C00-4981-1

DISTRICT HEATING AND COOLING SYSTEMS FOR COMMUNITIES THROUGH POWER PLANT RETROFIT AND DISTRIBUTION NETWORKS

PHASE I - IDENTIFICATION AND ASSESSMENT

FINAL REPORT

VOLUME III - APPENDICES

SEPTEMBER 1979

WISCONSIN STATE ENERGY OFFICE

PREPARED FOR:

U. S. DEPARTMENT OF ENERGY
CHICAGO OPERATIONS OFFICE
UNDER CONTRACT EM-78-C-02-4981

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DISCLAIMER

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APPENDIX A

UTILITY PLANT CHARACTERISTICS

This appendix contains information (Tables A-I through A-VIII) describing the characteristics of seven utility plants that were considered during the final site selection process.

Table A-I. Valley Electric Generating Plant

LOCATION: DOWNTOWN MILWAUKEE, ABOUT EIGHT BLOCKS SOUTH OF THE MILWAUKEE RIVER AND APPROXIMATELY ONE MILE WEST OF LAKE MICHIGAN.

OWNERSHIP: WISCONSIN ELECTRIC POWER COMPANY

NUMBER OF UNITS: 2

RATED CAPACITY: 136 MW/UNIT WITH NO STEAM EXTRACTION: 70-136 MW/UNIT WITH VARIOUS RATES OF STEAM EXTRACTION

DATES OF INSTALLATION: UNIT 1-1968; UNIT 2-1969

TYPE OF FUEL: ILLINOIS COAL

AVERAGE HEAT RATE (1977): 12,636 BTU/KWH

Table A-II. Manitowoc Electric Generating Plant

LOCATION: DOWNTOWN MANITOWOC, ON LAKE MICHIGAN, ABOUT EIGHT BLOCKS SOUTH OF THE MANITOWOC RIVER.

OWNERSHIP: MANITOWOC PUBLIC UTILITIES (MUNICIPAL)

NUMBER OF UNITS: 5 (NUMBERED 2 THROUGH 6)

RATED CAPACITY:
- UNIT 2 - 5MW WITH NO STEAM EXTRACTION (UP TO 50,000 POUNDS PER HOUR STEAM EXTRACTION CAPABILITY)
- UNIT 3 - 10 MW
- UNIT 4 - 10 MW WITH NO STEAM EXTRACTION (UP TO 100,000 POUNDS PER HOUR STEAM EXTRACTION CAPABILITY)
- UNIT 5 - 22 MW
- UNIT 6 - 22 MW

DATES OF INSTALLATION: UNIT 2 - 1935; UNIT 3 - 1941; UNIT 4 - 1950; UNIT 5 - 1956; UNIT 6 - 1964

TYPE OF FUEL: COAL

AVERAGE HEAT RATE (1977): 15,533 BTU/KWH

Table A-III. Blount Street Electric Generating Plant

LOCATION: DOWNTOWN MADISON, ABOUT SIX BLOCKS EAST OF THE CAPITOL BUILDING.

OWNERSHIP: MADISON GAS AND ELECTRIC COMPANY

NUMBER OF UNITS: 7

RATED CAPACITY:
UNIT 1 - 10 MW
UNIT 2 - 5 MW
UNIT 3 - 37.5 MW
UNIT 4 - 25 MW
UNIT 5 - 27.5 MW
UNIT 6 - 50 MW
UNIT 7 - 50 MW

DATES OF PLANNED RETIREMENT: UNIT 1 - 1984; UNIT 2 - 1984; UNIT 3 - 1994; UNIT 4 - 1989; UNIT 5 - 1989; UNIT 6 - 2004; UNIT 7 - 2004

TYPE OF FUEL: COAL

AVERAGE HEAT RATE (1977): 12,095 BTU/KWH

Table A-IV. Pulliam Electric Generating Plant

LOCATION: DOWNTOWN GREEN BAY, AT THE WEST SIDE OF THE MOUTH OF THE FOX RIVER.

OWNERSHIP: WISCONSIN PUBLIC SERVICE CORPORATION

NUMBER OF UNITS: 6 (NUMBERED 3 THROUGH 8)

RATED CAPACITY:
UNIT 3 - 30 MW
UNIT 4 - 30 MW
UNIT 5 - 50 MW
UNIT 6 - 62.5 MW
UNIT 7 - 75 MW
UNIT 8 - 125 MW

DATES OF INSTALLATION: UNIT 3 - 1943; UNIT 4 - 1947; UNIT 5 - 1949; UNIT 6 - 1951 UNIT 7 - 1958; UNIT 8 - 1964

TYPE OF FUEL: COAL

AVERAGE HEAT RATE (1977): 11,218 BTU/KWH

Table A-V. Edgewater Electric Generating Plant

LOCATION: DOWNTOWN SHEBOYGAN, ON LAKE MICHIGAN, ABOUT 1-3/4 MILES SOUTH OF THE SHEBOYGAN RIVER.

OWNERSHIP: UNITS 1, 2 and 3 - WISCONSIN POWER AND LIGHT COMPANY
UNIT 4 - WISCONSIN POWER AND LIGHT COMPANY (68.2%)
WISCONSIN PUBLIC SERVICE CORPORATION (31.8%)

NUMBER OF UNITS - 3 (NUMBERED 2 THROUGH 4)

RATED CAPACITY: UNIT 2 - 31 MW
UNIT 3 - 74 MW
UNIT 4 - 325 MW

DATES OF INSTALLATION: UNIT 2 - 1942; UNIT 3 - 1951;
UNIT 4 - 1969

TYPE OF FUEL: COAL

AVERAGE HEAT RATE (1977): 10,204 BTU/KWH

Table A-VI. Rock River Electric Generating Plant

LOCATION: ON THE ROCK RIVER, ABOUT TWO TO FOUR MILES NORTH OF BELOIT AND FOUR TO SIX MILES SOUTH OF JANESVILLE.

OWNERSHIP: WISCONSIN POWER AND LIGHT COMPANY

NUMBER OF UNITS: 2

RATED CAPACITY: UNIT 1 - 78 MW
UNIT 2 - 78 MW

DATES OF INSTALLATION: UNIT 1 - 1954; UNIT 2 - 1955

TYPE OF FUEL: COAL

AVERAGE HEAT RATE (1977): 11,097 BTU/KWH

Table A-VII. Black Hawk Electric Generating Plant

LOCATION: DOWNTOWN BELOIT, ON THE ROCK RIVER, ABOUT NINE BLOCKS NORTH OF THE WISCONSIN/ILLINOIS BORDER.

OWNERSHIP: WISCONSIN POWER AND LIGHT COMPANY

NUMBER OF UNITS: 2 (NUMBERED 3 AND 4)

RATED CAPACITY: UNIT 3 - 24 MW
UNIT 4 - 24 MW

DATES OF INSTALLATION: UNIT 3 - 1946; UNIT 4 - 1948

TYPE OF FUEL: COAL

AVERAGE HEAT RATE (1977): 12,845 BTU/KWH

APPENDIX B
FUTURE LOADS

This appendix contains a detailed description of future thermal loads for each of the three sites--Green Bay, Janesville/Beloit and Madison. Assumptions on their calculations and distribution within the service areas selected are described.

GREEN BAY, WISCONSIN

Future loads are forecasted for the downtown business district and an industrial park near the utility power plant.

Green Bay Central Business District

Development Plan--The city of Green Bay has developed a plan, Project Plan for Tax Incremental District Number One, to renovate areas in the Central Business District. The area covered by this plan includes the CBD area selected for detailed analysis in this feasibility study and a smaller area on the west side of the Fox River (Figure B-1).

The plan has been designed to:

- Promote necessary development to advance opportunities for intensifying the business activities within the area.
- Upgrade the physical qualities and use of the area by eliminating deteriorated, obsolete, blighted and structurally substandard buildings.
- Assemble an adequate number of readily saleable and developable sites for appropriate commercial, office and multifamily buildings through acquisition.

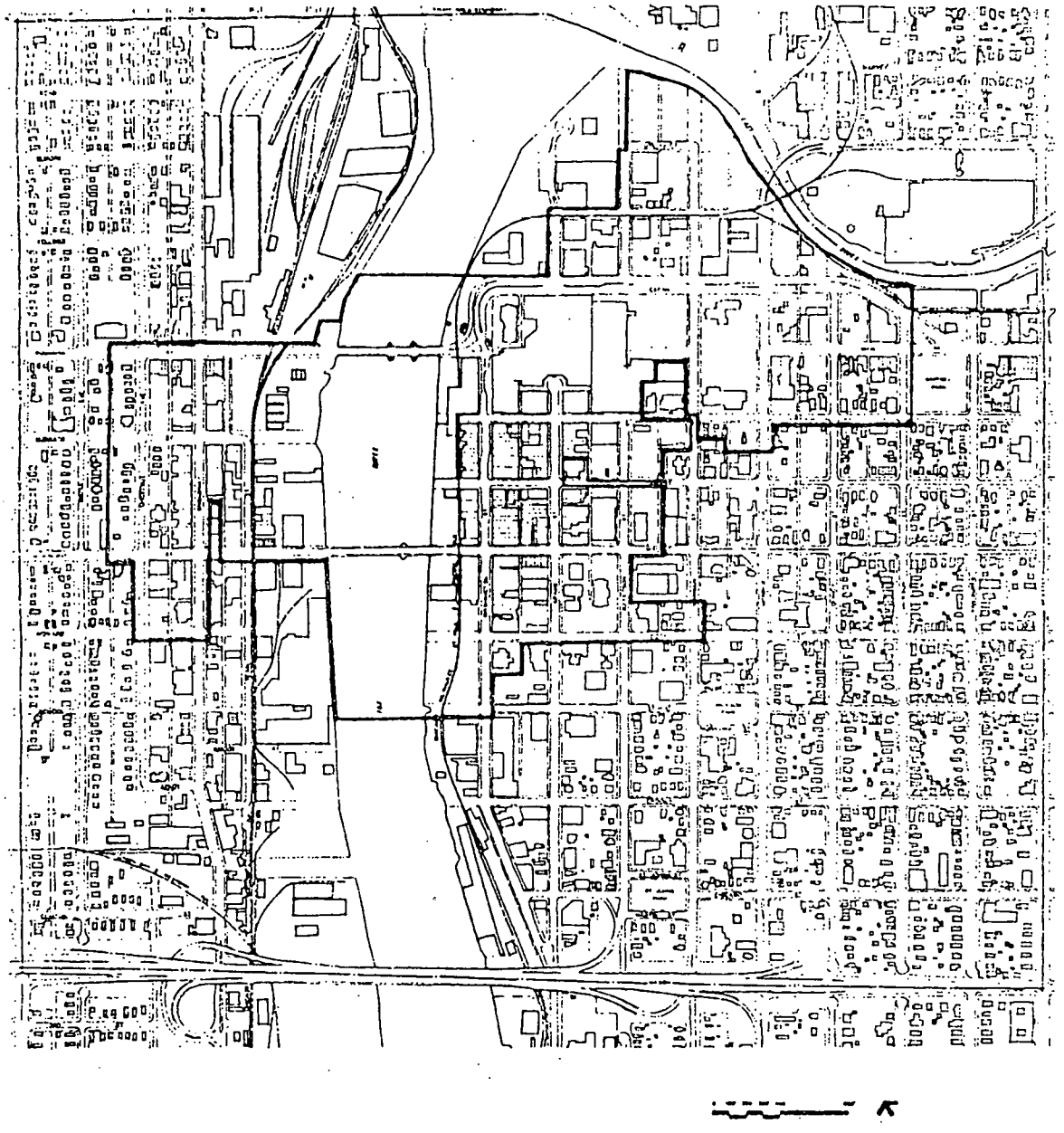

Figure B-1. Tax Incremental District Number One
Green Bay, Wisconsin

The plan, although recently enacted, has started to show fruition: A large (four square blocks) shopping plaza, parking ramp and multistory building for elderly housing have been built. Other areas are being razed for future buildings.

Future Load Potential--The potential increase for additional thermal energy can be estimated from the projected increase in building square footage for various building types (Table B-I). Since the available data indicates additional units for hotel/motel and multifamily, it was assumed that the corresponding square footage for this type of space would be 250 and 750 square feet, respectively.

Table B-I. Current/Planned Building Space

LOAD USE	EXISTING SPACE $FT^2 \times 10^3$	ADDITIONAL SPACE (1985) $FT^2 \times 10^3$
RETAIL	1,633.5	505.4
DEPARTMENT STORES	445.0	191.6
SERVICES	169.9	42.5
OFFICES	576.0	219.4
HOTEL/MOTEL	(764) UNITS	(212) UNITS*
MULTIFAMILY	NOT AVAILABLE	(507) UNITS**

*EACH UNIT EQUAL TO 250 SQUARE FEE

**EACH APARTMENT EQUAL TO 750 SQUARE FEET

To convert square footage to total monthly, yearly and peak hour energy consumption for space heating and hot water, the following empirical relationships were used:

- Residential buildings

  Space Heat = $14.6 \frac{\text{Btu}}{\text{ft}^2} \times$ heat degree-days

  Hot water = $22 \frac{\text{Btu}}{\text{ft}^2 \text{ day}}$

- High-density residential

  Space Heat = 0.72 x (residential building)

  Hot water = $15 \frac{\text{Btu}}{\text{ft}^2 \text{ day}}$

- Commercial

  Space heat = 0.5 x (residential)

  Hot water = $9 \frac{\text{Btu}}{\text{ft}^2 \text{ day}}$

The diverse building types identified in Table B-I were grouped into two classifications--commercial (retail, department, services, offices) and high-density residential (hotel/ motel, multifamily). This resulted in total additional planned square footage as follows:

• High-density residential	433,300
• Commercial	958,900

Based on monthly degree-day and design-day information for Green Bay (Table B-II), monthly space heating and hot water energy requirements were derived.

Table B-II. Monthly Degree-Day/Design Temperatures, Green Bay

MONTH	DEGREE-DAY	PERCENT OF DEGREE-DAYS PER MONTH
JANUARY	1494	18.6
FEBRUARY	1313	16.4
MARCH	1141	14.2
APRIL	654	8.1
MAY	335	4.2
JUNE	99	1.2
JULY	28	0.3
AUGUST	50	0.6
SEPTEMBER	174	2.2
OCTOBER	484	6.0
NOVEMBER	924	11.5
DECEMBER	1333	16.6
TOTAL	8029	

DESIGN TEMPERATURE (99%) -13°F

These are given in Table B-III (high-density residential) and Table B-IV (commercial).

Total Future Loads/Green Bay CBD--The future load was distributed in the area being analyzed using planning data supplied by the city of Green Bay. Based on this data, the following estimates were made (Table B-V):

- All future hotel/motel space will be in the area analyzed and is planned for blocks 39 and 40. It was assumed that the additional load will be equally split between the two blocks.
- Eighty percent of the increase in office space will be in the analyzed area. Of the total projected increase, 10 percent will be in blocks 24 and 25 and 15 percent will be in blocks 10, 31, 35 and 43.
- Sixty-five percent of the increase in retail, department and service store space will be in the area analyzed. Of the total projected increase, five percent will be in blocks 9, 10, 15, 16, 17, 21, 22, 23, 27, 28, 32, 37 and 41.
- Sixty percent of the increase in multifamily units will be in the area analyzed. Of the total increase, 30 percent will be in blocks 7 and 44.

Table B-III. Future High-Density Residential Heating/Hot Water Loads, Green Bay (1985)

MONTH	DAYS	DEGREE DAYS (DD)	HEATING BTU/FT^2 MONTH	HOT WATER BTU/FT^2 MONTH	TOTAL HEATING/ HOT WATER BTU/FT^2 MONTH	TOTAL BTU/MONTH X 10^9
JANUARY	31	1494	15,705	465	16,170	7.007
FEBRUARY	28	1313	13,802	420	14,222	6.161
MARCH	31	1141	11,994	465	12,459	5.399
APRIL	30	654	6,875	450	7,325	3.174
MAY	31	335	3,522	465	3.987	1.728
JUNE	30	99	1,041	450	1,491	.646
JULY	31	28	294	465	759	.329
AUGUST	31	50	526	465	991	.429
SEPTEMBER	30	174	1,829	450	2,279	.987
OCTOBER	31	484	5,088	465	5,553	2.406
NOVEMBER	30	924	9,713	450	10,163	4.404
DECEMBER	31	1333	14,013	465	14,478	6.273
					TOTAL	39.944

Table B-IV. Future Commercial Heating/Hot Water Loads, Green Bay (1985)

MONTH	DAYS	DEGREE DAYS (DD)	HEATING BTU/FT^2 MONTH	HOT WATER BTU/FT^2 MONTH	TOTAL/HEATING HOT WATER BTU/FT^2 MONTH	TOTAL BTU/MONTH X 10^9
JANUARY	31	1494	10,906	279	11,185	10.730
FEBRUARY	28	1313	9,585	252	9,837	9.433
MARCH	31	1141	8,329	279	8,608	8.254
APRIL	30	654	4,774	270	5,044	4.837
MAY	31	335	2,446	279	2,725	2.613
JUNE	30	99	723	270	993	.952
JULY	31	28	204	279	483	.463
AUGUST	31	50	365	279	644	.618
SEPTEMBER	30	174	1,270	270	1,540	1.477
OCTOBER	31	484	3,503	279	3,812	3.655
NOVEMBER	30	924	6,745	270	7,015	6.727
DECEMBER	31	1333	9,730	279	10,009	9.598

Table B-V. Future Load Data (Btu x 10^9)

BLOCK	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTAL
1	NONE												0
2	NONE												0
3	NONE												0
4	NONE												0
5	NONE												0
6	NONE												0
7	1.621	1.417	1.249	0.734	0.400	0.149	0.076	0.099	0.228	0.557	1.019	1.451	9.242
8	NONE												0
9	0.414	0.364	0.318	0.187	0.101	0.037	0.018	0.024	0.057	0.141	0.259	0.370	2.289
10	0.783	0.688	0.602	0.354	0.191	0.070	0.034	0.045	0.108	0.267	0.490	0.700	4.326
11	NONE												0
12	NONE												0
13	NONE												0
14	NONE												0
15	0.414	0.364	0.318	0.187	0.101	0.037	0.018	0.024	0.057	0.141	0.259	0.370	2.289
16	0.414	0.364	0.318	0.187	0.101	0.037	0.018	0.024	0.057	0.141	0.259	0.370	2.289
17	0.414	0.364	0.318	0.187	0.101	0.037	0.018	0.024	0.057	0.141	0.259	0.370	2.289
18	NONE												0
19	NONE												0
20	NONE												0
21	0.414	0.364	0.318	0.187	0.101	0.037	0.018	0.024	0.057	0.141	0.259	0.370	2.289
22	0.414	0.364	0.318	0.187	0.101	0.037	0.018	0.024	0.057	0.141	0.259	0.370	2.289
23	0.414	0.364	0.318	0.187	0.101	0.037	0.018	0.024	0.057	0.141	0.259	0.370	2.289
24	0.246	0.246	0.189	0.111	0.050	0.022	0.011	0.014	0.034	0.084	0.154	0.220	1.358
25	0.246	0.246	0.189	0.111	0.050	0.022	0.011	0.014	0.034	0.084	0.154	0.220	1.358
26	NONE												0
27	0.414	0.364	0.318	0.187	0.101	0.037	0.018	0.024	0.057	0.141	0.259	0.370	2.289
28	0.414	0.364	0.318	0.187	0.101	0.037	0.018	0.024	0.057	0.141	0.259	0.370	2.289
29	NONE												0
30	NONE												0
31	0.369	0.324	0.284	0.176	0.090	0.033	0.016	0.021	0.051	0.126	0.231	0.330	2.037
32	0.414	0.364	0.318	0.187	0.101	0.037	0.018	0.024	0.057	0.141	0.259	0.370	2.289
33	NONE												0
34	NONE												0
35	0.369	0.324	0.284	0.167	0.090	0.033	0.016	0.021	0.051	0.126	0.231	0.330	2.037
36	NONE												0
37	0.414	0.364	0.318	0.187	0.101	0.037	0.018	0.024	0.057	0.141	0.259	0.370	2.289
38	NONE												0
39	0.429	0.377	0.330	0.194	0.106	0.040	0.020	0.026	0.061	0.147	0.270	0.384	2.443
40	0.429	0.377	0.330	0.194	0.106	0.040	0.020	0.026	0.061	0.147	0.270	0.384	2.443
41	0.414	0.364	0.318	0.187	0.101	0.037	0.018	0.024	0.057	0.141	0.259	0.370	2.289
42	NONE												0
43	0.369	0.324	0.284	0.167	0.090	0.033	0.016	0.021	0.051	0.126	0.231	0.330	2.037
44	1.621	1.417	1.249	0.734	0.400	0.149	0.076	0.099	0.228	0.557	1.019	1.451	9.242
TOTALS	11.450	10.108	8.606	5.177	2.805	1.035	0.512	0.674	1.591	3.913	7.177	10.240	63.991

Peak Hour--An estimate of the peak hour space heat and hot water requirements were generated using the ASHRAE 99 percent design temperature. For Green Bay, this design temperature is - 13 F. This resulted in peak hour loads of:

- Space heating
  - Commercial
    $(0.5)\ (14.6\ \text{Btu/ft}^2 \times \text{HDD}) \times (65 - (-13/24\ \text{HDD/hour}$
    $= 23.725\ \text{Btu/ft}^2\text{- hour}$
  - High-density residential
    $(0.72)\ (14.6\ \text{Btu/ft}^2 \times \text{HDD}) \times (65 - (-13))/24\ \text{HDD/hour}$
    $= 34.164\ \text{Btu/ft}^2 - \text{hr}$
- Hot water
  - Commercial $\quad 9\ \frac{\text{Btu}}{\text{ft}^2\ \text{day}} \times 24\text{-hour day}$

    $= 0.375\ \frac{\text{Btu}}{\text{ft}^2\ \text{hour}}$
  - High-density residential $\quad 15\ \frac{\text{Btu}}{\text{ft}^2\ \text{day}} \cdot 24\text{-hour day}$

    $= 0.625\ \frac{\text{Btu}}{\text{ft}^2\ \text{hour}}$

The peak load is then

- Commercial
  $(23.725 + 0.375)\ \frac{\text{Btu}}{\text{ft}^2\ \text{hour}} \cdot 958.9 \times 10^3\ \text{ft}^2$
  $= 0.023 \times 10^9\ \frac{\text{Btu}}{\text{hour}}$
- High-density residential
  $(34.164 + 0.625)\ \frac{\text{Btu}}{\text{ft}^2\ \text{hour}}\ /433.3 \times 10^3\text{ft}^2$

$= 0.015 \times 10^9 \frac{\text{Btu}}{\text{hour}}$

The total peak hour load is: 0.038×10^9 Btu/hour

Green Bay Paper Mills

No increase in thermal load is forecast for the near future.

Future Industrial Park

An area adjacent to the power plant and along Lake Michigan has been set aside to attract future industry. Currently, there are no industrial plants in the area and no construction is in progress.

Although, this area offers a large potential for thermal energy, it would be difficult to speculate on the magnitude and timing of this future requirement.

JANESVILLE/BELOIT

Neither Janesville or Beloit can be expected to experience commercial growth that would significantly influence this thermal demand analysis. However, due to the large amount of available land, some potential for industrial parks between the two cities does exist. One planned industrial park is located just west of the Rock River Power Plant. Forecast loads for that park are estimated to be over 1×10^6 MMBtu/year with a peak of 250 MMBtu/hour based on WP&L discussions with potential tenants. Thus, this potential load would rank second in the selected area and represents over 32 percent of the existing land.

MADISON, WISCONSIN

Buildings that are being constructed and will be constructed in the CBD in the near time frame (1985) include the following:

- General Executive Facility No. 2 (under construction in block 107)
- General Executive Facility No. 3 (planned for block 107)
- Civic Center (planned for block 65)
- Federal Building (planned for block 53)

These buildings are being and will be built on vacant property. Thus, the loads represent additional thermal requirements for the DHCS.

The monthly, yearly (Table B-VI) and peak hour (Table B-VII) loads for these buildings were derived from a study conducted for MG&E (reference 4) in 1977. At that time, these loads were estimates based on conversations with designers and contractors.

Table B-VI. Future Loads, Madison (Btu x 10^6)

BLOCK	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTAL
53	0.50	0.40	0.40	0.20	0.10	--	--	--	0.10	0.20	0.30	0.40	2.60
65	2.01	1.68	1.45	0.79	0.40	0.10	0.02	0.05	0.23	0.64	1.22	1.80	10.39
107	1.80	1.40	1.40	1.00	1.00	1.20	1.20	1.20	1.00	1.00	1.20	1.40	14.80
TOTALS	4.31	3.48	3.25	1.99	1.50	1.30	1.22	1.25	1.33	1.84	2.72	3.60	27.79

Table B-VII. Peak Hour Demands - Future Loads, Madison

	Btu x 10^6/Hour
GENERAL EXECUTIVE FACILITY NO. 2	2.00
GENERAL EXECUTIVE FACILITY NO. 3	2.00
CIVIC CENTER	3.70
FEDERAL BUILDING	1.10
	8.80

APPENDIX C
HVAC INVENTORY

This appendix contains detailed data gathered on the type of heating, hot water and air conditioning equipment commonly found in the cities of Green Bay, Madison, Janesville and Beloit.

The data were gathered using three approaches--personnel interviews, utility data and discussions with utility personnel.

- Interviews - A number of interviews were conducted in each community to identify factors that would induce potential users to subscribe to the DHCS (Appendix E). As part of this interview the types and conditions of HVAC equipment were also surveyed.
- Utility Data - The utilities, routinely, have compiled data on the types of HVAC equipment on major energy users.
- Discussions with Utility Personnel - Additional information and clarification of HVAC data was obtained from personnel within the Consumers Affairs/Applications Departments. These people regularly visit customers and have a general, and in some cases specific, knowledge of user HVAC equipment.

HVAC INVENTORY PROBLEMS ENCOUNTERED

Problems encountered during the HVAC inventory included:

- The age of HVAC equipment often had to be estimated. The current owner/occupants of the building were not necessarily the original owners/occupants.

- Some buildings have two or more types of HVAC systems. This was the result of renovation, splitting up of buildings and add-ons over the years. All types within a building are mentioned.

Table C-I contains detailed data for Green Bay. Data for Madison and Janesville/Beloit are contained in Tables C-II and C-III, respectively.

