31, 1986.

All plants financed via taxable debt can use the Accelerated Cost Recovery System (ACRS) for depreciation of property. MSW plants financed via tax-exempt debt also qualify for use of ACRS. For a coal plant financed via "small-issue" tax-exempt bonds, property may not be depreciated using ACRS -- instead, straight-line depreciation must be used. Use of ACRS allows more of the asset to be written off in the years immediately after it is placed in service.

Investment Tax Credits (ITCs) are available to these plants regardless of the financing mode. However, when ITCs are used, the tax owner must either reduce the cost basis for depreciation write-offs or reduce the ITC. Because ITCs are not allowed for any property owned, used, or leased by a state or local government, the issue of municipal use must be considered when investing in a new plant burning municipal waste. If waste supply contracts are structured properly, the municipal use issue should not preclude capture of ITC benefits.

RETURNS TO THE INDUSTRIAL ENERGY USER

The returns to the industrial energy user under the nine coal and MSW plant options were measured as internal rates of return on an after-tax basis and as payback periods.

The return analysis was only performed for those seven plant options where the industrial energy user is assumed to own the new plant. In the other two options, as an energy buyer only, the industrial energy user's interest is limited to the savings he realizes through the steam purchase agreement and assuring himself that the returns to the independent contractor (i.e., the plant owner) are reasonable, thereby ensuring the provision of the steam supply service over the agreed-to contract period.

In performing the return analysis, it was assumed that all of the new plant options are financed via 100-percent debt. In other words, the owner does not invest any equity in the new plant. For all of the MSW plant options, 100-percent tax-exempt financing was used. For the coal plant options, 100-percent taxable debt financing was assumed, with a tax-exempt case also examined for the smallest coal plant option. Given fluctuations in market conditions, two different taxable and tax-exempt bond interest rates were also assumed. Finally, as applicable, the other available tax benefits discussed in the previous section were assumed. Table 6 lists the key financing assumptions made in performing the return analysis.

TABLE 6
KEY FINANCING ASSUMPTIONS

July 1, 1982, financing date

20-year amortization period

100-percent debt financing

No reserve funds

24-month construction period (i.e., plant operations begin July 1, 1984)

Uniform construction drawdown schedule

24 months of interest capitalized and paid (semi-annually) from the bond proceeds

No arbitrage on construction or capitalized interest funds

4-percent bond issuance fees

CONCLUSIONS

Table 7 presents the internal rates of returns and payback periods under the various options. The internal rates of return shown are the calculated discount rates at which the present value of the total after-tax savings equals the capital investment. The payback periods shown are the number of years from the first year of plant operations that it takes for the project to pay back the capital investment.

The results of this analysis of the financial impacts of using solid fuel (coal or MSW), rather than oil, in new industrial energy production plants indicate that solid fuel can indeed be competitive at the three plant sizes assessed. Both the coal and MSW new plant options provide attractive internal rates of returns and payback periods. It should be noted that this analysis was performed assuming that the industrial energy user is not contemplating a major reinvestment in his existing oil-fired plant. Where such a reinvestment is planned, the returns to the industrial energy user from a new coal or MSW plant will be even more attractive, as his avoided costs will also include the reinvestment costs.

The analysis also indicates that, given the assumed MSW disposal fee, the returns from the coal and MSW plant options are basically equally attractive. Thus, the major economic factor affecting a decision to use MSW, rather than coal, is the disposal fee that can be charged to the communities supplying the MSW. As discussed earlier, the disposal fee at an MSW plant is contingent on the prevailing landfill disposal cost in the waste generation area; landfill disposal costs vary greatly among and within regions.

In addition, the analysis indicates that the financial benefits to the industrial energy user from an MSW plant increase (relative to a coal plant) as the plant size increases. This occurs because the technology for the larger coal plants (pulverized-coal units) has a higher per-unit cost than that for the smaller coal plants, whereas the per-unit cost for the type of MSW plant technology assumed in this study does not generally increase with a larger plant.

As discussed in this report, a number of ownership and operating options are available for both coal and MSW energy production plants that provide attractive alternatives to the traditional option wherein the industrial energy user owns and operates the steam-generating plant. Depending on the circumstances, it may be preferable to hire an independent contractor to operate the new energy production plant or to simply purchase steam from a plant that is independently owned and operated.

TABLE 7
INTERNAL RATES OF RETURN
AND PAYBACK PERIODS

	TOTAL CAPITAL INVESTMENT (\$000)	INTERNAL RATE OF RETURN ON AFTER-TAX BASIS (%)	PAYBACK PERIOD ON EQUIVALENT PRE-TAX BASIS (years) ^a
OPTION 1 (Low-Sulfur Coal)			
Taxable:			
• 17 percent	\$ 5,200	19%	3.7 years
• 13 percent	4,900	21	3.1
Tax-Exempt:			
• 14 percent	5,000	21	3.5
• 10 percent	4,800	22	3.0
OPTION 2 (MSW)			
Tax-Exempt			
• 14 percent	8,900	16	3.9
• 10 percent	8,500	18	3.3
OPTION 3 (Low-Sulfur Coal)			
Taxable:			
• 17 percent	9,400	22	3.2
• 13 percent	9,000	23	2.7
OPTION 4 (MSW)			
Tax-Exempt:			
• 14 percent	15,000	19	3.3
• 10 percent	14,000	20	2.9
OPTION 5 (Low-Sulfur Coal)			
Taxable:			
• 17 percent	33,000	15	4.8
• 13 percent	31,000	16	4.0
OPTION 6 (High-Sulfur Coal)			
Taxable:			
• 17 percent	38,000	13	5.6
• 13 percent	36,000	15	4.4
OPTION 7 (MSW)			
Tax-Exempt:			
• 14 percent	29,000	22	2.7
• 10 percent	28,000	24	2.4

a. Calculated from first year of plant operations after accounting for benefits received during 2-year construction period.

APPENDIX A

TECHNOLOGY DESCRIPTION AND TECHNICAL PERFORMANCE AND OPERATING ASSUMPTIONS

In this appendix, the technical performance and operating assumptions are given for: (1) the nine coal and MSW new steam plant options; (2) the existing oil-fired plants that are replaced as a primary source of steam by the new plant options; and (3) the oil-fired capacity that is maintained on standby as backup for all new plant options. In addition, the technologies chosen for these nine plant options are briefly described.

The nine plant options fall into three categories in terms of peak instantaneous steam demand of the industrial energy user: 28,000, 56,000, and 123,000 pounds per hour of 250 psig, 500°F steam. Table A.1 describes the nine options according to peak hourly steam demand, fuel type and technology, the annual amount of steam supplied by the coal or MSW plant, and the annual amount of steam supplied by the oil-fired backup capacity.

The remainder of this appendix presents: (1) general performance and operating assumptions used for all nine options; (2) technology descriptions and performance and operating assumptions for the coal-fired plant options; (3) technology descriptions and performance and operating assumptions for the MSW-fired plant options; (4) performance and operating assumptions for the oil-fired plant being replaced as the primary supply of steam; and (5) performance and operating assumptions for the oil-fired capacity maintained as backup to the coal and MSW plant options. At the end of this appendix, energy flow diagrams are provided for the different systems making up the nine options.

GENERAL

All of the coal and MSW plant options replace an existing oil-fired plant as the primary supply of steam to the industrial energy user. A backup steam supply is provided by maintaining the existing oil-fired capacity on standby. All options are assumed to supply steam to a user having a relatively steady steam load.* Table A.2 presents the steam load and number of operating days (based on the actual load and operating schedule of a paper plant) assumed for all nine plant options.

* This assumptions was made to simplify the indicative analysis. It is not necessary that the industrial energy user have a steady load in order to benefit from a new coal or MSW plant.

TABLE A.1
DESCRIPTION OF NINE COAL AND
MSW PLANT OPTIONS

OPTION	PEAK STEAM DEMAND OF INDUSTRIAL USER (lbs/hr)	FUEL TYPE/TECHNOLOGY	ANNUAL COAL- OR MSW-FIRED STEAM SUPPLY (klbs/yr)	ANNUAL OIL- FIRED BACKUP STEAM SUPPLY (klbs/yr)	ANNUAL TOTAL ^c STEAM SUPPLY (klbs/yr)
1	28,000	Low-Sulfur Coal/ Chain-Grate Stoker Package Units	177,000	2,700	180,000
2	23,000	MSW/Starved-Air Massburn Units	165,000	14,600	180,000
3	56,000	Low-Sulfur Coal/ Spreader-Stoker Package Units	354,000	5,400	359,000
4	56,000	MSW/Starved-Air Massburn Units	330,000	29,200	359,000
5	123,000	Low-Sulfur Coal/ Pulverized Coal Unit	777,000	12,100	790,000
6&8 ^a	123,000	High-Sulfur Coal/ Pulverized Coal Unit	777,000	12,100	790,000
7&9 ^b	123,000	MSW/Excess-Air Massburn Units	755,000	34,100	790,000

a. Options 6 and 8 only differ in terms of assumed ownership and operating structure.

b. Options 7 and 9 only differ in terms of assumed ownership and operating structure.

c. Sum of components may not equal total because of rounding.

TABLE A.2
STEAM LOAD AND OPERATING DAYS^a

MONTH	NUMBER OF OPERATING DAYS	MONTHLY AVERAGE HOURLY LOAD (% of Peak Demand)
January	26	99.0
February	27	98.3
March	23	100.0
April	25	95.0
May	24	87.6
June	24	80.9
July	19	87.5
August	25	92.6
September	27	94.3
October	24	95.1
November	25	90.7
December	22	99.5
	291 days/year	93.3 ^b

a. Actual profile from steam user.

b. Average annual hourly load (as percent of peak demand).

The fuel combustion and steam production technologies chosen for the nine options match the industrial energy user's assumed demand and reflect current industrial practice. All options assume the use of electrostatic precipitators for the control of particulate emissions.*

Table A.3 gives the assumed fuel characteristics for the three fuel types considered: MSW, low-sulfur coal, and high-sulfur coal.

COAL-FIRED PLANT OPTIONS

Table A.4 gives the operating assumptions for the coal plant options (Options 1, 3, 5, 6, and 8); Table A.5 summarizes the technical performance of the coal plant options.

Three combustion technologies were assumed for the coal plant options: chain-grate stokers (Option 1); spreader-stokers (Option 3); and pulverized coal units (Options 5, 6, and 8). Each technology is briefly described below.

Chain-Grate Stokers

Chain-grate stokers have grates joined together in a moving-belt arrangement. These grates pass over "return bends" at the front and rear of the furnace. With chain-grate stokers, coal is fed onto the grate from a hopper located at the front of the flat, moving grate. As the coal enters the furnace, an adjustable gate regulates the thickness of the coal bed. The coal is ignited by furnace gases; air is supplied under the grate in sufficient amounts to complete the burning of the coal near the end of the grate's travel. Secondary air is supplied at the front of the furnace in sufficient amounts to ensure total burning of all volatiles. The remaining ash is dumped into a pit as the grate passes over the return bend at the rear of the furnace.

Shop-fabricated package units are generally available in sizes up to 35,000 pounds per hour. Thus, this technology was chosen for Option 1 (28,000 pounds per hour).

Spreader-Stokers

A spreader-stoker uses a combination of suspension burning and a fast-burning fuel bed. Mechanical feeders continually project the coal into the furnace, where it is fired almost instantaneously. Air metering is important, and load fluctuations must be carefully

* Particulate control is required for most coal and MSW facilities sized at 30,000 pounds per hour of steam and greater.

TABLE A.3

ASSUMED FUEL CHARACTERISTICS
(% by weight)

	MSW (as-received basis)	LOW-SULFUR COAL	HIGH-SULFUR COAL
Water	28.2	5.1	2.3
Carbon	25.6	73.4	73.4
Hydrogen	3.5	4.7	5.0
Oxygen	21.2	5.6	5.5
Sulfur	0.1	0.7	2.7
Nitrogen	0.6	1.4	1.3
Ash	<u>20.8</u>	<u>9.1</u>	<u>9.8</u>
	100%	100%	100%
Higher Heating Value ^a (HHV)	4,500 Btu/lb	13,000 Btu/lb	13,300 Btu/lb

a. The HHV for backup oil (distillate fuel oil) is 18,500 Btu/lb.

TABLE A.4
OPERATING ASSUMPTIONS FOR THE
NINE COAL AND MSW OPTIONS

	OPTION						
	1	2	3	4	5	6&8	7&9
Fuel Type	Low-Sulfur Coal	MSW	Low-Sulfur Coal	MSW	Low-Sulfur Coal	High-Sulfur Coal	MSW
Technology	Chain-Grate Stoker	Starvec-Air	Spreader-Stoker	Starved-Air	Pulverized Coal	Pulverized Coal	Excess-Air
Industrial Energy User							
Peak Steam Demand (lbs/hr)	28,000	28,000	56,000	56,000	123,000	123,000	123,000
Excess Air (%)	45	130	35	130	20	20	100
Carbon Loss (%)	2	3	2	3	1	1	3
Flue Gas Temperature (°F)	400	425	400	425	350	350	425
Combustion Air Temperature (°F)	80	80	80	80	80	80	80
Forced Outage Rate (%)	3	9.5	3	9.5	3	3	5.75
Boiler Efficiency (%)	82	60	83	60	86	86	66
Condensate Return (%)	50	50	50	50	50	50	50
Potable Water Use (gpm)	20	20	20	20	20	20	20
In-Plant Power Use (kWh/ton)	38	35	38	35	107	127	35
Water in Ash (%)	0	28	0	28	0	0	28
Magnetics Content (%)	0	4.5	0	4.5	0	0	4.5
Residue Rate (tons/ton)	.109	.303	.109	.303	.109	.358	.303

TABLE A.5
TECHNICAL PERFORMANCE SUMMARY
FOR THE NINE COAL AND MSW OPTIONS

	OPTION						
	1	2	3	4	5	6&8	7&9
Fuel Type	Low-Sulfur Coal	MSW	Low-Sulfur Coal	MSW	Low-Sulfur Coal	High-Sulfur Coal	MSW
Technology	Chain-Grate Stoker	Starved-Air	Spreader-Stoker	Starved-Air	Pulverized Coal	Pulverized Coal	Excess-Air
Industrial Energy User							
Peak Steam Demand (lbs/hr)	28,000	28,000	56,000	56,000	123,000	123,000	123,000
Total Annual Steam Production (klbs/yr) ^a	180,000	180,000	359,000	359,000	790,000	790,000	790,000
Steam Raising Rate (lbs/ton)	17,600	4,470	17,900	4,470	18,400	18,900	4,920
Annual Steam Production from Coal or MSW (klbs/yr)	177,000	165,000	354,000	330,000	777,000	777,000	755,000
Coal Burned (tons/yr)	10,100	N/A	19,900	N/A	42,200	41,100	N/A
MSW Burned (tons/yr)	N/A	36,900	N/A	73,800	N/A	N/A	154,000
In-Plant Power Use (MWh/yr)	382	1,290	756	2,580	4,510	5,220	5,370
Ash Produced (tons/yr)	1,100	11,200	2,170	22,400	4,590	14,700	46,500
Water Use (klbs/yr)	158,000	148,000	249,000	232,000	465,000	467,000	452,000
Soca Ash Use (tons/yr)	N/A	N/A	N/A	N/A	N/A	185	N/A
Lime Use (tons/yr)	N/A	N/A	N/A	N/A	N/A	2,060	N/A

a. Includes backup oil-fired steam supply and equals industrial energy user's total annual steam demand.

controlled because the fuel bed burns out rapidly. Fines (very small particles) are burned in suspension, and larger particles are burned on the grate, which is normally a traveling grate that moves from the back to the front end of the furnace, depositing ash in a hopper located at the front.

Shop-fabricated package units are available in sizes up to 60,000 pounds per hour. This technology was assumed for Option 3 (56,000 pounds per hour).

Pulverized Coal Units

Pulverized (finely ground) coal burns like natural gas and is, thus, more readily controlled in a furnace than denser coal particles. Pulverized coal is mixed with air in a semi-dense combination; this mixture is readily fired and burned.

Typically, pulverized coal systems are used when steam demand is in excess of 100,000 pounds per hour. These systems are usually field-erected. Some manufacturers, however, are introducing modular pulverized-coal units with capacities of up to 150,000 pounds per hour. These modular units are shop-fabricated and then assembled as an entire system on site. This technology was assumed for Options 5, 6, and 8 (123,000 pounds per hour).

For Options 6 and 8, where high-sulfur coal is used, a wet limestone scrubbing process is assumed for the control of sulfur dioxide emissions.

MSW-FIRED PLANT OPTIONS

Table A.4 gives the operating assumptions for the MSW plant options (Options 2, 4, 7, and 9); Table A.5 summarizes the technical performance of the MSW plant options.

For the assumed peak steam demands of the industrial energy users, appropriate MSW technologies typically employ a refractory-lined furnace with an associated heat recovery (waste-heat) boiler. These massburn furnaces use either starved-air or excess-air combustion technologies. Normally, the solid waste is fired on an as-received basis (i.e., there is no front-end processing, except to remove oversized, bulky items), and is fed directly from the tip floor into the furnace.

The waste is burned on a hearth where it is exposed to constant air flow and ignition. Waste is moved through the furnace by hydraulically assisted water-cooled rams. After the waste is combusted, residue remaining on the hearth (bottom ash) falls into a quench tank for cooling.

The two MSW combustion technologies considered in this analysis are described below.

Starved-Air/Waste-Heat Boiler Systems

In these systems, combustion occurs in two chambers. Initial combustion occurs in the primary chamber at sub-stoichiometric conditions in order to liberate volatiles and burn any solid materials. The gas then enters the secondary chamber, where combustion is completed. Excess air is used to cool the combustion gases (flue gases) prior to their entrance into the waste-heat boiler. The boiler may contain a superheater, which raises steam from saturation conditions to its required temperature and pressure. In the boiler's convection section, steam raised in the tubes is separated from the circulating feedwater in a steam drum. Following this process, the flue gases pass through an economizer section in order to raise the feedwater temperature to close to its boiling point. The feedwater is then pumped back through the economizer tubes and into the steam drum.

This starved-air/waste-heat boiler technology is usually shop-fabricated and is used for plants designed to process no more than 300 tons per day (TPD) of waste. This technology was assumed for Options 2 and 4 (28,000 and 56,000 pounds per hour, respectively).