Table C-I. HVAC Inventory Data - Green Bay

Building Type	Heat Source	Distribution Type	Heat System Age (Yr)	Notes	Hot Water System	Air Condition
1) Office/Retail	Boiler	Steam	35		Gas	Electric
2) Office/Retail	Boiler	Steam	30		Steam Exchanger	Electric
3) Office	Boiler	Steam	20		Steam Exchanger	Electric
4) Office	Boiler	Hot Water	4		Gas	Electric
5) Office/Retail	Boiler	Hot Water	20		Gas	Electric
6) Retail	Boiler	Steam	50		Gas	Electric
7) Retail Stores	Boiler Electric Units	Hot Water	3		Hot Water Exchanger	Electric
8) Retail	Boiler Electric Units	Hot Water	2		Hot Water Exchanger	Electric
9) Retail	Boiler Gas Forced Air	Steam Air	25 5		Gas	Electric
10) Motel	Boiler	Hot Water	10		Hot Water Exchanger	Electric
11) Multi-Family	Boiler	Hot Water	5		Hot Water Exchanger	Electric
12) School	Boiler	Steam	30		Gas	None
13) Church	Boiler	Steam	35		Gas	None
14) Office	Boiler	Hot Water	22	Replacing absorption unit	Hot Water Exchanger	Absorption
15) Office	Boiler	Steam	30		Steam Exchanger	Electric
16) Office	Gas	Air	12		Gas	Electric

Table C-I. HVAC Inventory Data - Green Bay (Concluded)

Building Type	Heat Source	Distribution Type	Heat System Age (Yr)	Notes	Hot Water System	Air Condition
17) Office	Boiler	Steam	30		Gas	Electric
18) Museum	Boiler	Steam	20		Gas	None
19) Motel	Boiler	Steam	30	Converting to H.W.	Steam Exchanger	Electric
20) Motel	Electric	Air	5	Electric unit each Room	Hot Water Exchanger	Electric
21) Office/Garage	Gas	Air	10		Gas	Electric
22) Department Store	Gas	Air	15		Gas	None
23) Department Store	Boiler	Hot Water	20		Hot Water Exchanger	Electric
24) Motel	Boiler	Hot Water	6		Hot Water Exchanger	Electric
25) Apartments	Boiler	Steam	40		Gas	Electric
26) Office	Gas Boiler	Air Hot Water	1 10		Gas	Electric
27) Manufacturing	Boiler	Steam	25		Steam Exchanger	Electric
28) Office	Boiler	Steam	20		Gas	Electric

Table C-II. HVAC Inventory Data - Janesville/Beloit

Building Type	Heat Source	Distribution Type	Age	Hot Water System	Air Condition
1. School	Boilers (2)	Hot Water		Gas	Elec.
2. Apartments	Boilers (3)	Steam	>7 yr	HX	Elec.
3. School	Boilers (3)	Steam	>7 yr	HX	Elec/Abs.
4. Mfg.	Boilers (2)	Steam	<7 yr	HX	Elec.
5. Mfg.	Boilers (3)	Steam	<7 yr	HX	
6. Mfg.	Boilers (5)	Steam	>7 yr	Gas	Elec.
7. Mfg.	Boiler	Steam	>7 yr	Gas	
8. Mfg.	Boilers (2)	Steam	>7 yr	Gas	
9. Mfg.	Boilers (3)	Steam	>7 yr	HX	Elec.
10. Mfg.	Boilers (2)	Steam	>7 yr	HX	
11. Hospital	Boilers (3)	Steam	<7 yr	HX	Abs.
12. Mfg.	Boilers (2)	Steam	<7 yr	HX	Elec.
13. Mfg.	Boilers (4)			Gas	
14. Mfg.	Boilers (3)				
15. Mfg.	Boilers (5)	Steam	>7 yr		
16. Mfg.	Gas Heaters	Air	<7 yr		
17. Mfg.	Boiler		>7 yr	Gas	
18. School	Boiler		>7 yr	Gas	
19. Mfg.	Boiler		>7 yr	Gas	
20. Mfg.	Boiler			Gas	
21. Mfg.	Boiler	Steam	>7 yr	HX	

Table C-III. HVAC Inventory Data - Madison

Building Type	Heat Source	Distribution Type	Age (yrs)	Notes	Hot Water System	Air Conditioning
1. Bank/Office	Boiler	Hot Water	10		Gas	Elec. Central
2. Bank/Office	Boiler	Steam	>20		Gas	Elec. Central
3. Retail/Office	Boiler	Steam	>20		Gas	Elec. Window
4. Bank/Office	Boiler	Steam	5	Gas W.H. in summer only	HX/Gas	Elec. Chiller
5. Retail/Apts.	Boiler	Steam	>20		Gas	Elec. Window
6. Retail/Theater	Boiler	Steam	>20		Gas	Elec. Central
7. Retail	Boiler	Steam/Hot Water	>20		Steam Exchanger	Elec. Window
8. Retail/Office	Boiler	Hot Water	>20		Gas	Elec. Window
9. Office	Boiler	Hot Water	>20		Gas	
10. Hotel	Boiler	Hot Water	17		Hot Water Exchanger	Elec. Window
11. Office	Boiler	Steam	>20		Gas	Elec. Window
12. School	Boiler	Steam	>20		Steam	None
13. Office	Boiler	Steam	15		Gas	Elec. Window
14. Library	Boiler	Steam	12		Gas	Elec. Central
15. Bank/Office	Boiler	Hot Water	8		Gas	Elec. Chiller

Table C-III. HVAC Inventory Data - Madison (Concluded)

Building Type	Heat Source	Distribution Type	Age (yrs)	Notes	Hot Water System	Air Conditioning
16. Office	Boiler	Steam	>20		Gas	Elec. Chiller
17. Hotel	Boiler	Steam	>20		Steam Exchanger	None
18. Office	Boiler	Steam	>20		Gas	Elec. Window
19. Office	Boiler	Steam	8		Gas	Elec. Central
20. Lodge Hall	Boiler	Hot Water	>20		Gas	Elec.
21. Office	Boiler	Steam	>20		Gas	Elec. Central
22. Office	Boiler	Steam	>20		Gas	Elec. Central
23. Office	Boiler	Steam	>20		Gas	Elec. Central
24. Retail/Office	Boiler	Hot Water	>20		Gas	Elec. Window
25. Hospital	Boiler	Steam	>20		Steam Exchanger	Absorption

APPENDIX D
LOAD CALCULATIONS

This appendix contains detailed information on load calculations for the Capitol Heating Plant and University of Wisconsin Plant located in Madison.

CAPITOL HEATING PLANT

The Capitol Heating Plant currently services four buidings: State Capitol Building, General Executive Facility No. 1, City County Building and State Office Building. One, the General Executive Facility No. 1, is both heated and cooled.

Load Data

Total steam production and loads for each of the buildings are contained in Table D-I. The total amount of steam distributed, on a monthly basis, was obtained during conversations with state personnel. This is itemized in Table D-I with respect to steam used for heating and hot water and steam consumed at the plant to produce chilled water.

To obtain heating and hot water loads for the individual buildings, the following distribution of steam was used, based on conversations with state personnel:

- Line losses/electric generation 20 percent
- State Capitol Building 18 percent
- General Executive Faility No. 1 26 percent
- City County Building 18 percent
- State Office Building 18 percent

Table D-I. Capitol Heating Plant/Building Data (1978)

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
Steam Distributed X 10^6 lbs													
Heating/Hot Water	25.0	21.0	17.5	13.5	11.8	12.8	9.7	9.3	9.5	13.0	17.3	24.8	185.2
Air Conditioning	-	-	-	-	.7	.4	2.3	2.7	1.5	-	-	-	7.6
Building Load BTU x 10^9													
State Capital	4.50	3.78	3.15	2.43	2.12	2.30	1.75	1.67	1.71	2.34	3.11	4.46	33.32
GEF No. 1	6.50	5.46	4.55	3.51	3.07	3.33	2.52	2.42	2.47	3.38	4.50	6.45	48.16
City/County	4.50	3.78	3.15	2.43	2.12	2.30	1.75	1.67	1.71	2.34	3.11	4.46	33.32
State Office	4.50	3.78	3.15	2.43	2.12	2.30	1.75	1.67	1.71	2.34	3.11	4.46	33.32
Total Loads	20.00	16.80	14.00	10.80	9.43	10.23	7.77	7.43	7.60	10.40	7.61	19.83	148.12

The load calculated for each building is included in the section on Madison. The load for the Capitol building is specified in block 0.

Fuel Consumed

The Capitol Heating Plant burns natural gas, No. 6 fuel oil and coal. Based on 1977 records (1977 was a respresentative year for types of fuels consumed), the following percentages of different fuels were used:

- Natural Gas 65 percent
- Coal 28 percent
- No. 6 Fuel Oil 7 percent

UNIVERSITY OF WISCONSIN PLANTS

The University of Wisconsin operates two steam generating power plants, Charter Street and Walnut Street, to heat all of and cool some of the approximately 150 buildings on the campus. Steam production (1978) for each plant is itemized on a monthly basis in Table D-II.

Load Data

Some of the steam produced is used by mechanically driven chillers at the plants. Exact data could not be obtained on the amount of steam consumed by the chillers. Therefore, the amount was estimated using the following assumptions:

- There are four 3500-ton and one 7000-ton (21,000-ton total) chillers at the University.
- Ten pounds of steam are required per ton-hour of cooling.

Table D-II. University of Wisconsin Data (1978)

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
Steam Produced lbs x 10^6													
Charter St.	233	206	170	114	119	113	119	116	102	104	135	191	1722
Walnut	48	45	44	35	38	48	40	38	34	29	41	51	491
Totals	281	251	214	149	157	161	159	154	136	133	176	242	2213
Steam Distribution lbs x 10^6													
Heating/Hot Water	281	251	214	149	132	129	117	110	111	133	176	242	2045
Air Conditioning	-	-	-	-	25	32	42	44	25	-	-	-	168
Load BTU x 10^9													
Heat/Hot Water	225	201	171	119	106	103	94	88	89	106	141	194	1637

- Total amount of steam required for cooling was estimated to be:

$$21{,}000 \text{ tons} \times 800 \frac{\text{full load hours}}{\text{year}} \times \frac{10 \text{ pounds}}{\text{ton-hour}}$$

$$= 168 \times 10^6 \text{ pounds/year for chillers}$$

- The cooling season is 800 hours over the following months:

May	120 hours	15 percent
June	150 hours	19 percent
July	200 hours	25 percent
August	210 hours	26 percent
September	120 hours	15 percent

Once the amount of steam consumed by the chillers was determined, the remainder was reduced by 20 percent and converted to Btu (1000 Btu/pound). The 20 percent reduction was a reasonable estimate for distribution losses and in-plant electrical generation. The load data calculated is included in the Madison Service Area load data.

Peak Hour Demand

The peak hour demand was 580,000 pounds/hour, or 580×10^6 Btu/hour, based on conversations with plant operational personnel.

Fuel Used

Based on 1978 records, the following fuels were used:

- Natural Gas 39.0 percent
- No. 2 Fuel Oil 16.5 percent
- No. 5 Fuel Oil 6.5 percent
- Coal 38.0 percent

APPENDIX E
FACTORS TO INDUCE POTENTIAL USERS

INTRODUCTION

Interviews were conducted with building owners and managers and facility directors in an effort to explore concerns that people would have with respect to subscribing to a District Heating and Cooling System. This appendix contains a tabulation of concerns and viewpoints expressed. For each interview, the position of the person (i.e., manager, owner) and building type are described. Views expressed are personal and do not necessarily reflect the views of the owners.

INTERVIEW RESULTS

President, Banker and Architect - Hotel

The president is the owner of the building. He also owns other commercial buildings in the community. The banker and architect are close business associates and participated in the interview.

Applicable comments from the interview included:

- The primary concern is one of economics; are the rates and conversion costs such that the project is a viable investment?
- There is a building in Duluth, Minnesota, where a small community steam system exists. Their rates would be about 30 percent higher if they used their own equipment.
- Tax rebates and low interest loans for retrofit costs would be a further inducement to subscribe to a DHCS.

- Side benefits, such as a reduced pollution and being a resident of the community, would enter into the decision-making process.
- The present boilers would be kept as backup. This would also be a hedge against unreasonable future rate increases.
- A commitment or letter of intent would, for now, be based purely on economics. More information about the project would be required.
- The government should consider funding some of the actual construction. I don't think the Federal Government would finance a project that would create funds for a public corporation. They may finance a project that was owned by a municipality. This would take care of other institutional problems since the municipality owns the streets. This financial splitting would relieve the utilities of a large expenditure that they probably don't want.
- The concept of a central heating source should be an added enticement to get new business to locate in the community.

President - Realty Company

The president of the realty company is the owner of the building.

Applicable comments from the interview included:

- The primary concern is one of costs. The present heating system would be used unless there were some inertia to change.
- The DHCS system would have to be more economical to run and operate. The conversion costs would have to be amortized.
- All the costs involved would be examined. The remaining life of my present boiler system would also be examined. I do not measure investments only in terms of payback times or return on investment rates.

- Tax rebates, low interest loans or any financial considerations that would improve the economics of participation in a DHCS would be most welcome.
- Improvements in the air quality would be welcome. However, the economics would still be the prime consideration.
- If business were generally good, I would be more favorable, in terms of committing capital for conversion equipment, to connecting to the DHCS system.
- The reliability of the system would not be of great concern. I would assume that the system would be designed properly. I do not foresee that it will be any less reliable than a gas pipe.
- I would be reluctant to throw out my current boiler, unless it were in the way.
- When streets are ripped up they are an inconvenience to the local business people. They have always been torn up for improvements, except for the last year.
- To sign a letter of intent or commitment, I would have to have a better picture of the costs.
- I would have to get more information on the systems, its costs and merits before I could support the concept. I have the feeling that the government is trying to "foist something" on me.

Director - YMCA

Applicable comments from the interview included:

- The number one concern would be the economics of the district heating and cooling system.
- The board of directors (local businessmen) would help review and evaluate the investment of connecting and subscribing to a DHCS.
- I am familiar with a steam district heating system in St. Louis. It was very reliable. There never was a failure during the time

that I was there. I would gladly get rid of my boiler when the DHCS was checked out. This would also eliminate the insurance premium on the boiler.

- The YMCA is a nonprofit organization. All improvements are paid in cash. Tax rebates and low interest loans would be of no interest to us.
- A letter of commitment or intent would have to be approved by the board of directors. A letter probably could be obtained, based on specified economic and reliability constraints.
- Any improvement in air pollution would be welcome as long as the benefits are not excessively costly.
- I would be interested in hearing more about the DHCS at a later date when more concrete data is available.

Manager, Plant Engineer - Shopping Plaza

The shopping plaza is owned by a series of corporations located from coast to coast.

Applicable comments from the interview included:

- The first concern would be the capital costs, where the savings would come from and the point at which a net gain would be realized.
- The owners (corporations) look at all investments from a cash flow basis. A connection to a district heating and cooling system would be veiwed in that light.
- The owners probably would not consider side benefits, such as decreased air pollution and energy savings, to weight in the decision-making process.

- Tax rebates, low interest loans, etc., that would improve the cash flow from an investment point of view would be considered.
- Reliability is of utmost importance because the lease requires me to maintain a certain space temperature in the stores. When the temperature is not maintained, the tenants do not have to pay rent.
- If the store were on the DHCS, the present system could serve as a backup.
- A reliability agreement with the utilities that could be passed on to the tenants would be considered.
- To obtain a commitment, a formal presentation would have to be made to the corporations.
- A letter of intent probably could be obtained based on specified economic conditions. This could take a long period of time (6 to 8 months) since a number of corporations are involved.

President, Vice President - Screen Printing Company

The company is a subsidiary of another company. The parent company is also the building owner.

Applicable comments from the interview included:

- Rates should be less than competitive fuels because of the cost of retrofit must be amortized.
- The retrofit system should have a payback of three to five years.
- Our current heating system was revamped in the last year. I would not be particularly interested in redoing the system again without good justification.

- Because the cost of borrowed money is so expensive, tax rebates, low interest loans, etc., that would help reduce the potential payback would be most welcome.
- The reliability would not be a great concern, since I would believe that the people that would put in the DHCS would know what they are doing.
- The present boilers and rooftop unit would be kept as a backup and as a hedge against the rates going up too high.
- I am familiar with the steam district heating system in Milwaukee. Other than turning the system off too early in the spring and on too late in the fall, I do not remember any failures or downtime during the heating season. Our own equipment has not maintained this track record.
- The improvement gained in air pollution would be a welcome benefit and I would rate it high in the decision process; but my first responsibility is to stay in business.
- Because this appears to be such a large program and the success appears to be strongly linked to the number of people that would have to be connected, I would be concerned if I were forced to join.
- My requirements for a commitment to sign up would be to get data on initial retrofit costs, energy costs and some guarantee on future energy costs such that they do not escalate unnecessarily.
- I would like to have the right to disconnect if I wanted.
- Ripped up streets would not be a prime concern.
- The government should consider putting money into the construction phase of this project. They put money in hydropower plants.

Plant Manager, Engineer - Vegetable Canning Company

Applicable comments from the interview included:

- The price of the energy would have to be, at the least, as low as gas (the least expensive fuel in this area). This would be an equitable price, especially if it would help the supply of gas for other uses.
- The price of the heat would have to take into account the cost of capitalization of the retrofit system.
- The payback of the retrofit costs would have to be less than five years and preferably two to three years. In the interest of conservation, the payback times may be relaxed.
- Connection costs would be favorable for new construction.
- Two much emphasis may be placed on costs; we are very much conservation oriented. especially with respect to gas.
- Pollution would not be a concern to our particular company or operation and would have little bearing on the decision whether to participate as a user.
- Reliability of the supply is very important. Heat is used to keep the product from freezing in the warehouse. We would have to be convinced of the reliability of the system--its supply, peaks and valleys, temperatures, etc.
- The present system would be kept. It could serve as a backup. It would probably cost more to tear it out than we could get by selling the system.
- Some hot water from the DHCS could possibly be used to produce low pressure steam for in-plant use.
- If rates were regulated, the PSC would look for the industrial customers to absorb high rates and subsidize the system.

- To provide a commitment for use, we would have to calculate in-house use of energy and connection costs. We would then talk to the utility about rates.
- A letter of intent, based on costs and benefits, would be a possibility.
- Disruptions to the plant and streets would not be a determinant. They seem to be the norm lately.
- The DHCS concept sounds like a very good idea. One should never turn our back on a proposition such as this because it is in the public interest.

Plant Engineering Manager - Paper Industry

Applicable comments from the interview included:

- At this plant, there is a large requirement for boiler makeup water and hot process water.
- Since the company is a profit-making organization that uses a substantial amount of energy, the company is very concerned about the current and future costs of energy.
- The company would be interested if the energy costs were priced attractively. We would be even more interested if the power company would provide hot treated water that could be used directly.
- Because energy related costs are given priority on capital investments, the return on investment would be relaxed from greater than 20 per cent to less than 20 per cent.

President - Commercial Building Owner/Manager

The president owns and manages a number of builsings that are used as office space, retail sales and hotel/motel.

Applicable comments from the interview included:

- The financial aspects of a DHCS would be the first concern. The finances would have to be such that a payback could be realized in less than five years.
- Tax rebates, low interest loands, etc., that would improve the economics would be acceptable and possibly necessary to get the idea going in a community.
- Energy-related expenditures are high on my priority list. I would consider relaxing my payback requirements, given that business conditions were generally good.
- The government should help finance the DHCS. They finance every other social program.
- A DHCS program would benefit the community and enhance the business environment.
- I would be willing to sign a letter of intent based on favorable economic conditons.

Property Manager, Engineering Service Manager - Bank

Applicable comments from the interview included:

- To get people interested in the DHCS concept, the energy must be sold at lower price than other fuels.
- Our bank and officers of the bank are very energy conscious. Even though the building is rather new, a considerable amount of money has been spent on rezoning the heating system and using condensing water for the reheat system.
- An absorption air conditioning system would be an expensive retrofit--more so than the heating conversion costs.
- A payback of less than five years is desirable; up to eight years is acceptable.

- Energy-related investments are different from other investment alternatives in that you know that you will never get it cheaper.
- DHCS seems to have a lot of potential. One of our banks in Milwaukee is heated by a steam district heating system. They do not seem to have any problems.
- Reliability of supply is important to us because we rent office space in the building. Our office space is some of the highest priced in town, and our tenants are under contract to be serviced.
- A letter of commitment or intent would not be appropriate at the present time. We would have to learn more about the project and the true costs.
- Tax credits and low interest loans to help finance retrofit costs would be an inducement to subscribe to the DHCS system.

Bureau of Engineering - State of Wisconsin

The Capitol Heating Plant is owned and operated by the State of Wisconsin. The plant currently supplies steam to the State Capitol Building, State Office Building, the City/County building and the General Executive Facility (GEF) No. 1 (i.e., office building). It will serve two other State buildings, General Executive Facilities No. 1 and No. 2, which are currently under construction. The plant also contains a central chiller that supplies chilled water to GEF No. 1 and will to GEF No. 2 and No. 3.

Applicable comments from the interview included:

- The State got into the energy business because it was cheaper and because of the limited capacity of the utility plant at the time.

- Economics would be the prime consideration that would be investigated in switching to a DHCS. The economic evaluation would include looking at building retrofit costs.
- If the DHCS concept were good for the community and had widespread support in the community, it would receive better State support.
- State financing procedures (financing vehicle and rates) differ from private companies. The present plant was paid for with tax dollars. Any borrowed money (bonds) is retired at a modest (5 to 7 percent) interest rate.
- Legislative action would be required for the State to participate in a DHCS.
- A letter of commitment or intent, based on favorable economics, might be obtained.
- The plant complies with State EPA regulations on emmissions. We burn a mixture of natural gas, oil and coal, in order to achieve specified levels.

Plant Manger - Large Manufacturing Facility

The company is locally owned and has three sites. The manager lives in the community.

Applicable comments from the interview included:

- The existing boilers are old and it is expected that they will have to be replaced about 1980. The new units will be expensive because they will have to meet strict pollution standards.
- For capital investment, paybacks must be three to five years. Large projects could show payoffs out to 15 years.
- The DHCS energy price that would be paid is related to the size of the investment. A discounted rate would be preferred.

- A contract with the utility would be required.
- Discounts and tax rebates should be related to the investment and amount of energy use. The preferred inducement would be investment tax credits.
- I would expect the utility (not a private corporation) to sell the energy. We have a good relationship with the utility.
- Our plant typically operates 24 hours a day (sometimes 16 to 20) and the energy service must be reliable. The length of the down time is more important than the number of times. It could be down for 10 minutes frequently, but never for over an hour. I would expect the reliability to be consistent with other utility services.
- Conversion time and disruption are not problems. Disruption is no problem as long as materials can be shipped and received.
- Air pollution is a problem only when considering the cost of new boilers.
- If the plant were converted to the DHCS, the boilers would be kept for a couple of years as backup. They would then tear them out to use the space.
- Boiler maintenance could be eliminated, about one-quarter. Pressurized surge tanks would be required and would need some maintenance.
- I would be concerned about corrosion and problems with the condensate return pipes. This is typically a problem due to chemical action of condensate.
- A 15 percent ROI would be acceptable.
- A letter of committment could be submitted based on favorable economics.

Plant Manger - Manufacturing Facility

The plant manager lives in the community. The company is locally owned. Most of the thermal energy is used in processes.

Applicable comments from the interview included:

- Primary concerns are: availability of gas, price of gas, price of oil.
- Those concerns and the rate structure would influence the decision to hook up. We are happy with the utility as a supplier.
- Payback time is the key--anywhere from one to ten years.
- A tax rebate would be the best way to reduce conversion costs.
- Reliability is not a concern. The present boilers would be kept as backup.
- Conversion time and disruption time are not foreseen as problems.
- Air pollution would be a problem if coal were used as fuel.
- No boiler replacement is foreseen. The existing boilers will work for decades. Availability of fuel and/or cost of fuel would change this consideration.
- A letter of interest or commitment, based on the final results of the economic analysis, could be generated.

Vice-President - Business Operations College

The vice-president lives in the community. The school is a small private liberal arts college.

Applicable comments from the interview included:

- No new construction on campus is foreseen. There are now ten dorms in operation; two are being refurbished, so heating loads could increase slightly when they are occupied.
- The rate structure of the DHCS should allow us to achieve a future cost saving. Energy costs are a significant part of their operating expenses, and we are willing to invest in future savings.
- The entity that sells the steam does not seem important.
- A tax rebate is of no consequence to the school. Low interest loans are more appropriate.
- Paybacks of two to fifty years would be considered. The investment could be financed with 30-year bonds.
- The school is operating with minimum manpower; removing the boilers would not reduce manpower. It might reduce insurance costs.
- Conversion would be no problem in the summer. Disruption would not be a problem in their location.
- There currently is no pollution problem.

APPENDIX F

TURBINE RETROFIT/DISTRIBUTION SYSTEM DATA

This appendix contains background data used in the technical review and assessment task, including:

- General Electric Company discussion of three turbine retrofit schemes;
- Flow diagram (Figure F-1) and Mollier diagram (Figure F-2) of a single case turbine with extractions;
- Flow diagram (Figure F-3) and Mollier diagram (Figure F-4) of a cross-compound turbine;
- Installation data for distribution piping (Tables F-I through F-IV);
- Customer retrofit costs (Tables F-V and F-VI);
- Thermal losses in distribution piping (Tables F-VII and F-VIII).

GENERAL ELECTRIC

INDUSTRIAL
SALES
DIVISION

GENERAL ELECTRIC COMPANY, 641 LEXINGTON AVENUE, NEW YORK, NEW YORK 10022
Phone (212) 750-2000

MODIFICATION OF EXISTING UTILITY
POWER PLANTS FOR DISTRICT HEATING

February 17, 1977

Mr. William Diskant
Executive Vice President
American Hydrotherm Corporation
470 Park Avenue South
New York, N.Y., 10016

Dear Mr. Diskant:

It was a pleasure talking with you over the phone earlier last week. We understand that you have been asked by ERDA to discuss the possibility of modifying existing utility power plants to provide additional steam flows for district heating. As we have discussed, modifications to the steam turbine would be possible in several ways.

1. As you are aware, the typical utility steam turbine is a condensing machine with uncontrolled extraction points at various pressures. These extraction points consist simply of openings in the casing, sized for the required feedwater heating load. To provide an additional district heating steam flow, these openings could quite simply be enlarged to permit an increased flow for this second usage. Generally speaking, all steam path parts i.e., turbine wheels and diaphragms and inlet valve gear would need to be checked to assure that any new operating condition did not exceed those set as a maximum for safe operation. Although each case would, of course, have to be reviewed on an individual basis, we would not expect a modification of this sort to propose any great problems.