Excess-Air/Waste-Heat Boiler Systems

These systems introduce sufficient excess air into the furnace -- approximately twice the amount theoretically required for combustion -- to fully combust all waste in the primary chamber. The flue gases pass through the associated waste-heat boiler. These gases then pass through the convection and economizer sections of the boiler, as described above for the starved-air systems. Again, a superheater may be necessary.

This excess-air/waste-heat boiler technology is usually shop-fabricated and is used for plants designed to process no more than 600 TPD of waste. This technology was assumed for Options 7 and 9 (123,000 pounds per hour).

EXISTING OIL-FIRED PLANTS

The nine coal and MSW new plant options are assumed to provide the primary steam supply to the user and, thereby, replace the user's existing steam plant, which is assumed to be oil-fired. Table A.6 lists the operating assumptions for the existing oil-fired plants; Table A.7 summarizes the technical performance of the existing oil-fired plants.

TABLE A.6

OPERATING ASSUMPTIONS FOR THE EXISTING
AND BACKUP OIL-FIRED PLANTS

Fuel Type:	Distillate Oil
Excess Air:	20%
Flue Gas Temperature:	350°F
Combustion Air Temperature:	80°F
Forced Outage Rate:	1.5%
Boiler Efficiency:	85%
Condensate Return:	50%
Potable Water Use:	20 gpm
In-Plant Power Use:	0.25 kW/gal

TABLE A.7

TECHNICAL PERFORMANCE SUMMARY
FOR THE EXISTING OIL-FIRED PLANTS

	OIL-FIRED PLANT REPLACED BY OPTIONS 1&2	OIL-FIRED PLANT REPLACED BY OPTIONS 3&4	OIL-FIRED PLANT REPLACED BY OPTIONS 5-9
Peak Steam Output (lbs/hr)	28,000	56,000	123,000
Annual Steam Production (klbs/yr)	180,000	359,000	790,000
Distillate Fuel Oil Use (bbls/yr)	44,500	88,900	195,000
In-Plant Power Use (MWh/yr)	467	934	2,050
Water Use (klbs/yr)	161,000	253,000	472,000

BACKUP OIL-FIRED CAPACITY

As discussed earlier, for all nine options, it was assumed that the backup steam supply is provided by maintaining the existing oil-fired capacity on standby. Table A.6 lists the operating assumptions for the backup oil-fired capacity; Table A.8 summarizes the technical performance of the oil-fired plants as backup to the nine coal and MSW plant options.

For all options, it was assumed that planned outages (for routine maintenance purposes) are scheduled to coincide with those periods of time when the industrial energy user's manufacturing facility is not operating. Thus, the backup oil-fired capacity is only used whenever the coal or MSW plant is inoperable because of unexpected malfunctions or other difficulties (i.e., during forced outages).

It should be noted that maintaining an existing oil-fired unit on standby for backup purposes is only one alternative for ensuring that the industrial user's steam demand can be met. Other alternatives include:

- Installing a package boiler as part of the new coal or MSW plant.
- Installing more redundancy in the coal or MSW plant.
- Altering the production schedule at the industrial user's facility.

ENERGY FLOW DIAGRAMS

Figures A.1 - A.7 are energy flow diagrams for the different systems making up the nine plant options.

TABLE A.8

TECHNICAL PERFORMANCE SUMMARY FOR
THE BACKUP OIL-FIRED PLANTS

	BACKUP OIL-FIRED PLANT FOR OPTIONS					
	1	2	3	4	5,6,&8	7&9
Annual Steam Production From Backup Oil ^a (klbs/hr)	2,700	14,600	5,400	29,200	12,000	34,100
Steam Production From Back- up Oil (% of total demand)	1.50	8.00	1.50	8.00	1.50	4.30
Distillate Fuel Oil Use (bbls/yr)	667	3,560	1,330	7,110	2,930	8,300
In-Plant Power Use (MWh/yr)	7.0	37.3	14.0	74.7	30.8	87.2
Water Use (klbs/yr)	1,400	12,900	3,900	20,600	7,100	20,100

a. Oil-fired steam produced in order to meet the industrial energy user's total annual demand.

FIGURE A.1

ENERGY FLOW DIAGRAM FOR CHAIN-GRATE STOKER
CYCLE: OPTION 1 (LOW-SULFUR COAL)

FIGURE A.2

ENERGY FLOW DIAGRAM FOR STARVED-AIR
CYCLE: OPTION 2 (MSW)

FIGURE A.3

ENERGY FLOW DIAGRAM FOR SPREADER-STOKER
CYCLE: OPTION 3 (LOW-SULFUR COAL)

FIGURE A.4

ENERGY FLOW DIAGRAM FOR STARVED-AIR
CYCLE: OPTION 4 (MSW)

FIGURE A.5

ENERGY FLOW DIAGRAM FOR PULVERIZED COAL
CYCLE: OPTION 5 (LOW-SULFUR COAL)

FIGURE A.6

ENERGY FLOW DIAGRAM FOR PULVERIZED COAL
CYCLE: OPTIONS 6 & 8 (HIGH-SULFUR COAL)

FIGURE A.7

ENERGY FLOW DIAGRAM FOR EXCESS-AIF.
CYCLE: OPTIONS 7 & 9 (MSW)

APPENDIX B

METHODOLOGY AND ASSUMPTIONS FOR CALCULATING OPERATING AND MAINTENANCE COST SAVINGS AND EXPENSES

This appendix describes the general methodology and assumptions used to calculate pre-tax O&M cost savings and expenses for the nine coal and MSW plant options.

The form and allocation of certain savings and expense items depends on the ownership and operating structure assumed for the various options. The nine plant options fall into three categories in terms of the ownership and operating structure (see Table B.1):

- The industrial energy user owns and operates the plant (Coal Options 1, 3, 5, and 6).
- The industrial energy user owns the plant, which is operated by an independent contractor (MSW Options 2, 4, and 7).
- The industrial energy user buys steam from the plant, which is owned and operated by an independent contractor (Coal Option 8 and MSW Option 9).

The ownership and operating structures chosen for the nine options allow the industrial energy user to compare ownership versus simply being an energy buyer. These structures also reflect current practice in the United States, whereby operation of an MSW plant is typically performed by an independent contractor (i.e., the system vendor who designs and constructs the plant) because the latter is experienced in handling and processing MSW, which is a nonhomogeneous, nonspecification fuel.

In the following section, General Methodology, the general equation used to calculate savings and expenses is given, along with a discussion of what constitutes savings and expenses to the industrial energy user under each plant option. This discussion is followed by a summary of the pricing and escalation assumptions used, and calculations of gross savings and expenses. At the end of this appendix, income statements showing pre-tax net savings to the industrial energy user for the first 20 years of plant operations are provided for each of the plant options.

TABLE B.1
DESCRIPTION OF NINE COAL AND
MSW STEAM PLANT OPTIONS

OPTION	PEAK STEAM DEMAND OF INDUSTRIAL ENERGY USER (lbs/hr)	FUEL TYPE/ TECHNOLOGY	OWNERSHIP AND OPERATING STRUCTURE
1	28,000	Low-Sulfur Coal/ Chain-Grate Stoker Package Units	Industry Owns and Operates
2	28,000	MSW/Starved-Air Massburn Units	Industry Owns; Independent Contractor Operates
3	56,000	Low-Sulfur Coal/ Spreader-Stoker Package Units	Industry Owns and Operates
4	56,000	MSW/Starved-Air Massburn Units	Industry Owns; Independent Contractor Operates
5	123,000	Low-Sulfur Coal/ Pulverized Coal Unit	Industry Owns and Operates
6	123,000	High-Sulfur Coal/ Pulverized Coal Unit	Industry Owns and Operates
7	123,000	MSW/Excess-Air Massburn Units	Industry Owns; Independent Contractor Operates
8	123,000	High-Sulfur Coal/ Pulverized Coal Unit	Industry is Energy Buyer; Independent Contractor Owns and Operates
9	123,000	MSW/Excess-Air Massburn Units	Industry is Energy Buyer; Independent Contractor Owns and Operates

GENERAL METHODOLOGY

The net O&M savings to the industrial energy user are calculated by subtracting expenses from gross savings. Table B.2 indicates what the gross savings and expenses sides of the equation comprise for each of the nine options.

For all options, gross savings include the O&M cost savings resulting from replacing an existing oil-fired plant by the new coal or MSW plant as the primary supply of steam. For those MSW options where the industrial energy user owns the plant (Options 2, 4, and 7), the revenues received from the disposal fees paid by the MSW suppliers also appear on the gross savings side of the equation.*

As mentioned previously, the allocation of expenses depends on the assumed ownership and operation structure. For all options, however, it was assumed that the industrial energy user incurs the expenses related to operating the oil-fired capacity which is maintained on standby as backup to the new coal or MSW plant.

For those coal options where the industrial energy user owns and operates the plant (Options 1, 3, 5, and 6), the coal plant O&M costs (including fuel costs) must be added to the backup oil O&M costs to derive the expenses side of the equation.

Because MSW is a nonspecification, nonhomogeneous fuel, it is desirable to have an independent contractor (a system vendor who is experienced in the operation of these plants) as the operator. Accordingly, for those MSW plants where the industrial energy user is the owner (Options 2, 4, and 7), an operating fee is paid to the independent contractor and must be added to the backup oil O&M costs to derive the expenses side of the equation. (The MSW plant O&M costs are incurred by the independent contractor who factors these costs plus his profit into the operating fee that is charged to the industrial energy user/plant owner.)

Finally, for those options where the industrial energy user has no ownership interest in the plant and simply purchases steam generated by the plant (Coal Option 8 and MSW Option 9), the steam purchase payment must be added to the backup oil O&M costs to derive the expenses side of the equation.

* In MSW Option 9, where the plant is owned by an independent contractor, disposal fee revenues go to the independent contractor.

TABLE B.2

DEFINITION OF GROSS O&M SAVINGS AND
EXPENSES TO INDUSTRIAL ENERGY USERS
UNDER EACH COAL AND MSW PLANT OPTION

OPTION	GROSS SAVINGS				EXPENSES					
	Gross Oil Plant O&M Savings			MSW Disposal Fee Revenues	Coal Plant O&M Costs			Operating Fee	Steam Purchase Payment	Oil-Fired Backup O&M Costs
	Gross Oil Savings	Gross Oil Plant Non- Energy O&M Savings	Gross Oil Plant Electric Savings		Coal Plant Fuel Costs	Coal Plant Non-Energy O&M Costs	Coal Plant Electric Costs			
1, 3, 5, & 6 (coal; industrial energy user owns & operates)	•	•	•		•	•	•			•
2, 4, & 7 (MSW; industrial energy user owns, independent contractor operates)	•	•	•	•				•		•
8 (coal; industrial energy user buys energy, indepen- dent contractor owns & operates)	•	•	•						•	•
9 (MSW; industrial energy user buys energy, indepen- dent contractor owns & operates)	•	•	•						•	•

PRICING AND ESCALATION ASSUMPTIONS

The analysis presented in this report is meant to be indicative only. As such, no attempt has been made to reflect the fact that each industrial energy user faces unique circumstances. Moreover, items that are obviously specific to the user (e.g., administrative overhead) are not included in the calculation of savings and expenses.

The O&M costs for the MSW plant options were developed from cost information contained in recent vendor bids for comparably sized MSW plants and engineering estimates. The O&M costs for the coal plant options were developed from engineering estimates.

The pricing data used in this analysis, with the exception of the assumed MSW disposal fee and the ash disposal cost, are the latest available 1982 prices from the New England area (see Table B.3).

The escalation rates assumed in this analysis are from the Department of Energy's (DOE) low-price forecast of general economic and energy price escalation.¹ The DOE forecast extends to 1995. Because a 20-year planning horizon was assumed in this analysis (1984 to 2003*), after 1995, it was assumed that all expense items escalate at the GNP price deflator as forecast by DOE for 1991 through 1995. Table B.4 gives the escalators used in this analysis. Table B.5 indicates how these escalators were applied in the analysis.

CALCULATIONS OF GROSS SAVINGS

Table B.6 shows the gross savings calculated for each of the nine coal and MSW options (1982 dollars). Because in MSW Options 2, 4, and 7, the industrial energy user is the plant owner, MSW disposal fee revenues must be added to the gross savings resulting from replacing the existing oil-fired plant as a primary supply of steam, to calculate the gross savings side of the equation.

Table B.7 is a further breakdown of the O&M cost savings for the three different-sized existing oil plants that are replaced.

CALCULATIONS OF EXPENSES

Table B.8 shows the expenses calculated for each of the nine coal and MSW options (1982 dollars). Table B.9 provides a further breakdown of the coal plant O&M expenses. Table B.10 provides a breakdown of

1. Energy Information Administration, DOE, 1981 Annual Report to Congress, "Energy Projections" (Vol. 3), February 1982.

* A 2-year construction period (1982 to 1984) was assumed.

TABLE B.3

PRICE DATA USED TO CALCULATE
SAVINGS AND EXPENSES (\$ 1982
IN NEW ENGLAND AREA)

ITEM	PRICE
Electricity	\$0.0700/kWh
Distillate Fuel Oil	\$42.4/barrel (\$6.78/MBtu)
Low-Sulfur Coal (0.7% sulfur)	\$65.0/ton (\$2.51/MBtu)
High-Sulfur Coal (2.7% sulfur)	\$51.9/ton (\$1.99/MBtu)
MSW Disposal Fee ^a	\$15.0/ton (paid by MSW suppliers)
Landfill Haul and Disposal Cost ^b (Coal and MSW Ash)	\$20.0/ton
Water	\$0.50/klbs
Lime	\$61.2/ton
Soda Ash	\$136/ton

a. MSW disposal fees (i.e., the fee paid to the MSW plant owner by the MSW supplier) are dependent on the hauling and landfilling costs prevalent in the particular area; accordingly, this fee will vary both across the country and within regions. The \$15/ton assumed for purposes of this study does not, therefore, necessarily reflect prevailing MSW disposal costs in New England or other areas of the country.

b. Assumes: \$15/ton disposal fee, and \$5/ton haul cost [landfill is 15 miles (one-way) from the plant and haul costs are \$0.017/ton-mile]. The fee paid by the coal or MSW plant owner for the disposal of coal or MSW processing ash in a landfill will likely be the same per-ton fee as can be expected to be received for the MSW delivered [the MSW disposal fee at the plant must be competitive with the cost to the supplier of alternative disposal (i.e., straight landfilling of MSW)]. Again, the ash disposal fee does not necessarily reflect prevailing landfill disposal costs in New England or other areas of the country.

TABLE B.4
 ESCALATORS^a
 (Annual Percentage Change)

YEAR	GNP PRICE DEFLATOR	DISTILLATE FUEL OIL	RESIDUAL FUEL OIL	COAL
1982-1983	8.00	10.56	15.54	14.84
1984	8.00	10.56	15.54	14.84
1985	8.00	10.56	15.54	14.84
1986	6.81	13.22	12.37	8.80
1987	6.81	13.22	12.37	8.80
1988	6.81	13.22	12.37	8.80
1989	6.81	13.22	12.37	8.80
1990	6.81	13.22	12.37	8.80
1991	5.63	11.53	12.37	7.67
1992	5.63	11.53	12.37	7.67
1993	5.63	11.53	12.37	7.67
1994	5.63	11.53	12.37	7.67
1995	5.63	11.53	12.37	7.67
1996	5.63	5.63	5.63	5.63
1997	5.63	5.63	5.63	5.63
1998	5.63	5.63	5.63	5.63
1999	5.63	5.63	5.63	5.63
2000	5.63	5.63	5.63	5.63
2001	5.63	5.63	5.63	5.63
2002	5.63	5.63	5.63	5.63
2003	5.63	5.63	5.63	5.63

a. Source (1982-1995): Energy Information Administration, DOE, 1981 Annual Report to Congress, "Energy Projections" (Vol. 3), February 1982; thereafter, escalation of all expense items at the GNP Price Deflator for 1991-1995, or at 5.63 percent annually.

TABLE B.5
APPLICATION OF ESCALATORS^a

ITEM	ESCALATORS			
	GNP Price Deflator	Distillate Fuel Oil	Residual Fuel Oil	Coal
MSW Disposal Fee	•			
Operating Fee	•			
Steam Purchase Price		•		
Direct Labor	•			
Indirect Labor	•			
Coal				•
Water	•			
Maintenance	•			
Insurance	•			
Ash Disposal ^b	•	•		
Backup Fuel Oil		•		
Electricity			•	
Other Costs	•			

- a. Unless otherwise indicated, escalation is at 100 percent of the annual percentage change as given in Table B.4 for the escalator applied.
- b. Escalation of the haul cost portion of the total ash disposal cost is at 50 percent of the annual percentage change for the GNP Price Deflator and 50 percent of the annual percentage change for distillate fuel oil. Escalation of the ash disposal fee portion of the total ash disposal cost is at 100 percent of the GNP Price Deflator.

TABLE B.6
GROSS SAVINGS (1982 \$000)

OPTION	GROSS OIL PLANT O&M SAVINGS			MSW DISPOSAL FEE REVENUES	TOTAL ^a
	Gross Oil Savings	Gross Oil Plant Non-Energy O&M Savings	Gross Oil Plant Electric Savings		
1 (coal; industrial energy user owns and operates; 28,000 lbs/hr)	\$1,900	220	33	N/A	\$ 2,100
2 (MSW; industrial energy user owns, independent contractor operates; 28,000 lbs/hr)	\$1,900	220	33	550	\$ 2,700
3 (coal; industrial energy user owns and operates; 56,000 lbs/hr)	\$3,800	290	65	N/A	\$ 4,100
4 (MSW; industrial energy user owns, independent contractor operates; 56,000 lbs/hr)	\$3,800	290	65	1,100	\$ 5,200
5&6 (coal; industrial energy user owns and operates; 123,000 lbs/hr)	\$8,300	450	140	N/A	\$ 8,900
7 (MSW; industrial energy user owns, independent contractor operates; 123,000 lbs/hr)	\$8,300	450	140	2,300	\$11,000
8 (coal; industrial energy user buys energy, independent contractor owns and operates; 123,000 lbs/hr)	\$8,300	450	140	N/A	\$ 8,900
9 (MSW; industrial energy user buys energy, independent contractor owns and operates; 123,000 lbs/hr)	\$8,300	450	140	N/A	\$ 8,900

a. Sum of components may not equal total because of rounding.

TABLE B.7
OIL PLANT O&M COST SAVINGS
(1982 \$000)

SAVINGS ITEM	PEAK HOURLY DEMAND OF INDUSTRIAL ENERGY USER		
	28,000 lbs/hr	56,000 lbs/hr	123,000 lbs/hr
Fuel Oil ^a	\$1,900	\$3,800	\$8,300
Non-Energy O&M			
- Direct Labor ^b	80	80	80
- Indirect Labor ^c	28	28	28
- Water	80	130	240
- Maintenance ^d	14	28	62
- Insurance	20	26	56
Subtotal ^e	220	290	450
Electricity ^f	33	65	140
TOTAL ^e	\$2,100	\$4,100	\$8,900

a. Based on 0.247 bbls/1,000 lbs of steam.

b. Four men at \$20k/yr.

c. 35% of direct labor.

d. 2.5% of capital cost of existing oil plant (estimated to be \$20/1,000 lbs of oil).

e. Sum of components may not equal total because of rounding.

f. Based on 0.25 kW/gal and 10.39 gal/1,000 lbs of steam.

TABLE B.8
EXPENSES (1982 \$000)

OPTION	COAL PLANT O&M COSTS			OPERATING FEE	STEAM PURCHASE PAYMENT	OIL-FIRED BACKUP O&M COSTS	TOTAL ^a
	Coal Plant Fuel Costs	Coal Plant Non- Energy O&M Costs	Coal Plant Electric Costs				
1 (low-sulfur coal; industrial energy user owns and operates; 28,000 lbs/hr)	\$ 650	460	27	N/A	N/A	30	\$1,200
2 (MSW; industrial energy user owns, independent contractor operates; 28,000 lbs/hr)	N/A	N/A	N/A	\$1,200	N/A	190	\$1,400
3 (low-sulfur coal; industrial energy user owns and operates; 56,000 lbs/hr)	\$1,300	610	53	N/A	N/A	60	\$2,000
4 (MSW; industrial energy user owns, independent contractor operates; 56,000 lbs/hr)	N/A	N/A	N/A	\$2,400	N/A	350	\$2,700
5 (low-sulfur coal; industrial energy user owns and operates; 123,000 lbs/hr)	\$2,700	1,300	320	N/A	N/A	130	\$4,500
6 (high-sulfur coal; industrial energy user owns and operates; 123,000 lbs/hr)	\$2,200	1,800	370	N/A	N/A	130	\$4,500
7 (MSW; industrial energy user owns, independent contractor operates; 123,000 lbs/hr)	N/A	N/A	N/A	\$3,600	N/A	400	\$4,000
8 (high-sulfur coal; industrial energy user buys energy, independent contractor owns and operates; (123,000 lbs/hr)	N/A	N/A	N/A	N/A	\$8,000	160	\$8,200
9 (MSW; industrial energy user buys energy; independent contractor owns and operates; 123,000 lbs/hr)	N/A	N/A	N/A	N/A	\$8,000	400	\$8,400

a. Sum of components may not equal total because of rounding.

TABLE B.9
COAL PLANT O&M EXPENSES (1982 \$000)

EXPENSE ITEM	COAL OPTION			
	1 (low-sulfur 28,000 lbs/hr)	3 (low-sulfur 56,000 lbs/hr)	5 (low-sulfur 123,000 lbs/hr)	6 (high-sulfur 123,000 lbs/hr)
Coal	\$ 650	\$1,300	\$2,700	\$2,200
Non-Energy O&M				
- Direct Labor	180	180	220	260
- Indirect Labor	63	63	77	91
- Water	79	120	230	230
- Maintenance	95	170	600	700
- Insurance	20	28	69	91
- Ash Disposal	22	43	92	290
- Limestone and Soda Ash	N/A	N/A	N/A	150
Subtotal ^a	460	610	1,300	1,800
Electricity	27	53	320	370
TOTAL ^a	\$1,100	\$2,000	\$4,300	\$4,400

a. Sum of components may not equal total because of rounding.

TABLE B.10
MSW PLANT O&M EXPENSES^a
(1982 \$000)

EXPENSE ITEM	MSW OPTION		
	2 (28,000 lbs/hr)	5 (56,000 lbs/hr)	7 (123,000 lbs/hr)
Non-Energy O&M			
- Direct and In-direct Labor	\$290	\$ 400	\$ 550
- Water	74	120	230
- Maintenance	160	380	430
- Insurance	41	71	130
- Ash Disposal	220	450	930
- Miscellaneous	75	240	140
Electricity	90	180	380
TOTAL ^b	\$960	\$1,800	\$2,800

- a. These expenses are incurred by the independent contractor, who is the plant operator in all options. The operating fee that is paid by the industrial energy user to the independent contractor in MSW Options 2, 4, and 7 is equal to the plant O&M expenses plus contractor profit (assumed to be 30 percent of the plant O&M expenses).
- b. Sum of components may not equal total because of rounding.

the MSW plant O&M expenses. These latter O&M expenses are the basis for calculating the operating fee to be paid by the industrial energy user to the independent contractor who operates the MSW plant. The operating fee also includes contractor profit, which was assumed to be equal to 30 percent of the MSW plant O&M costs.

The steam purchase payments shown for Options 8 and 9 in Table B.8 assume a 10-percent discount off of the industrial energy user's avoided costs (assumed to be distillate fuel oil and the O&M and electricity cost savings from not operating the oil-fired plant) in the first year of plant operations, escalated thereafter at 100 percent of the escalation in distillate fuel oil. It should be noted that the pricing formula to be used for energy purchases is negotiated as part of the energy purchase contract between the industrial energy user and, in this case, the independent contractor who owns the plant. Accordingly, a variety of pricing formulas are possible.

Table B.11 provides a breakdown of the O&M expenses for the oil-fired backup capacity, which is maintained on standby. These expenses are incurred by the industrial energy user in all nine plant options. Because MSW plants typically have a higher forced outage rate because of the nonhomogeneous nature of MSW, the backup O&M expenses are higher for the MSW plant options than for the coal plant options within the same size range.

INCOME STATEMENTS

Tables B.12 - B.20 are income statements showing the pre-tax net O&M savings (see "Gross Savings less Expenses") over the 20-year period of plant operations for each coal and MSW plant option. These income statements are the output of RECOVER, which is a computer model developed by CSI Resource Systems, Inc., under the sponsorship of DOE. RECOVER is designed to quantify the financial impacts and benefits of various business structures on project participants.

TABLE B.11

BACKUP OIL CAPACITY O&M
EXPENSES (1982 \$000)

EXPENSE ITEM	BACKUP OIL-FIRED PLANT FOR OPTIONS						
	1	2	3	4	5&6	8	7&9
Fuel Oil	\$28	\$150	\$57	\$300	\$120	\$120	\$350
Non-Energy O&M							
- Direct Labor	N/A ^a	20	N/A ^a	20	N/A ^a	20	N/A ^a
- Indirect Labor	N/A	7.0	N/A	7.0	N/A	7.0	N/A
- Water	1.2	6.4	1.9	10	3.5	3.5	10
- Maintenance	0.21	1.1	0.42	2.2	0.92	0.92	2.6
- Insurance	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Subtotal ^b	1.4	35	2.3	39	4.4	31	40
Electricity	0.49	2.6	0.98	5.2	2.2	2.2	6.1
TOTAL ^b	\$30	\$190	\$60	\$350	\$130	\$160	\$400

a. Because the industrial energy user operates the coal plant, it is assumed that the operating personnel for the coal plant will also operate the backup oil-fired plant.

b. Sum of components may not equal total because of rounding.

TABLE B.12

INCOME STATEMENT: OPTION 1 (LOW-SULFUR COAL)

WASTE RECOVERY MODEL INCOME STATEMENT (\$000)										
INDUSTRIAL ENERGY USER										
YEARS	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
GROSS SAVINGS										

Fuel Oil	2306	2550	2887	3239	3701	4190	4744	5291	5901	6582
Non-Energy O&M	259	280	299	319	341	364	389	411	434	459
Electricity	44	50	57	64	72	80	90	101	114	128
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TOTAL GROSS SAVINGS	2609	2880	3243	3652	4114	4635	5224	5804	6449	7168
EXPENSES										

O&M										
Direct Labor	210	227	242	259	276	295	315	333	352	372
Indirect Labor	73	75	85	91	97	103	110	117	123	130
Coal	863	991	1078	1173	1276	1388	1510	1626	1751	1885
Water	94	101	108	115	123	132	141	149	157	166
Maintenance	111	120	128	137	146	156	167	176	186	197
Insurance	23	25	27	29	31	33	35	37	39	41
Ash Disposal	26	28	30	32	35	38	40	43	46	49
Oil (Backup Capacity)	35	38	43	49	56	63	71	79	89	99
Electricity	36	42	47	53	60	67	75	85	95	107
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TOTAL O&M	1471	1651	1788	1937	2099	2275	2465	2644	2837	3045
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TOTAL EXPENSES	1471	1651	1788	1937	2099	2275	2465	2644	2837	3045
PRE-TAX SAVING (i.e., Gross Savings Less Expenses)	1138	1229	1454	1715	2015	2360	2759	3159	3612	4124

TABLE B.12 (continued)

WASTE RECOVERY MODEL INCOME STATEMENT (\$000)										
INDUSTRIAL ENERGY USER										
YEARS	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003

GROSS SAVINGS										

Fuel Oil	7340	8187	8648	9135	9649	10192	10766	11372	12012	12689
Non-Energy O&M	485	512	541	571	603	637	673	711	751	793
Electricity	144	162	171	180	191	201	213	225	237	251

TOTAL GROSS SAVINGS	7969	8860	9359	9886	10443	11031	11652	12308	13001	13733
EXPENSES										

O&M										
Direct Labor	392	415	438	463	489	516	545	576	608	643
Indirect Labor	137	145	153	162	171	181	191	202	213	225
Coal	2030	2185	2308	2438	2576	2721	2874	3036	3207	3387
Water	175	185	195	206	218	230	243	257	271	287
Maintenance	208	219	232	245	258	273	288	305	322	340
Insurance	44	46	49	51	54	57	61	64	68	71
Ash Disposal	52	56	59	62	66	70	74	78	82	87
Oil (Backup Capacity)	110	123	130	137	145	153	162	171	180	190
Electricity	120	135	142	150	159	168	177	187	198	209

TOTAL O&M	3268	3509	3706	3915	4136	4368	4614	4874	5149	5438

TOTAL EXPENSES	3268	3509	3706	3915	4136	4368	4614	4874	5149	5438

PRE-TAX SAVING (i.e., Gross Savings Less Expenses)	4701	5352	5653	5971	6307	6662	7037	7434	7852	8294

TABLE B.13

INCOME STATEMENT: OPTION 2 (MSW)

WASTE RECOVERY MODEL INCOME STATEMENT (\$000)										
INDUSTRIAL ENERGY USER										
YEARS	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993

GROSS SAVINGS										

Fuel Oil	2306	2550	2887	3269	3701	4190	4744	5291	5901	6582
Non-Energy O&M	259	280	298	319	341	364	388	411	434	459
Electricity	44	50	57	64	72	80	90	101	114	128
MSW Disposal Fees	646	698	745	796	850	908	970	1024	1082	1143

TOTAL GROSS SAVINGS	3255	3578	3988	4448	4964	5543	6194	6828	7531	8311

EXPENSES										

Operating Fees	1473	1603	1726	1858	2002	2156	2326	2484	2652	2839
O&M (Backup Capacity)										
Direct Labor	23	25	27	29	31	33	35	37	39	41
Indirect Labor	8	9	9	10	11	12	12	13	14	15
Water	7	8	8	9	10	10	11	11	12	13
Maintenance	1	1	1	2	2	2	2	2	2	2
Oil	185	204	231	261	296	335	380	423	472	526
Electricity	3	4	5	5	6	6	7	8	9	10

TOTAL O&M	229	252	282	316	354	398	448	495	549	608

TOTAL EXPENSES	1702	1855	2008	2174	2356	2554	2774	2979	3201	3447

PREF-TAX SAVING (i.e., Gross Savings Less Expenses)	1553	1723	1980	2274	2608	2989	3420	3849	4330	4864

TABLE B.13 (continued)

WASTE RECOVERY MODEL INCOME STATEMENT (\$000)										
INDUSTRIAL ENERGY USER										
YEARS	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003

GROSS SAVINGS										

Fuel Oil	7340	8187	8648	9135	9649	10192	10766	11372	12012	12689
Non-Energy O&M	485	512	541	571	603	637	673	711	751	793
Electricity	144	162	171	180	191	201	213	225	237	251
MSW Disposal Fees	1207	1275	1347	1423	1503	1587	1677	1771	1871	1974

TOTAL GROSS SAVINGS	9176	10135	10706	11309	11946	12613	13329	14079	14872	15709

EXPENSES										

Operating Fees	3034	3249	3433	3624	3831	4045	4272	4513	4767	5036
O&M (Backup Capacity)										
Direct Labor	44	46	49	52	55	58	61	64	68	72
Indirect Labor	15	16	17	18	19	20	21	22	24	25
Water	14	14	15	16	17	18	19	20	21	22
Maintenance	2	3	3	3	3	3	3	4	4	4
Oil	587	655	692	731	772	815	861	910	961	1015
Electricity	12	13	14	14	15	16	17	18	19	20

TOTAL O&M	674	747	790	834	880	930	983	1039	1097	1158

TOTAL EXPENSES	3708	3996	4223	4458	4711	4975	5255	5552	5864	6194

PRE-TAX SAVING (i.e., Gross Savings Less Expenses)	5468	6139	6483	6851	7235	7638	8074	8527	9008	9515

TABLE B.14
INCOME STATEMENT: OPTION 3 (LOW-SULFUR COAL)

WASTE RECOVERY MODEL INCOME STATEMENT (\$000)										
INDUSTRIAL ENERGY USER										
YEARS	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993

GROSS SAVINGS										

Fuel Oil	4613	5100	5775	6538	7402	8381	9489	10583	11803	13164
Non-Energy O&M	338	365	390	417	445	476	508	537	567	599
Electricity	87	101	113	127	143	161	181	203	228	256

TOTAL GROSS SAVINGS	5038	5566	6278	7083	7990	9017	10177	11323	12598	14020

EXPENSES										

O&M										
Direct Labor	210	227	242	259	276	295	315	333	352	372
Indirect Labor	73	79	85	91	97	103	110	117	123	130
Coal	1704	1957	2130	2317	2521	2743	2984	3213	3459	3725
Water	147	159	170	181	194	207	221	233	247	260
Maintenance	202	218	233	249	265	284	303	320	338	357
Insurance	33	36	38	41	43	46	49	52	55	58
Ash Disposal	51	55	59	64	69	74	80	85	91	97
Oil (Backup Capacity)	69	77	87	98	111	126	142	159	177	197
Electricity	72	83	93	105	118	132	149	167	188	211

TOTAL O&M	2562	2890	3136	3404	3694	4010	4354	4679	5030	5407

TOTAL EXPENSES	2562	2890	3136	3404	3694	4010	4354	4679	5030	5407

PRE-TAX SAVING (i.e., Gross Savings Less Expenses)	2476	2676	3142	3679	4296	5007	5823	6644	7568	8613

TABLE B.14 (continued)

WASTE RECOVERY MODEL INCOME STATEMENT (\$'000)										
INDUSTRIAL ENERGY USER										
YEARS	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003

GROSS SAVINGS										

Fuel Oil	14682	16375	17297	18271	19299	20386	21533	22746	24026	25379
Non-Energy O&M	632	668	706	745	787	832	879	928	980	1035
Electricity	288	323	342	361	381	403	425	449	475	501

TOTAL GROSS SAVINGS	15602	17367	18344	19377	20468	21521	22838	24123	25481	26916

EXPENSES										

O&M										
Direct Labor	392	415	438	463	489	516	545	576	608	643
Indirect Labor	137	145	153	162	171	181	191	202	213	225
Coal	4011	4318	4561	4818	5089	5376	5679	5998	6336	6693
Water	275	291	307	324	342	362	382	404	426	450
Maintenance	377	398	421	444	469	496	524	553	584	617
Insurance	62	65	69	73	77	81	86	90	95	101
Ash Disposal	104	111	117	123	130	138	145	154	162	171
Oil (Backup Capacity)	220	246	259	274	289	306	323	341	360	381
Electricity	237	266	281	297	314	332	350	370	391	413

TOTAL O&M	5815	6254	6606	6978	7371	7786	8224	8687	9177	9693

TOTAL EXPENSES	5815	6254	6606	6978	7371	7786	8224	8687	9177	9693

PRE-TAX SAVING	9789	11113	11738	12399	13097	13835	14614	15436	16304	17223

(i.e., Gross Savings Less Expenses)										

TABLE B.15
INCOME STATEMENT: OPTION 4. (MSW)

WASTE RECOVERY MODEL INCOME STATEMENT (\$000)										
INDUSTRIAL ENERGY USER	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
YEARS	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
GROSS SAVINGS	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Fuel Oil	4613	5100	5775	5538	7402	8381	9489	10583	11833	13164
Non-Energy O&M	338	365	390	417	445	476	508	537	567	599
Electricity	87	101	113	127	143	161	181	203	228	256
MSW Disposal Fees	1292	1395	1490	1592	1700	1816	1939	2048	2164	2286
TOTAL GROSS SAVINGS	6330	6961	7768	8675	9690	10833	12116	13371	14762	16306
EXPENSES	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Operating Fees	2819	3000	3231	3480	3752	4043	4362	4661	4986	5334
O&M (Backup Capacity)										
Direct Labor	23	25	27	29	31	33	35	37	39	41
Indirect Labor	8	9	9	10	11	11	12	13	14	14
Water	12	13	14	15	16	17	18	19	20	21
Maintenance	3	3	3	3	4	4	4	4	5	5
Oil	369	403	462	523	592	670	759	847	944	1053
Electricity	7	3	9	10	11	13	14	16	18	21
TOTAL O&M	422	466	524	590	664	748	843	936	1040	1155
TOTAL EXPENSES	3241	3466	3755	4070	4416	4791	5205	5597	6026	6489
PRE-TAX SAVING (i.e., Gross Savings- Less Expenses)	3085	3495	4013	4605	5274	6042	6911	7774	8736	9817