2. The conversion of a straight condensing steam turbine to operation with noncondensing exhaust is also in general a quite feasible modification. Such a modification would involve the removal through machining of both turbine wheels and diaphragms in the condensing end of the machine. A blanking diaphragm to prevent flow past the required exhaust pressure would be installed

GENERAL ELECTRIC

2. Continued

and openings machined into the casing to allow for the exhaust flow. Modifications could be also required to the shaft sealing system. This type of modification is one which our factory has performed on numerous occasions.

3. The addition of an extraction valve gear to an existing straight condensing steam turbine to allow for the controlled provision of steam for district heating would be a much more complicated and expensive modification than No. 2 discussed above. Such a modification would require the removal of one or more stages at some point on the rotor, to create sufficient space for the insertion of an extraction diaphragm. An extraction valve gear would be mounted on top of the casing. This is a modification which we have never performed before and would be very expensive. We would not, however, rule out the possibility of successfully completing such a modification and believe that a final conclusion would only be reached regarding a specific steam turbine.

In all three of the above cases, our comments apply to units rated less than 100 MW. The cost for any of the above modifications could vary in the extreme depending upon the basic configuration of the unit under consideration as well as the perceived modification. Modifications described in No. 1 and No. 2 above could often be performed at a total cost of less than $100,000. An estimate of the cost of modification No. 3 above is much more difficult to make. If attempted successfully, the cost of such a modification could extend up close to a million dollars.

The above comments are necessarily very general in nature. More specific comments could be made on any unit chosen for consideration which has been manufactured by the General Electric Company. Please call if we can be of further assistance.

Yours truly,

Eric F. Grina

Eric F. Grina, Industrial Turbine Sales, Ext. 2371

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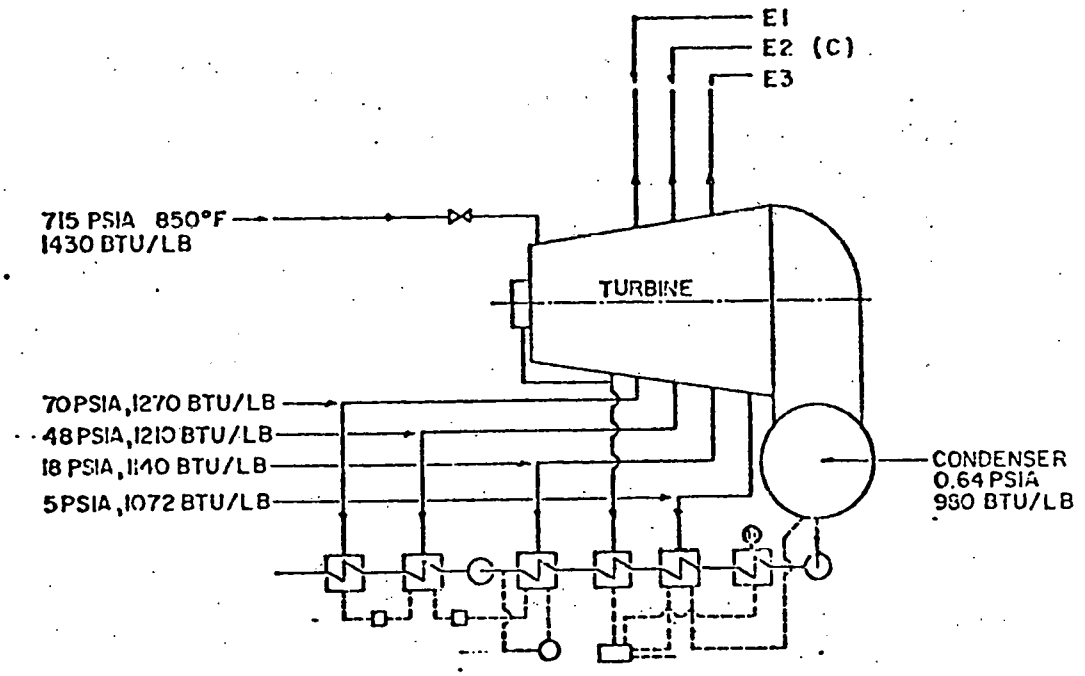

Figure F-1. Generic 30 MW Single Case Steam Turbine with Extractions

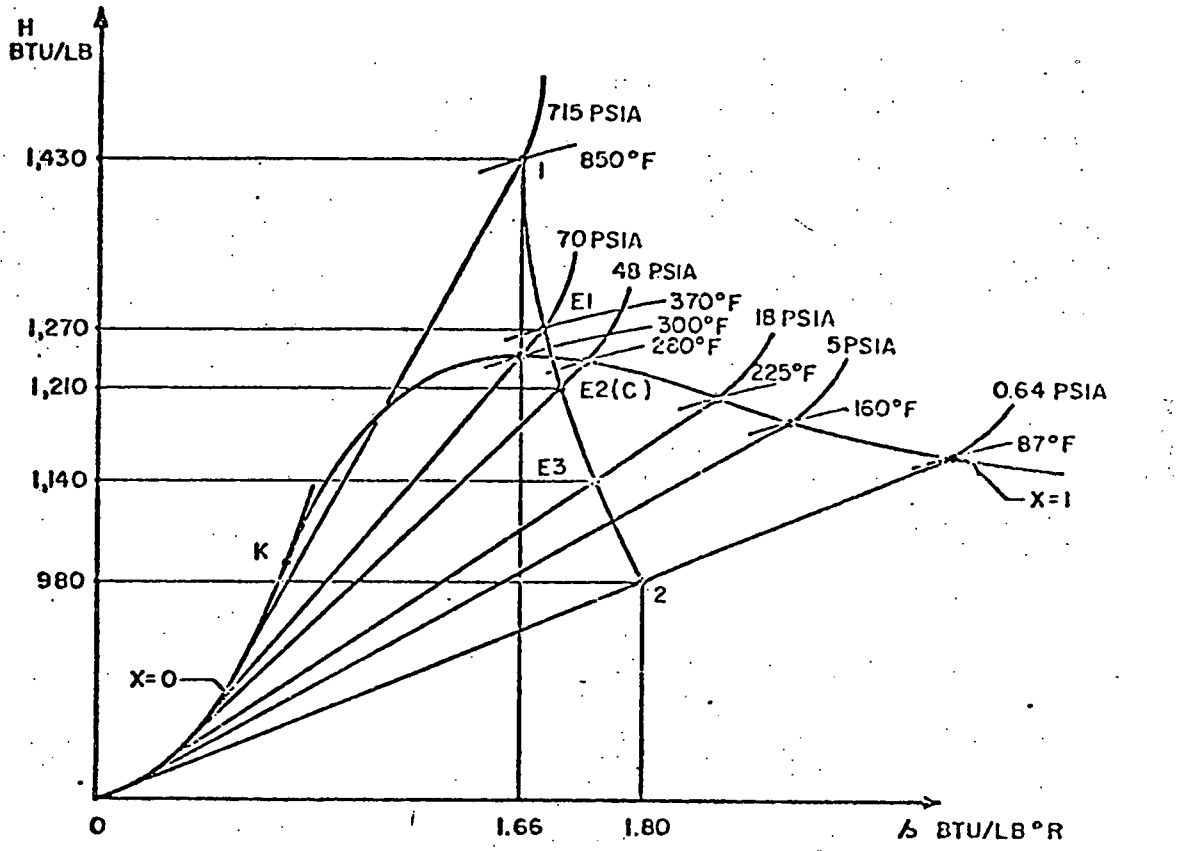

Figure F-2. Mollier Diagram of Cycle for Generic 30 MW Steam Turbine

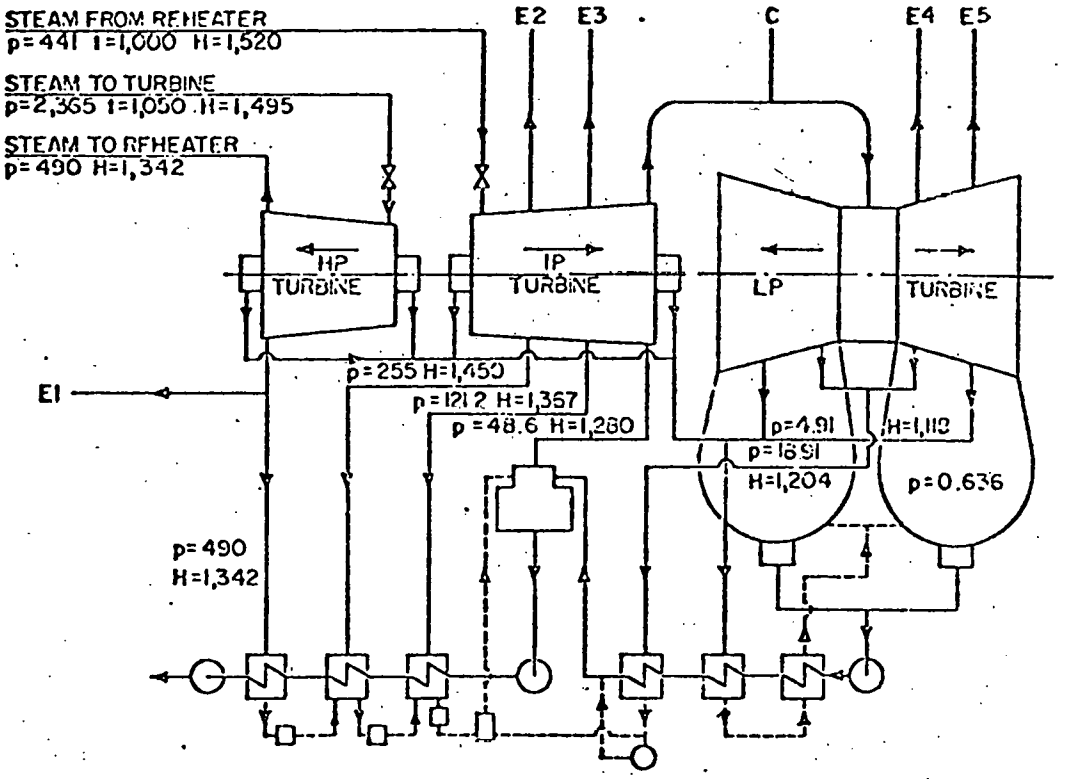

Figure F-3. Generic 200 MW Cross-Compound Steam Turbine

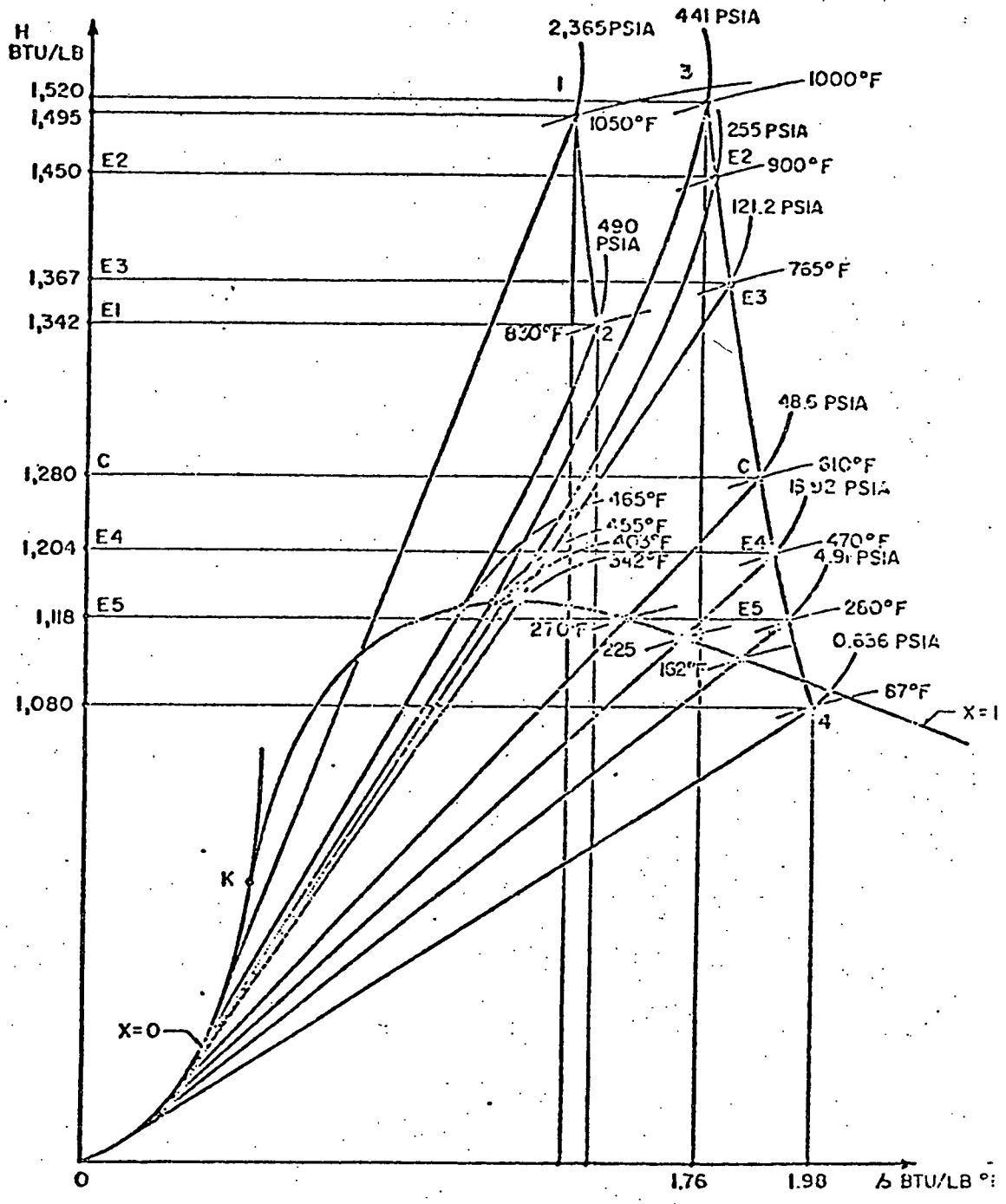

Figure F-4. Mollier Diagram of Cycle for Generic 200 MW Steam Turbine

Table F-I. Primary Distribution Cost Data, Poured Concrete, 30-Inch Pipe

EXCAVATION--	
TRENCH 8 FEET DEEP, 10 INCH BOTTOM WIDTH, 1-FOOT X 1-FOOT SIDE SLOPE	$ 9.90/LF
CONCRETE REMOVAL TO 6 INCHES THICK, WIRE MESH, 26 FEET WIDE	14.22/LF
PIPE BEDDING	15.26/LF
PIPE--30-INCH-DIAMETER INSTALLED IN TRENCH, TWO PIPES	131.20/LF
PIPE INSULATION--TWO PIPES, 4 INCHES THICK	94.43/LF
BACKFILL	0.84/LF
CRANE AND CREW (25 DAYS/MILE)	5.71/LF
UTILITY VAULT (3/MILE)	1.88/LF
CONCRETE ENCASEMENT OF PIPES	
FORMWORK	25.93/LF
CONCRETE	56.64/LF
LABOR	7.00/LF
VALVES--TWO/VAULT	15.63/LF
REPAVING	27.92/LF
SUBTOTAL	$406.56/LF
CONTINGENCY, CLEANUP , FEES, PERMITS (17 PERCENT OF TOTAL)	69.11/LF
TOTAL	$475.68/LF

Table F-II. Primary Distribution Cost Data, Poured Concrete, 24-Inch Pipe

EXCAVATION	
TRENCH, 8 FEET DEEP, 8 FOOT BOTTOM WIDTH, 1 FOOT X 1 FOOT SIDE SLOPE	$ 8.80/LF
*CONCRETE REMOVAL TO 6 INCHES THICK, WIRE MESH, 24 FEET WIDE	13.13/LF
PIPE BEDDING	10.36/LF
PIPE--24 INCH DIAMETER, INSTALLED IN TRENCH, TWO PIPES	100.80/LF
PIPE INSULATION--TWO PIPES, 4 INCHES THICK	80.00/LF
BACKFILL	0.84/LF
CRANE AND CREW (20 DAYS/MILE)	4.57/LF
UTILITY VAULT--8 FEET X 14 FOOT X 7 FEET, 3/MILE)	1.88/LF
CONCRETE ENCASEMENT OF PIPES	
FORMWORK	20.74/LF
CONCRETE	46.09/LF
LABOR	6.25/LF
VALVES--TWO/VAULT	12.48/LF
REPAVING	25.77/LF
SUBTOTAL	$ 331.71/LF
CLEANUP, CONTINGENCY, ENGINEERING FEES, PERMITS--17 PERCENT OF TOTAL	$ 56.39/LF
TOTAL	** $ 388.10/LF

NOTE: THE ABOVE AND SUCCEEDING COST DATA ARE BASED PRIMARILY ON "MECHANICAL AND ELECTRICAL COST DATA, 1979," BY MEANS.

* INCLUDES HAULING TO DUMP

** FOR RURAL AREAS, USE AS IS. FOR SUBURBAN AREAS, MULTIPLY BY 1.1, AND FOR URBAN AREAS, BY 2.7.

Table F-III. Primary Distribution Cost Data, Poured Concrete, 20-Inch Pipe

EXCAVATION--SAME AS FOR 24-INCH PIPE	$ 21.93/LF
PIPE BEDDING	9.27/LF
PIPE--20-INCH-DIAMETER INSTALLED, TWO PIPES	84.00/LF
PIPE INSULATION--TWO PIPES, 4 INCHES THICK	75.50/LF
BACKFILL	0.84/LF
CRANE AND CREW (20 DAYS/MILE)	4.57/LF
UTILITY VAULT (THREE/MILE)	1.88/LF
CONCRETE ENCASEMENT--	
FORMS	20.74/LF
CONCRETE	39.37/LF
LABOR	5.75/LF
VALVES--TWO/VAULT	9.39/LF
REPAVING	25.77/LF
SUBTOTAL	$ 299.01/LF
CLEANUP, CONTINGENCY, FEES, PERMITS--17 PERCENT OF TOTAL	50.83/LF
TOTAL	$ 349.84/LF

NOTE: THE ABOVE AND SUCCEEDING COST DATA ARE BASED PRIMARILY ON "MECHANICAL AND ELECTRICAL COST DATA, 1979," BY MEANS.

Table F-IV. Primary Distribution Cost Data, Poured Concrete, 12-Inch Pipe

EXCAVATION--	
TRENCH, 8 FEET DEEP, 6-FOOT BOTTOM, 1-FOOT X 1-FOOT SIDE SLOPE	$ 7.70/LF
CONCRETE REMOVAL TO 6 INCHES THICK, WIRE MESH, 2 FEET WIDE	6.11/LF
PIPE BEDDING	4.91/LF
PIPE--12-INCH-DIAMETER, TWO PIPES	50.40/LF
PIPE INSULATION--TWO PIPES, 4 INCHES THICK	49.00/LF
BACKFILL	1.80/LF
CRANE AND CREW (15 DAYS/MILE)	3.43/LF
UTILITY VAULT (THREE/MILE)	1.88/LF
CONCRETE ENCASEMENT OF PIPES	
FORMS	12.10/LF
CONCRETE	27.52/LF
LABOR	4.75/LF
VALVES--TWO/VAULT	6.24/LF
REPAVING	23.50/LF
SUBTOTAL	$199.34/LF
CLEANUP, CONTINGENCY, FEES, PERMITS--17 PERCENT OF TOTAL	33.89/LF
TOTAL	$233.23/LF

NOTE: THE ABOVE AND SUCCEEDING COST DATA ARE BASED PRIMARILY ON "MECHANICAL AND ELECTRICAL COST DATA, 1979", BY MEANS.

Table F-V. Customer Retrofit Costs

HEAT EXCHANGERS--HTW TO HOT WATER

LOAD MMBH	SURFACE AREA (FT^2)	COST * ($)
1	36.2	1554
2	58	2236
3	75	2610
4	110	3450
5	124	3706
6	138	3960
7	180	5056
8	200	5438
9	200	5438
10	258	7778

HEAT EXCHANGERS-HTW TO STEAM

LOAD MMBH	SURFACE AREA (FT^2)	COST * ($)
1	22.1	1216
2	22.1	1216
4	41	1882
6	68	2678
8	98	3532
10	143	5896
12	143	5896
14	195	7402
16	195	7402
18	195	7402
20	251	9322

* INCLUDES FEES AND REMOVAL OF EXISTING BOILERS

INTERIOR PLUMBING: SPACE HEATING AND DOMESTIC HOT WATER--TYPICAL COSTS	
PIPE--2-1/2-INCH DIAMETER, INSTALLED,TWO PIPES	$ 19.00/LF
INSULATION--2 INCHES	10.30/LF
SUBTOTAL	$ 29.30/LF
FEES, CONTINGENCY, ETC.	4.98/LF
TOTAL	$ 34.28/LF
PROCESS HEAT	
PIPE--4-INCH DIAMETER INSTALLED, TWO PIPES	$ 30.30
INSULATION--2-INCHES, TWO PIPES	12.80
SUBTOTAL	$ 43.10
FEES, CONTINGENCY, ETC.	7.33
TOTAL	$ 50.43

Table F-V. Customer Retrofit Costs (continued)

CONTROL SYSTEMS	
SPACE HEATING AND DOMESTIC HOT WATER	
INSTRUMENTS, PANELS, VALVES	$7,603
CONTINGENCY AND FEES	1,293
TOTAL	$8,896
PROCESS HEATING	
INSTRUMENTS, PANELS, VALVES	$ 9,083
CONTINGENCY AND FEES	1,544
TOTAL	$10,627
EXTERIOR PLUMBING	
SPACE HEATING AND DHW PIPING	
PIPE--2-1/2-INCH DIAMETER, INSTALLED IN TRENCH, TWO PIPES	$ 9.00/LF
INSULATION--4 INCHES THICK, TWO PIPES	23.18/LF
SUBTOTAL	32.18/LF
CONTINGENCY AND FEES	5.47/LF
TOTAL	$ 37.65/LF
PROCESS HEATING	
PIPE--4-INCH DIAMETER, INSTALLED IN TRENCH, TWO PIPES	$ 12.10/LF
INSULATION--4 INCHES THICK, TWO PIPES	28.46/LF
SUBTOTAL	$ 40.56/LF
CONTINGENCY AND FEES	6.90/LF
TOTAL	$ 47.46/LF
EXCAVATION--	
TRENCH, 8 FEET DEEP, 4-FOOT BOTTOM, 1-FOOT X 1-FOOT SIDE SLOPE	$ 5.93/LF
CONCRETE REMOVAL, 20 FEET WIDE	10.94/LF
BEDDING	4.91/LF
BACKFILL	1.80/LF
CRANE AND CREW, 1/2 DAY	10.00/LF
ENCASE CONDUIT IN CONCRETE	
FORMS	2.75/LF
CONCRETE	22.22/LF
LABOR	1.88/LF
VALVES (2)	50.00/LF
REPAVING	21.44/LF
SUBTOTAL	$131.87/LF
CONTINGENCY, FEES	22.42/LF
TOTAL	$154.29/LF

Table F-V. Customer Retrofit Costs (concluded)

COSTS FOR TYPICAL BUILDING ASSUMING:
100-FOOT INTERIOR AND EXTERIOR RUNS
6 MBH FOR DHW
8 MBH LOW PRESSURE STEAM FOR PROCESS OR SPACE HEATING

	DHW ($)	PROCESS OR SPACE HEAT ($)
INTERIOR PLUMBING	3,428	5,043
EXTERIOR PLUMBING	3,765	4,747
CONTROLS	8,896	10,627
HEAT EXCHANGER	3,960	3,532
EXCAVATION	--	15,428
TOTAL EACH SYSTEM	20,049	39,377
GRAND TOTAL	$59,426	

COMPARISON TO PUBLISHED DATA:

REPORT BY OLIKER AND PHILIPP--TECHNICAL AND ECONOMIC ASPECTS OF DISTRICT HEATING SYSTEMS SUPPLIED FROM COGENERATION OF POWER PLANTS.

COST FOR RETROFITTING APARTMENT BUILDING, HOT WATER HEAT, WINDOW AIR CONDITIONING, INSTALLED CAPACITY 16.5 MMBH--$63,600 IN 1977 DOLLARS.

ESCALATED TO 1979 COST IS $73,776 (16 PERCENT ESCALATION)
OUR COST FOR TYPICAL BUILDING INCREASED BY $11,305 TO SUPPLY TOTAL OF 16.45 MMBH $61,662

Table F-VI. Absorption Cooling Cost Data

FROM ASHRAE 1979 EQUIPMENT VOLUME(PAGE 14.3)A TYPICAL COEFFICIENT OF PERFORMANCE (COP) FOR ABSORPTION SYSTEMS IS 0.6.