TABLE B.15 (continued)

WASTE RECOVERY MODEL INCOME STATEMENT (\$000)										
INDUSTRIAL ENERGY USER										
YEARS	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003

GROSS SAVINGS										

Fuel Oil	14682	16375	17297	18271	19299	20386	21533	22746	24026	25379
Non-Energy O&M	632	668	706	745	787	832	879	928	980	1035
Electricity	288	323	342	361	381	403	425	449	475	501
MSW Disposal Fees	2414	2550	2694	2845	3006	3175	3354	3542	3742	3953

TOTAL GROSS SAVINGS	18016	19917	21038	22222	23474	24796	26192	27665	29223	30869
EXPENSES										

Operating Fees	5712	6118	6462	6828	7211	7618	8047	8499	8978	9482
O&M (Backup Capacity)										
Direct Labor	44	46	49	51	54	57	61	64	68	71
Indirect Labor	15	16	17	18	19	20	21	22	24	25
Water	22	23	25	26	27	29	31	32	34	36
Maintenance	5	6	6	6	7	7	7	8	8	9
Oil	1174	1310	1384	1461	1544	1631	1722	1819	1922	2030
Electricity	23	26	27	29	31	32	34	36	38	40

TOTAL O&M	1284	1427	1507	1592	1682	1776	1876	1982	2093	2211

TOTAL EXPENSES	6996	7545	7969	8420	8893	9394	9923	10481	11071	11693

PRE-TAX SAVING (i.e., Gross Savings Less Expenses)	11020	12372	13069	13802	14581	15402	16269	17184	18152	19176

TABLE B.16

INCOME STATEMENT: OPTION 5 (LOW-SULFUR COAL)

WASTE RECOVERY MODEL INCOME STATEMENT (\$000)										
INDUSTRIAL ENERGY USER										
YEARS	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
GROSS SAVINGS										
Fuel Oil	10132	11202	12683	14359	16256	18407	20840	23243	25923	28912
Non-Energy O&M	528	570	609	650	694	742	752	837	884	934
Electricity	192	222	249	279	314	353	356	446	501	563
TOTAL GROSS SAVINGS	10851	11993	13540	15289	17265	19502	22029	24526	27308	30408
EXPENSES										
O&M										
Direct Labor	257	277	296	316	336	361	385	407	430	454
Indirect Labor	90	97	104	111	118	126	135	142	150	159
Coal	3613	4149	4515	4912	5344	5814	6326	6811	7334	7896
Water	275	297	318	339	362	387	413	437	461	487
Maintenance	701	757	809	864	922	985	1052	1112	1174	1240
Insurance	90	87	93	99	106	113	120	127	134	142
Ash Disposal	108	117	126	135	146	157	169	181	193	206
Oil (Backup Capacity)	152	168	190	215	244	276	313	349	389	434
Electricity	424	490	551	619	695	781	878	987	1109	1246
TOTAL O&M	5700	6439	7000	7610	8275	9001	9752	10552	11374	12264
TOTAL EXPENSES	5700	6439	7000	7610	8275	9001	9752	10552	11374	12264
PRE-TAX SAVING (i.e., Gross Savings Less Expenses)	5151	5554	6540	7679	8990	10501	12257	13974	15934	18144

TABLE B.16 (continued)

WASTE RECOVERY MODEL INCOME STATEMENT (\$000)										
INDUSTRIAL ENERGY USER										
YEARS	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
GROSS SAVINGS										
Fuel Oil	32246	35964	37988	40127	42386	44773	47293	49956	52768	55739
Non-Energy O&M	986	1042	1100	1162	1228	1297	1370	1447	1528	1614
Electricity	632	710	750	792	837	884	934	987	1042	1101
TOTAL GROSS SAVINGS	33863	37716	39838	42081	44451	46953	49597	52389	55338	58454
EXPENSES										
Steam Purchase Payments O&M (Backup Capacity)	30477	33944	35854	37873	40006	42258	44637	47150	49804	52609
Direct Labor	44	46	49	51	54	57	61	64	68	71
Indirect Labor	15	16	17	18	19	20	21	22	24	25
Water	8	8	9	9	10	10	11	11	12	13
Maintenance	2	2	2	2	3	3	3	3	3	3
Oil	484	539	570	602	636	672	709	749	791	836
Electricity	9	11	11	12	13	13	14	15	16	17
TOTAL O&M	562	623	658	695	734	775	819	865	913	965
TOTAL EXPENSES	31038	34567	36512	38518	40740	43033	45456	48015	50718	53573
PRE-TAX SAVING (i.e., Gross Savings Less Expenses)	2825	3149	3326	3513	3711	3920	4141	4374	4620	4881

TABLE B.17

INCOME STATEMENT: OPTION 6 (HIGH-SULFUR COAL)

WASTE RECOVERY MODEL INCOME STATEMENT (\$000)										
INDUSTRIAL ENERGY USER										
YEARS	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993

GROSS SAVINGS										

Fuel Oil	10132	11202	12663	14359	16258	18407	20840	23243	25923	28912
Non-Energy O&M	528	570	609	650	694	742	792	837	884	934
Electricity	192	221	245	279	314	353	396	446	501	563

TOTAL GROSS SAVINGS	10851	11993	13540	15289	17265	19502	22028	24526	27308	30408
EXPENSES										

O&M										
Direct Labor	303	328	350	374	399	426	455	481	508	537
Indirect Labor	106	115	122	131	140	149	157	168	173	188
Coal	2866	3291	3581	3896	4239	4612	5013	5403	5817	6264
Water, soda ash, lime	451	488	521	556	594	635	673	716	756	799
Maintenance	818	883	943	1007	1076	1149	1227	1297	1370	1447
Insurance	107	115	123	131	140	150	160	169	179	189
Ash Disposal	345	374	402	433	467	503	543	578	617	658
Oil (Backup Capacity)	152	168	180	215	244	276	313	349	389	434
Electricity	490	566	637	715	804	903	1014	1140	1281	1440

TOTAL O&M	5639	6328	6869	7460	8103	8804	9568	10301	11095	11954

TOTAL EXPENSES	5639	6328	6869	7460	8103	8804	9568	10301	11095	11954

PRE-TAX SAVING (i.e., Gross Savings Less Expenses)	5212	5665	6571	7829	9162	10698	12461	14225	16213	18454

TABLE B.17 (continued)

WASTE RECOVERY MODEL INCOME STATEMENT (\$000)										
INDUSTRIAL ENERGY USER										
YEARS	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
GROSS SAVINGS										
Fuel Oil	32246	35964	37988	40127	42386	44773	47293	49956	52768	55739
Non-Energy O&M	986	1042	1100	1162	1228	1297	1370	1447	1528	1614
Electricity	632	710	750	792	837	884	934	987	1042	1101
TOTAL GROSS SAVINGS	33863	37716	39838	42081	44451	46953	49579	52389	55338	58454
EXPENSES										
O&M										
Direct Labor	567	599	633	668	706	745	787	832	879	928
Indirect Labor	198	210	221	234	247	261	276	291	308	325
Coal	6744	7261	7670	8102	8558	9040	9549	10086	10654	11254
Water, soda ash, lime	844	891	941	994	1050	1110	1172	1238	1308	1381
Maintenance	1528	1614	1705	1801	1902	2009	2123	2242	2368	2502
Insurance	199	210	222	235	248	262	277	292	309	326
Ash Disposal	703	751	793	838	885	935	987	1043	1101	1163
Oil (Backup Capacity)	484	539	570	602	636	672	709	749	792	836
Electricity	1618	1818	1921	2029	2143	2263	2391	2526	2668	2818
TOTAL O&M	12885	13894	14676	15502	16375	17297	18271	19299	20386	21534
TOTAL EXPENSES	12885	13894	14676	15502	16375	17297	18271	19299	20386	21534
PRE-TAX SAVING (i.e., Gross Savings Less Expenses)	20978	23822	25162	26579	28076	29656	31326	33090	34952	36920

TABLE B.18
INCOME STATEMENT: OPTION 7 (MSW)

WASTE RECOVERY MODEL INCOME STATEMENT (\$000)										
INDUSTRIAL ENERGY USER										
YEARS	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
GROSS SAVINGS										

Fuel Oil	10132	11202	12683	14359	16258	18407	20840	23243	25923	28912
Non-Energy O&M	528	570	609	650	694	742	792	837	884	934
Electricity	192	221	249	280	314	353	397	446	501	563
MSW Disposal Fees	2686	2901	3099	3310	3535	3776	4033	4260	4500	4753
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
TOTAL GROSS SAVINGS	13537	14894	16659	18599	20800	23278	26062	28786	31806	35161
EXPENSES										

Operating Fees	4308	4710	5095	5513	5969	6465	7011	7534	8103	8721
O&M (Backup Capacity)										
Direct Labor	23	25	27	29	31	33	35	37	39	41
Indirect Labor	8	9	9	10	11	11	12	13	14	14
Water	12	13	13	14	15	16	18	19	20	21
Maintenance	3	3	4	4	4	4	5	5	5	5
Oil	431	476	537	610	691	782	885	988	1102	1229
Electricity	8	9	11	12	13	15	17	19	21	24
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
TOTAL O&M	485	535	603	679	765	862	972	1080	1200	1334
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
TOTAL EXPENSES	4793	5245	5698	6192	6734	7327	7983	8614	9303	10055
PRE-TAX SAVING (i.e., Gross Savings Less Expenses)	8744	9649	10961	12407	14066	15951	18079	20172	22505	25106

TABLE B.18 (continued)

WASTE RECOVERY MODEL INCOME STATEMENT (\$000)										
INDUSTRIAL ENERGY USER										
YEARS	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003

GROSS SAVINGS										

Fuel Oil	32246	35963	37988	40127	42386	44772	47293	49956	52768	55739
Non-Energy O&M	986	1042	1100	1162	1228	1297	1370	1447	1528	1614
Electricity	633	711	751	793	838	885	935	987	1043	1102
MSW Disposal Fees	5021	5304	5602	5918	6251	6603	6974	7367	7782	8220

TOTAL GROSS SAVINGS	38884	43020	45440	47999	50702	53556	56571	59756	63120	66674

EXPENSES										

Operating Fees	9395	10126	10860	11467	12117	12798	13520	14281	15084	15934
O&M (Backup Capacity)										
Direct Labor	44	46	49	51	54	57	61	64	68	71
Indirect Labor	15	16	17	18	19	20	21	22	24	25
Water	22	23	24	26	27	29	30	32	34	36
Maintenance	6	6	6	7	7	7	8	8	9	9
Oil	1370	1528	1614	1705	1801	1903	2010	2123	2243	2369
Electricity	27	30	34	36	38	40	42	45	47	50

TOTAL O&M	1484	1650	1745	1843	1947	2056	2172	2295	2424	2560

TOTAL EXPENSES	10879	11776	12605	13310	14064	14854	15692	16576	17508	18494

PRE-TAX SAVING (i.e., Gross Savings Less Expenses)	28005	31244	32835	34689	36638	38702	40879	43180	45612	48180

TABLE B.19

INCOME STATEMENT: OPTION 8 (HIGH-SULFUR COAL)

WASTE RECOVERY MODEL INCOME STATEMENT (\$000)										
INDUSTRIAL ENERGY USER	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
YEARS	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
GROSS SAVINGS	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Fuel Oil	10132	11202	12683	14359	16258	18407	20840	23243	25923	28912
Non-Energy O&M	528	570	609	650	694	742	792	837	884	934
Electricity	192	221	249	279	314	353	396	446	501	563
TOTAL GROSS SAVINGS	10851	11993	13540	15289	17265	19502	22029	24526	27338	30409
EXPENSES	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Steam Purchase Payments O&M (Backup Capacity)	9766	10794	12166	13760	15539	17552	19826	22073	24577	27367
Direct Labor	23	25	27	29	31	33	35	37	39	41
Indirect Labor	8	9	9	10	11	11	12	13	14	14
Water	4	4	5	5	5	6	6	7	7	7
Maintenance	1	1	1	1	1	2	2	2	2	2
Oil	152	168	190	215	244	276	313	349	389	434
Electricity	3	3	4	4	5	5	6	7	8	9
TOTAL O&M	192	211	236	265	297	333	374	414	458	507
TOTAL EXPENSES	9957	11005	12422	14025	15835	17885	20200	22487	25035	27874
PRE-TAX SAVING (i.e., Gross Savings Less Expenses)	894	988	1118	1264	1430	1617	1829	2039	2273	2534

TABLE B.19 (continued)

WASTE RECOVERY MODEL INCOME STATEMENT (\$000)										
INDUSTRIAL ENERGY USER										
YEARS	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003

GROSS SAVINGS										

Fuel Oil	32246	35964	37988	40127	42386	44773	47293	49956	52768	55739
Non-Energy O&M	986	1042	1100	1162	1228	1297	1370	1447	1528	1614
Electricity	632	710	750	792	837	884	934	987	1042	1101

TOTAL GROSS SAVINGS	33863	37716	39838	42081	44451	46953	49597	52389	55338	58454
EXPENSES										

Steam Purchase Payments	30477	33944	35854	37873	40006	42258	44637	47150	49804	52609
O&M (Backup Capacity)										
Direct Labor	44	46	49	51	54	57	61	64	68	71
Indirect Labor	15	16	17	18	19	20	21	22	24	25
Water	8	8	9	9	10	10	11	11	12	13
Maintenance	2	2	2	2	3	3	3	3	3	3
Oil	484	539	570	602	636	672	709	749	791	836
Electricity	9	11	11	12	13	13	14	15	16	17

TOTAL O&M	562	623	658	695	734	775	819	865	913	965

TOTAL EXPENSES	31038	34567	36512	38518	40740	43033	45456	48015	50718	53573
PRE-TAX SAVING (i.e., Gross Savings Less Expenses)	2825	3149	3326	3513	3711	3920	4141	4374	4620	4881

TABLE B.20
INCOME STATEMENT: OPTION 9 (MSW)

WASTE RECOVERY MODEL INCOME STATEMENT (\$000)										
INDUSTRIAL ENERGY USER										
YEARS	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
GROSS SAVINGS										
Fuel Oil	10132	11202	12683	14359	16258	18407	20840	23243	25923	28912
Non-Energy O&M	528	570	609	650	694	742	792	837	884	934
Electricity	192	221	249	280	314	353	397	446	501	563
MSW Disposal Fees	2636	2901	3099	3310	3535	3775	4033	4260	4500	4753
TOTAL GROSS SAVINGS	13537	14894	16639	18599	20800	23278	26062	29786	31808	35161
EXPENSES										
Steam Purchase Payments (O&M (Backup Capacity))	9766	10794	12186	13760	15535	17552	19826	22073	24577	27267
Direct Labor	23	25	27	29	31	33	35	37	39	41
Indirect Labor	8	9	9	10	11	11	12	13	14	14
Water	12	13	14	14	15	16	18	19	20	21
Maintenance	3	3	4	4	4	4	5	5	5	5
Oil	431	476	539	610	691	782	836	988	1102	1229
Electricity	8	9	11	12	13	15	17	19	21	24
TOTAL O&M	485	535	603	679	765	862	972	1080	1200	1334
TOTAL EXPENSES	10251	11329	12789	14439	16304	18414	20798	23153	25778	28702
PRE-TAX SAVING (i.e., Gross Savings Less Expenses)	3286	3565	3850	4160	4496	4864	5264	5633	6030	6459

TABLE B.20 (continued)

WASTE RECOVERY MODEL INCOME STATEMENT (\$000)										
INDUSTRIAL ENERGY USER										
YEARS	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
GROSS SAVINGS										
Fuel Oil	32246	35964	37988	40127	42386	44773	47293	49956	52768	55739
Non-Energy O&M	986	1042	1100	1162	1228	1297	1370	1447	1528	1614
Electricity	633	711	751	793	838	885	935	987	1043	1102
MSW Disposal Fees	5021	5304	5602	5918	6251	6603	6974	7367	7782	8220
TOTAL GROSS SAVINGS	38884	43020	45440	47979	50702	53556	56571	59756	63120	66674
EXPENSES										
Steam Purchase Payments B&M (Backup Capacity)	30477	33944	35854	37873	40006	42258	44637	47150	49804	52609
Direct Labor	44	46	49	51	54	57	61	64	68	71
Indirect Labor	15	16	17	18	19	20	21	22	24	25
Water	22	23	24	26	27	29	30	32	34	36
Maintenance	6	6	6	7	7	7	8	8	9	9
Oil	1370	1528	1614	1705	1801	1903	2010	2123	2243	2369
Electricity	27	30	32	34	36	38	40	42	44	47
TOTAL O&M	1484	1650	1743	1841	1945	2054	2170	2292	2421	2557
TOTAL EXPENSES	31960	35594	37597	39714	41950	44312	46807	49442	52225	55166
PRE-TAX SAVING (i.e., Gross Savings Less Expenses)	6924	7426	7843	8285	8752	9244	9764	10314	10895	11508

APPENDIX C

SUMMARY OF AVAILABLE TAX BENEFITS FOR MSW-BURNING AND COAL-BURNING ENERGY PRODUCTION FACILITIES

The passage of the Economic Recovery Tax Act of 1981 and the Tax Equity and Fiscal Responsibility Act of 1982 has significantly changed the tax implications of investing in new MSW-burning and coal-burning energy production facilities. Of particular concern are provisions for the issuance of tax-exempt bonds for private industry activities, depreciation write-offs, tax credits, and leasing options.

These provisions are summarized below, followed by an illustrative quantification of certain tax benefits available to a new MSW- or coal-burning energy production facility. The following summary is not intended to be comprehensive; it does, however, provide the basis for the analysis presented in Appendix D.*

TAX-EXEMPT FINANCING

Industrial Development Bonds (IDBs) are debt obligations where the proceeds of the issue are used to finance property used in a for-profit business or trade and where payment of principal and interest is secured by the property or by payments with respect to the property. Interest earned by the bondholders on IDBs is usually taxable.

Tax-exempt IDBs can, however, be issued in certain cases. First, for a number of specified "exempt facilities," including certain solid waste disposal facilities and pollution control equipment, tax-exempt IDBs can be issued for up to 100 percent of the capital cost of the project. The MSW plant options considered in this study fall into this exempt-facilities category. Second, for facilities that do not qualify as exempt facilities, certain small-issue tax-exempt IDBs for the acquisition, construction, or improvement of land or depreciable property are available. These small-issue IDBs will only be available through December 31, 1986, and can only be used to finance

* Tax counsel should be consulted to ensure that all available tax benefits are considered when investing in a new MSW- or coal-burning plant.

a project with a capital cost of up to \$10 million.* These small-issue tax-exempt IDBs could, therefore, be used to finance small coal plants.

In considering the use of tax-exempt IDBs to finance coal facilities, it is important to note that there is a trade-off issue. Namely, when small-issue tax-exempt IDBs are used, the Accelerated Cost Recovery System (ACRS) cannot be employed for depreciation write-offs. Instead, a straight-line depreciation schedule must be applied over the applicable depreciation period of the property.

This restriction on the use of ACRS does not apply to MSW-burning energy production facilities financed via tax-exempt IDBs, provided that the waste used as feedstock is collected from the general public. The phrase "general public," as amplified in the House-Senate Conference Report for clarification of Congressional intent, appears to include the following:

- Qualifying MSW-burning facilities may collect waste from within the governmental unit or from a larger, multi-jurisdictional area.
- Qualifying facilities may be operated by a governmental unit or by a private company.
- Waste collected need not include source-separated or recyclable materials.
- The general public from which wastes are collected may include residential and commercial wastes, as well as nonhazardous and nontoxic industrial wastes.

The Tax Equity and Fiscal Responsibility Act has added certain reporting requirements for the use of tax-exempt IDBs by private enterprises, as well as the requirement for public hearings and approval by an elected official or legislative body. In addition, there is a limit on the term of maturity of IDBs that is tied to the useful life of the financed facility.

DEPRECIATION WRITE-OFFS

As discussed previously, MSW-burning energy production facilities financed with tax-exempt IDBs can also use the ACRS depreciation write-offs; a coal-burning energy production facility financed via

* In the case of a facility for which an Urban Development Action Grant has been made, capital expenditures of up to \$20 million are allowed.

small-issue tax-exempt IDBs must use straight-line depreciation, rather than ACRS. When financed with taxable bonds, either type of facility can use ACRS. Use of ACRS allows more of the asset to be written off in the years immediately after it is placed in service.

In general, except for land,* all property (equipment and real property) qualifies for depreciation. The cost basis for the depreciation of property includes engineering and design costs and any applicable capitalized interest on debt financing, except for capitalized interest on real property. Capitalized interest on real property and other financing costs (e.g., issuance fees) must be depreciated separately.

Classifying property as equipment (3- and 5-year property) or real property has a significant impact on available ACRS write-offs for an MSW- or coal-burning energy production facility. In general, for these types of facilities: 3-year property includes rolling stock, such as front-end loaders, cars, light-duty trucks, and short-lived equipment; 5-year property includes most equipment and appurtenances, such as furnaces/boilers, cranes, ash handling equipment, pumps, motors, water treatment equipment, and deaerators, and represents the major portion of the capital expense; and real property includes buildings and other permanent structures.

The Tax Equity and Fiscal Responsibility Act has repealed the more rapid ACRS depreciation schedules that were to apply to equipment placed in service in 1985 and after. Therefore, the ACRS depreciation schedule given in Table C.1 is applicable to all 3- and 5-year property regardless of the in-service date. Table C.2 provides the ACRS depreciation schedule for real property. The ACRS write-off is equal to the cost basis for the property multiplied by the recovery percentage for the particular recovery year.

Interest expenses and real estate taxes attributed to the construction period of nonresidential real property, which must be depreciated separately, are capitalized and depreciated using the straight-line method over a 10-year period. One-tenth of the capitalized amounts is deductible in the year paid or accrued; the remaining nine-tenths is deducted over a 9-year period beginning with the year the property is placed in service.

TAX CREDITS

Ten-percent and six-percent Investment Tax Credits (ITCs) are available for both MSW-burning and coal-burning energy production facilities. Tangible personal property, such as equipment (i.e.,

* For tax purposes, land cannot be depreciated.

TABLE C.1

ACRS DEPRECIATION SCHEDULE
FOR 3- AND 5-YEAR PROPERTY^a

RECOVERY YEAR	RECOVERY PERCENTAGE (% of applicable cost basis)	
	3-Year Property	5-Year Property
1	25	15
2	38	22
3	37	21
4	--	21
5	--	21
TOTAL	100%	100%

- a. Schedule is independent of month in which property is placed in service. The schedule uses the half-year conversion (i.e., it assumes property is placed in service mid-year).

TABLE C.2

ACRS DEPRECIATION SCHEDULE
FOR REAL PROPERTY

RECOVERY YEAR	RECOVERY PERCENTAGE (% of applicable cost basis)											
	Month ^a											
	1	2	3	4	5	6	7	8	9	10	11	12
1	12	11	10	9	8	7	6	5	4	3	2	1
2	10	10	11	11	11	11	11	11	11	11	11	12
3	9	9	9	9	10	10	10	10	10	10	10	10
4	8	8	8	8	8	8	9	9	9	9	9	9
5	7	7	7	7	7	7	8	8	8	8	8	8
6	6	6	6	6	7	7	7	7	7	7	7	7
7	6	6	6	6	6	6	6	6	6	6	6	6
8	6	6	6	6	6	6	5	6	6	6	6	6
9	6	6	6	6	5	6	5	5	5	6	6	6
10	5	6	5	6	5	5	5	5	5	5	6	5
11	5	5	5	5	5	5	5	5	5	5	5	5
12	5	5	5	5	5	5	5	5	5	5	5	5
13	5	5	5	5	5	5	5	5	5	5	5	5
14	5	5	5	5	5	5	5	5	5	5	5	5
15	5	5	5	5	5	5	5	5	5	5	5	5
16	--	--	1	1	2	2	3	3	4	4	4	5
TOTAL	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

a. Indicates month in first year in which property is placed in service.

5-year property), qualifies for an ITC equal to 10 percent of the cost of the qualifying property. Qualifying property subject to the 3-year ACRS recovery period (3-year property) is eligible only for a 6-percent ITC. Real property generally does not qualify for an ITC.

ITCs are not allowed for any property owned, used, or leased by a state or local government or a tax-exempt organization. Thus, even when an MSW plant is privately owned, the municipal use issue must be considered in a tax benefit analysis because of the source of the waste supply. If waste supply contracts are structured properly, the municipal use issue will not preclude capture of ITC benefits. Therefore, the analysis presented in Appendix D assumes that ITCs are available for both the MSW and the coal plant options.

The ITC is generally available in the year the qualifying property is placed in service. For property having a construction period of over 2 years, the ITC can be taken on a prorata basis as construction progresses. Because all of the new plant options considered in this analysis are assumed to have a 2-year construction period, this latter provision does not apply.

Subject to certain limited exceptions, when the full ITC is taken for equipment (in this case, 3- and 5-year property) placed in service after 1982, the cost basis for computing the depreciation write-off must be reduced by one-half of the ITC percentage basis. That is, for a 10-percent ITC, the cost basis for depreciation would be reduced by 5 percent, and for a 6-percent ITC, it would be reduced by 3 percent. Instead of reducing the cost basis for depreciation, the tax owner may elect to reduce the applicable ITC by 2 percent. That is, the 10-percent ITC would become 8 percent, and the 6-percent ITC would become 4 percent. The analysis presented in Appendix D assumed that the full ITC is taken with the corresponding reduction in the cost basis for depreciation of the property.

Since December 31, 1982, Energy Tax Credits (ETCs) that were authorized under the Energy Tax Act of 1978 are generally no longer available for the type of property considered in this analysis. Portions of an MSW-burning energy production facility may qualify as a biomass property and, thus be eligible for an ETC to the extent the costs are not financed with tax-exempt debt. Because the use of taxable debt for MSW-burning facilities was not considered in this report, the analysis does not include an ETC for biomass property.

LEASING OPTIONS

Changes in leasing rules under the Tax Equity and Fiscal Responsibility Act are too extensive to be reviewed within the scope of this summary. In short, the Act repeals the Safe Harbor Leasing provisions for leases entered into after December 31, 1983, but allows a modified version of Safe Harbor Leasing for the period between July 1, 1982, and January 1, 1984. Because the analysis presented in this report does not address leasing options, changes in these options under current tax law are not discussed further. For more information, the reader is referred to "Summary of the Revenue Provisions of H.R. 4961" (The Tax Equity and Fiscal Responsibility Act of 1982).

EXAMPLE OF ITC AND ACRS TAX BENEFITS

Table C.3 presents ITC and ACRS tax benefits available to Facility X, a new MSW- or coal-burning energy production facility. To quantify these benefits, the following simplifying assumptions were made:

- Total construction cost -- \$10,000,000
 - Equipment (all equipment is 5-year property) -- \$8,500,000
 - Buildings (real property) -- \$1,500,000.
- Land is leased, not purchased.
- Corporate tax rate -- 46 percent.
- Financing -- 100-percent taxable debt.
- Facility completion date -- July 1, 1985.
- Full ITC taken in year facility completed.
- All depreciation write-offs used in year available.

TABLE C.3
ITC AND ACRS TAX BENEFITS
AVAILABLE TO FACILITY X

YEAR	ITC	ACRS		TAX SAVINGS
		5-Year Property	Real Property	
1	\$850,000 ^a	\$1,211,250 ^b	\$ 90,000 ^c	\$1,448,575 ^d
2	--	1,776,500	165,000	893,090
3	--	1,695,750	150,000	849,045
4	--	1,695,750	135,000	842,145
5	--	1,695,750	120,000	835,245
6	--	--	105,000	48,300
7	--	--	90,000	41,400
8	--	--	75,000	34,500
9	--	--	75,000	34,500
10	--	--	75,000	34,500
11	--	--	75,000	34,500
12	--	--	75,000	34,500
13	--	--	75,000	34,500
14	--	--	75,000	34,500
15	--	--	75,000	34,500
16	--	--	45,000	20,700
TOTAL	\$850,000	\$8,075,000	\$1,500,000	\$5,254,700

- a. \$850,000 equals the cost of equipment (\$8,500,000) times 0.10 (full 10-percent ITC is taken for 5-year property).
- b. \$1,211,250 equals the recovery percentage from Table C.1 (0.15) times the cost of equipment (\$8,500,000) times 0.95 (because the full 10-percent ITC is taken, the cost basis for depreciation is reduced by 5 percent).
- c. \$90,000 equals the recovery percentage from Table C.2 (0.06) times the cost of real property (\$1,500,000).
- d. \$1,448,575 equals the corporate tax rate (0.46) times total ACRS write-offs (\$1,211,250 + \$90,000) plus the ITC (\$850,000).

APPENDIX D

METHODOLOGY AND ASSUMPTIONS FOR CALCULATING RETURNS TO THE INDUSTRIAL ENERGY USER

This appendix describes the methodology and assumptions used to calculate returns to the industrial energy user (measured as internal rates of return on an after-tax basis and payback periods). In addition, the industrial energy user's annual cash flows are given for the 20-year financing period of the bonds.

This appendix only addresses Options 1 through 7, i.e., those options where the industrial energy user owns the new coal or MSW plant. In Options 8 and 9, the industrial energy user has no ownership interest in the plant and, thus, does not receive the tax benefits of ownership and is not obligated for the debt. In these latter options, the industrial energy user's after-tax returns are its net savings as given in Appendix B (i.e., gross oil plant O&M savings minus energy purchase payments and backup oil O&M expenses) after adjustment for taxes.* Accordingly, Options 8 and 9 are not addressed further in the remainder of this appendix.

All of the options assume 100-percent debt financing. The MSW plant options assume financing via tax-exempt IDBs. The coal plant options assume financing via taxable IDBs, except for the smallest coal option (Option 1), which was analyzed for both small-issue tax-exempt IDBs and taxable IDBs. To provide an indication of the effects of bond interest rates on returns, each financing scenario considered two different interest rates. Table D.1 indicates the financing scenarios analyzed for the various coal and MSW plant options.

While this analysis assumes 100-percent IDB financing, it should be noted that there are a variety of possible financing scenarios. First, a combination of debt and equity can be used. Second, debt obligations other than IDBs can be used. Finally, a different type of financing structure (e.g., leasing) could be considered.

In the following section, the general methodology and assumptions used to calculate internal rates of return and payback periods are discussed. This discussion is followed by the return calculations. At the end of this appendix, annual cash flows are presented.

* In these two options, the steam price paid by the industrial energy user to the independent contractor (the plant owner) must allow for attractive returns to the independent contractor. In making an investment decision, the independent contractor would perform an analysis similar to the return analysis described in this appendix.

TABLE D.1
DESCRIPTION OF COAL AND
MSW STEAM PLANT OPTIONS^a

OPTION	PEAK STEAM DEMAND OF INDUSTRIAL ENERGY USER (lbs/hr)	FUEL TYPE/ TECHNOLOGY	OWNERSHIP AND OPERATING STRUCTURE	FINANCING SCENARIO ^a	
1	28,000	Low-Sulfur Coal/Chain- Grate Stoker Package Units	Industry Owns and Operates	Taxable - 17% - 13%	Tax-Exempt - 14% - 10%
2	28,000	MSW/Starved- Air Massburn Units	Industry Owns; Independent Contractor Operates	Tax-Exempt - 14% - 10%	
3	56,000	Low-Sulfur Coal/ Spreader- Stoker Package Units	Industry Owns and Operates	Taxable - 17% - 13%	
4	56,000	MSW/Starved- Air Massburn Units	Industry Owns; Independent Contractor Operates	Tax-Exempt - 14% - 10%	
5	123,000	Low-Sulfur Coal/Pul- verized Coal Unit	Industry Owns and Operates	Taxable - 17% - 13%	
6	123,000	High-Sulfur Coal/Pul- verized Coal Unit	Industry Owns and Operates	Taxable - 17% - 13%	
7	123,000	MSW/Excess- Air Mass- burn Units	Industry Owns; Independent Contractor Operates	Tax-Exempt - 14% - 10%	

a. 100-percent debt financing is assumed in all cases.

GENERAL METHODOLOGY AND ASSUMPTIONS

To calculate the internal rates of return and the payback periods, the following was first performed:

1. The required capital investment was estimated.
2. Costs were broken down by property type.
3. Tax benefits were calculated.

Each is discussed in the following subsections.

Capital Investment Estimation

Because 100-percent debt financing was assumed for all options, the capital investment is the same as the bond size and represents the total obligation of the owner. Once the bond size is determined, the issuance fees, the principal and interest payments during the bond amortization period, and the net capitalized interest payments (net of interest earnings during the 2-year construction period) can be calculated.

All of the capital investment estimates assumed the following:

- July 1, 1982, financing date.
- 20-year amortization period.
- 100-percent debt financing.
- No reserve funds.
- 24-month construction period.
- Uniform construction drawdown schedule.
- 24 months of interest capitalized and paid (semi-annually) from the bond proceeds.
- No arbitrage on construction or capitalized interest funds.
- 4-percent bond issuance fees.

Table D.2 provides the capital investment estimates for the plant options.

The construction costs for the MSW plant options are assumed to be firm fixed prices (i.e., they do not escalate over the 2-year construction period). They are based on recent firm fixed price bids

TABLE D.2
CAPITAL INVESTMENT ESTIMATES (\$000)

	TOTAL CONSTRUCTION COST ^a	TOTAL CAPITAL INVESTMENT (Bond Size)	DEBT SERVICE	ISSUANCE Fees
OPTION 1				
Taxable:				
• 17 percent	\$ 4,100	\$ 5,200	\$ 920	\$ 210
• 13 percent	4,100	4,900	700	200
Tax-Exempt:				
• 14 percent	4,100	5,000	750	200
• 10 percent	4,100	4,000	560	190
OPTION 2				
Tax-Exempt:				
• 14 percent	7,300	8,900	1,300	360
• 10 percent	7,300	8,500	1,000	340
OPTION 3				
Taxable:				
• 17 percent	7,500	9,400	1,700	380
• 13 percent	7,500	9,000	1,300	360
OPTION 4				
Tax-Exempt:				
• 14 percent	12,000	15,000	2,200	590
• 10 percent	12,000	14,000	1,600	560
OPTION 5				
Taxable:				
• 17 percent	26,000	33,000	5,800	1,300
• 13 percent	26,000	31,000	4,400	1,200
OPTION 6				
Taxable:				
• 17 percent	30,000	38,000	6,800	1,500
• 13 percent	30,000	36,000	5,200	1,500
OPTION 7				
Tax-Exempt:				
• 14 percent	24,000	29,000	4,400	1,200
• 10 percent	24,000	28,000	3,300	1,100

a. Includes escalation during 2-year construction period for coal plant options.

for comparably sized facilities and engineering estimates. The construction costs for the coal plant options were calculated in 1982 dollars based on engineering estimates and were escalated during the construction period according to the DOE forecast for the GNP Price Deflator.

Table D.3 gives the net capitalized interest payments (i.e., capitalized interest payments minus interest earnings on the construction and capitalized interest funds) made each year during the 2-year construction period for each option.

Cost Breakdown By Property Type

As discussed in Appendix C, in order to calculate the tax benefits under each plant option, the construction cost and the net capitalized interest payments must be broken down by property type. Table D.4 provides a construction cost breakdown by property type (3-year, 5-year, and real property). In Table D.5, the net capitalized interest payments are broken down by property type.

Tax Benefit Calculations

The calculations of ITC deductions and depreciation write-offs are presented below.

ITC Deductions. As discussed in Appendix C, for the type of plants considered in this analysis, both 3- and 5-year property are eligible for ITCs; real property is not eligible. This analysis assumed that the full ITCs (i.e., 10-percent ITC for 5-year property and 6-percent ITC for 3-year property) are taken in the first year of plant operations.

For both 3- and 5-year property, the cost basis for determining the ITC consists of the construction cost (including design and engineering costs) and net capitalized interest payments attributable to the property type. Table D.6 gives the ITCs calculated for each option.

Depreciation Write-Offs. As discussed in Appendix C, ACRS depreciation write-offs can be used for the MSW plant options financed via tax-exempt IDBs and for the coal plant options financed via taxable IDBs. Straight-line depreciation must be used for the smallest coal plant option under the small-issue tax-exempt financing scenario. In addition, under all options, net capitalized interest payments attributable to real property and issuance fees must be depreciated separately using the straight-line method.