THEREFORE FOR EACH TON OF COOLING THE THERMAL INPUT IS:

$$\frac{12000}{.6} \text{ BTUH/TON} = 20{,}000 \text{ BTUH/TON}$$

HIGH TEMP WATER RATE REQUIRED IS:

$$Q = \frac{20000}{\Delta T} \text{ BTUH} \times \frac{1}{60} \frac{\text{MIN}}{\text{HR}} \times \frac{1}{\rho_T} = \text{GPM}$$

WHERE:

ΔT = TEMP (°F) AT INLET - TEMP (°F) AT OUTLET

ρ_T = DENSITY (#/GAL) AT INLET WATER TEMP

ASSUME: INLET TEMP = 290° F

ΔT = 50° F

ρ_T = 7.7#/GAL

$$Q = \frac{20000}{50} \times \frac{1}{60} \times \frac{1}{7.7} = .865 \text{ gpm/TON}$$

TONS OF REFRIGERATION	GPM OF HOT WATER	MMBTUH SUPPLIED BY CENTRAL PLANT
60	69	1.2
90	104	1.8
125	145	2.5
150	173	3.0
300	347	6.0
400	462	8.0
1000	1156	20.0

Table F-VI. Absorption Cooling Cost Data (concluded)

TYPICAL COSTS FOR ABSORPTION COOLING *

TONS OF REFRIGERATION	ABSORPTION UNIT ($/TON)	INSTALLATION ($/TON)	PUMPS AND MOTORS ($/TON)	COOLING TOWER ($/TON)	PLUMBING ($/TON)	WIRING ($/TON)	TOTAL ($/TON)
60	180	25	100	214	55	55	629
90	180	20	100	186	55	55	596
125	160	18	100	173	55	55	561
150	160	18	100	172	55	55	560
300	160	17	100	163	55	55	550
400	160	15	100	156	55	55	541
1000	140	14	100	149	55	55	293

* DOES NOT INCLUDE COST OF DISTRIBUTION WITHIN THE BUILDING

Table F-VII. Thermal Losses, Pipe in Steel Conduit

THERMAL LOSSES IN PIPE WITH AN AVERAGE OF ΔT OF 220°F AND 4 INCHES OF INSULATION--OBTAINED FROM JOHNS MANSVILLE THERMOBESTOS SPECIFICATION DATA:

$$k = 0.37 \text{ Btu } \frac{\text{inch}}{\text{ft}^2 \text{°F hour}}$$

12 INCH PIPE--81.2 Btu/hour/LF

20 INCH PIPE--122 Btu/hour/LF

24 INCH PIPE--146 Btu/hour/LF

THEREFORE A ONE-MILE-LONG DISTRIBUTION SYSTEM WITH 20-INCH MAINS WOULD HAVE A THERMAL LOSS OF:

2 X 5,280 X 122 = 1.288 MMBH

Table F-VIII. Primary Distribution Cost Data, Pipe in Steel Conduit *

12-INCH PIPE, 4 INCHES INSULATION IN STEEL CONDUIT **	
PIPE AND FITTINGS (TWO PIPES)	$ 208.66/LF
INSTALLATION (INCLUDES REPAVING, CLEANUP, ETC.)	208.66/LF
UTILITY VAULTS--THREE/MILE	1.88/LF
VALVES (TWO/VAULT)	6.24/LF
TOTAL	$ 425.44/LF
RURAL AREA	$ 425.44/LF
SUBURBAN AREA	$ 510.53/LF
URBAN AREA	$ 638.16/LF
16-INCH PIPE, 4 INCHES INSULATION IN STEEL CONDUIT	
PIPE AND FITTINGS (TWO PIPES)	$ 261.79/LF
INSTALLATION	261.79/LF
UTILITY VAULTS--THREE/MILE	1.88/LF
VALVES (TWO/VAULT)	7.82/LF
TOTAL	$ 533.28/LF
RURAL AREA	$ 533.28/LF
SUBURBAN AREA	$ 639.94/LF
URBAN AREA	$ 799.92/LF
20-INCH PIPE, 4 INCHES INSULATION IN STEEL CONDUIT	
PIPE AND FITTINGS (TWO PIPES)	$ 338.80/LF
INSTALLATION	338.80/LF
UTILITY VAULT (THREE/MILE)	1.88/LF
VALVES (TWO/VAULT)	9.39/LF
TOTAL	$ 688.87/LF
RURAL AREA	$ 688.87/LF
SUBURBAN AREA	$ 826.64/LF
URBAN AREA	$1033.31/LF

* PIPE, FITTING AND INSTALLATION COSTS AND SCALING FACTORS FOR URBAN AREA WERE SUPPLIED BY A MANUFACTURER OF DISTRICT HEATING PIPING SYSTEMS.

** ALL PIPES ARE 0.500-INCH WALL.

Table F-VIII. Primary Distribution Cost Data, Pipe in Steel Conduit (concluded)

24-INCH PIPE, 4 INCHES INSULATION IN STEEL CONDUIT	
PIPE AND FITTINGS (TWO PIPES)	$ 404.73/LF
INSTALLATION	404.73/LF
UTILITY VAULT (THREE/MILE)	1.88/LF
VALVES (TWO/VAULT)	12.48/LF
TOTAL	$ 823.82/LF
RURAL AREA	$ 823.82/LF
SUBURBAN AREA	$ 988.58/LF
URBAN AREA	$1235.73/LF
30-INCH PIPE, 4 INCHES INSULATION IN STEEL CONDUIT	
PIPE AND FITTINGS (TWO PIPES)	$ 477.82/LF
INSTALLATION	477.82/LF
UTILITY VAULT (THREE/MILE)	1.88/LF
VALVES (TWO/VAULT)	15.63/LF
TOTAL	$ 973.15/LF
RURAL AREA	$ 973.15/LF
SUBURBAN AREA	$1167.78/LF
URBAN AREA	$1459.73/LF
36-INCH PIPE, 4 INCHES INSULATION IN STEEL CONDUIT	
PIPE AND FITTINGS (TWO PIPES)	$ 679.97/LF
INSTALLATION	679.97/LF
UTILITY VAULT (THREE/MILE)	1.88/LF
VALVES (TWO/VAULT)	18.75/LF
TOTAL	$1380.56/LF
RURAL AREA	$1380.56/LF
SUBURBAN AREA	$1656.67/LF
URBAN AREA	$2070.84/LF

APPENDIX G
DETAILED ECONOMIC ANALYSIS RESULTS/DATA

This appendix contains detailed results and supporting data used in the economic analysis of district heating system alternatives for Green Bay, Janesville/Beloit and Madison.

District heating alternatives analyzed are briefly described with total yearly heat supplied and system costs. A detailed example is provided for one alternative in Green Bay. Summary tables and results are provided for the other sites. Income statements and balance sheets are provided for Green Bay, the most promising site.

DISTRICT HEATING ALTERNATIVES ANALYZED

The district heating alternatives analyzed were described in detail in Section 6.0. A brief summary of these alternatives includes:

Green Bay

- Three Mills and CBD - Includes three paper mills (located across the Fox River from the power plant) and the Central Business District (CBD), which is located immediately south of the paper mills. The distance from the Green Bay Pullium Plant to the southern boundry of the CBD is approximately two miles. The distribution costs include the costs (1,000,000) for a pipe bridge across the Fox River.

  - Heat Supplied — 3540.85×10^9 Btu per year
  - System Costs

Plant Retrofit	$3,000,000
Distribution System	$8,000,000

- Two Mills and CBD - Includes the two smaller paper mills and the CBD. The largest paper mill was omitted. The distribution costs include the cost (1,000,000) for a pipe bridge across the Fox River.

▲ Heat Supplied	1418.33×10^9 Btu per year
▲ System Costs	
Plant Retrofit	$1,500,000
Distribution System	$5,200,000

Janesville/Beloit

- Rock River to Industrial Park - Includes a proposed (i.e., no current tenants) industrial park located near the Rock River Power Plant.

Heat Supplied (Estimate)	1234.80×10^9 Btu per year
System Costs	
Plant Retrofit	$1,500,000
Distribution System	$5,200,000

- Blackhawk to Beloit - Includes large industrial users in and near Beloit, Wisconsin.

▲ Heat Supplied	670.41×10^9 Btu per year
▲ System Costs	
Plant Retrofit	$ 1,500,000
Distribution System	$14,300,000

- Rock River to Janesville and Beloit - Includes heavy users near Janesville and Beloit, with all energy extracted from the Rock River Power Plant.

▲ Heat Supplied	1928.61 x 10^9 Btu per year
▲ System Costs	
Plant Retrofit	$ 2,500,000
Distribution System	$67,200,000

Madison

- CBD and Capitol Heating Complex - Includes portions of the Central Business District and the buildings heated by the Capitol Heating Plant.

▲ Heat Supplied	215.10 x 10^9 Btu per year
▲ System Costs	
Plant Retrofit	$1,000,000
Distribution	$3,500,000

- University of Wisconsin - Includes a complex of buildings (approximately 150) at the University of Wisconsin.

▲ Heat Supplied	1176.05 x 10^9 Btu per year
▲ System Costs	
Plant Retrofit	$ 2,400,000
Distribution	$14,200,000

ECONOMIC INPUTS

The economic viability of each alternative was determined using the capitalization structure of the utility for that site. These inputs, by site, are summarized in Table G-1. A single-return requirement of eight percent for municipal financing was used at each site.

Table G-1. Economic Analysis Input Summary

	Green Bay Wisconsin Public Service Corporation	Janesville/Beloit Wisconsin Power & Light	Madison Madison Gas & Electric
Capitalization	Bonds 47% @ 9% Preferred 12% @ 9% Common 41% @ 13%	Bonds 48% @ 9.75% Preferred 12% @ 9.5% Common 40% @ 14.5%	Bonds 51% @ 8.0% Preferred 14% @ 9.0% Common 35% @ 12.0%
Income Tax Rate (State/Fed)	49.95%	50%	49.95%
Advalorem Tax Rate	$30 per $1000 Assessed Valuation	$25 per 1000 Assessed Valuation	$30 per 1000 Assessed Valuation
Investment Tax Credit Rate	10%	10%	10%
Utility Discount Rate Employed	17%	11.62%	9.54%
Book Life	27 years	31 years	27 years
Depreciation Method	Double Declining - 1st two years Sum of Digits - Remaining years	Double Declining - 1st two years Sum of Digits - Remaining years	Double Declining - 1st two years Sum of Digits - Remaining years
Municipal Financing Rate	Bonds 100% @ 8%	Bonds 100% @ 8%	Bonds 100% @ 8%
Municipal Discount Rate Employed	8%	8%	8%

DETAILED EXAMPLES

The following is a detailed example of the economic analysis used for Green Bay--three mills and CBD alternative. Each of the three financing alternatives is illustrated

Utility Financing

Fixed-return requirements were calculated using the capitalization structure of the utilities and included:

- Book depreciation,
- Ad valorem tax,
- Income tax,
- Return for equity and debt.

An example of these fixed-return requirements for an $11,000,000 district heating investment in Green Bay is illustrated in Table G-2, Depreciation, Table G-3, Return on Debt and Equity, Table G-4, Taxes. Total fixed return requirements are summarized in Table G-5. All amounts are expressed in terms of thousands of dollars. Once determined, fixed-return requirements were discounted to present value (1979 dollars) using the utility discount rate. For the Green Bay example illustrated, this is 17 percent.

Table G-2. Depreciation (x 1000), Green Bay, Three Mills and CBD Alternative, Utility Financing Option

YEAR	NET PLANT	BOOK DEPR
1980	11000	346
1981	10654	670
1982	9984	639
1983	9345	618
1984	8727	597
1985	8130	576
1986	7554	556
1987	6998	535
1988	6463	514
1989	5949	493
1990	5456	473
1991	4983	452
1992	4531	431
1993	4100	411
1994	3689	391
1995	3298	369
1996	2929	349
1997	2580	328
1998	2252	307
1999	1945	287
2000	1658	266
2001	1392	245
2002	1147	224
2003	923	204
2004	719	204

Table G-3. Return Requirement (x 1000), Green Bay, Three Mills and CBD Alternative, Utility Financing Option

YEAR	BOND INTEREST	PREFERRED DIVIDENDS	COMMON STOCK	TOTAL RETURN
1980	465	119	586	1170
1981	451	115	568	1134
1982	422	108	532	1062
1983	395	101	498	994
1984	369	94	465	928
1985	344	88	433	865
1986	319	82	403	804
1987	296	76	373	745
1988	273	70	344	687
1989	252	64	317	633
1990	231	59	291	581
1991	211	54	266	531
1992	192	49	241	482
1993	173	44	218	435
1994	156	40	197	393
1995	139	36	176	351
1996	124	32	156	312
1997	109	28	137	274
1998	95	24	120	239
1999	82	21	104	207
2000	70	18	88	176
2001	59	15	74	148
2002	48	12	61	121
2003	39	10	49	98
2004	30	8	38	76

Table G-4. Taxes (x 1000), Green Bay, Three Mills and CBD Alternative, Utility Financing Option

YEAR	TAX SAVE	ITC RESTORED	REV. T.E.	GROSS TAX	INCOME TAX
1980	142	21	21	704	520
1981	263	41	41	681	336
1982	232	41	41	639	325
1983	211	41	41	598	305
1984	190	41	41	558	286
1985	169	41	41	520	269
1986	149	41	41	483	252
1987	128	41	41	448	238
1988	107	41	41	413	224
1989	86	41	41	381	213
1990	66	41	41	349	201
1991	45	41	41	319	192
1992	24	41	41	290	184
1993	4	41	41	262	176
1994	-16	41	41	236	170
1995	-38	41	41	211	167
1996	-58	41	41	187	163
1997	-79	41	41	165	162
1998	-100	41	41	144	162
1999	-120	41	41	124	162
2000	-141	41	41	106	165
2001	-162	41	41	89	169
2002	-183	41	41	73	174
2003	-203	41	41	59	180
2004	-203	41	41	46	167

Table G-5. Summary, Fixed Charges (x 1000), Green Bay, Three Mills and CBD Alternative, Utility Financing Option

	TOTAL FIXED CHARGES						
YEAR	BOOK DEPR	INCOME TAX	ADVALOREM TAX	TOTAL RETURN	TOTAL FIXCHRG	PV	ACC PV
1980	346	520	330	1170	2366	2022	2022
1981	670	336	320	1134	2460	1797	3819
1982	639	325	300	1062	2326	1451	5270
1983	618	305	280	994	2197	1171	6441
1984	597	286	262	928	2073	944	7385
1985	576	269	244	865	1954	760	8145
1986	556	252	227	804	1839	612	8757
1987	535	238	210	745	1728	491	9248
1988	514	224	194	687	1619	393	9641
1989	493	213	178	633	1517	315	9956
1990	473	201	164	581	1419	251	10207
1991	452	192	149	531	1324	200	10407
1992	431	184	136	482	1233	160	10567
1993	411	176	123	435	1145	127	10694
1994	391	170	111	393	1065	101	10795
1995	369	167	99	351	986	80	10875
1996	349	163	88	312	912	63	10938
1997	328	162	77	274	841	50	10988
1998	307	162	68	239	776	39	11027
1999	287	162	58	207	714	31	11058
2000	266	165	50	176	657	24	11082
2001	245	169	42	148	604	19	11101
2002	224	174	34	121	553	15	11116
2003	204	180	28	98	510	12	11128
2004	204	167	22	76	469	9	11137

Variable return requirements (operation, maintenance, fuel costs) were determined for a range of fuel escalation rates. Table G-6 itemizes operations and maintenance costs. Table G-7 illustrates fuel and O&M costs for the range of fuel escalation rates used and the single rate selected.

Gross income from the sale of thermal energy was determined by selecting a base charge per 10^6 Btu and escalating that charge at a number of different rates. These are illustrated in Table G-8. In the example for Green Bay (Table G-8) the base charge rate is $1.80/10^6$ Btu (90 percent of the current rate for natural gas in Green Bay). Yearly income is based on a total consumer thermal energy requirement of 3540.85×10^9 Btu per year. The base charge rate is escalating at 7 percent (14 percent with inflation).

Results are illustrated by two graphs:

- Life-Cycle Savings versus Real Fuel Escalation Rates (Figure G-1) for four fuel escalation ranges. A "+" indicates the results for the fuel escalation rate case selected as most representative of Wisconsin (real annual rates of coal--4 percent, oil--4 percent, natural gas--7 percent.
- Accumulated Net Present Worth versus Year of Operation (Figure G-2) for two rate structures and the single escalation rate assumed for each fuel type.

Table G-6. Green Bay, Operations and Maintenance Costs, Three Mills and CBD Alternative

Year	Distribution			Plant		
	Maintenance 1% of Cost ($8x10^6$)	Insurance .2% of Cost ($8x10^6$)	Pump Power $5.5x10^6$ kWh/yr @ 022/kWh	District Heating Portion	Cost of Shifting to less Efficient Boilers	Total O&M Costs
1980	80	16	122	260	117	595
1981	86	17	131	295	140	669
1982	92	18	140	315	239	804
1983	98	20	149	337	223	827
1984	105	21	160	359	199	844
1985	112	22	171	384	276	966
1986	120	24	183	408	330	1066
1987	128	26	196	432	427	1209
1988	137	27	210	464	443	1282
1989	147	29	224	495	316	1212
1990	157	31	240	472	329	1230
1991	168	34	257	456	286	1233
1992	180	36	275	488	306	1320
1993	193	39	294	522	328	1412
1994	206	41	315	559	351	1511
1995	221	44	337	598	375	1617
1996	236	47	360	640	401	1730
1997	253	51	385	684	430	1851
1998	270	54	412	732	460	1981
1999	289	58	441	783	492	2120
2000	310	62	472	838	526	2268
2001	331	66	505	897	563	2426
2002	354	71	541	960	603	2596
2003	379	76	578	1027	645	2778
2004	406	81	619	1099	690	2972

Table G-7. Fuel/O & M Data (x 1000), Green Bay, Three Mills and CBD Alternative, Utility Financing Option

COAL COS	1.4/10^6 Btu
OIL COST	2.9/10^6 Btu
COAL ESC RATE	7%
OIL ESC RATE	10%
DISCOUNT RATES	17%

Year	Coal Cost	Oil Cost	Total Fuel	Total O&M	Total Fuel/O&M	PV	Acc. PV
1980	3402.	695.	4097.	595.	4692.	4011.	4011.
1981	3457.	1576.	5033.	669.	5702.	4165.	8176.
1982	3713.	1374.	5087.	804.	5891.	3678.	11854.
1983	4105.	1002.	5107.	827.	5934.	3167.	15021.
1984	4367.	1565.	5932.	844.	6776.	3090.	18111.
1985	4408.	2317.	6725.	966.	7691.	2998.	21110.
1986	4606.	3317.	7924.	1066.	8990.	2995.	24105.
1987	4604.	4066.	8670.	1209.	9879.	2813.	26918.
1988	5078.	3303.	8381.	1282.	9663.	2352.	29270.
1989	5621.	3182.	8803.	1212.	10015.	2083.	31354.
1990	5838.	3210.	9048.	1229.	10277.	1827.	33181.
1991	6246.	3531.	9778.	1233.	11011.	1673.	34854.
1992	6683.	3884.	10568.	1320.	11888.	1544.	36398.
1993	7151.	4273.	11424.	1412.	12836.	1425.	37824.
1994	7652.	4700.	12352.	1511.	13863.	1315.	39139.
1995	8188.	5170.	13358.	1617.	14975.	1214.	40353.
1996	8761.	5687.	14448.	1730.	16178.	1121.	41475.
1997	9374.	6256.	15630.	1851.	17481.	1036.	42511.
1998	10030.	6882.	16912.	1981.	18893.	957.	43467.
1999	10732.	7570.	18302.	2119.	20421.	884.	44351.
2000	11483.	8327.	19810.	2268.	22078.	817.	45168.
2001	12287.	9159.	21447.	2426.	23873.	755.	45922.
2002	13147.	10075.	23223.	2596.	25819.	698.	46620.
2003	14068.	11083.	25151.	2778.	27929.	645.	47265.
2004	15052.	12191.	27244.	2972.	30216.	596.	47862.

Table G-7. Fuel/O & M Data (x 1000), Green Bay, Three Mills and CBD Alternative, Utility Financing Option (continued)

COAL COST	$1.40/10^6 Btu
OIL COST	$2.90/10^6 Btu
COAL ESC RATE	7%
OIL ESC RATE	17%
DISCOUNT RATES	17%

Year	Coal	Oil	Total Fuel	O&M	Total Fuel/O&M	PV	Acc. PV
1980	3402.	740.	4142.	595.	4737.	4048.	4048.
1981	3457.	1782.	5240.	669.	5909.	4316.	8365.
1982	3713.	1654.	5367.	804.	6171.	3853.	12218.
1983	4105.	1282.	5388.	827.	6215.	3316.	15534.
1984	4367.	2130.	6497.	844.	7341.	3348.	18882.
1985	4408.	3355.	7763.	966.	8729.	3403.	22285.
1986	4606.	5109.	9715.	1066.	10781.	3592.	25878.
1987	4604.	6660.	11264.	1209.	12473.	3552.	29430.
1988	5078.	5755.	10833.	1282.	12115.	2949.	32378.
1989	5621.	5897.	11517.	1212.	12729.	2648.	35027.
1990	5838.	6328.	12166.	1229.	13395.	2382.	37408.
1991	6246.	7404.	13650.	1233.	14883.	2262.	39670.
1992	6683.	8663.	15346.	1320.	16666.	2165.	41835.
1993	7151.	10135.	17286.	1412.	18698.	2076.	43911.
1994	7652.	11858.	19510.	1511.	21021.	1995.	45905.
1995	8188.	13874.	22062.	1617.	23679.	1920.	47826.
1996	8761.	16233.	24993.	1730.	26723.	1852.	49678.
1997	9374.	18992.	28366.	1851.	30217.	1790.	51468.
1998	10030.	22221.	32251.	1981.	34232.	1733.	53202.
1999	10732.	25998.	36731.	2119.	38850.	1681.	54883.
2000	11483.	30418.	41902.	2268.	44170.	1634.	56517.
2001	12287.	35589.	47877.	2426.	50303.	1590.	58107.
2002	13147.	41639.	54787.	2596.	57383.	1551.	59658.
2003	14068.	48718.	62786.	2778.	65564.	1514.	61172.
2004	15052.	57000.	72053.	2972.	75025.	1481.	62653.

Table G-7. Fuel/O & M Data (x 1000), Green Bay, Three Mills and CBD Alternative, Utility Financing Option (continued)

COAL COST	1.4/10^6 Btu
OIL COST	2.9/10^6 Btu
COAL ESC RATE	14%
OIL ESC RATE	10%
DISCOUNT RATES	17%

Year	Coal	Oil	Total Fuel	O&M	Total Fuel/O&M	PV	Acc. PV
1980	3625.	695.	4320.	595.	4915.	4201.	4201.
1981	3925.	1576.	5500.	669.	6169.	4507.	8707.
1982	4491.	1374.	5865.	804.	6669.	4164.	12871.
1983	5289.	1002.	6292.	827.	7119.	3799.	16670.
1984	5995.	1565.	7560.	844.	8404.	3833.	20503.
1985	6447.	2317.	8764.	966.	9730.	3793.	24296.
1986	7178.	3317.	10495.	1066.	11561.	3852.	28148.
1987	7644.	4066.	11709.	1209.	12918.	3679.	31827.
1988	8983.	3303.	12285.	1282.	13567.	3302.	35129.
1989	10593.	3182.	13775.	1212.	14987.	3118.	38247.
1990	11721.	3210.	14931.	1229.	16160.	2873.	41121.
1991	13362.	3531.	16893.	1233.	18126.	2755.	43875.
1992	15233.	3884.	19117.	1320.	20437.	2655.	46530.
1993	17365.	4273.	21638.	1412.	23050.	2559.	49089.
1994	19796.	4700.	24497.	1511.	26008.	2468.	51557.
1995	22568.	5170.	27738.	1617.	29355.	2381.	53938.
1996	25727.	5687.	31415.	1730.	33145.	2297.	56235.
1997	29329.	6256.	35585.	1851.	37436.	2218.	58453.
1998	33435.	6882.	40317.	1981.	42298.	2142.	60595.
1999	38116.	7570.	45686.	2119.	47805.	2069.	62664.
2000	43452.	8327.	51779.	2268.	54047.	1999.	64663.
2001	49536.	9159.	58695.	2426.	61121.	1932.	66596.
2002	56471.	10075.	66546.	2596.	69142.	1868.	68464.
2003	64377.	11083.	75460.	2778.	78238.	1807.	70271.
2004	73389.	12191.	85581.	2972.	88553.	1748.	72019.

Table G-7. Fuel/O & M Data (x 1000), Green Bay, Three Mills and CBD Alternative, Utility Financing Option (continued)

COAL COST	$1.4/10^6$ Btu
OIL COST	$2.9/10^6$ Btu
COAL ESC RATE	14%
OIL ESC RATE	17%
DISCOUNT RATES	17%

Year	Coal	Oil	Total Fuel	O&M	Total Fuel/O&M	PV	Acc. PV
1980	3625.	740.	4364.	595.	4959.	4239.	4239.
1981	3925.	1782.	5707.	669.	6376.	4658.	8896.
1982	4491.	1654.	6144.	804.	6948.	4338.	13235.
1983	5289.	1282.	6572.	827.	7399.	3948.	17183.
1984	5995.	2130.	8125.	844.	8969.	4091.	21274.
1985	6447.	3355.	9802.	966.	10768.	4198.	25472.
1986	7178.	5109.	12287.	1066.	13353.	4449.	29921.
1987	7644.	6660.	14304.	1209.	15513.	4418.	34339.
1988	8983.	5755.	14737.	1282.	16019.	3899.	38238.
1989	10593.	5897.	16490.	1212.	17702.	3683.	41920.
1990	11721.	6328.	18049.	1229.	19278.	3428.	45348.
1991	13362.	7404.	20766.	1233.	21999.	3343.	48691.
1992	15233.	8663.	23895.	1320.	25215.	3275.	51967.
1993	17365.	10135.	27500.	1412.	28912.	3210.	55176.
1994	19796.	11858.	31655.	1511.	33166.	3147.	58323.
1995	22568.	13874.	36442.	1617.	38059.	3087.	61410.
1996	25727.	16233.	41960.	1730.	43690.	3028.	64439.
1997	29329.	18992.	48321.	1851.	50172.	2972.	67411.
1998	33435.	22221.	55656.	1981.	57637.	2919.	70330.
1999	38116.	25998.	64115.	2119.	66234.	2867.	73196.
2000	43452.	30418.	73871.	2268.	76139.	2816.	76013.
2001	49536.	35589.	85125.	2426.	87551.	2768.	78781.
2002	56471.	41639.	98110.	2596.	100706.	2721.	81502.
2003	64377.	48718.	113095.	2778.	115873.	2676.	84178.
2004	73389.	57000.	130390.	2972.	133362.	2633.	86811.

Table G-7. Fuel/O & M Data (x 1000), Green Bay, Three Mills and CBD Alternative, Utility Financing Option (concluded)

COAL COST	1.40/10^6 Btu
OIL COST	2.90/10^6 Btu
COAL ESC RATE	11%
OIL ESC RATE	11.1%
DISCOUNT RATES	17%

Year	Coal	Oil	Total Fuel	O&M	Total Fuel/O&M	PV	Acc. PV
1980	3529.	702.	4232.	595.	4827.	4125.	4125.
1981	3721.	1607.	5328.	669.	5997.	4381.	8506.
1982	4145.	1416.	5561.	804.	6365.	3974.	12480.
1983	4754.	1043.	5797.	827.	6624.	3535.	16015.
1984	5247.	1644.	6891.	844.	7735.	3528.	19543.
1985	5494.	2460.	7953.	966.	8919.	3477.	23020.
1986	5956.	3557.	9512.	1066.	10578.	3525.	26545.
1987	6175.	4402.	10578.	1209.	11787.	3357.	29901.
1988	7066.	3612.	10678.	1282.	11960.	2911.	32813.
1989	8113.	3515.	11628.	1212.	12840.	2671.	35484.
1990	8741.	3582.	12323.	1229.	13552.	2410.	37893.
1991	9703.	3979.	13682.	1233.	14915.	2267.	40160.
1992	10770.	4421.	15191.	1320.	16511.	2145.	42305.
1993	11955.	4912.	16866.	1412.	18278.	2029.	44334.
1994	13270.	5457.	18726.	1511.	20237.	1920.	46254.
1995	14729.	6063.	20792.	1617.	22409.	1817.	48072.
1996	16349.	6735.	23085.	1730.	24815.	1720.	49792.
1997	18148.	7483.	25631.	1851.	27482.	1628.	51420.
1998	20144.	8314.	28458.	1981.	30439.	1541.	52961.
1999	22360.	9237.	31597.	2119.	33716.	1459.	54420.
2000	24820.	10262.	35081.	2268.	37349.	1382.	55802.
2001	27550.	11401.	38951.	2426.	41377.	1308.	57110.
2002	30580.	12666.	43247.	2596.	45843.	1239.	58349.
2003	33944.	14072.	48016.	2778.	50794.	1173.	59522.
2004	37678.	15634.	53312.	2972.	56284.	1111.	60633.

Table G-8. Gross Income Data (x 1000), Green Bay, Three Mills and CBD Alternative, Utility Financing Option

DISCOUNT RATE	17%
FUEL QUANTITY	3540.85×10^9 Btu/yr
FUEL COST	$1.80/10^6$ Btu
ESCALATION RATE	9%

Year	Income	PV	Acc. PV
1980	6947.	5938.	5938.
1981	7572.	5532.	11469.
1982	8254.	5153.	16623.
1983	8997.	4801.	21424.
1984	9806.	4473.	25897.
1985	10689.	4167.	30064.
1986	11651.	3882.	33946.
1987	12700.	3617.	37563.
1988	13843.	3369.	40932.
1989	15088.	3139.	44071.
1990	16446.	2924.	46995.
1991	17927.	2724.	49720.
1992	19540.	2538.	52258.
1993	21299.	2365.	54622.
1994	23215.	2203.	56825.
1995	25305.	2052.	58877.
1996	27582.	1912.	60789.
1997	30065.	1781.	62571.
1998	32771.	1659.	64230.
1999	35720.	1546.	65776.
2000	38935.	1440.	67216.
2001	42439.	1342.	68558.
2002	46258.	1250.	69808.
2003	50422.	1165.	70972.
2004	54959.	1085.	72057.

DISCOUNT RATE	17%
FUEL QUANTITY	3540.85×10^9 Btu/yr
FUEL COST	$1.80/10^6$ Btu
ESCALATION RATE	11%

Year	Income	PV	Acc. PV
1980	7075.	6047.	6047.
1981	7853.	5737.	11783.
1982	8717.	5442.	17226.
1983	9675.	5163.	22389.
1984	10740.	4899.	27288.
1985	11921.	4647.	31935.
1986	13232.	4409.	36344.
1987	14688.	4183.	40527.
1988	16304.	3968.	44495.
1989	18097.	3765.	48260.
1990	20088.	3572.	51832.
1991	22297.	3389.	55220.
1992	24750.	3215.	58435.
1993	27473.	3050.	61485.
1994	30495.	2894.	64379.
1995	33849.	2745.	67124.
1996	37573.	2604.	69729.
1997	41706.	2471.	72199.
1998	46293.	2344.	74544.
1999	51385.	2224.	76767.
2000	57038.	2110.	78877.
2001	63312.	2002.	80879.
2002	70276.	1899.	82778.
2003	78007.	1802.	84580.
2004	86587.	1709.	86289.

Table G-8. Gross Income Data (x 1000), Green Bay, Three Mills and CBD Alternative, Utility Financing Option (continued)

DISCOUNT RATE	17%
FUEL QUANTITY	3540.85×10^9 Btu/yr
FUEL COST	$1.80/10^6$ Btu
ESCALATION RATE	13%

Year	Income	PV	Acc. PV
1980	7202.	6156.	6156.
1981	8138.	5945.	12101.
1982	9196.	5742.	17843.
1983	10392.	5546.	23388.
1984	11743.	5356.	28744.
1985	13269.	5173.	33917.
1986	14994.	4996.	38913.
1987	16944.	4825.	43739.
1988	19146.	4660.	48399.
1989	21635.	4501.	52900.
1990	24446.	4347.	57247.
1991	27626.	4198.	61445.
1992	31218.	4055.	65500.
1993	35276.	3916.	69417.
1994	39862.	3782.	73199.
1995	45044.	3653.	76852.
1996	50900.	3528.	80380.
1997	57516.	3408.	83788.
1998	64994.	3291.	87079.
1999	73443.	3179.	90258.
2000	82990.	3070.	93328.
2001	93779.	2965.	96292.
2002	105970.	2864.	99156.
2003	119746.	2766.	101922.
2004	135313.	2671.	104593.

DISCOUNT RATE	17%
FUEL QUANTITY	3540.85×10^9 Btu/yr
FUEL COST	$1.80/10^6$ Btu
ESCALATION RATE	15%

Year	Income	PV	Acc. PV
1980	7330.	6265.	6265.
1981	8429.	6157.	12422.
1982	9693.	6052.	18474.
1983	11147.	5949.	24423.
1984	12819.	5847.	30270.
1985	14742.	5747.	36017.
1986	16954.	5649.	41666.
1987	19497.	5552.	47219.
1988	22421.	5457.	52676.
1989	25784.	5364.	58040.
1990	29652.	5272.	63313.
1991	34100.	5182.	68495.
1992	39215.	5094.	73589.
1993	45097.	5007.	78595.
1994	51862.	4921.	83516.
1995	59641.	4837.	88353.
1996	68587.	4754.	93108.
1997	78875.	4673.	97781.
1998	90707.	4593.	102374.
1999	104313.	4515.	106888.
2000	119960.	4437.	111326.
2001	137953.	4362.	115687.
2002	158646.	4287.	119974.
2003	182443.	4214.	124188.
2004	209810.	4142.	128330.

Table G-8. Gross Income Data (x 1000), Green Bay, Three Mills and CBD Alternative, Utility Financing Option (concluded)

DISCOUNT RATE	17%
FUEL QUANTITY	3540.85×10^9 Btu/yr
FUEL COST	$1.80/10^6$ Btu
ESCALATION RATE	17%

Year	Income	PV	Acc. PV
1980	6459.	5520.	5520.
1981	7363.	5379.	10899.
1982	8393.	5241.	16139.
1983	9569.	5106.	21246.
1984	10908.	4975.	26221.
1985	12435.	4848.	31069.
1986	14176.	4723.	35792.
1987	16161.	4602.	40394.
1988	18423.	4484.	44879.
1989	21003.	4369.	49248.
1990	23943.	4257.	53505.
1991	27295.	4148.	57654.
1992	31116.	4042.	61695.
1993	35473.	3938.	65634.
1994	40439.	3837.	69471.
1995	46100.	3739.	73210.
1996	52555.	3643.	76852.
1997	59912.	3550.	80402.
1998	68300.	3459.	83861.
1999	77862.	3370.	87230.
2000	88762.	3283.	90514.
2001	101189.	3199.	93713.
2002	115356.	3117.	96830.
2003	131506.	3037.	99867.
2004	149916.	2959.	102827.

DISCOUNT RATE	17%
FUEL QUANTITY	3540.85×10^9 Btu/yr
FUEL COST	$1.80/10^6$ Btu
ESCALATION RATE	14%

Year	Income	PV	Acc. PV
1980	7266.	6210.	6210.
1981	8283.	6051.	12261.
1982	9443.	5896.	18157.
1983	10765.	5745.	23901.
1984	12272.	5597.	29499.
1985	13990.	5454.	34952.
1986	15948.	5314.	40266.
1987	18181.	5178.	45444.
1988	20726.	5045.	50489.
1989	23628.	4916.	55404.
1990	26936.	4789.	60194.
1991	30707.	4667.	64860.
1992	35006.	4547.	69407.
1993	39907.	4430.	73838.
1994	45494.	4317.	78155.
1995	51863.	4206.	82361.
1996	59124.	4098.	86459.
1997	67401.	3993.	90452.
1998	76837.	3891.	94343.
1999	87595.	3791.	98134.
2000	99858.	3694.	101828.
2001	113838.	3599.	105427.
2002	129775.	3507.	108934.
2003	147944.	3417.	112351.
2004	168656.	3329.	115680.

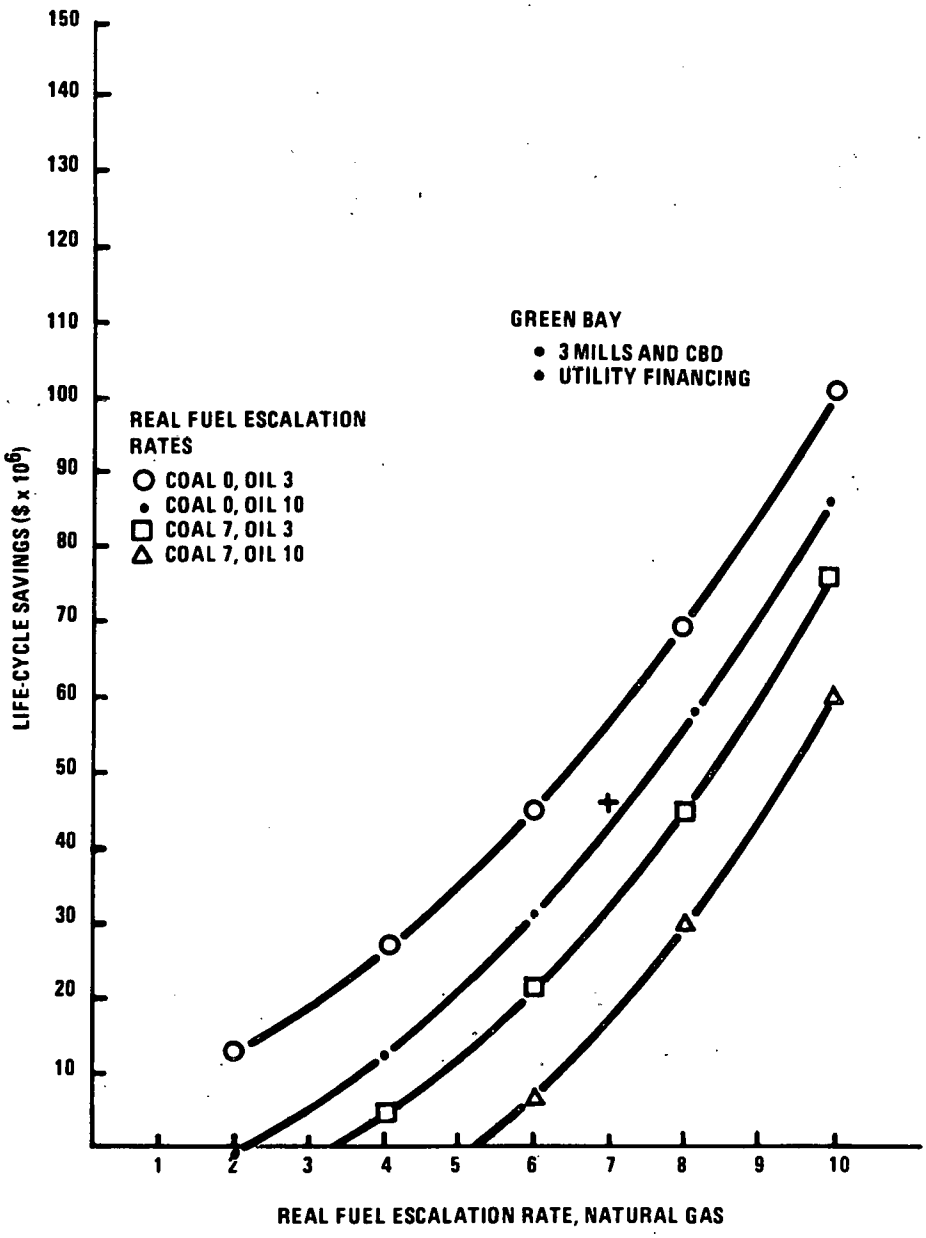

Figure G-1. Life-Cycle Savings versus Real Fuel Escalation Rate, Natural Gas

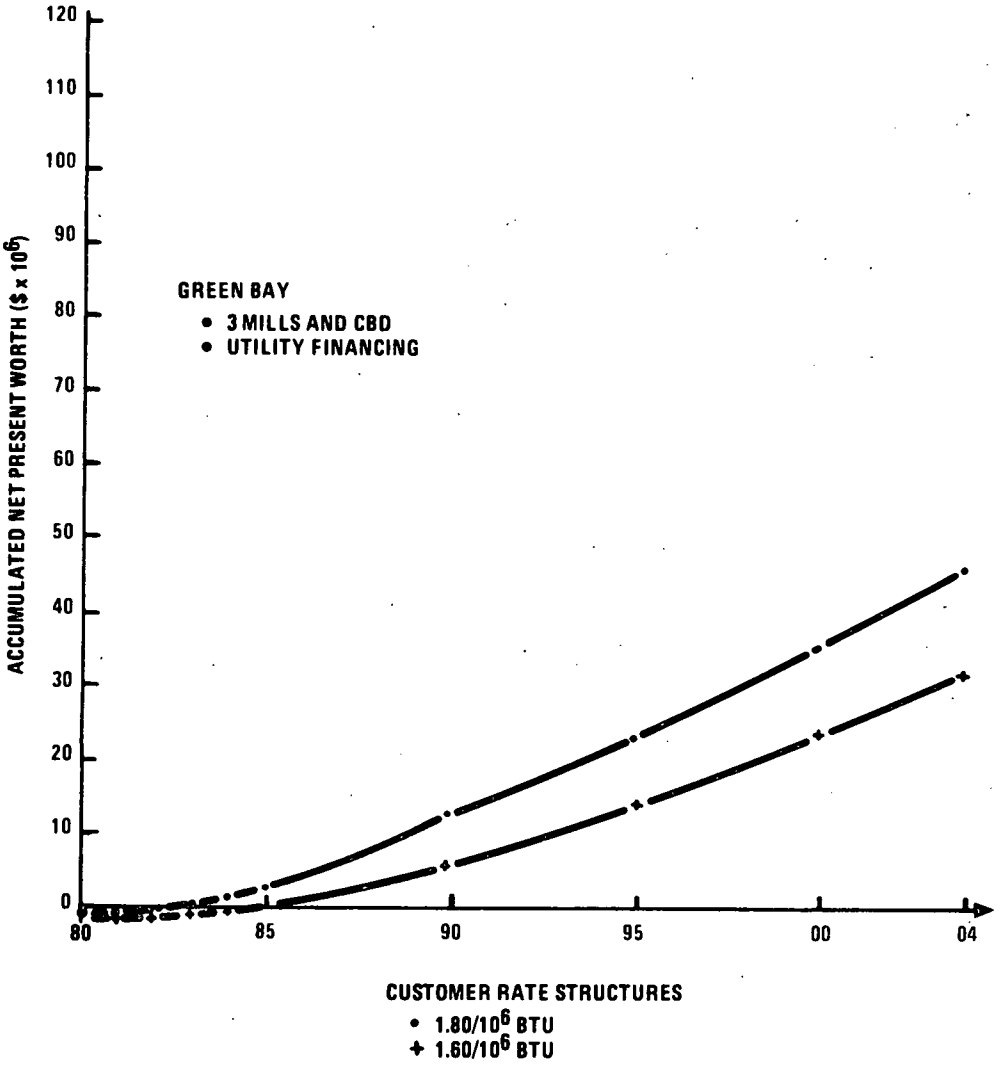

Figure G-2. Accumulated Net Present Worth versus Year of Operation

Municipal Financing

Return requirements were based on a return rate of eight percent and discounted at eight percent to determine the present value. A book life equal to that used by the utility was used. Depreciation was calculated using the straight line method.

An example of the fixed return requirements for a municipality are illustrated in Table G-9. All numbers are expressed in terms of thousands of dollars. The example represents a 11,000,000 district heating system investment, a book life of 27 years, a return requirement of eight percent of the net investment and a total return discounted at eight percent.

Annual savings for this case were determined by calculating the gross income, subtracting the fixed revenue requirements and variable operations, maintenance and fuel expenses, and discounting the results at eight percent. Resultant calculations were expressed similarly to those described for utility financing (Tables G-9 through G-13). Figure G-3 and G-4 are examples for Green Bay, three mills and CBD alternative.

Table G-9. Return Requirements (x 100), Green Bay, Three Mills and CBD Alternative, Municipal Financing Option

Book Life 27 years
Capital Cost 11,000,000

Depreciation Method St. Line
Return Rate 8%
Discount Rate 8%

Year	Book Dep	Net Book Dep	Net Inv	Ret Req	Total Ret	PV	Acc. PV
1980	407.	0.	11000.	880.	1287.	1192.	1192.
1981	407.	407.	10593.	847.	1255.	1076.	2268.
1982	407.	815.	10185.	815.	1222.	970.	3238.
1983	407.	1222.	9778.	782.	1190.	874.	4112.
1984	407.	1630.	9370.	750.	1157.	787.	4900.
1985	407.	2037.	8963.	717.	1124.	709.	5609.
1986	407.	2444.	8556.	684.	1092.	637.	6246.
1987	407.	2852.	8148.	652.	1059.	572.	6818.
1988	407.	3259.	7741.	619.	1027.	514.	7332.
1989	407.	3667.	7333.	587.	994.	460.	7792.
1990	407.	4074.	6926.	554.	961.	412.	8204.
1991	407.	4481.	6519.	521.	929.	369.	8573.
1992	407.	4889.	6111.	489.	896.	330.	8903.
1993	407.	5296.	5704.	456.	864.	294.	9197.
1994	407.	5704.	5296.	424.	831.	262.	9459.
1995	407.	6111.	4889.	391.	799.	233.	9692.
1996	407.	6519.	4481.	359.	766.	207.	9899.
1997	407.	6926.	4074.	326.	733.	184.	10082.
1998	407.	7333.	3667.	293.	701.	162.	10245.
1999	407.	7741.	3259.	261.	668.	143.	10388.
2000	407.	8148.	2852.	228.	636.	126.	10514.
2001	407.	8556.	2444.	196.	603.	111.	10625.
2002	407.	8963.	2037.	163.	570.	97.	10722.
2003	407.	9370.	1630.	130.	538.	85.	10807.
2004	407.	9778.	1222.	98.	505.	74.	10881.

Table G-10. Gross Income Data (x 1000), Green Bay, Three Mills and CBD Alternative, Municipal Financing Option

DISCOUNT RATE	8%
FUEL QUANTITY	$3540.85/10^9$ Btu/yr
FUEL COST	$\$1.80/10^6$ Btu
ESCALATION RATE	9%

Year	Income	PV	Acc. PV
1980	6947.	6433.	6433.
1981	7572.	6492.	12925.
1982	8254.	6552.	19477.
1983	8997.	6613.	26090.
1984	9806.	6674.	32764.
1985	10689.	6736.	39500.
1986	11651.	6798.	46298.
1987	12700.	6861.	53159.
1988	13843.	6925.	60084.
1989	15088.	6989.	67073.
1990	16446.	7054.	74127.
1991	17927.	7119.	81245.
1992	19540.	7185.	88430.
1993	21299.	7251.	95682.
1994	23215.	7318.	103000.
1995	25305.	7386.	110386.
1996	27582.	7455.	117841.
1997	30065.	7524.	125365.
1998	32771.	7593.	132958.
1999	35720.	7664.	140622.
2000	38935.	7735.	148356.
2001	42439.	7806.	156162.
2002	46258.	7878.	164041.
2003	50422.	7951.	171992.
2004	54959.	8025.	180017.

DISCOUNT RATE	8%
FUEL QUANTITY	3540.85×10^9 Btu/yr
FUEL COST	$\$1.80/10^6$ Btu
ESCALATION RATE	11%

Year	Income	PV	Acc. PV
1980	7075.	6551.	6551.
1981	7853.	6733.	13283.
1982	8717.	6920.	20203.
1983	9675.	7112.	27314.
1984	10740.	7309.	34624.
1985	11921.	7512.	42136.
1986	13232.	7721.	49857.
1987	14688.	7935.	57793.
1988	16304.	8156.	65948.
1989	18097.	8382.	74331.
1990	20088.	8615.	82946.
1991	22297.	8855.	91801.
1992	24750.	9101.	100902.
1993	27473.	9353.	110255.
1994	30495.	9613.	119868.
1995	33849.	9880.	129748.
1996	37573.	10155.	139903.
1997	41706.	10437.	150340.
1998	46293.	10727.	161067.
1999	51385.	11025.	172091.
2000	57038.	11331.	183422.
2001	63312.	11646.	195068.
2002	70276.	11969.	207037.
2003	78007.	12302.	219338.
2004	86587.	12643.	231982.

Table G-10. Gross Income Data (x 1000), Green Bay, Three Mills and CBD Alternative, Municipal Financing Option (continued)

DISCOUNT RATE	8%
FUEL QUANTITY	3540.85 x 10^9 Btu/yr
FUEL COST	\$1.80/10^6 Btu
ESCALATION RATE	13%

Year	Income	PV	Acc. PV
1980	7202.	6669.	6669.
1981	8138.	6977.	13646.
1982	9196.	7300.	20946.
1983	10392.	7638.	28585.
1984	11743.	7992.	36577.
1985	13269.	8362.	44939.
1986	14994.	8749.	53688.
1987	16944.	9154.	62842.
1988	19146.	9578.	72420.
1989	21635.	10021.	82441.
1990	24448.	10485.	92926.
1991	27626.	10971.	103897.
1992	31218.	11479.	115376.
1993	35276.	12010.	127386.
1994	39862.	12566.	139952.
1995	45044.	13148.	153100.
1996	50900.	13757.	166856.
1997	57516.	14393.	181250.
1998	64994.	15060.	196310.
1999	73443.	15757.	212067.
2000	82990.	16486.	228553.
2001	93779.	17250.	245803.
2002	105970.	18048.	263851.
2003	119746.	18884.	282735.
2004	135313.	19758.	302493.

DISCOUNT RATE	8%
FUEL QUANTITY	3540.85 x 10^9 Btu/yr
FUEL COST	\$1.80/10^6 Btu
ESCALATION RATE	15%

Year	Income	PV	Acc. PV
1980	7330.	6787.	6787.
1981	8429.	7227.	14013.
1982	9693.	7695.	21708.
1983	11147.	8194.	29902.
1984	12819.	8725.	38626.
1985	14742.	9290.	47917.
1986	16954.	9892.	57809.
1987	19497.	10534.	68342.
1988	22421.	11216.	79559.
1989	25784.	11943.	91502.
1990	29652.	12717.	104219.
1991	34100.	13542.	117761.
1992	39215.	14419.	132180.
1993	45097.	15354.	147534.
1994	51862.	16349.	163883.
1995	59641.	17409.	181291.
1996	68587.	18537.	199828.
1997	78875.	19738.	219567.
1998	90707.	21018.	240585.
1999	104313.	22380.	262965.
2000	119960.	23831.	286796.
2001	137953.	25375.	312171.
2002	158646.	27020.	339191.
2003	182443.	28771.	367962.
2004	209810.	30636.	398598.

Table G-10. Gross Income Data (x 1000), Green Bay, Three Mills and CBD Alternative, Municipal Financing Option (concluded)

DISCOUNT RATE	8%
FUEL QUANTITY	3540.85 x 10^9 Btu
FUEL COST	\$1.80/10^6 Btu
ESCALATION RATE	17%

Year	Income	PV	Acc. PV
1980	6459.	5980.	5980.
1981	7363.	6312.	12292.
1982	8393.	6663.	18955.
1983	9569.	7033.	25989.
1984	10908.	7424.	33413.
1985	12435.	7836.	41249.
1986	14176.	8272.	49521.
1987	16161.	8731.	58252.
1988	18423.	9216.	67468.
1989	21003.	9728.	77197.
1990	23943.	10269.	87465.
1991	27295.	10839.	98305.
1992	31116.	11441.	109746.
1993	35473.	12077.	121823.
1994	40439.	12748.	134571.
1995	46100.	13456.	148028.
1996	52555.	14204.	162231.
1997	59912.	14993.	177224.
1998	68300.	15826.	193050.
1999	77862.	16705.	209755.
2000	88762.	17633.	227388.
2001	101189.	18613.	246001.
2002	115356.	19647.	265648.
2003	131506.	20738.	286386.
2004	149916.	21890.	308277.

DISCOUNT RATE	8%
FUEL QUANTITY	3540.85 x 10^9 Btu
FUEL COST	\$1.80/10^6 Btu
ESCALATION RATE	14%

Year	Income	PV	Acc. PV
1980	7266.	6728.	6728.
1981	8283.	7101.	13829.
1982	9443.	7496.	21325.
1983	10765.	7912.	29237.
1984	12272.	8352.	37589.
1985	13990.	8816.	46405.
1986	15948.	9306.	55711.
1987	18181.	9823.	65533.
1988	20726.	10368.	75902.
1989	23628.	10944.	86846.
1990	26936.	11552.	98398.
1991	30707.	12194.	110593.
1992	35006.	12872.	123464.
1993	39907.	13587.	137051.
1994	45494.	14342.	151393.
1995	51863.	15138.	166531.
1996	59124.	15979.	182510.
1997	67401.	16867.	199377.
1998	76837.	17804.	217181.
1999	87595.	18793.	235975.
2000	99858.	19837.	255812.
2001	113838.	20939.	276751.
2002	129775.	22103.	298854.
2003	147944.	23331.	322185.
2004	168656.	24627.	346812.