For both 3- and 5-year property, the cost basis for depreciation consists of the construction costs (including design and engineering costs) and net capitalized interest payments attributable to the

TABLE D.3

NET CAPITALIZED INTEREST PAYMENTS
DURING CONSTRUCTION PERIOD (\$000)

	OPTION															
	1				2		3		4		5		6		7	
	Taxable		Tax-Exempt		Tax-Exempt		Taxable		Tax-Exempt		Taxable		Taxable		Tax-Exempt	
	17%	13%	14%	10%	14%	10%	17%	13%	14%	10%	17%	13%	17%	13%	14%	10%
<u>1982</u>																
Capitalized Interest Paid	\$830	\$640	\$700	\$480	\$1,200	\$350	\$1,600	\$1,200	\$2,000	\$1,400	\$5,500	\$4,100	\$6,500	\$4,700	\$4,100	\$2,800
Interest Earned On:																
• Construction Fund	430	340	370	270	640	480	780	620	1,100	790	2,710	2,200	3,200	2,500	2,100	1,600
• Capitalized Interest Fund	210	120	140	73	250	130	380	220	420	210	1,300	780	1,600	910	840	430
Total Interest Earned ^a	640	470	510	350	890	610	1,200	850	1,500	1,000	4,000	2,900	4,700	3,400	2,900	2,000
Net Capitalized Interest Payments	\$240	\$170	\$190	\$130	\$ 350	\$240	\$ 430	\$ 320	\$ 580	\$ 400	\$1,500	\$1,100	\$1,800	\$1,300	\$1,200	\$ 790
<u>1983</u>																
Capitalized Interest Paid	\$830	\$640	\$700	\$480	\$1,200	\$350	\$1,600	\$1,200	\$2,000	\$1,400	\$5,500	\$4,100	\$6,500	\$4,700	\$4,100	\$2,800
Interest Earned On:																
• Construction Fund	170	130	140	100	240	180	300	240	390	290	1,100	830	1,200	970	780	580
• Capitalized Interest Fund	37	56	65	33	120	58	180	100	130	96	610	350	710	410	380	190
Total Interest Earned ^a	250	190	210	140	350	230	480	340	530	380	1,700	1,200	1,900	1,400	1,200	770
Net Capitalized Interest Payments	\$610	\$450	\$490	\$340	\$ 890	\$520	\$1,100	\$ 820	\$1,500	\$1,000	\$3,900	\$2,900	\$4,500	\$3,300	\$2,900	\$2,000

a. Sum of components may not equal total because of rounding.

TABLE D.4

CONSTRUCTION COST BREAKDOWN BY PROPERTY TYPE
(\$000)

PROPERTY TYPE	OPTION						
	1	2	3	4	5	6	7
3-Year Property	\$ 50	\$ 630	\$ 91	\$ 630	\$ 320	\$ 370	\$ 290
5-Year Property	3,200	5,300	5,800	9,200	20,000	23,000	17,000
Real Property	<u>880</u>	<u>1,300</u>	<u>1,600</u>	<u>2,200</u>	<u>5,500</u>	<u>6,500</u>	<u>7,100</u>
TOTAL ^a	4,100	7,300	7,500	12,000	26,000	30,000	24,000

a. Sum of components may not equal total because of rounding.

TABLE D.5
NET CAPITALIZED INTEREST PAYMENTS
BY PROPERTY TYPE (\$000)

	1982				1983			
	PROPERTY TYPE				PROPERTY TYPE			
	3-Year	5-Year	Real	Total	3-Year	5-Year	Real	Total
OPTION 1								
Taxable:								
• 17 percent	\$ 2.9	180	51	\$ 240	\$ 7.5	480	130	\$ 610
• 13 percent	\$ 2.1	140	37	\$ 170	\$ 5.5	350	97	\$ 450
Tax-Exempt:								
• 14 percent	\$ 2.3	150	41	\$ 190	\$ 6	380	110	\$ 490
• 10 percent	\$ 1.6	100	28	\$ 130	\$ 4.2	260	73	\$ 340
OPTION 2								
Tax-Exempt:								
• 14 percent	\$ 30	260	64	\$ 350	\$ 77	650	160	\$ 890
• 10 percent	\$ 21	180	44	\$ 240	\$ 53	450	110	\$ 620
OPTION 3								
Taxable:								
• 17 percent	\$ 5.3	340	92	\$ 430	\$ 14	860	240	\$1,100
• 13 percent	\$ 3.9	250	68	\$ 320	\$ 10	640	180	\$ 820
OPTION 4								
Tax-Exempt:								
• 14 percent:	\$ 30	440	110	\$ 580	\$ 77	1,100	270	\$1,500
• 10 percent:	\$ 21	300	72	\$ 400	\$ 53	780	180	\$1,000
OPTION 5								
Taxable:								
• 17 percent	\$ 18	1,200	320	\$1,500	\$ 47	3,000	830	\$3,900
• 13 percent	\$ 11	860	240	\$1,100	\$ 35	2,200	610	\$2,900
OPTION 6								
Taxable:								
• 17 percent	\$ 21	1,400	380	\$1,800	\$ 55	3,500	960	\$4,500
• 13 percent	\$ 16	1,000	270	\$1,300	\$ 41	2,600	710	\$3,300
OPTION 7								
Tax-Exempt:								
• 14 percent	\$ 14	800	340	\$1,200	\$ 35	2,000	870	\$2,900
• 10 percent	\$ 9.6	550	230	\$ 790	\$ 24	1,400	600	\$2,000

a. Sum of components may not equal total because of rounding.

TABLE D.6
CALCULATED ITCS (\$000)

	3-YEAR PROPERTY		5-YEAR PROPERTY		TOTAL ITC ^a
	Cost Basis	ITC (6%)	Cost Basis	ITC (10%)	
OPTION 1					
Taxable:					
• 17 percent	\$ 60	3.6	3,800	380	\$ 390
• 13 percent	\$ 58	3.5	3,700	370	\$ 370
Tax-Exempt:					
• 14 percent	\$ 58	3.5	3,700	370	\$ 370
• 10 percent	\$ 56	3.4	3,500	350	\$ 360
OPTION 2					
Tax-Exempt:					
• 14 percent	\$ 740	44	6,300	630	\$ 670
• 10 percent	\$ 700	42	6,000	600	\$ 640
OPTION 3					
Taxable:					
• 17 percent	\$ 110	6.6	7,000	700	\$ 700
• 13 percent	\$ 105	6.3	6,700	670	\$ 670
OPTION 4					
Tax-Exempt:					
• 14 percent	\$ 730	44	11,000	1,100	\$1,100
• 10 percent	\$ 700	42	10,000	1,000	\$1,100
OPTION 5					
Taxable:					
• 17 percent	\$ 380	23	24,000	2,400	\$2,500
• 13 percent	\$ 360	22	23,000	2,300	\$2,300
OPTION 6					
Taxable:					
• 17 percent	\$ 450	27	28,000	2,800	\$2,900
• 13 percent	\$ 430	26	27,000	2,700	\$2,700
OPTION 7					
Tax-Exempt:					
• 14 percent	\$ 340	20	19,000	1,900	\$2,000
• 10 percent	\$ 320	19	19,000	1,900	\$1,900

a. Sum of components may not equal total because of rounding.

property type. Because the analysis assumed that the full ITCs are taken, the cost basis for depreciation of 3- and 5-year property is decreased by one-half of the ITC percentage basis. The cost basis for depreciation of real property consists of the construction costs (including design and engineering costs) attributable to real property. The cost basis for depreciation of net capitalized interest payments attributable to real property for the first year of construction equals the pertinent net capitalized interest payments in 1982, and for the second year of construction, those in 1983. The cost basis for depreciation of bond issuance fees equals the total issuance fees.

Table D.7 gives the cost bases for depreciation write-offs under each option. The depreciation write-offs under each option are obtained by applying the pertinent depreciation schedules (see Tables D.8 - D.10) to these cost bases.

RETURN CALCULATIONS

The returns to the industrial energy user/owner are measured as the internal rate of return on an after-tax basis and the payback period. Table D.11 gives the internal rates of return and payback periods for each option and under each financing scenario. The internal rate of return is the calculated discount rate at which the present value of the total after-tax savings (i.e., pre-tax O&M savings adjusted for interest payments and taxes, plus tax benefits) equals the capital investment. The payback period is calculated as the number of years (from the first year of plant operations) it takes for the project to pay back the capital investment. The payback calculation is based on equivalent pre-tax income after accounting for tax benefits.

ANNUAL CASH FLOWS

Tables D.12 - D.18 provide the industrial energy user/owner's annual cash flows for each of the options during the 20-year period of plant operations. These annual cash flows account for the full debt service on the bonds (i.e., principal and interest payments).

TABLE D.7
COST BASES FOR DEPRECIATION
WRITE-OFFS (\$000)

	3-YEAR PROPERTY ^a	5-YEAR PROPERTY ^a	REAL PROPERTY (construction costs only)	NET CAPITALIZED INTEREST PAYMENTS ATTRIBUTABLE TO REAL PROPERTY		ISSUANCE FEES
				Paid in 1982	Paid in 1983	
OPTION 1						
Taxable:						
• 17 percent	\$ 59	\$ 3,700	\$ 880	\$ 51	\$ 130	\$ 210
• 13 percent	56	3,500	880	37	97	200
Tax-Exempt:						
• 14 percent	57	3,500	880	41	110	200
• 10 percent	54	3,400	880	28	73	190
OPTION 2						
Tax-Exempt:						
• 14 percent	710	5,900	1,300	64	160	360
• 10 percent	680	5,700	1,300	44	110	340
OPTION 3						
Taxable:						
• 17 percent	110	6,600	1,600	92	240	380
• 13 percent	100	6,300	1,600	68	180	360
OPTION 4						
Tax-Exempt:						
• 14 percent	710	10,000	2,200	110	270	590
• 10 percent	680	9,800	2,200	72	180	560
OPTION 5						
Taxable:						
• 17 percent	370	23,000	5,500	320	830	1,300
• 13 percent	350	22,000	5,500	240	610	1,200
OPTION 6						
Taxable:						
• 17 percent	430	27,000	6,500	380	960	1,500
• 13 percent	410	26,000	6,500	270	710	1,500
OPTION 7						
Tax-Exempt:						
• 14 percent	330	18,000	7,100	340	870	1,200
• 10 percent	310	18,000	7,100	230	600	1,100

a. Adjusted to reflect the use of full ITC deductions.

TABLE D.8

ACRS DEPRCIATION SCHEDULES
BY PROPERTY TYPE^a

RECOVERY YEAR	RECOVERY PERCENTAGE (% of applicable cost basis)		
	3-Year Property	5-Year Property	Real Property
1982	--	--	--
1983	--	--	--
1984	25	15	6
1985	38	22	11
1986	37	21	10
1987	--	21	9
1988	--	21	8
1989	--	--	7
1990	--	--	6
1991	--	--	5
1992	--	--	5
1993	--	--	5
1994	--	--	5
1995	--	--	5
1996	--	--	5
1997	--	--	5
1998	--	--	5
1999	--	--	3
TOTAL	100%	100%	100%

a. This schedule cannot be used for Coal Option 1 under the small-issue tax-exempt financing scenario.

TABLE D.9
STRAIGHT-LINE DEPRECIATION
SCHEDULE BY PROPERTY TYPE^a

RECOVERY YEAR	RECOVERY PERCENTAGE (% of applicable cost basis)		
	3-Year Property	5-Year Property	Real Property
1982	--	--	--
1983	--	--	--
1984	16.67	10	3.33
1985	33.33	20	6.67
1986	33.33	20	6.67
1987	16.67	20	6.67
1988	--	10	6.67
1989	--	10	6.67
1990	--	--	6.67
1991	--	--	6.67
1992	--	--	6.67
1993	--	--	6.67
1994	--	--	6.67
1995	--	--	6.67
1996	--	--	6.67
1997	--	--	6.67
1998	--	--	6.67
1999	--	--	3.33
TOTAL	100%	100%	100%

- a. This schedule is used for Coal Option 1 under the small-issue tax-exempt financing scenario.

TABLE D.10

STRAIGHT-LINE DEPRECIATION SCHEDULES FOR
NET CAPITALIZED INTEREST PAYMENTS
ATTRIBUTABLE TO REAL PROPERTY AND
ISSUANCE FEES

RECOVERY YEAR	RECOVERY PERCENTAGE (% of applicable cost basis)		
	Net Capitalized Interest Payments		Issuance Fees
	In 1983	In 1984	
1982	10	--	--
1983	--	10	--
1984	10	10	10
1985	10	10	10
1986	10	10	10
1987	10	10	10
1988	10	10	10
1989	10	10	10
1990	10	10	10
1991	10	10	10
1992	10	10	10
1993	--	--	10
TOTAL	100%	100%	100%

TABLE D.11
INTERNAL RATES OF RETURN
AND PAYBACK PERIODS

	TOTAL CAPITAL INVESTMENT (\$000)	INTERNAL RATE OF RETURN ON AFTER-TAX BASIS (%)	PAYBACK PERIOD ON EQUIVALENT PRE-TAX BASIS (years) ^a
OPTION 1 (Low-Sulfur Coal)			
Taxable:			
• 17 percent	\$ 5,200	19%	3.7 years
• 13 percent	4,900	21	3.1
Tax-Exempt:			
• 14 percent	5,000	21	3.5
• 10 percent	4,800	22	3.0
OPTION 2 (MSW)			
Tax-Exempt			
• 14 percent	8,900	16	3.9
• 10 percent	8,500	18	3.3
OPTION 3 (Low-Sulfur Coal)			
Taxable:			
• 17 percent	9,400	22	3.2
• 13 percent	9,000	23	2.7
OPTION 4 (MSW)			
Tax-Exempt:			
• 14 percent	15,000	19	3.3
• 10 percent	14,000	20	2.9
OPTION 5 (Low-Sulfur Coal)			
Taxable:			
• 17 percent	33,000	15	4.8
• 13 percent	31,000	16	4.0
OPTION 6 (High-Sulfur Coal)			
Taxable:			
• 17 percent	38,000	13	5.6
• 13 percent	36,000	15	4.4
OPTION 7 (MSW)			
Tax-Exempt:			
• 14 percent	29,000	22	2.7
• 10 percent	28,000	24	2.4

a. Calculated from first year of plant operations after accounting for benefits received during 2-year construction period.

TABLE D.12a

ANNUAL CASH FLOW OPTION 1:
COAL, 17% TAXABLE (\$000)

YEAR	PRE-TAX SAVINGS	INTEREST PAYMENTS	TAXABLE INCOME	TAXES	AFTER-TAX INCOME	PRINCIPAL PAYMENTS	TOTAL TAX BENEFITS	ANNUAL NET CASH FLOWS
1982	0.000	0.000	0.000	0.000	0.000	0.000	2.342	2.342
1983	0.000	0.000	0.000	0.000	0.000	0.000	6.022	6.022
1984	1138.002	878.571	259.429	119.337	140.091	35.744	688.675	789.023
1985	1229.001	871.815	357.185	164.305	192.880	46.501	441.934	588.314
1986	1454.002	863.911	590.089	271.441	318.648	54.405	420.841	685.084
1987	1715.002	854.662	860.338	395.755	464.583	63.654	406.828	807.756
1988	2015.002	843.839	1171.162	538.734	632.427	74.476	402.799	960.749
1989	2360.001	831.178	1528.823	703.258	825.564	87.138	46.072	784.498
1990	2759.002	816.365	1942.636	893.612	1049.025	101.950	42.044	989.116
1991	3159.002	799.033	2359.968	1085.586	1274.383	119.282	38.015	1193.116
1992	3612.002	778.757	2833.245	1303.293	1529.953	139.559	38.015	1428.409
1993	4124.001	755.029	3368.971	1549.728	1819.245	163.286	29.652	1685.611
1994	4701.001	727.271	3973.730	1827.917	2145.815	191.045	20.142	1974.912
1995	5352.001	694.796	4657.205	2142.316	2514.892	223.520	20.142	2311.513
1996	5653.002	656.796	4996.205	2298.255	2697.952	261.520	20.142	2456.574
1997	5971.001	612.336	5358.666	2464.987	2893.680	305.980	20.142	2607.842
1998	6307.001	560.321	5746.680	2643.474	3103.207	357.994	20.142	2765.355
1999	6662.001	499.460	6162.540	2834.770	3327.772	418.855	12.085	2921.003
2000	7037.000	428.256	6608.744	3040.023	3568.724	490.059	0.000	3078.664
2001	7434.000	344.945	7089.056	3260.967	3828.092	573.370	0.000	3254.721
2002	7852.001	247.475	7604.526	3498.083	4106.445	670.840	0.000	3435.604
2003	8294.000	133.429	8160.572	3753.864	4406.709	784.886	0.000	3621.823

TABLE D.12b

ANNUAL CASH FLOW OPTION 1:
COAL, 13% TAXABLE (\$000)

YEAR	PRE-TAX SAVINGS	INTEREST PAYMENTS	TAXABLE INCOME	TAXES	AFTER-TAX INCOME	PRINCIPAL PAYMENTS	TOTAL TAX BENEFITS	ANNUAL NET CASH FLOWS
1982	0.000	0.000	0.000	0.000	0.000	0.000	1.715	1.715
1983	0.000	0.000	0.000	0.000	0.000	0.000	4.448	4.448
1984	1138.002	641.459	496.541	228.409	268.132	60.956	656.799	863.975
1985	1229.001	633.536	595.464	273.913	321.550	68.883	422.128	674.796
1986	1454.002	624.579	829.421	381.533	447.887	77.835	401.807	771.858
1987	1715.002	614.464	1100.538	506.247	594.290	87.955	388.245	894.580
1988	2015.002	603.029	1411.972	649.506	762.464	99.389	384.217	1047.293
1989	2360.001	590.106	1769.896	814.151	955.743	112.309	43.442	886.875
1990	2759.002	575.506	2183.495	1004.409	1179.088	126.909	39.413	1091.592
1991	3159.002	559.010	2599.991	1195.996	1403.996	143.408	35.385	1295.973
1992	3512.002	540.367	3071.634	1412.953	1658.683	162.051	35.385	1532.017
1993	4124.001	519.300	3604.701	1658.163	1946.539	183.118	29.221	1792.642
1994	4701.001	495.493	4205.507	1934.534	2270.974	206.925	20.142	2084.191
1995	5352.001	468.593	4883.407	2246.368	2637.041	233.825	20.142	2423.357
1996	5653.002	438.197	5214.804	2398.810	2815.995	264.222	20.142	2571.915
1997	5971.001	403.849	5567.153	2560.891	3006.263	298.570	20.142	2727.835
1998	6307.001	365.032	5941.970	2733.307	3208.664	337.383	20.142	2891.423
1999	6662.001	321.172	6340.829	2916.782	3424.048	381.242	12.085	3054.891
2000	7037.000	271.613	6765.389	3112.079	3653.311	430.806	0.000	3222.504
2001	7434.000	214.240	7219.762	3321.090	3898.672	486.810	0.000	3411.861
2002	7852.001	152.323	7699.679	3541.853	4157.826	550.096	0.000	3607.731
2003	8294.000	80.811	8213.188	3778.067	4435.123	621.608	0.000	3813.514

TABLE D.12c

ANNUAL CASH FLOW OPTION 1:
COAL, 14% TAX-EXEMPT (\$000)

YEAR	PRE-TAX SAVINGS	INTEREST PAYMENTS	TAXABLE INCOME	TAXES	AFTER-TAX INCOME	PRINCIPAL PAYMENTS	TOTAL TAX BENEFITS	ANNUAL NET CASH FLOWS
1982	0.000	0.000	0.000	0.000	0.000	0.000	1.867	1.867
1983	0.000	0.000	0.000	0.000	0.000	0.000	4.831	4.831
1984	1138.032	698.755	439.245	202.053	237.192	54.834	570.531	752.889
1985	1229.031	691.079	537.921	247.443	290.477	62.510	375.828	603.795
1986	1454.032	682.328	771.672	354.969	416.703	71.261	375.828	721.269
1987	1715.032	672.353	1042.649	479.618	563.029	81.236	371.485	853.278
1988	2015.032	660.979	1354.022	622.849	731.171	92.610	367.141	1005.704
1989	2360.031	648.014	1711.987	787.513	924.472	105.575	204.940	1023.838
1990	2759.032	633.232	2125.769	977.853	1147.916	120.357	42.738	1070.297
1991	3159.032	616.383	2542.619	1169.605	1373.015	137.206	42.738	1278.547
1992	3512.032	597.174	3014.827	1386.822	1628.008	156.416	42.738	1514.330
1993	4124.031	575.278	3548.724	1632.414	1916.311	178.311	36.040	1774.040
1994	4701.031	550.312	4150.689	1909.318	2241.373	203.277	26.857	2064.952
1995	5352.031	521.854	4830.147	2221.868	2608.280	231.735	26.857	2403.401
1996	5653.032	489.409	5163.592	2375.252	2788.341	264.176	26.857	2551.020
1997	5971.001	452.428	5518.574	2536.545	2980.030	301.161	26.857	2705.725
1998	6307.001	410.263	5896.737	2712.501	3184.239	343.326	26.857	2867.769
1999	6662.001	362.197	6299.804	2897.911	3401.895	391.389	13.428	3023.934
2000	7037.000	307.405	6729.596	3095.615	3633.983	446.184	0.000	3187.798
2001	7434.000	244.937	7189.064	3306.971	3882.095	508.649	0.000	3373.446
2002	7852.001	173.723	7678.273	3532.007	4146.268	579.861	0.000	3566.406
2003	8294.000	92.545	8201.453	3772.670	4428.784	661.040	0.000	3767.744

TABLE D.12d

ANNUAL CASH FLOW OPTION 1:
COAL, 10% TAX-EXEMPT (\$000)

YEAR	PRE-TAX SAVINGS	INTEREST PAYMENTS	TAXABLE INCOME	TAXES	AFTER-TAX INCOME	PRINCIPAL PAYMENTS	TOTAL TAX BENEFITS	ANNUAL NET CASH FLOWS
1982	0.000	0.000	0.000	0.000	0.000	0.000	1.279	1.279
1983	0.000	0.000	0.000	0.000	0.000	0.000	3.338	3.338
1984	1138.002	476.999	661.001	304.060	356.940	83.221	544.062	817.722
1985	1229.001	468.669	760.331	349.752	410.579	91.610	358.582	677.550
1986	1454.002	459.511	994.489	457.465	537.024	100.772	358.582	794.834
1987	1715.002	449.433	1265.568	582.160	683.406	110.850	354.431	926.987
1988	2015.002	438.349	1576.653	725.259	851.391	121.934	350.280	1079.738
1989	2360.001	426.155	1933.847	889.569	1044.278	134.129	195.265	1105.414
1990	2759.002	412.741	2346.260	1079.280	1266.981	147.539	40.250	1159.692
1991	3159.002	397.989	2761.012	1270.067	1490.947	162.294	40.250	1368.903
1992	3612.002	381.759	3230.242	1485.912	1744.332	178.524	40.250	1606.057
1993	4124.001	363.907	3760.095	1729.644	2030.451	196.376	35.633	1869.708
1994	4701.001	344.268	4356.732	2004.098	2352.636	216.011	26.857	2163.481
1995	5352.001	322.666	5029.335	2313.495	2715.842	237.614	26.857	2505.084
1996	5653.002	298.904	5354.098	2462.885	2891.214	261.375	26.857	2656.695
1997	5971.001	272.768	5698.232	2621.188	3077.046	287.512	26.857	2816.391
1998	6307.001	244.017	6062.984	2788.974	3274.012	316.263	26.857	2984.606
1999	6662.001	212.390	6449.613	2966.822	3482.791	347.890	13.428	3148.328
2000	7037.000	177.601	6859.400	3155.325	3704.077	382.679	0.000	3321.398
2001	7434.000	139.335	7294.667	3355.547	3939.121	420.949	0.000	3518.172
2002	7852.001	97.238	7754.764	3567.192	4187.572	463.041	0.000	3724.531
2003	8294.000	50.935	8243.064	3791.812	4451.255	509.344	0.000	3941.911

TABLE D.13a

ANNUAL CASH FLOW OPTION 2:
MSW, 14% TAX-EXEMPT (\$000)

YEAR	PRE-TAX SAVINGS	INTEREST PAYMENTS	TAXABLE INCOME	TAXES	AFTER-TAX INCOME	PRINCIPAL PAYMENTS	TOTAL TAX BENEFITS	ANNUAL NET CASH FLOWS
1982	0.000	0.000	0.000	0.000	0.000	0.000	2.954	2.954
1983	0.000	0.000	0.000	0.000	0.000	0.000	7.479	7.479
1984	1553.001	1246.111	306.890	141.169	165.721	97.783	1224.765	1292.703
1985	1723.002	1232.424	490.578	225.666	264.912	111.471	819.893	973.334
1986	1780.001	1216.816	763.185	351.065	412.120	127.078	783.170	1068.214
1987	2274.001	1199.026	1074.976	494.488	580.487	144.868	655.687	1091.307
1988	2608.002	1178.747	1429.256	657.457	771.797	165.155	649.568	1256.212
1989	2989.002	1155.621	1833.382	843.355	990.026	188.274	69.642	871.393
1990	3420.001	1129.268	2290.735	1053.739	1236.998	214.635	63.523	1085.886
1991	3849.002	1099.214	2749.789	1264.904	1484.887	244.681	57.405	1297.610
1992	4330.002	1064.962	3265.041	1501.920	1763.123	278.940	57.405	1541.587
1993	4864.002	1025.907	3838.095	1765.525	2072.572	317.988	46.971	1801.555
1994	5468.002	981.390	4486.610	2063.842	2422.770	352.511	30.594	2090.852
1995	6139.001	930.641	5208.361	2395.846	2812.515	413.260	30.594	2429.848
1996	6483.001	872.781	5610.220	2580.703	3029.519	471.113	30.594	2589.000
1997	6851.000	806.825	6044.176	2780.322	3263.856	537.068	30.594	2757.381
1998	7235.002	731.635	6503.367	2991.549	3511.818	612.258	30.594	2930.153
1999	7638.002	645.918	6992.082	3216.358	3775.726	697.975	18.356	3096.107
2000	8074.003	548.201	7525.800	3461.868	4063.934	795.693	0.000	3268.240
2001	8526.959	436.803	8090.200	3721.492	4368.708	907.091	0.000	3461.617
2002	9008.001	309.812	8698.189	4001.167	4697.023	1034.083	0.000	3662.941
2003	9515.001	165.038	9349.962	4300.983	5048.980	1178.857	0.000	3870.125

TABLE D.13b

ANNUAL CASH FLOW OPTION 2:
MSW, 10% TAX-EXEMPT (\$000)

YEAR	FRE-TAX SAVINGS	INTEREST PAYMENTS	TAXABLE INCOME	TAXES	AFTER-TAX INCOME	PRINCIPAL PAYMENTS	TOTAL TAX BENEFITS	ANNUAL NET CASH FLOWS
1982	0.000	0.000	0.000	0.000	0.000	0.000	2.026	2.026
1983	0.000	0.000	0.000	0.000	0.000	0.000	5.166	5.166
1984	1553.001	849.800	703.200	323.472	379.728	148.372	1168.237	1399.595
1985	1723.002	834.967	888.033	408.495	479.538	163.206	783.071	1099.404
1986	1980.001	818.644	1161.358	534.224	627.132	179.529	747.732	1195.337
1987	2274.001	800.693	1473.308	677.721	795.585	197.487	625.742	1223.841
1988	2608.002	780.947	1827.055	840.445	986.608	217.233	619.623	1389.000
1989	2939.002	759.222	2229.779	1025.699	1204.082	238.958	65.661	1030.784
1990	3420.001	735.322	2684.680	1234.953	1449.728	262.851	59.542	1246.418
1991	3849.002	709.042	3139.960	1444.382	1695.579	289.138	53.423	1459.863
1992	4330.002	680.126	3649.875	1678.943	1970.933	318.046	53.423	1706.310
1993	4854.002	648.320	4215.681	1939.215	2276.468	349.852	46.230	1972.846
1994	5458.002	613.339	4854.663	2233.145	2621.518	384.841	30.594	2267.270
1995	6139.001	574.853	5564.148	2559.509	3004.640	423.327	30.594	2611.907
1996	6483.001	532.521	5950.481	2737.222	3213.260	465.660	30.594	2778.194
1997	6851.000	485.954	6365.047	2927.923	3437.127	512.219	30.594	2955.501
1998	7235.002	434.730	6800.272	3128.125	3672.147	563.443	30.594	3139.297
1999	7638.002	378.388	7259.613	3339.422	3920.192	619.792	18.356	3318.756
2000	8074.003	316.411	7757.589	3568.491	4189.099	681.769	0.000	3507.330
2001	8526.999	248.229	8278.770	3808.235	4470.536	749.943	0.000	3720.594
2002	9008.001	173.236	8834.764	4063.992	4770.774	824.937	0.000	3945.835
2003	9515.001	90.746	9424.253	4335.156	5089.097	907.434	0.000	4181.663

TABLE D.14a

ANNUAL CASH FLOW OPTION 3:
COAL, 17% TAXABLE (\$000)

YEAR	PRE-TAX SAVINGS	INTEREST PAYMENTS	TAXABLE INCOME	TAXES	AFTER-TAX INCOME	PRINCIPAL PAYMENTS	TOTAL TAX BENEFITS	ANNUAL NET CASH FLOWS
1982	0.000	0.000	0.000	0.000	0.000	0.000	4.252	4.252
1983	0.000	0.000	0.000	0.000	0.000	0.000	10.935	10.935
1984	2476.001	1595.302	880.699	405.122	475.578	72.167	1250.492	1653.902
1985	2676.001	1583.034	1092.969	502.765	590.203	84.435	802.460	1308.229
1986	3142.002	1568.682	1573.321	723.727	849.593	98.787	764.159	1514.965
1987	3579.002	1551.888	2127.115	978.472	1148.643	115.582	738.714	1771.775
1988	4296.001	1532.236	2763.768	1271.334	1492.435	135.233	731.399	2088.601
1989	5007.001	1509.246	3497.757	1608.959	1888.790	158.224	83.657	1814.223
1990	5823.001	1482.349	4340.653	1996.701	2343.954	185.120	76.342	2235.176
1991	6644.002	1450.878	5193.123	2388.838	2804.288	216.591	69.028	2656.724
1992	7568.002	1414.060	6153.943	2830.815	3323.130	253.409	69.028	3138.747
1993	8613.001	1370.977	7242.027	3331.333	3910.695	296.493	53.841	3668.042
1994	9787.000	1320.572	8466.430	3894.559	4571.872	346.897	36.574	4261.548
1995	11113.001	1261.605	9851.398	4531.643	5319.756	405.865	35.574	4950.463
1996	11738.008	1192.604	10545.402	4850.883	5694.515	474.865	35.574	5256.223
1997	12399.005	1111.874	11287.134	5192.079	6095.051	555.595	35.574	5576.028
1998	13097.012	1017.427	12079.584	5556.607	6522.972	650.042	36.574	5909.502
1999	13835.006	906.915	12928.092	5946.519	6981.167	760.552	21.945	6242.558
2000	14614.009	777.623	13836.389	6364.736	7471.644	889.845	0.000	6581.797
2001	15436.011	626.347	14809.662	6812.441	7997.215	1041.122	0.000	6956.095
2002	16304.010	449.362	15854.644	7293.133	8561.506	1218.107	0.000	7343.401
2003	17223.006	242.280	16980.731	7811.131	9169.585	1425.189	0.000	7744.398

TABLE D.14b

ANNUAL CASH FLOW OPTION 3:
COAL, 13% TAXABLE (\$000)

YEAR	PRE-TAX SAVINGS	INTEREST PAYMENTS	TAXABLE INCOME	TAXES	AFTER-TAX INCOME	PRINCIPAL PAYMENTS	TOTAL TAX BENEFITS	ANNUAL NET CASH FLOWS
1982	0.000	0.000	0.000	0.000	0.000	0.000	3.114	3.114
1983	0.000	0.000	0.000	0.000	0.000	0.000	8.077	8.077
1984	2476.001	1164.757	1311.247	603.173	708.072	110.683	1192.609	1789.998
1985	2676.001	1150.370	1525.633	701.791	823.841	125.076	766.496	1465.262
1986	3142.002	1134.106	2007.897	923.632	1084.265	141.333	729.596	1672.528
1987	3679.002	1115.738	2563.265	1179.103	1384.164	159.707	704.971	1929.427
1988	4296.001	1094.976	3201.027	1472.473	1728.556	180.469	697.656	2245.742
1989	5007.001	1071.509	3935.493	1810.328	2125.167	203.929	78.881	2000.118
1990	5823.001	1044.999	4778.003	2197.883	2580.123	230.439	71.566	2421.249
1991	6644.002	1015.046	5628.957	2589.321	3039.637	260.399	64.251	2843.490
1992	7568.002	981.194	6586.807	3029.932	3556.877	294.250	64.251	3326.877
1993	8613.001	942.940	7670.061	3528.228	4141.834	332.504	53.060	3862.388
1994	9787.000	899.711	8887.288	4088.153	4799.137	375.733	36.574	4459.976
1995	11113.011	850.867	10262.143	4720.582	5541.552	424.578	36.574	5153.548
1996	11738.008	775.673	10942.333	5033.471	5908.856	479.771	36.574	5465.658
1997	12399.005	733.304	11665.701	5366.221	6299.476	542.140	36.574	5793.910
1998	13097.012	662.821	12434.184	5719.723	6714.458	612.616	36.574	6138.412
1999	13835.006	583.181	13251.829	6095.838	7155.985	692.256	21.945	6485.671
2000	14614.009	493.191	14120.817	6495.573	7625.238	782.253	0.000	6842.985
2001	15436.011	389.015	15046.995	6921.614	8125.371	883.945	0.000	7241.427
2002	16304.010	276.587	16027.420	7372.612	8654.804	998.858	0.000	7655.944
2003	17223.006	146.735	17076.271	7855.082	9221.181	1128.710	0.000	8092.473

TABLE C.15a

ANNUAL CASH FLCW OPTION 4:
MSW, 14% TAX-EXEMPT (\$000)

YEAR	PRE-TAX SAVINGS	INTEREST PAYMENTS	TAXABLE INCOME	TAXES	AFTER-TAX INCOME	PRINCIPAL PAYMENTS	TOTAL TAX BENEFITS	ANNUAL NET CASH FLOWS
1982	0.000	0.000	0.000	0.000	0.000	0.000	4.856	4.856
1983	0.000	0.000	0.000	0.000	0.000	0.000	12.294	12.294
1984	3089.002	2048.401	1040.602	478.676	561.924	160.740	2010.483	2411.668
1985	3495.001	2025.901	1469.102	675.766	793.314	183.240	1312.999	1923.072
1986	4013.001	2000.245	2012.758	925.868	1086.890	208.896	1252.675	2130.668
1987	4605.002	1971.002	2634.001	1211.642	1422.362	238.140	1121.320	2305.540
1988	5274.002	1937.665	3336.337	1534.714	1801.623	271.488	1111.263	2641.397
1989	6042.001	1899.650	4142.353	1905.483	2236.871	309.492	114.477	2041.856
1990	6911.001	1856.330	5054.674	2325.150	2729.524	352.624	104.419	2481.118
1991	7774.002	1806.926	5967.077	2744.857	3222.222	402.216	94.361	2914.367
1992	8736.002	1750.622	6985.380	3213.275	3772.106	458.532	94.361	3407.934
1993	9817.001	1686.422	8130.582	3740.069	4390.514	522.720	77.211	3945.004
1994	11020.010	1613.246	9406.757	4327.109	5079.650	595.908	50.239	4534.031
1995	12372.004	1529.822	10842.192	4987.404	5854.779	679.332	50.239	5225.734
1996	13069.009	1434.710	11634.302	5351.775	6282.519	774.432	50.239	5558.375
1997	13802.009	1326.239	12475.717	5738.829	6736.884	882.852	50.239	5904.320
1998	14581.006	1202.690	13378.322	6154.024	7224.289	1006.454	50.239	6268.124
1999	15402.007	1061.735	14340.227	6596.499	7743.718	1147.358	30.173	6626.535
2000	16269.010	901.152	15367.859	7069.212	8298.637	1307.989	0.000	6990.649
2001	17184.007	718.032	16465.973	7574.346	8891.623	1491.109	0.000	7400.512
2002	18152.010	509.230	17642.730	8115.651	9527.066	1699.861	0.000	7827.206
2003	19176.006	271.296	18904.709	8696.165	10208.547	1937.846	0.000	8270.696