Table G-11. Fuel/O & M Cost Data (x 1000), Green Bay, Three Mills and CBD Alternative, Municipal Financing Option (continued)

COAL COST	$1.40/10^6 Btu
OIL COST	$2.90/10^6 Btu
COAL ESC RATE	7%
OIL ESC RATE	10%
DISCOUNT RATES	8%

Year	Coal	Oil	Total Fuel	O&M	Total Fuel/O&M	PV	Acc. PV
1980	3402.	695.	4097.	595.	4692.	4345.	4345.
1981	3457.	1576.	5033.	669.	5702.	4888.	9233.
1982	3713.	1374.	5087.	804.	5891.	4677.	13910.
1983	4105.	1002.	5107.	827.	5934.	4362.	18272.
1984	4367.	1565.	5932.	844.	6776.	4611.	22883.
1985	4408.	2317.	6725.	966.	7691.	4847.	27730.
1986	4606.	3317.	7924.	1066.	8990.	5245.	32975.
1987	4604.	4066.	8670.	1209.	9879.	5337.	38312.
1988	5078.	3303.	8381.	1282.	9663.	4834.	43146.
1989	5621.	3182.	8803.	1212.	10015.	4639.	47785.
1990	5838.	3210.	9048.	1229.	10277.	4408.	52192.
1991	6246.	3531.	9778.	1233.	11011.	4372.	56565.
1992	6683.	3884.	10568.	1320.	11888.	4371.	60936.
1993	7151.	4273.	11424.	1412.	12836.	4370.	65306.
1994	7652.	4700.	12352.	1511.	13863.	4370.	69676.
1995	8188.	5170.	13358.	1617.	14975.	4371.	74047.
1996	8761.	5687.	14448.	1730.	16178.	4372.	78420.
1997	9374.	6256.	15630.	1851.	17481.	4375.	82794.
1998	10030.	6882.	16912.	1981.	18893.	4378.	87172.
1999	10732.	7570.	18302.	2119.	20421.	4381.	91553.
2000	11483.	8327.	19810.	2268.	22078.	4386.	95939.
2001	12287.	9159.	21447.	2426.	23873.	4391.	100331.
2002	13147.	10075.	23223.	2596.	25819.	4397.	104728.
2003	14068.	11083.	25151.	2778.	27929.	4404.	109132.
2004	15052.	12191.	27244.	2972.	30216.	4412.	113544.

Table G-11. Fuel/O & M Cost Data (x 1000), Green Bay, Three Mills and CBD Alternative, Municipal Financing Option (continued)

COAL COST	$1.40/10^6 Btu
OIL COST	$2.90/10^6 Btu
COAL ESC RATE	7%
OIL ESC RATE	17%
DISCOUNT RATES	8%

Year	Coal	Oil	Total Fuel	O&M	Total Fuel/O&M	PV	Acc. PV
1980	3402.	740.	4142.	595.	4737.	4386.	4386.
1981	3457.	1782.	5240.	669.	5909.	5066.	9452.
1982	3713.	1654.	5367.	804.	6171.	4898.	14350.
1983	4105.	1282.	5388.	827.	6215.	4568.	18918.
1984	4367.	2130.	6497.	844.	7341.	4996.	23914.
1985	4408.	3355.	7763.	966.	8729.	5501.	29415.
1986	4606.	5109.	9715.	1066.	10781.	6291.	35706.
1987	4604.	6660.	11264.	1209.	12473.	6739.	42444.
1988	5078.	5755.	10833.	1282.	12115.	6060.	48505.
1989	5621.	5897.	11517.	1212.	12729.	5896.	54401.
1990	5838.	6328.	12166.	1229.	13395.	5745.	60146.
1991	6246.	7404.	13650.	1233.	14883.	5910.	66056.
1992	6683.	8663.	15346.	1320.	16666.	6128.	72184.
1993	7151.	10135.	17286.	1412.	18698.	6366.	78550.
1994	7652.	11858.	19510.	1511.	21021.	6627.	85177.
1995	8188.	13874.	22062.	1617.	23679.	6912.	92088.
1996	8761.	16233.	24993.	1730.	26723.	7222.	99311.
1997	9374.	18992.	28366.	1851.	30217.	7562.	106873.
1998	10030.	22221.	32251.	1981.	34232.	7932.	114805.
1999	10732.	25998.	36731.	2119.	38850.	8335.	123140.
2000	11483.	30418.	41902.	2268.	44170.	8775.	131914.
2001	12287.	35589.	47877.	2426.	50303.	9253.	141167.
2002	13147.	41639.	54787.	2596.	57383.	9773.	150940.
2003	14068.	48718.	62786.	2778.	65564.	10339.	161280.
2004	15052.	57000.	72053.	2972.	75025.	10955.	172235.

Table G-11. Fuel/O & M Cost Data (x 1000), Green Bay, Three Mills and CBD Alternative, Municipal Financing Option (continued)

COAL COST	$1.40/10^6 Btu
OIL COST	$2.90/10^6 Btu
COAL ESC RATE	14%
OIL ESC RATE	10%
DISCOUNT RATES	8%

Year	Coal	Oil	Total Fuel	O&M	Total Fuel/O&M	PV	Acc. PV
1980	3625.	695.	4320.	595.	4915.	4551.	4551.
1981	3925.	1576.	5500.	669.	6169.	5289.	9840.
1982	4491.	1374.	5865.	804.	6669.	5294.	15134.
1983	5289.	1002.	6292.	827.	7119.	5232.	20366.
1984	5995.	1565.	7560.	844.	8404.	5719.	26085.
1985	6447.	2317.	8764.	966.	9730.	6132.	32217.
1986	7178.	3317.	10495.	1066.	11561.	6746.	38963.
1987	7644.	4066.	11709.	1209.	12918.	6979.	45942.
1988	8983.	3303.	12285.	1282.	13567.	6787.	52729.
1989	10593.	3182.	13775.	1212.	14987.	6942.	59671.
1990	11721.	3210.	14931.	1229.	16160.	6931.	66602.
1991	13362.	3531.	16893.	1233.	18126.	7198.	73800.
1992	15233.	3884.	19117.	1320.	20437.	7515.	81315.
1993	17365.	4273.	21638.	1412.	23050.	7848.	89163.
1994	19796.	4700.	24497.	1511.	26008.	8199.	97361.
1995	22568.	5170.	27738.	1617.	29355.	8568.	105930.
1996	25727.	5687.	31415.	1730.	33145.	8958.	114888.
1997	29329.	6256.	35585.	1851.	37436.	9368.	124256.
1998	33435.	6882.	40317.	1981.	42298.	9801.	134057.
1999	38116.	7570.	45686.	2119.	47805.	10256.	144313.
2000	43452.	8327.	51779.	2268.	54047.	10737.	155050.
2001	49536.	9159.	58695.	2426.	61121.	11243.	166293.
2002	56471.	10075.	66546.	2596.	69142.	11776.	178069.
2003	64377.	11083.	75460.	2778.	78238.	12338.	190407.
2004	73389.	12191.	85581.	2972.	88553.	12930.	203337.

Table G-11. Fuel/O & M Cost Data (x 1000), Green Bay, Three Mills and CBD Alternative, Municipal Financing Option

COAL COST	$1.40/10^6 Btu
OIL COST	$2.90/10^6 Btu
COAL ESC RATE	14%
OIL ESC RATE	17%
DISCOUNT RATES	8%

Year	Coal	Oil	Total Fuel	O&M	Total Fuel/O&M	PV	Acc. PV
1980	3625.	740.	4364.	595.	4959.	4592.	4592.
1981	3925.	1782.	5707.	669.	6376.	5466.	10058.
1982	4491.	1654.	6144.	804.	6948.	5516.	15574.
1983	5289.	1282.	6572.	827.	7399.	5438.	21012.
1984	5995.	2130.	8125.	844.	8969.	6104.	27116.
1985	6447.	3355.	9802.	966.	10768.	6786.	33902.
1986	7178.	5109.	12287.	1066.	13353.	7791.	41693.
1987	7644.	6660.	14304.	1209.	15513.	8381.	50074.
1988	8983.	5755.	14737.	1282.	16019.	8014.	58088.
1989	10593.	5897.	16490.	1212.	17702.	8199.	66287.
1990	11721.	6328.	18049.	1229.	19278.	8268.	74555.
1991	13362.	7404.	20766.	1233.	21999.	8736.	83291.
1992	15233.	8663.	23895.	1320.	25215.	9272.	92563.
1993	17365.	10135.	27500.	1412.	28912.	9844.	102406.
1994	19796.	11858.	31655.	1511.	33166.	10455.	112862.
1995	22568.	13874.	36442.	1617.	38059.	11109.	123971.
1996	25727.	16233.	41960.	1730.	43690.	11808.	135779.
1997	29329.	18992.	48321.	1851.	50172.	12556.	148334.
1998	33435.	22221.	55656.	1981.	57637.	13355.	161690.
1999	38116.	25998.	64115.	2119.	66234.	14210.	175900.
2000	43452.	30418.	73871.	2268.	76139.	15125.	191025.
2001	49536.	35589.	85125.	2426.	87551.	16104.	207129.
2002	56471.	41639.	98110.	2596.	100706.	17152.	224281.
2003	64377.	48718.	113095.	2778.	115873.	18273.	242554.
2004	73389.	57000.	130390.	2972.	133362.	19473.	262027.

Table G-11. Fuel/O & M Cost Data (x 1000), Green Bay, Three Mills and CBD Alternative, Municipal Financing Option (concluded)

COAL COST	$1.40/10^6$ Btu
OIL COST	$2.90/10^6$ Btu
COAL ESC RATE	11%
OIL ESC RATE	11.1%
DISCOUNT RATES	8%

Year	Coal	Oil	Total Fuel	O&M	Total Fuel/O&M	PV	Acc. PV
1980	3529.	702.	4232.	595.	4827.	4469.	4469.
1981	3721.	1607.	5328.	669.	5997.	5141.	9610.
1982	4145.	1416.	5561.	804.	6365.	5053.	14663.
1983	4754.	1043.	5797.	827.	6624.	4869.	19532.
1984	5247.	1644.	6891.	844.	7735.	5264.	24796.
1985	5494.	2460.	7953.	966.	8919.	5621.	30417.
1986	5956.	3557.	9512.	1066.	10578.	6172.	36589.
1987	6175.	4402.	10578.	1209.	11787.	6368.	42957.
1988	7066.	3612.	10678.	1282.	11960.	5983.	48940.
1989	8113.	3515.	11628.	1212.	12840.	5947.	54888.
1990	8741.	3582.	12323.	1229.	13552.	5812.	60700.
1991	9703.	3979.	13682.	1233.	14915.	5923.	66623.
1992	10770.	4421.	15191.	1320.	16511.	6071.	72694.
1993	11955.	4912.	16866.	1412.	18278.	6223.	78917.
1994	13270.	5457.	18726.	1511.	20237.	6380.	85296.
1995	14729.	6063.	20792.	1617.	22409.	6541.	91837.
1996	16349.	6735.	23085.	1730.	24815.	6707.	98544.
1997	18148.	7483.	25631.	1851.	27482.	6877.	105421.
1998	20144.	8314.	28458.	1981.	30439.	7053.	112474.
1999	22360.	9237.	31597.	2119.	33716.	7234.	119708.
2000	24820.	10262.	35081.	2268.	37349.	7420.	127128.
2001	27550.	11401.	38951.	2426.	41377.	7611.	134739.
2002	30580.	12666.	43247.	2596.	45843.	7808.	142546.
2003	33944.	14072.	48016.	2778.	50794.	8010.	150556.
2004	37678.	15634.	53312.	2972.	56284.	8219.	158775.

Table G-12. Income Statement (x 1000), Green Bay, Three Mills and CBD Alternative, Utility Financing Option

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
REVENUE													
GROSS INCOME	7266	8283	9443	10765	12272	13990	15948	18181	20726	23628	26946	30707	35006
EXPENSES													
OPERATION/MAINTENANCE	595	669	804	827	844	966	1066	1209	1282	1212	1230	1233	1320
FUEL	4243	5328	5561	5797	6891	7953	9512	10578	10678	11628	12323	13682	15191
TAXES	520	336	325	305	286	269	252	238	224	213	201	192	184
ADVALOREM TAX	330	320	300	280	262	244	227	210	194	178	164	149	136
DEPRECIATION	346	670	639	618	597	576	556	535	514	493	473	452	431
INTEREST	1170	1134	1062	994	928	865	804	745	687	633	581	531	482
TOTAL EXPENSES	7193	8457	8691	8821	9808	10873	12418	13515	13579	14357	14972	16239	17744
INCOME (BEFORE TAXES)	73	-174	752	1944	2464	3117	3530	4666	7147	9271	11964	14468	17262
INCOME ($ 1979)	62	-127	469	1036	1121	1213	1172	1325	1737	1919	2118	2185	2227

Table G-12. Income Statement (x 1000), Green Bay, Three Mills and CBD Alternative, Utility Financing Option (concluded)

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
REVENUE												
GROSS INCOME	39907	45494	51863	59124	67401	76837	87595	99858	113838	129775	147944	168656
EXPENSES												
OPERATING EXPENSES	1412	1511	1617	1730	1851	1981	2120	2268	2426	2596	2778	2972
FUEL	16866	18726	20792	23085	25631	28458	31597	35081	38951	43247	48016	53312
TAXES	176	170	167	163	162	162	162	165	169	174	180	167
ADVALOREM TAX	123	111	99	88	77	68	58	50	42	34	28	22
DEPRECIATION	411	391	369	349	328	307	287	266	245	224	204	204
INTEREST	435	393	351	312	274	239	207	176	148	121	98	76
TOTAL EXPENSES	19423	21302	23395	25727	28323	31215	34431	38006	41981	46396	51304	56753
INCOME (BEFORE TAXES)	20484	24192	28468	33397	39078	45622	53164	61852	71857	83379	96690	111903
INCOME ($ 1979)	2274	2284	2297	2301	2302	2296	2286	2273	2256	2237	2216	2192

Table G-13. Balance Sheet ($ x 1000) as of December 31, 1980, District Heating System, Green Bay, CBD and Three-Mill Alternative, Utility Financing Option

Assets			Liabilities and Stockholders' Equity		
Fixed Assets:			Long-Term Liabilities:		
Property			Long-Term Debt		
Plant Retrofit	$3000		Bonds	$5170	
Distribution Network	7000		Total Liabilities		$5170
Pipe Bridge	1000				
Total Property		$11,000	*Stockholders' Equity:		
			Preferred Stock - x par value	1320	
			Authorized - x shares Issued - x shares		
			Common Stock - x par value	4510	
			Authorized - x shares Issued - x shares		
			Total Stockholder Equity		$5830
Total Assets		$11,000	Total Liabilities and Stockholders' Equity		$11,000

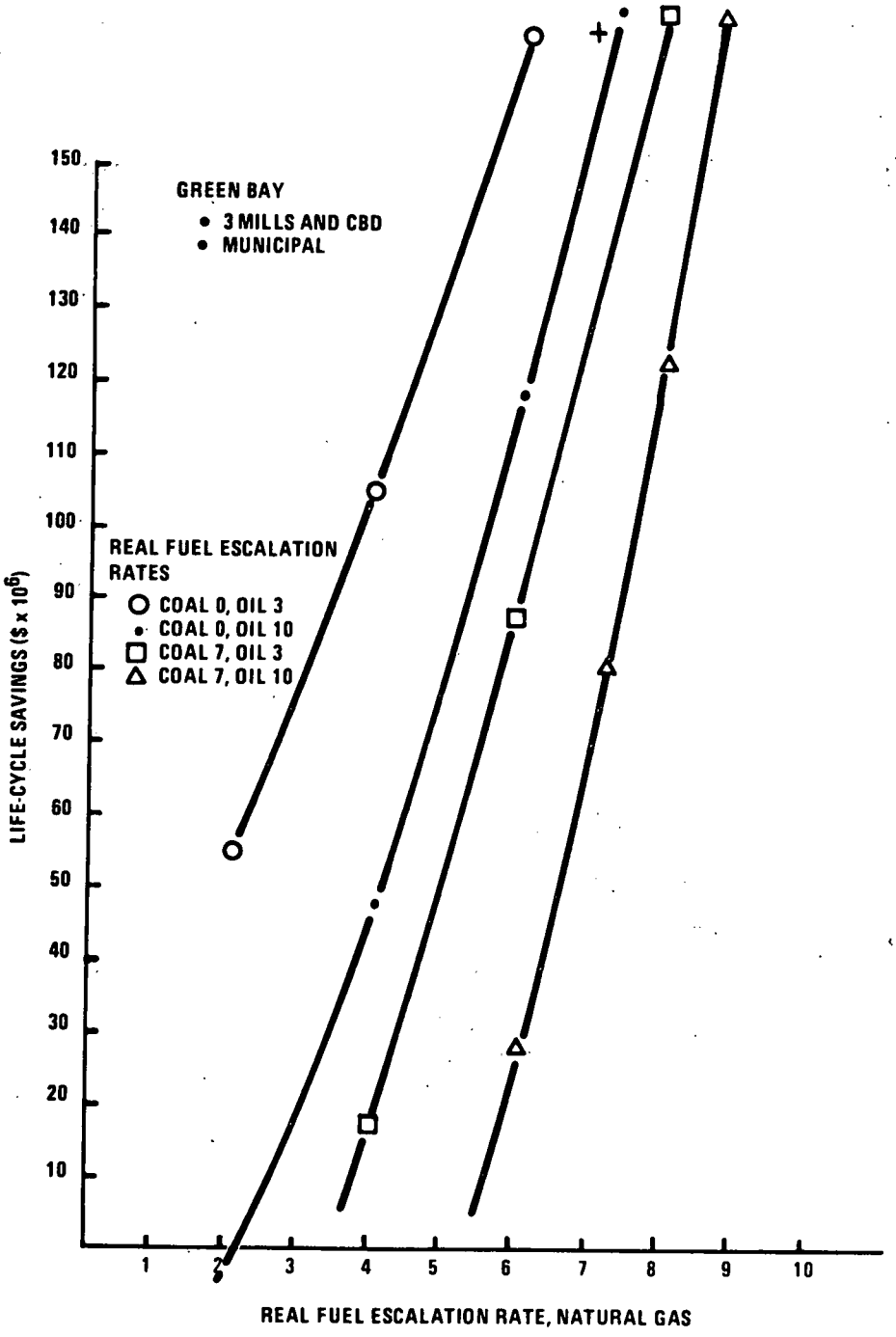

Figure G-3. Life-Cycle Savings versus Real Fuel Escalation Rate, Natural Gas

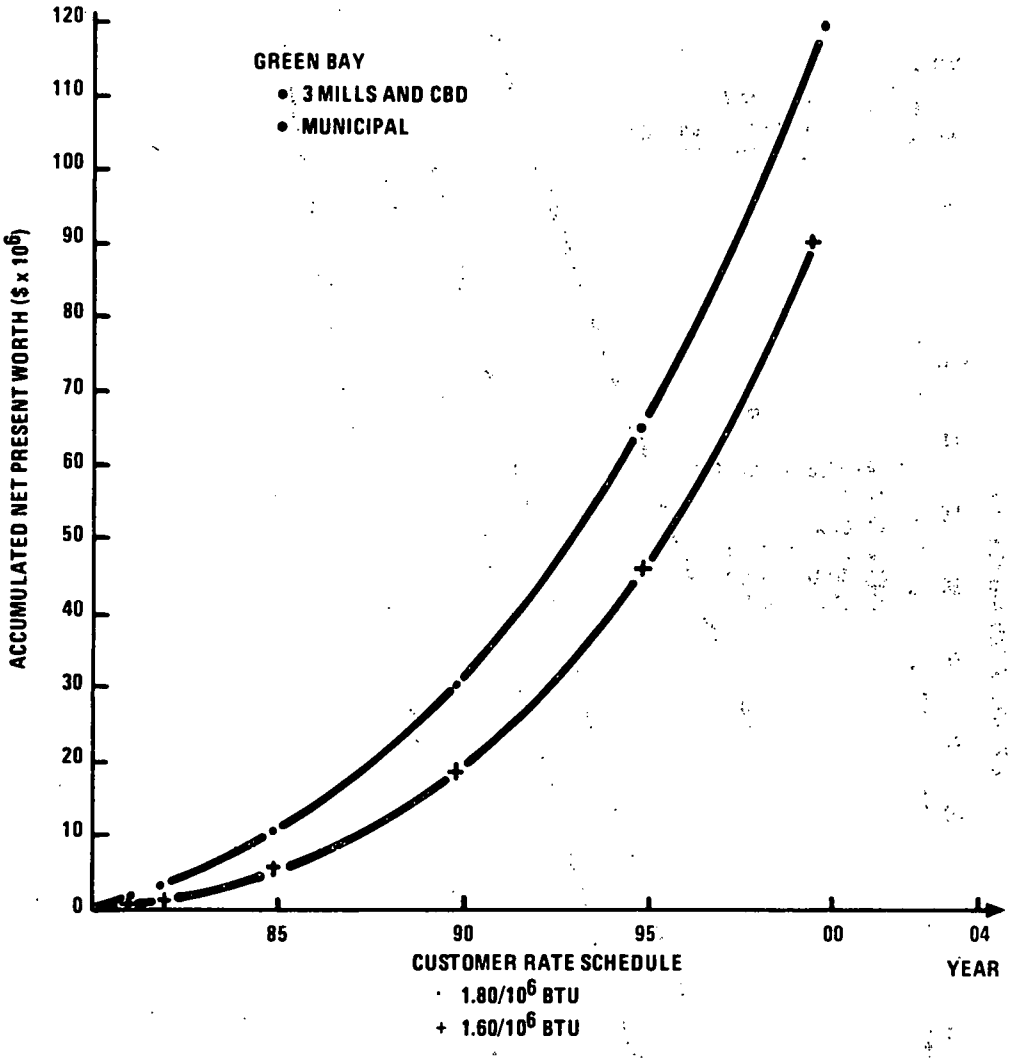

Figure G-4. Accumulated Net Present Worth versus Year

Joint Utility/Municipal Financing

The effect of joint financing of the district heating system was determined by:

- Determining the total return requirements associated with that portion financed, operated and maintained by the utility (Table G-14). These included return requirements for plant retrofit equipment, operations and maintenance expenses for the plant and fuel (Table G-15). Once these were determined, the net result was discounted to present value using the discount rate of the utility.
- Determing the total return requirements associated with that portion financed, operated and maintained by the municipality (Table G-16). This included return requirements for the distribution system and operation and maintenance expenses (Table G-17). These yearly costs were then discounted to present value using the discount rate of the municipality.
- Determining the gross income, distributing the gross income on a percentage basis (Table G-18) with respect to the return required by each owner, and discounting each portion accordingly (Tables G-19 and G-20). An income statement is given as Table G-21, and a balance sheet is given as Table G-22.

The result (Figure G-5) illustrates the Accumulated Net Percent Worth versus Year. Life-Cycle Savings curves were not generated due to the prohibitive number of runs required.

Table G-14. Summary, Fixed Charges (x 1000), Green Bay, Three Mills and CBD Alternative, Joint Financing Option Utility Portion ($3 x 10^6)

	TOTAL FIXED CHARGES						
YEAR	BOOK DEPR	INCOME TAX	ADVALOREM TAX	TOTAL RETURN	TOTAL FIXCHRG	PV	ACC PV
1980	94	142	90	319	645	551	551
1981	183	92	87	309	671	490	1041
1982	174	89	82	289	634	395	1436
1983	168	84	76	272	600	320	1756
1984	163	78	71	254	566	258	2014
1985	157	74	67	236	534	208	2222
1986	151	70	62	219	502	167	2389
1987	146	65	57	204	472	134	2523
1988	140	62	53	188	443	108	2631
1989	134	59	49	174	416	86	2717
1990	129	55	45	158	387	69	2786
1991	123	53	41	145	362	55	2841
1992	117	51	37	131	336	43	2884
1993	112	49	34	119	314	35	2919
1994	107	46	30	108	291	27	2946
1995	101	46	27	96	270	22	2968
1996	95	45	24	86	250	17	2985
1997	90	44	21	76	231	14	2999
1998	84	44	18	66	212	11	3010
1999	78	45	16	56	195	8	3018
2000	73	45	14	48	180	7	3025
2001	67	46	11	40	164	5	3030
2002	61	48	9	33	151	4	3034
2003	56	49	8	27	140	3	3037
2004	57	45	6	20	128	3	3040

Table G-15. Fuel/O & M Cost Data (x 1000), Green Bay, Three Mills and CBD Alternative, Joint Financing Option, Utility Portion

COAL COST	$1.40/10^6$ Btu
OIL COST	$2.90/10^6$ Btu
COAL ESC RATE	11%
OIL ESC RATE	11.1%
DISCOUNT RATES	17%

Year	Coal	Oil	Total Fuel	O&M	Total Fuel/O&M	PV	Acc. PV
1980	3529.	702.	4232.	377.	4609.	3939.	3939.
1981	3721.	1607.	5328.	436.	5764.	4211.	8150.
1982	4145.	1416.	5561.	554.	6115.	3818.	11968.
1983	4754.	1043.	5797.	560.	6357.	3392.	15360.
1984	5247.	1644.	6891.	558.	7449.	3398.	18758.
1985	5494.	2460.	7953.	660.	8613.	3358.	22115.
1986	5956.	3557.	9512.	739.	10251.	3416.	25531.
1987	6175.	4402.	10578.	859.	11437.	3257.	28788.
1988	7066.	3612.	10678.	907.	11585.	2820.	31608.
1989	8113.	3515.	11628.	811.	12439.	2588.	34196.
1990	8741.	3582.	12323.	800.	13123.	2333.	36529.
1991	9703.	3979.	13682.	774.	14456.	2197.	38726.
1992	10770.	4421.	15191.	829.	16020.	2081.	40807.
1993	11955.	4912.	16866.	887.	17753.	1971.	42778.
1994	13270.	5457.	18726.	947.	19673.	1867.	44644.
1995	14729.	6063.	20792.	1015.	21807.	1769.	46413.
1996	16349.	6735.	23085.	1086.	24171.	1675.	48088.
1997	18148.	7483.	25631.	1162.	26793.	1587.	49676.
1998	20144.	8314.	28458.	1244.	29702.	1504.	51180.
1999	22360.	9237.	31597.	1331.	32928.	1425.	52605.
2000	24820.	10262.	35081.	1424.	36505.	1350.	53955.
2001	27550.	11401.	38951.	1523.	40474.	1280.	55235.
2002	30580.	12666.	43247.	1630.	44877.	1213.	56448.
2003	33944.	14072.	48016.	1745.	49761.	1149.	57597.
2004	37678.	15634.	53312.	1866.	55178.	1089.	58686.

Table G-16. Return Requirements (x 1000), Green Bay, Three Mills and CBD Alternative, Joint Financing Option, Municipal Portion

Book Life 27 years
Capital Costs $8,000,000

Depreciation Method - St. Line
Return Rate 8%
Discount Rate 8%

Year	Book Dep	Net Book Dep	Net Inv	Ret Req	Tot Ret	PV	Acc PV
1980	296.	0.	8000.	640.	936.	867.	867.
1981	296.	296.	7704.	616.	913.	782.	1649.
1982	296.	593.	7407.	593.	889.	706.	2355.
1983	296.	889.	7111.	569.	865.	636.	2991.
1984	296.	1185.	6815.	545.	841.	573.	3564.
1985	296.	1481.	6519.	521.	818.	515.	4079.
1986	296.	1778.	6222.	498.	794.	463.	4542.
1987	296.	2074.	5926.	474.	770.	416.	4958.
1988	296.	2370.	5630.	450.	747.	374.	5332.
1989	296.	2667.	5333.	427.	723.	335.	5667.
1990	296.	2963.	5037.	403.	699.	300.	5967.
1991	296.	3259.	4741.	379.	676.	268.	6235.
1992	296.	3556.	4444.	356.	652.	240.	6475.
1993	296.	3852.	4148.	332.	628.	214.	6689.
1994	296.	4148.	3852.	308.	604.	191.	6879.
1995	296.	4444.	3556.	284.	581.	170.	7049.
1996	296.	4741.	3259.	261.	557.	151.	7199.
1997	296.	5037.	2963.	237.	533.	133.	7333.
1998	296.	5333.	2667.	213.	510.	118.	7451.
1999	296.	5630.	2370.	190.	486.	104.	7555.
2000	296.	5926.	2074.	166.	462.	92.	7647.
2001	296.	6222.	1778.	142.	439.	81.	7727.
2002	296.	6519.	1481.	119.	415.	71.	7798.
2003	296.	6815.	1185.	95.	391.	62.	7860.
2004	296.	7111.	889.	71.	367.	54.	7913.

Table G-17. Fuel/O & M Cost Data (x 1000), Green Bay, Three Mills and CBD Alternative, Joint Financing Option, Municipal Portion

COAL COST	$1.40/10^6$ Btu
OIL COST	$2.90/10^6$ Btu
COAL ESC RATE	11%
OIL ESC RATE	11.1%
DISCOUNT RATES	8%

Year	Coal	Oil	Total Fuel	O&M	Total Fuel/O&M	PV	Acc. PV
1980	0.	0.	0.	218.	218.	202.	202.
1981	0.	0.	0.	233.	233.	200.	402.
1982	0.	0.	0.	250.	250.	198.	600.
1983	0.	0.	0.	267.	267.	196.	796.
1984	0.	0.	0.	286.	286.	195.	991.
1985	0.	0.	0.	306.	306.	193.	1184.
1986	0.	0.	0.	327.	327.	191.	1375.
1987	0.	0.	0.	350.	350.	189.	1564.
1988	0.	0.	0.	375.	375.	188.	1751.
1989	0.	0.	0.	401.	401.	186.	1937.
1990	0.	0.	0.	429.	429.	184.	2121.
1991	0.	0.	0.	459.	459.	182.	2303.
1992	0.	0.	0.	491.	491.	181.	2484.
1993	0.	0.	0.	525.	525.	179.	2663.
1994	0.	0.	0.	562.	562.	177.	2840.
1995	0.	0.	0.	601.	601.	175.	3015.
1996	0.	0.	0.	644.	644.	174.	3189.
1997	0.	0.	0.	689.	689.	172.	3362.
1998	0.	0.	0.	737.	737.	171.	3532.
1999	0.	0.	0.	788.	788.	169.	3701.
2000	0.	0.	0.	844.	844.	168.	3869.
2001	0.	0.	0.	903.	903.	166.	4035.
2002	0.	0.	0.	966.	966.	165.	4200.
2003	0.	0.	0.	1033.	1033.	163.	4363.
2004	0.	0.	0.	1106.	1106.	161.	4524.

Table G-18. Cost/Fuel Distribution, Green Bay Joint Financing Option

Utility				Municipal							
Fuel Cost	Plant O&M	Fixed Ret Utility	Total Utility	Dist O&M	Dist Return	Total Municipal	Total Utility & Municipal	% Municipal	% Utility	Municipal Fuel Input	Utility Fuel Input
3 Mill Scenario Data											
503,115	24,724	9,094	536,933	13,790	16,296	30,086	567,019	5.31	94,69	188.02	3352.83
2 Mill Scenario Data											
181,071	18,017	6,658	205,746	8,094	13,241	21,335	227,081	9.40	90.60	76.25	1342.08

Table G-19. Gross Income Data (x 1000), Green Bay, Three Mills and CBD Alternative, Joint Financing Option, Municipal Portion

DISCOUNT RATE 8%
FUEL QUANTITY 188.02×10^9 Btu/yr
FUEL COST $\$1.80/10^6$ Btu
ESCALATION RATE 14%

Year	Income	PV	Acc. PV
1980	386.	357.	357.
1981	440.	377.	734.
1982	501.	398.	1132.
1983	572.	420.	1553.
1984	652.	443.	1996.
1985	743.	468.	2464.
1986	847.	494.	2958.
1987	965.	522.	3480.
1988	1101.	551.	4030.
1989	1255.	581.	4612.
1990	1430.	613.	5225.
1991	1631.	648.	5872.
1992	1859.	683.	6556.
1993	2119.	721.	7277.
1994	2416.	762.	8039.
1995	2754.	804.	8843.
1996	3139.	849.	9691.
1997	3579.	896.	10587.
1998	4080.	945.	11532.
1999	4651.	998.	12530.
2000	5302.	1053.	13584.
2001	6045.	1112.	14696.
2002	6891.	1174.	15869.
2003	7856.	1239.	17108.
2004	8956.	1308.	18416.

DISCOUNT RATE 8%
FUEL QUANTITY 188.02×10^9 Btu/yr
FUEL COST $\$1.80/10^6$ Btu
ESCALATION RATE 14%

Year	Income	PV	Acc. PV
1980	343.	318.	318.
1981	391.	335.	653.
1982	446.	354.	1007.
1983	508.	373.	1380.
1984	579.	394.	1774.
1985	660.	416.	2190.
1986	753.	439.	2630.
1987	858.	464.	3093.
1988	978.	489.	3583.
1989	1115.	517.	4099.
1990	1271.	545.	4644.
1991	1449.	576.	5220.
1992	1652.	608.	5828.
1993	1884.	641.	6469.
1994	2147.	677.	7146.
1995	2448.	715.	7860.
1996	2791.	754.	8615.
1997	3181.	796.	9411.
1998	3627.	840.	10251.
1999	4134.	887.	11138.
2000	4713.	936.	12074.
2001	5373.	988.	13063.
2002	6125.	1043.	14106.
2003	6983.	1101.	15207.
2004	7961.	1162.	16370.

Table G-20. Gross Income Data (x 1000), Green Bay, Three Mills and CBD Alternative, Joint Financing Option, Utility Portion

DISCOUNT RATE	17%
FUEL QUANTITY	3352.83 x 10^9 Btu/yr
FUEL COST =	\$1.80/10^6 Btu
ESCALATION RATE	14%

Year	Income	PV	Acc. PV
1980	6880.	5880.	5880.
1981	7843.	5730.	11610.
1982	8941.	5583.	17193.
1983	10193.	5440.	22632.
1984	11620.	5300.	27932.
1985	13247.	5164.	33096.
1986	15101.	5032.	38128.
1987	17216.	4903.	43031.
1988	19626.	4777.	47808.
1989	22373.	4655.	52462.
1990	25506.	4535.	56997.
1991	29077.	4419.	61416.
1992	33147.	4306.	65722.
1993	37788.	4195.	69917.
1994	43078.	4088.	74005.
1995	49109.	3983.	77987.
1996	55984.	3881.	81868.
1997	63822.	3781.	85649.
1998	72757.	3684.	89333.
1999	82943.	3590.	92923.
2000	94555.	3498.	96421.
2001	107793.	3408.	99829.
2002	122884.	3321.	103150.
2003	140088.	3235.	106385.
2004	159700.	3153.	109538.

DISCOUNT RATE	17%
FUEL QUANTITY	3352.83 x 10^9 Btu/yr
FUEL COST	\$1.60/10^6 Btu
ESCALATION RATE	14%

Year	Income	PV	Acc. PV
1980	6116.	5227.	5227.
1981	6972.	5093.	10320.
1982	7948.	4962.	15282.
1983	9060.	4835.	20117.
1984	10329.	4711.	24829.
1985	11775.	4590.	29419.
1986	13423.	4473.	33892.
1987	15303.	4358.	38250.
1988	17445.	4246.	42496.
1989	19887.	4137.	46633.
1990	22672.	4031.	50664.
1991	25846.	3928.	54592.
1992	29464.	3827.	58419.
1993	33589.	3729.	62148.
1994	38292.	3633.	65782.
1995	43653.	3540.	69322.
1996	49764.	3449.	72772.
1997	56731.	3361.	76133.
1998	64673.	3275.	79408.
1999	73727.	3191.	82598.
2000	84049.	3109.	85707.
2001	95816.	3029.	88737.
2002	109230.	2952.	91688.
2003	124523.	2876.	94564.
2004	141956.	2802.	97367.

Table G-21. Income Statement (x 1000), Green Bay, Three-Mill and CBD Alternative, Municipal Financing Option

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
REVENUE													
GROSS INCOME	7266	8283	9443	10765	12272	13990	15948	18181	20726	23628	26936	30707	35006
EXPENSES													
OPERATION/MAINTENANCE	595	669	804	827	844	966	1066	1209	1282	1212	1230	1233	1320
FUEL	4232	5328	5561	5797	6891	7953	9512	10578	10678	11628	12323	13682	15191
DEPRECIATION	407	407	407	407	407	407	407	407	407	407	407	407	407
INTEREST	880	847	815	782	750	717	684	652	619	587	554	521	489
TOTAL EXPENSES	6114	7251	7587	7813	8892	10043	11669	12846	12986	13834	14514	15843	17407
INCOME	1152	1032	1856	2952	3380	3947	4279	5335	7740	9794	12422	14864	17599
INCOME ($ 1979)	1067	885	1473	2170	2300	2487	2497	2882	3872	4537	5328	5903	6471

Table G-21. Income Statement (x 1000), Green Bay, Three-Mill and CBD Alternative, Municipal Financing Option (concluded)

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
REVENUE												
GROSS INCOME	39907	45494	51863	59124	67401	76837	87595	99858	113838	129775	147944	168656
EXPENSES												
OPERATION/MAINTENANCE	1412	1511	1617	1730	1851	1981	2120	2268	2426	2596	2778	2972
FUEL	16866	18726	20792	23085	25631	28458	31597	35081	38951	43247	48016	53312
DEPRECIATION	407	407	407	407	407	407	407	407	407	407	407	407
INTEREST	456	424	391	359	326	293	261	228	196	163	130	98
TOTAL EXPENSES	19141	21068	23207	25581	28215	31139	34385	37984	41980	46413	51331	56789
INCOME	20766	24426	28656	33543	39186	45698	53210	61874	71858	83362	96613	111867
INCOME ($ 1979)	7070	7700	8364	9066	9806	10589	11416	12292	13218	14198	15236	16335

Table G-22. Balance Sheet ($ x 1000) as of December 31, 1980, District Heating System, Green Bay, CBD and Three-Mill Alternative, Municipal Financing Option

Assets			Liabilities and Stockholders' Equity		
Fixed Assets:			Long-Term Liabilities:		
Property			Long-Term Debt		
Plant Retrofit	$3000		Bonds	$11,000	
Distribution Network	7000				
Pipe Bridge	1000		Total Liabilities		$11,000
Total Property		$11,000			
Total Assets		$11,000	Total Liabilities		$11,000

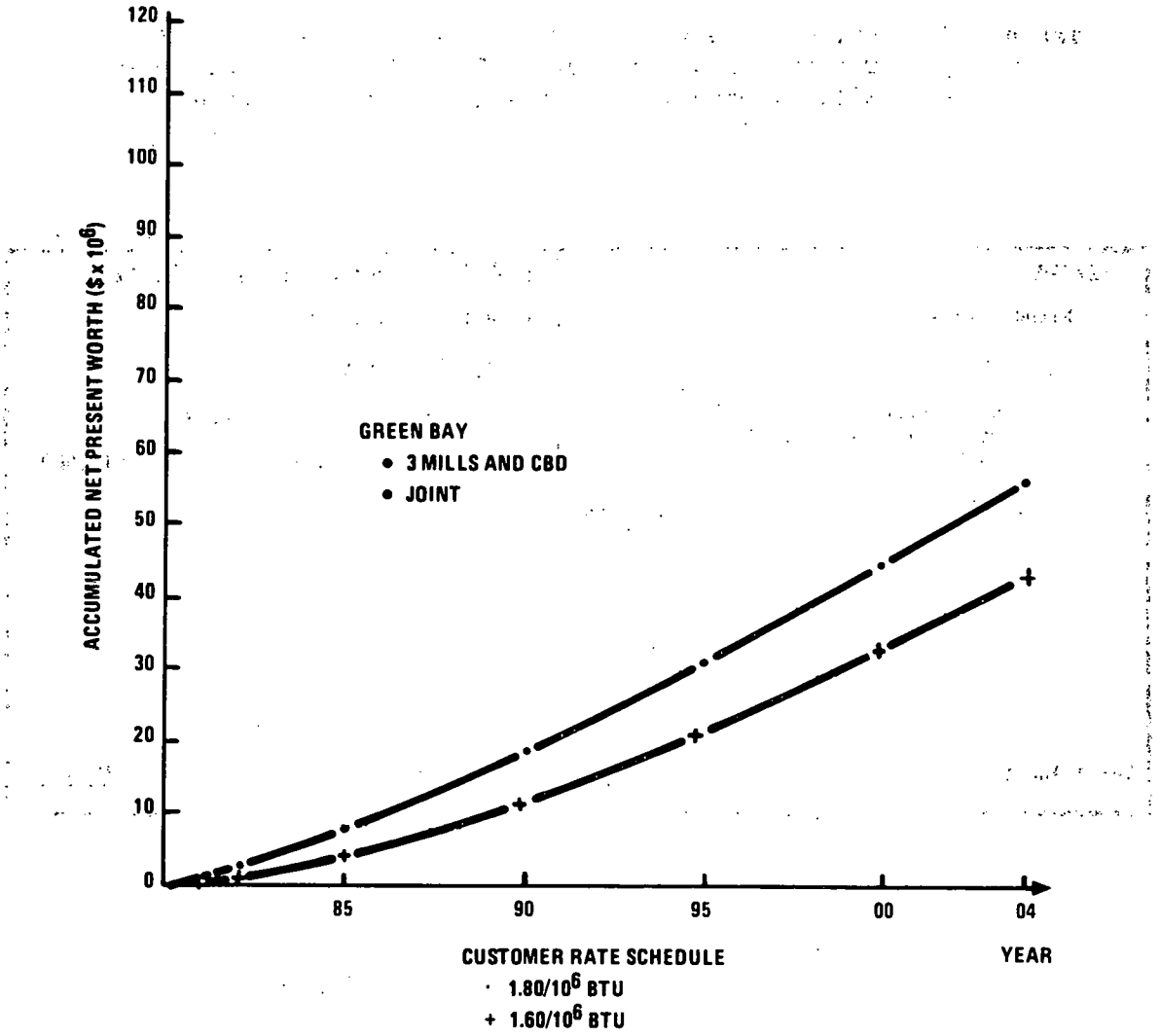

Figure G-5. Accumulated Net Present Worth versus Year

COMPARATIVE RESULTS

Results illustrating the three financial alternatives are summarized in Figure G-6. One rate structure (i.e., 90 percent of the current cost of fuel) is illustrated.

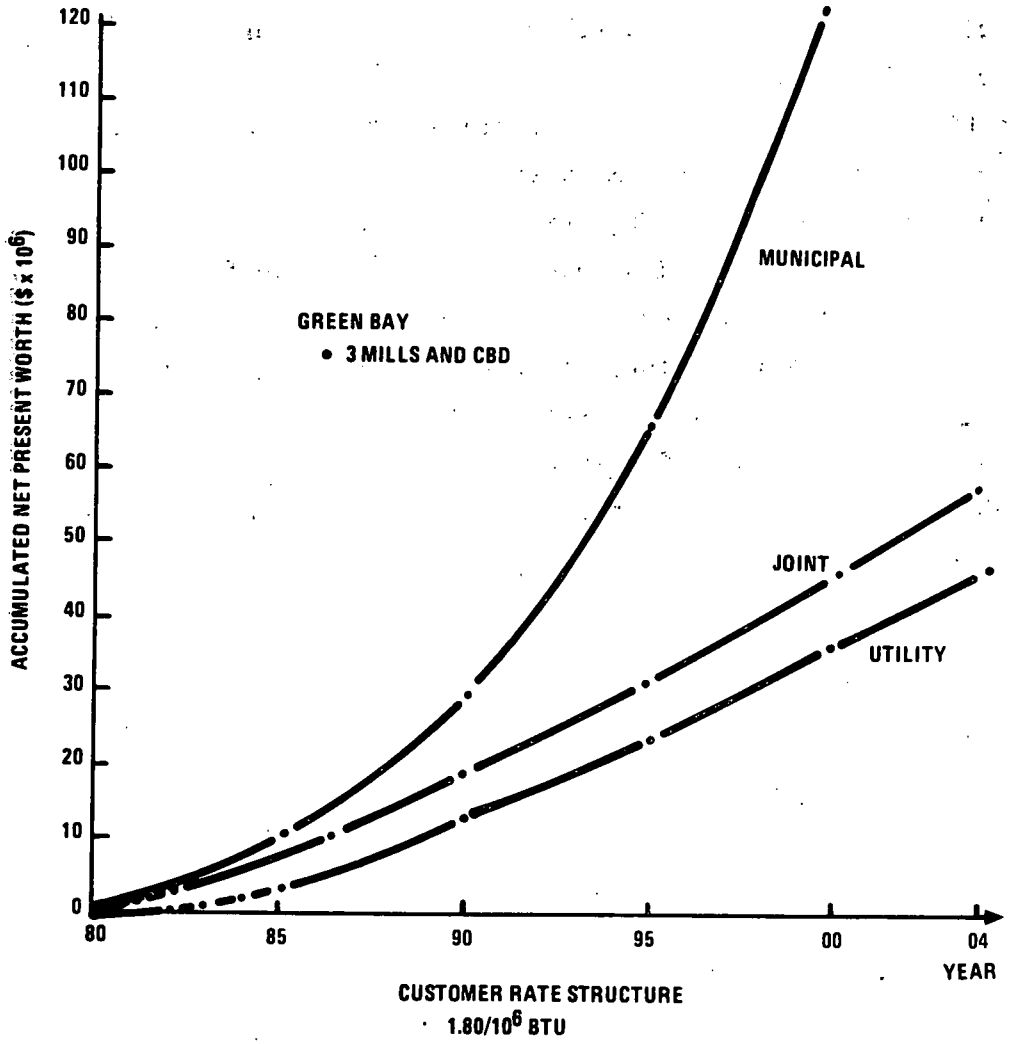

Figure G-6. Accumulated Net Present Worth versus Year

REMAINING ALTERNATIVES

For the remaining alternatives analyzed, only summary tables and results are illustrated. These include:

- Life-Cycle Savings versus Real Fuel Escalation Rates for each financing option;
- Accumulated Net Present Worth versus Year of Operation for each financing option;
- Combined Life-Cycle Savings for financing options considered;
- Tables of operations and maintenance costs;
- Tables of fixed-return requirements for each financing option;
- Tables of fuel, operations and maintenance costs for each financing option for real fuel escalation rates of Coal--4 percent, Oil--4.1 percent, and Natural Gas--7 percent;
- Tables of Gross Income for each financing option for a real fuel escalation rate of 7 percent;
- Tables of annual-savings for range of fuel escalation rates for each financing option.