TABLE D.15b

ANNUAL CASH FLOW OPTION 4:
MSW, 10% TAX-EXEMPT (\$000)

YEAR	PRE-TAX SAVINGS	INTEREST PAYMENTS	TAXABLE INCOME	TAXES	AFTER-TAX INCOME	PRINCIPAL PAYMENTS	TOTAL TAX BENEFITS	ANNUAL NET CASH FLOWS
1982	0.000	0.000	0.000	0.000	0.000	0.000	3.331	3.331
1983	0.000	0.000	0.000	0.000	0.000	0.000	8.492	8.492
1984	3089.002	1396.933	1692.070	778.351	913.717	243.900	1917.689	2587.505
1985	3495.001	1372.550	2122.454	976.328	1146.125	268.284	1254.041	2131.881
1986	4013.001	1345.718	2667.283	1226.952	1440.336	295.116	1195.992	2341.209
1987	4605.002	1316.210	3288.794	1512.846	1775.950	324.636	1070.127	2521.438
1988	5274.002	1283.750	3990.253	1835.517	2154.737	357.096	1060.069	2857.709
1989	6042.001	1248.037	4793.965	2205.225	2588.742	392.808	107.931	2303.864
1990	6911.001	1208.750	5702.254	2623.038	3079.217	432.084	97.873	2745.007
1991	7774.002	1165.550	6608.452	3039.889	3568.565	475.296	87.816	3181.084
1992	8736.002	1118.018	7617.983	3504.273	4113.712	522.816	87.816	3678.711
1993	9817.001	1065.734	8751.268	4025.585	4725.685	575.100	75.993	4226.577
1994	11020.010	1008.229	10011.780	4605.417	5406.357	632.616	50.289	4824.029
1995	12372.004	944.964	11427.044	5256.438	6170.601	695.880	50.289	5525.009
1996	13069.009	875.376	12193.632	5609.068	6584.558	765.468	50.289	5869.377
1997	13802.009	798.828	13003.182	5981.460	7021.715	842.004	50.289	6230.000
1998	14581.006	714.624	13866.382	6378.535	7487.844	926.208	50.289	6611.924
1999	15402.007	622.008	14780.002	6798.796	7981.196	1018.837	30.173	6992.534
2000	16269.010	520.128	15748.882	7244.482	8504.393	1120.718	0.000	7383.676
2001	17184.007	408.048	16775.959	7716.937	9059.013	1232.785	0.000	7826.228
2002	18152.010	284.772	17367.237	8218.924	9648.301	1356.062	0.000	8292.242
2003	19176.006	149.172	19026.833	8752.340	10274.493	1491.674	0.000	8782.813

TABLE D.16a

ANNUAL CASH FLOW OPTION 5:
COAL, 17% TAXABLE (\$000)

YEAR	PRE-TAX SAVINGS	INTEREST PAYMENTS	TAXABLE INCOME	TAXES	AFTER-TAX INCOME	PRINCIPAL PAYMENTS	TOTAL TAX BENEFITS	ANNUAL NET CASH FLOWS
1982	0.000	0.000	0.000	0.000	0.000	0.000	14.789	14.789
1983	0.000	0.000	0.000	0.000	0.000	0.000	38.033	38.033
1984	5151.001	5548.872	-397.871	-183.921	-214.850	251.016	4349.642	3883.775
1985	5554.002	5506.200	47.801	21.988	25.812	293.688	2791.166	2523.289
1986	6540.001	5456.280	1083.722	498.511	585.209	343.608	2657.943	2899.545
1987	7679.003	5397.865	2281.137	1049.324	1231.815	402.024	2569.440	3399.228
1988	8990.001	5329.513	3660.490	1683.827	1976.665	470.376	2543.997	4050.284
1989	10501.005	5249.545	5251.457	2415.671	2835.787	550.344	290.981	2576.424
1990	12237.012	5155.992	7081.011	3257.266	3823.746	643.896	265.539	3445.389
1991	13974.010	5046.529	8927.472	4106.640	4820.835	753.360	240.096	4307.570
1992	15934.008	4918.466	11015.546	5067.148	5948.390	881.424	240.096	5307.060
1993	18144.011	4768.609	13375.401	6152.682	7222.713	1031.281	187.273	6378.705
1994	20636.004	4593.289	16042.721	7379.648	8663.066	1206.601	127.215	7583.677
1995	23445.010	4388.185	19056.826	8766.136	10290.688	1411.705	127.215	9006.187
1996	24764.007	4148.185	20615.828	9483.276	11132.550	1651.706	127.215	9608.049
1997	26158.004	3867.385	22290.623	10253.691	12036.937	1932.505	127.215	10231.649
1998	27632.009	3538.874	24093.133	11082.845	13010.293	2261.018	127.215	10876.488
1999	29187.011	3154.485	26032.519	11974.966	14057.564	2645.401	76.329	11488.491
2000	30831.009	2704.777	28126.233	12938.070	15188.169	3095.115	0.000	12093.055
2001	32566.010	2178.601	30387.401	13978.213	16409.206	3621.289	0.000	12787.914
2002	34399.008	1563.001	32836.008	15104.568	17731.446	4236.888	0.000	13494.557
2003	36336.010	842.712	35493.290	16326.922	19166.374	4957.176	0.000	14209.198

TABLE D.16b

ANNUAL CASH FLOW OPTION 5:
COAL, 13% TAXABLE (\$000)

YEAR	PRE-TAX SAVINGS	INTEREST PAYMENTS	TAXABLE INCOME	TAXES	AFTER-TAX INCOME	PRINCIPAL PAYMENTS	TOTAL TAX BENEFITS	ANNUAL NET CASH FLOWS
1982	0.000	0.000	0.000	0.000	0.000	0.000	10.831	10.831
1983	0.000	0.000	0.000	0.000	0.000	0.000	28.095	28.095
1984	5151.001	4051.322	1099.681	505.853	593.827	384.984	4148.203	4357.044
1985	5554.002	4001.281	1552.721	714.251	838.469	435.048	2666.075	3069.494
1986	6540.001	3944.713	2595.290	1193.834	1401.457	491.592	2537.726	3447.589
1987	7679.003	3880.825	3798.178	1747.162	2051.017	555.504	2452.075	3947.586
1988	8990.001	3808.609	5181.394	2383.442	2797.954	627.720	2426.632	4596.862
1989	10501.009	3726.986	6774.017	3116.048	3657.971	709.320	274.368	3223.018
1990	12237.012	3634.777	8602.225	3957.024	4645.202	801.528	248.925	4092.600
1991	13974.010	3530.592	10443.419	4803.969	5639.442	905.736	223.482	4957.187
1992	15934.008	3412.849	12521.165	5759.731	6761.424	1023.482	223.482	5961.425
1993	18144.011	3279.793	14864.212	6837.537	8026.673	1156.537	184.556	7054.692
1994	20636.004	3129.433	17506.575	8053.022	9453.544	1306.897	127.215	8273.861
1995	23445.010	2959.538	20485.466	9423.315	11062.157	1476.793	127.215	9712.569
1996	24764.007	2767.562	21996.444	10118.371	11878.085	1668.769	127.215	10336.530
1997	26158.004	2550.625	23607.385	10859.400	12747.991	1885.705	127.215	10989.499
1998	27632.009	2305.465	25326.538	11650.216	13676.339	2130.842	127.215	11672.711
1999	29187.011	2028.458	27158.552	12492.936	14665.621	2407.849	76.329	12334.102
2000	30831.009	1715.449	29115.563	13393.157	15722.405	2720.882	0.000	13001.531
2001	32566.010	1353.097	31212.913	14357.942	16854.977	3074.593	0.000	13780.385
2002	34399.008	962.040	33436.959	15381.008	18055.957	3474.289	0.000	14581.674
2003	36336.010	510.384	35825.616	16479.790	19345.837	3925.945	0.000	15419.894

TABLE D.17a

ANNUAL CASH FLOW OPTION 6:
CCAL, 17% TAXABLE (\$000)

YEAR	PRE-TAX SAVINGS	INTEREST PAYMENTS	TAXABLE INCOME	TAXES	AFTER-TAX INCOME	PRINCIPAL PAYMENTS	TOTAL TAX BENEFITS	ANNUAL NET CASH FLOWS
1982	0.000	0.000	0.000	0.000	0.000	0.000	17.254	17.254
1983	0.000	0.000	0.000	0.000	0.000	0.000	44.372	44.372
1984	5212.001	6473.684	-1261.684	-530.374	-681.308	292.852	5074.454	4100.292
1985	5665.001	6423.900	-758.898	-349.092	-409.805	342.636	3256.360	2503.919
1986	6671.000	6365.661	305.340	140.456	164.883	400.876	3100.935	2864.941
1987	7829.003	6297.508	1531.494	704.486	827.006	465.028	2997.680	3355.658
1988	9162.000	6217.764	2944.238	1354.351	1589.890	546.772	2967.997	4009.112
1989	10698.008	6124.471	4573.532	2103.826	2469.708	642.068	339.478	2167.118
1990	12461.006	6015.324	6445.677	2965.012	3480.667	751.212	309.795	3039.250
1991	14225.012	5887.616	8337.385	3835.198	4502.189	878.920	280.112	3903.381
1992	16213.011	5738.210	10474.801	4618.405	5656.388	1028.329	280.112	4908.171
1993	18454.009	5563.378	12890.636	5529.689	6960.940	1203.162	218.486	5976.264
1994	20978.005	5358.837	15619.176	7184.817	8434.349	1407.701	148.417	7175.064
1995	23822.005	5119.550	18702.453	8603.128	10099.327	1640.989	148.417	8600.749
1996	25162.011	4839.550	20322.453	9348.323	10974.133	1923.989	148.417	9195.549
1997	26579.004	4511.948	22067.058	10150.355	11916.214	2251.589	148.417	9810.035
1998	28076.010	4126.684	23947.322	11015.772	12931.561	2637.854	148.417	10442.125
1999	29656.010	3680.237	25975.775	11948.859	14026.921	3085.301	89.050	11029.666
2000	31326.007	3155.573	28170.436	12956.401	15212.041	3610.967	0.000	11601.078
2001	33090.013	2541.701	30548.310	14052.224	16496.086	4224.838	0.000	12271.249
2002	34952.002	1823.502	33128.499	15239.119	17889.398	4943.036	0.000	12946.367
2003	36920.005	983.164	35936.844	16530.954	19405.901	5763.373	0.000	13622.528

TABLE D.17b

ANNUAL CASH FLOW OPTION 6:
COAL, 13% TAXABLE (\$000)

YEAR	PRE-TAX SAVINGS	INTEREST PAYMENTS	TAXABLE INCOME	TAXES	AFTER-TAX INCOME	PRINCIPAL PAYMENTS	TOTAL TAX BENEFITS	ANNUAL NET CASH FLOWS
1982	0.000	0.000	0.000	0.000	0.000	0.000	12.636	12.636
1983	0.000	0.000	0.000	0.000	0.000	0.000	32.777	32.777
1984	5212.001	4726.541	485.460	223.312	262.148	449.148	4839.569	4652.568
1985	5665.001	4668.161	996.840	458.546	538.293	507.556	3110.420	3141.157
1986	6671.000	4602.165	2068.839	951.665	1117.174	573.524	2960.680	3504.328
1987	7629.003	4527.629	3301.375	1518.633	1782.743	648.088	2860.754	3995.407
1988	5162.000	4443.376	4718.627	2170.569	2548.059	732.340	2831.071	4646.787
1989	10698.008	4348.148	6349.853	2920.933	3428.922	827.540	320.096	2921.477
1990	12461.006	4240.574	8220.428	3781.398	4439.032	935.116	290.412	3794.329
1991	14225.012	4119.024	10105.985	4648.750	5457.229	1056.693	260.729	4661.264
1992	16213.011	3981.658	12231.349	5626.420	6604.927	1194.062	260.729	5671.596
1993	18454.009	3826.426	14627.581	6728.686	7898.893	1349.294	215.316	6764.916
1994	20978.009	3651.005	17327.004	7970.418	9356.578	1524.714	148.417	7980.283
1995	23822.009	3452.794	20369.219	9369.834	10999.381	1722.926	148.417	9424.864
1996	25162.011	3228.821	21933.186	10089.266	11843.925	1946.898	148.417	10045.444
1997	26579.004	2975.729	23603.284	10857.510	12745.779	2199.990	148.417	10694.205
1998	28076.010	2689.710	25386.297	11677.700	13708.603	2485.982	148.417	11371.040
1999	29656.010	2366.533	27289.474	12553.161	14736.324	2809.157	89.050	12016.212
2000	31326.007	2001.357	29324.656	13489.347	15835.320	3174.361	0.000	12660.956
2001	33090.013	1578.614	31511.396	14495.247	17016.154	3587.024	0.000	13429.129
2002	34752.002	1122.382	33829.623	15561.634	18268.001	4053.337	0.000	14214.664
2003	36920.005	595.448	36324.554	16709.297	19615.268	4580.268	0.000	15034.997

TABLE D.18a

ANNUAL CASH FLOW OPTION 7:
MSW, 14% TAX-EXEMPT (\$000)

YEAR	PRE-TAX SAVINGS	INTEREST PAYMENTS	TAXABLE INCOME	TAXES	AFTER-TAX INCOME	PRINCIPAL PAYMENTS	TOTAL TAX BENEFITS	ANNUAL NET CASH FLOWS
1982	0.000	0.000	0.000	0.000	0.000	0.000	15.748	15.748
1983	0.000	0.000	0.000	0.000	0.000	0.000	39.871	39.871
1984	8744.001	4096.801	4647.201	2137.713	2509.489	321.480	3583.824	5771.831
1985	9649.000	4051.800	5597.201	2574.713	3022.488	366.480	2395.898	5051.903
1986	10941.010	4000.488	6940.513	3192.638	3747.878	417.792	2276.756	5606.840
1987	12407.010	3942.002	8465.001	3893.902	4571.101	476.280	2188.376	5283.196
1988	14066.010	3875.329	10190.677	4687.711	5502.964	542.976	2155.758	7115.744
1989	15951.007	3799.297	12151.712	5589.765	6561.923	618.934	337.791	5280.727
1990	18079.006	3712.657	14366.352	6608.519	7757.828	705.648	305.173	7357.354
1991	20172.011	3613.849	16558.158	7616.750	8941.398	804.432	272.555	3409.521
1992	22505.009	3501.242	19003.766	8741.729	10262.036	917.064	272.555	9617.519
1993	25106.012	3372.842	21733.170	9597.255	11735.916	1045.442	216.935	10907.405
1994	28005.009	3226.490	24778.521	11398.124	13380.402	1191.818	163.091	12351.673
1995	31244.015	3059.642	28184.372	12964.814	15219.563	1358.665	163.091	14023.989
1996	32835.006	2869.417	29965.581	13764.176	16181.421	1548.866	163.091	14795.643
1997	34689.015	2652.577	32036.429	14736.735	17299.675	1765.705	163.091	15697.062
1998	36638.009	2405.377	34232.628	15747.010	18485.617	2012.906	163.091	16635.799
1999	38702.005	2123.569	36578.440	16826.037	19752.359	2294.714	97.855	17555.499
2000	40879.011	1802.305	39076.709	17775.282	21101.427	2615.977	0.000	18485.444
2001	43180.006	1436.066	41743.928	19202.214	22541.725	2982.217	0.000	19559.508
2002	45612.013	1018.562	44593.441	20512.986	24080.461	3399.721	0.000	20680.743
2003	48180.007	542.592	47637.414	21913.218	25724.202	3875.690	0.000	21848.511

TABLE D.18b

ANNUAL CASH FLOW OPTION 7:
MSW, 10% TAX-EXEMPT (\$000)

YEAR	PRE-TAX SAVINGS	INTEREST PAYMENTS	TAXABLE INCOME	TAXES	AFTER-TAX INCOME	PRINCIPAL PAYMENTS	TOTAL TAX BENEFITS	ANNUAL NET CASH FLOWS
1982	0.000	0.000	0.000	0.000	0.000	0.000	10.803	10.803
1982	0.000	0.000	0.000	0.000	0.000	0.000	27.540	27.540
1984	8744.001	2793.865	5950.138	2737.065	3213.075	487.800	3415.755	6141.026
1985	9649.000	2745.097	6903.905	3175.798	3728.110	536.568	2288.960	5480.501
1986	10941.010	2691.434	8249.571	3794.803	4454.767	590.232	2173.733	6038.265
1987	12407.010	2632.418	9774.585	4496.311	5278.277	649.272	2087.878	6716.880
1988	14066.010	2567.498	11498.510	5289.313	6209.194	714.192	2055.259	7550.258
1989	15951.007	2496.073	13454.937	6189.268	7265.661	785.616	318.078	6798.124
1990	18079.006	2417.498	15661.513	7204.293	8457.212	864.168	295.460	7878.504
1991	20172.011	2331.098	17840.909	8206.815	9634.087	950.592	252.842	8936.338
1992	22505.009	2236.033	20268.976	9323.723	10945.248	1045.634	252.842	10152.459
1993	25106.012	2131.465	22974.550	10568.296	12406.259	1150.202	214.499	11470.556
1994	28005.009	2016.457	25988.554	11954.736	14033.824	1265.233	163.091	12931.680
1995	31244.015	1889.929	29354.077	13502.877	15851.205	1391.761	163.091	14622.539
1996	32835.006	1750.754	31084.251	14298.760	16785.502	1530.938	163.091	15417.653
1997	34689.015	1597.657	33091.354	15222.024	17869.323	1684.010	163.091	16348.415
1998	36638.009	1429.250	35208.767	16196.030	19012.737	1852.418	163.091	17323.410
1999	38702.005	1244.018	37457.978	17230.677	20227.313	2037.673	97.855	18287.491
2000	40879.011	1040.257	39838.743	18325.829	21512.925	2241.433	0.000	19271.498
2001	43180.006	816.096	42363.899	19487.398	22874.513	2465.568	0.000	20410.948
2002	45612.013	569.544	45042.455	20719.534	24322.926	2712.122	0.000	21610.814
2003	48160.007	298.344	47881.650	22025.567	25856.095	2983.345	0.000	22872.751

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