GREEN BAY, TWO MILLS AND CBD ALTERNATIVE

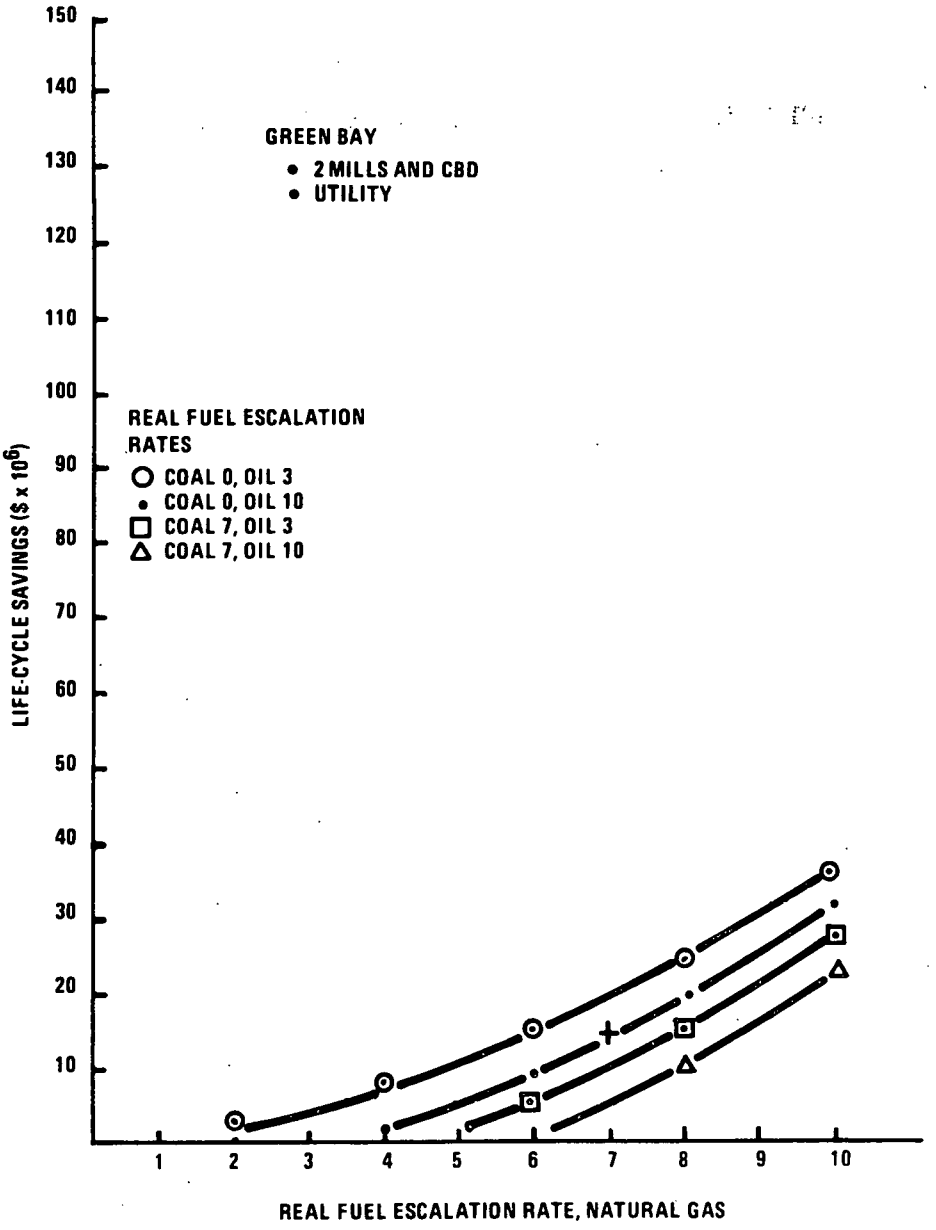

Figure G-7. Life-Cycle Savings versus Real Fuel Escalation Rate, Natural Gas

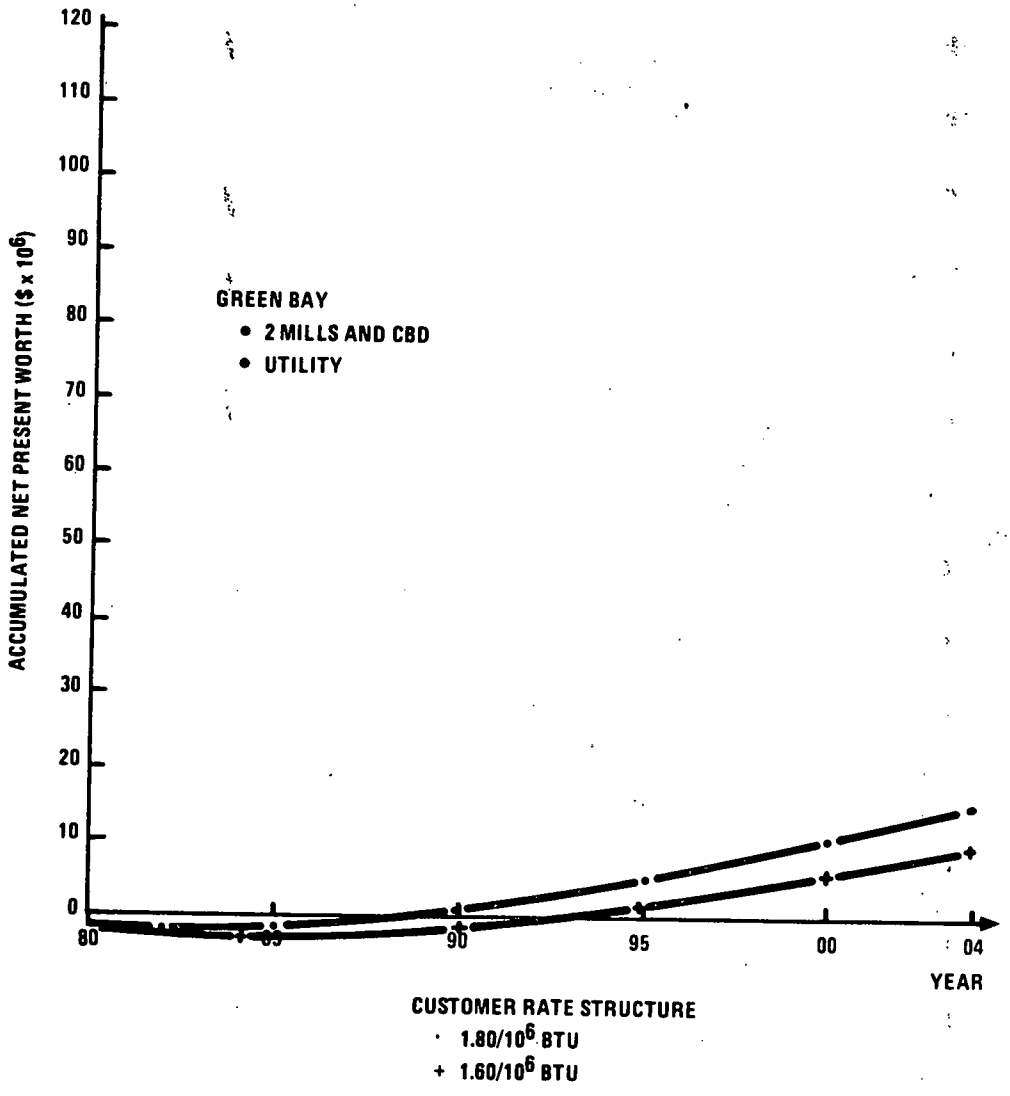

Figure G-8. Accumulated Net Present Worth versus Year

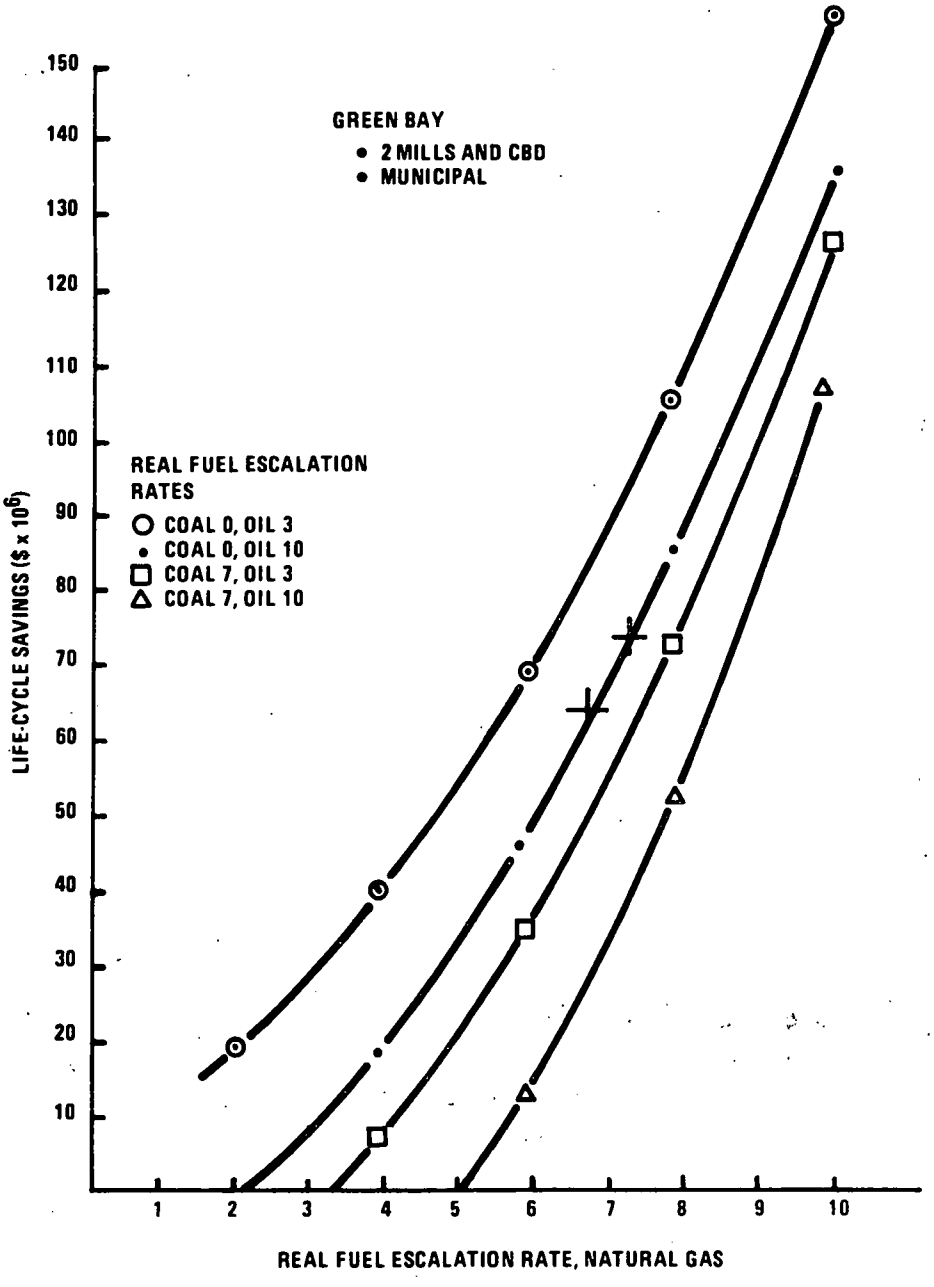

Figure G-9. Life-Cycle Savings versus Real Fuel Escalation Rate, Natural Gas

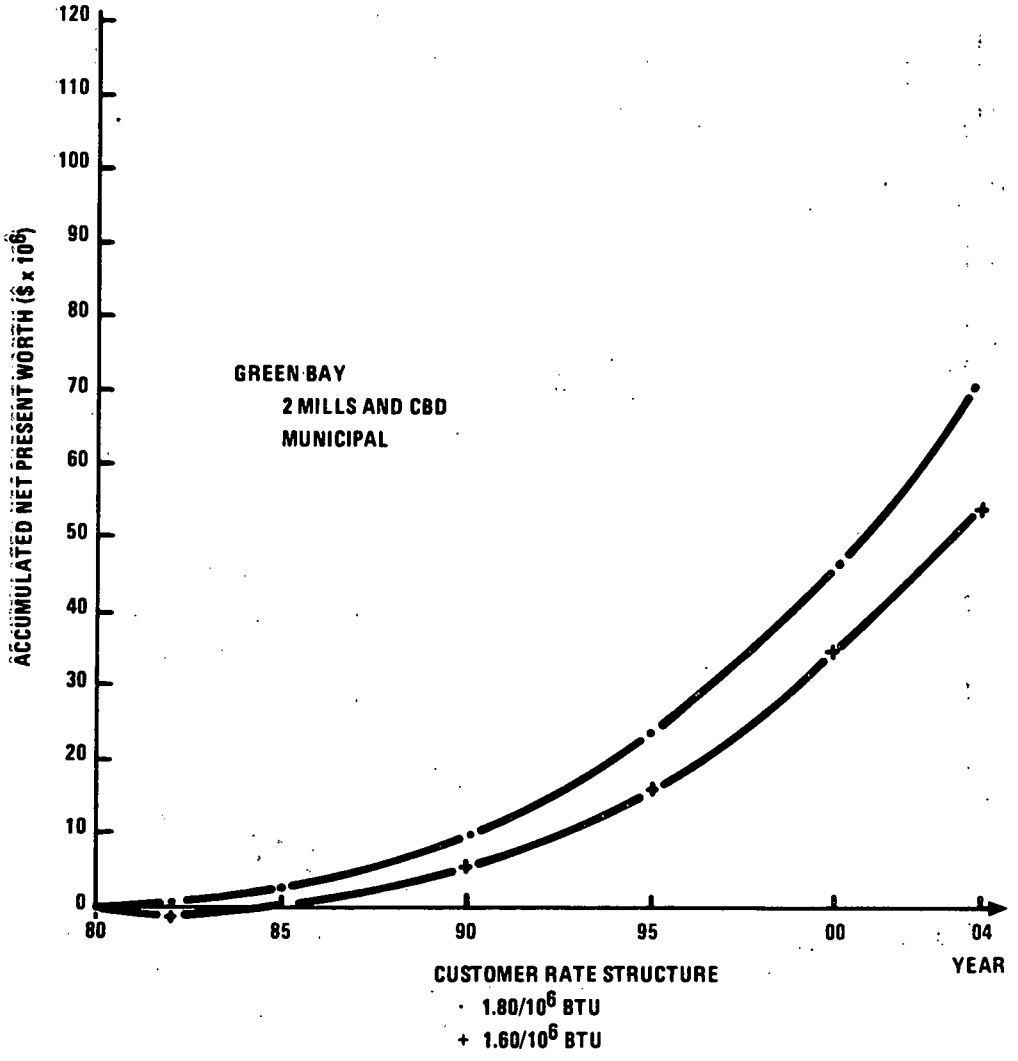

Figure G-10. Accumulated Net Present Worth versus Year

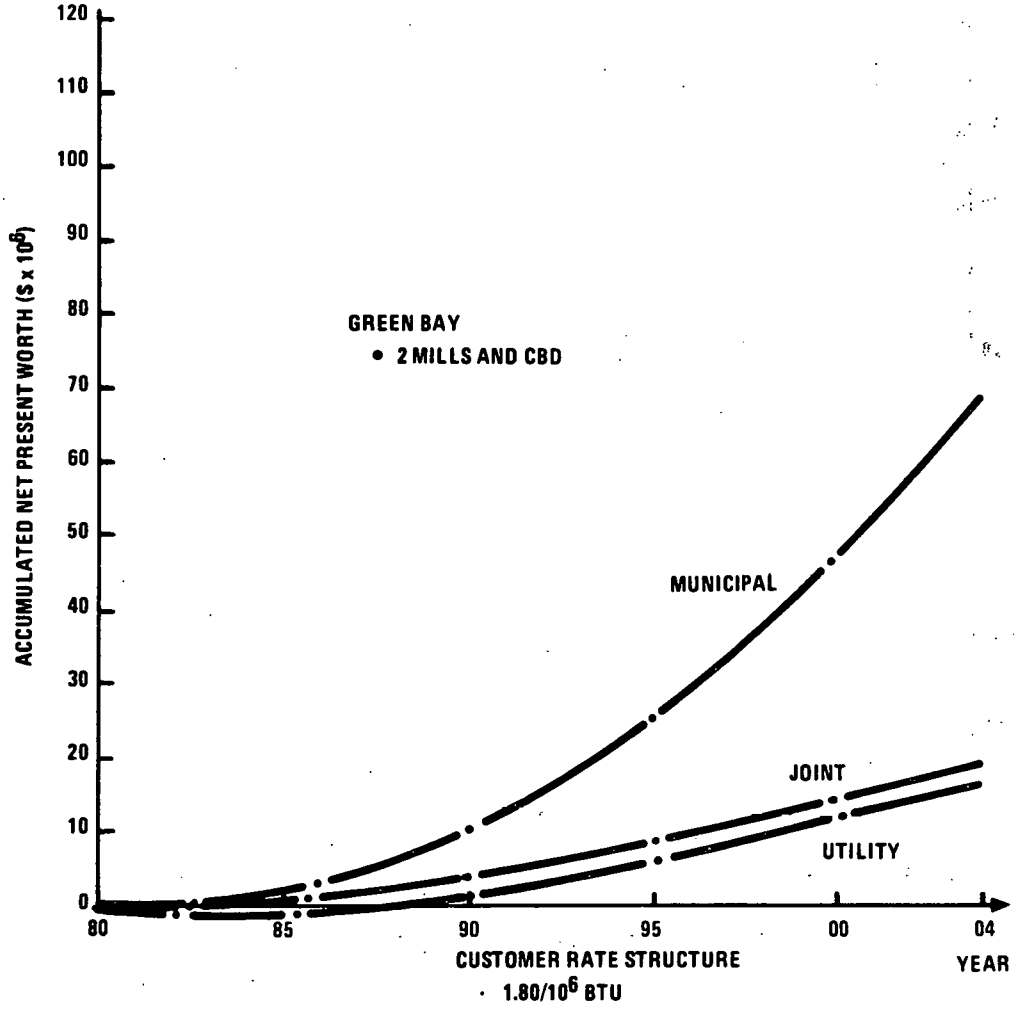

Figure G-11. Accumulated Net Present Worth versus Year

Table G-23. Operations and Maintenance Costs, Green Bay, Two Mills and CBD Alternative

	Distribution			Plant		
Year	Maintenance 1% of Cost (6.5×10^6)	Insurance .2% of Cost ($\$2.2 \times 10^6$)	Pump Power 2.27×10^6 kWh/yr @ .022/kWh	District Heating Portion	Cost of Shifting to less Efficient Boilers	Total O&M Costs
1980	65	13	50	94	42	264
1981	70	14	54	106	50	293
1982	74	15	57	113	86	392
1983	80	16	61	121	81	359
1984	85	17	66	130	72	370
1985	91	18	70	139	100	418
1986	98	20	75	147	119	458
1987	104	21	80	156	154	800
1988	112	22	86	167	160	851
1989	120	24	92	178	114	853
1990	128	26	98	169	118	887
1991	137	27	105	177	103	922
1992	146	29	113	189	110	986
1993	157	31	120	203	118	1056
1994	168	34	129	217	126	1129
1995	179	36	138	232	135	1208
1996	192	38	148	248	144	1293
1997	205	41	158	266	155	1384
1998	220	44	169	284	165	1480
1999	235	47	181	304	177	1584
2000	252	50	193	325	189	1695
2001	269	54	207	348	203	1814
2002	288	58	222	373	217	1941
2003	308	62	237	399	232	2076
2004	330	66	254	427	248	2222

Table G-24. Summary, Fixed Charges (x 1000), Green Bay, Two Mills and CBD Alternative, Utility Financing Option

Year	Total Fixed Charge	PV	Acc PV
1980	1872	1599	1599
1981	1946	1420	3019
1982	1842	1148	4167
1983	1738	927	5094
1984	1641	747	5841
1985	1547	602	6443
1986	1455	484	6927
1987	1366	388	7315
1988	1281	311	7626
1989	1201	249	7875
1990	1122	199	8074
1991	1047	158	8232
1992	974	126	8358
1993	908	101	8459
1994	843	80	8539
1995	780	63	8602
1996	723	49	8651
1997	666	39	8690
1998	614	31	8721
1999	565	25	8746
2000	519	19	8765
2001	478	15	8780
2002	440	12	8792
2003	403	9	8801
2004	371	7	8808

Table G-25. Return Requirements (x 1000), Green Bay, Two Mills and CBD Alternative, Municipal Financing Option

Book Life 27 years
Capital Costs 8,700,000

Depreciation Method - St. Line
Return Rate 8%
Discount Rate 8%

Year	Book Depr	Net Book Depr	Net Inv	Ret Req	Total Return	PV	Acc PV
1980	322.	0.	8700.	696.	1018.	943.	943.
1981	322.	322.	8378.	670.	992.	851.	1794.
1982	322.	644.	8056.	644.	967.	767.	2561.
1983	322.	967.	7733.	619.	941.	692.	3253.
1984	322.	1289.	7411.	593.	915.	623.	3875.
1985	322.	1611.	7089.	567.	889.	560.	4436.
1986	322.	1933.	6767.	541.	864.	504.	4940.
1987	322.	2256.	6444.	516.	838.	453.	5392.
1988	322.	2578.	6122.	490.	812.	406.	5799.
1989	322.	2900.	5800.	464.	786.	364.	6163.
1990	322.	3222.	5478.	438.	760.	326.	6489.
1991	322.	3544.	5156.	412.	735.	292.	6781.
1992	322.	3867.	4833.	387.	709.	261.	7041.
1993	322.	4189.	4511.	361.	683.	233.	7274.
1994	322.	4511.	4189.	335.	657.	207.	7481.
1995	322.	4833.	3867.	309.	632.	184.	7665.
1996	322.	5156.	3544.	284.	606.	164.	7829.
1997	322.	5478.	3222.	258.	580.	145.	7974.
1998	322.	5800.	2900.	232.	554.	128.	8103.
1999	322.	6122.	2578.	206.	528.	113.	8216.
2000	322.	6444.	2256.	180.	503.	100.	8316.
2001	322.	6767.	1933.	155.	477.	88.	8404.
2002	322.	7089.	1611.	129.	451.	77.	8480.
2003	322.	7411.	1289.	103.	425.	67.	8548.
2004	322.	7733.	967.	77.	400.	58.	8606.

Table G-26. Return Requirements (x 1000), Green Bay, Two Mills and CBD Alternative, Joint Financing Option

Book Life	27 years	Depreciation Method -	St. Line
Capital Cost	$6,500,000	Return Rate	8%
		Discount Rate	8%

Year	Book Depr	Net Book Dep	Net Inv	Ret Req	Total Ret	PV	Acc PV
1980	241.	0.	6500.	520.	761.	704.	704.
1981	241.	241.	6259.	501.	741.	636.	1340.
1982	241.	481.	6019.	481.	722.	573.	1913.
1983	241.	722.	5778.	462.	703.	517.	2430.
1984	241.	963.	5537.	443.	684.	465.	2895.
1985	241.	1204.	5296.	424.	664.	419.	3314.
1986	241.	1444.	5056.	404.	645.	376.	3691.
1987	241.	1685.	4815.	385.	626.	338.	4029.
1988	241.	1926.	4574.	366.	607.	303.	4332.
1989	241.	2167.	4333.	347.	587.	272.	4604.
1990	241.	2407.	4093.	327.	568.	244.	4848.
1991	241.	2648.	3852.	308.	549.	218.	5066.
1992	241.	2889.	3611.	289.	530.	195.	5261.
1993	241.	3130.	3370.	270.	510.	174.	5434.
1994	241.	3370.	3130.	250.	491.	155.	5589.
1995	241.	3611.	2889.	231.	472.	138.	5727.
1996	241.	3852.	2648.	212.	453.	122.	5849.
1997	241.	4093.	2407.	193.	433.	108.	5958.
1998	241.	4333.	2167.	173.	414.	96.	6054.
1999	241.	4574.	1926.	154.	395.	85.	6138.
2000	241.	4815.	1685.	135.	376.	75.	6213.
2001	241.	5056.	1444.	116.	356.	66.	6279.
2002	241.	5296.	1204.	96.	337.	57.	6336.
2003	241.	5537.	963.	77.	318.	50.	6386.
2004	241.	5778.	722.	58.	299.	44.	6430.

Table G-27. Summary, Return Requirements (x 1000), Green Bay, Two Mills and CBD Alternative, Joint Financing Option, Utility Portion

Year	Total Fixed	PV	Acc PV
1980	473	404	404
1981	492	359	763
1982	466	290	1053
1983	440	234	1287
1984	415	189	1476
1985	391	152	1628
1986	368	122	1750
1987	345	98	1848
1988	324	79	1927
1989	304	63	1990
1990	284	50	2040
1991	265	40	2080
1992	246	32	2112
1993	229	26	2138
1994	213	20	2158
1995	197	16	2174
1996	183	12	2186
1997	168	10	2196
1998	155	8	2204
1999	143	6	2210
2000	131	5	2215
2001	121	4	2219
2002	111	3	2222
2003	102	2	2224
2004	94	2	2226

Table G-28. Fuel/O&M Cost Data (x 1000), Green Bay, Two Mills and CBD Alternative, Utility Financing Option

COAL COST = $1.40/10^6$ Btu
OIL COST = $2.90/10^6$ Btu
COAL ESC RATE = 11%
OIL ESC RATE = 11.1%
DISCOUNT RATES = 17%

Year	Coal	Oil	Total Fuel	O&M	Total Fuel/O&M	PV	Acc. PV
1980	1270.	253.	1523.	264.	1787.	1527.	1527.
1981	1339.	578.	1918.	293.	2211.	1615.	3142.
1982	1492.	510.	2001.	392.	2393.	1494.	4636.
1983	1711.	375.	2086.	359.	2445.	1305.	5941.
1984	1888.	592.	2480.	370.	2850.	1300.	7241.
1985	1977.	885.	2862.	418.	3280.	1279.	8520.
1986	2143.	1280.	3423.	458.	3881.	1293.	9814.
1987	2222.	1584.	3807.	800.	4607.	1312.	11125.
1988	2543.	1300.	3843.	851.	4694.	1143.	12268.
1989	2920.	1265.	4185.	853.	5038.	1048.	13316.
1990	3146.	1289.	4435.	887.	5322.	946.	14262.
1991	3492.	1432.	4924.	922.	5846.	888.	15151.
1992	3876.	1591.	5467.	986.	6453.	838.	15989.
1993	4302.	1768.	6070.	1056.	7126.	791.	16780.
1994	4776.	1964.	6740.	1129.	7869.	747.	17527.
1995	5301.	2182.	7483.	1208.	8691.	705.	18232.
1996	5884.	2424.	8308.	1293.	9601.	666.	18897.
1997	6531.	2693.	9225.	1384.	10609.	629.	19526.
1998	7250.	2992.	10242.	1480.	11722.	594.	20119.
1999	8047.	3324.	11372.	1584.	12956.	561.	20680.
2000	8933.	3693.	12626.	1695.	14321.	530.	21210.
2001	9915.	4103.	14018.	1814.	15832.	501.	21710.
2002	11006.	4559.	15564.	1941.	17505.	473.	22183.
2003	12216.	5065.	17281.	2076.	19357.	447.	22630.
2004	13560.	5627.	19187.	2222.	21409.	423.	23053.

Table G-29. Fuel/O&M Cost Data (x 1000), Green Bay, Two Mills and CBD Alternative, Municipal Financing Option

COAL COST = $\$1.4/10^6$ Btu
OIL COST = $\$2.9/10^6$ Btu
COAL ESC RATE = 11%
OIL ESC RATE = 11.1%
DISCOUNT RATES = 8%

Year	Coal	Oil	Total Fuel	O&M	Total Fuel/L&M	PV	Acc. PV
1980	1270.	253.	1523.	264.	1787.	1655.	1655.
1981	1339.	578.	1918.	293.	2211.	1895.	3550.
1982	1492.	510.	2001.	392.	2393.	1900.	5450.
1983	1711.	375.	2086.	359.	2445.	1797.	7247.
1984	1888.	592.	2480.	370.	2850.	1940.	9187.
1985	1977.	885.	2862.	418.	3280.	2067.	11254.
1986	2143.	1280.	3423.	458.	3881.	2265.	13519.
1987	2222.	1584.	3807.	800.	4607.	2489.	16008.
1988	2543.	1300.	3843.	851.	4694.	2348.	18356.
1989	2920.	1265.	4185.	853.	5038.	2334.	20689.
1990	3146.	1289.	4435.	887.	5322.	2282.	22972.
1991	3492.	1432.	4924.	922.	5846.	2322.	25294.
1992	3876.	1591.	5467.	986.	6453.	2373.	27666.
1993	4302.	1768.	6070.	1056.	7126.	2426.	30093.
1994	4776.	1964.	6740.	1129.	7869.	2481.	32573.
1995	5301.	2182.	7483.	1208.	8691.	2537.	35110.
1996	5884.	2424.	8308.	1293.	9601.	2595.	37705.
1997	6531.	2693.	9225.	1384.	10609.	2655.	40360.
1998	7250.	2992.	10242.	1480.	11722.	2716.	43076.
1999	8047.	3324.	11372.	1584.	12956.	2780.	45855.
2000	8933.	3693.	12626.	1695.	14321.	2845.	48700.
2001	9915.	4103.	14018.	1814.	15832.	2912.	51612.
2002	11006.	4559.	15564.	1941.	17505.	2981.	54594.
2003	12216.	5065.	17281.	2076.	19357.	3053.	57646.
2004	13560.	5627.	19187.	2222.	21409.	3126.	60773.

Table G-30. Fuel/O&M Cost Data (x 1000), Green Bay, Two Mills and CBD Alternative, Joint Financing Option, Utility Portion

COAL COST = $1.4/10^6$ Btu
OIL COST = $2.9/10^6$ Btu
COAL ESC RATE = 11%
OIL ESC RATE = 11.1%
DISCOUNT RATES = 17%

Year	Coal	Oil	Total Fuel	O&M	Total Fuel/O&M	PV	Acc. PV
1980	1270.	253.	1523.	136.	1659.	1418.	1418.
1981	1389.	578.	1918.	127.	2045.	1494.	2911.
1982	1492.	510.	2001.	146.	2147.	1341.	4252.
1983	1711.	375.	2086.	235.	2321.	1239.	5491.
1984	1888.	592.	2480.	191.	2671.	1218.	6709.
1985	1977.	885.	2862.	190.	3052.	1190.	7899.
1986	2143.	1280.	3423.	226.	3649.	1216.	9115.
1987	2222.	1584.	3807.	252.	4059.	1156.	10271.
1988	2543.	1300.	3843.	580.	4423.	1077.	11348.
1989	2920.	1265.	4185.	616.	4801.	999.	12346.
1990	3146.	1289.	4435.	601.	5036.	895.	13242.
1991	3492.	1432.	4924.	655.	5579.	848.	14090.
1992	3876.	1591.	5467.	698.	6165.	801.	14891.
1993	4302.	1768.	6070.	747.	6817.	757.	15647.
1994	4776.	1964.	6740.	799.	7539.	715.	16363.
1995	5301.	2182.	7483.	855.	8338.	676.	17039.
1996	5884.	2424.	8308.	915.	9223.	639.	17678.
1997	6531.	2693.	9225.	980.	10205.	605.	18283.
1998	7250.	2992.	10242.	1047.	11289.	572.	18855.
1999	8047.	3324.	11372.	1121.	12493.	541.	19395.
2000	8933.	3693.	12626.	1200.	13826.	511.	19907.
2001	9915.	4103.	14018.	1284.	15302.	484.	20390.
2002	11006.	4559.	15564.	1374.	16938.	458.	20848.
2003	12216.	5065.	17281.	1469.	18750.	433.	21281.
2004	13560.	5627.	19187.	1573.	20760.	410.	21691.

Table G-31. Fuel/O&M Cost Data (x 1000), Green Bay, Two Mills and CBD Alternative, Joint Financing Option, Municipal Portion

COAL COST = $1.40/10^6 Btu
OIL COST = $2.90/10^6 Btu
COAL ESC RATE = 11%
OIL ESC RATE = 11.1%
DISCOUNT RATES = 8%

Year	Coal	Oil	Total Fuel	O&M	Total Fuel/O&M	PV	Acc. PV
1980	0.	0.	0.	128.	128.	119.	119.
1981	0.	0.	0.	137.	137.	117.	236.
1982	0.	0.	0.	147.	147.	117.	353.
1983	0.	0.	0.	156.	156.	115.	467.
1984	0.	0.	0.	168.	168.	114.	582.
1985	0.	0.	0.	180.	180.	113.	695.
1986	0.	0.	0.	192.	192.	112.	807.
1987	0.	0.	0.	206.	206.	111.	918.
1988	0.	0.	0.	220.	220.	110.	1028.
1989	0.	0.	0.	235.	235.	109.	1137.
1990	0.	0.	0.	252.	252.	108.	1245.
1991	0.	0.	0.	269.	269.	107.	1352.
1992	0.	0.	0.	288.	288.	106.	1458.
1993	0.	0.	0.	308.	308.	105.	1563.
1994	0.	0.	0.	330.	330.	104.	1667.
1995	0.	0.	0.	353.	353.	103.	1770.
1996	0.	0.	0.	378.	378.	102.	1872.
1997	0.	0.	0.	404.	404.	101.	1973.
1998	0.	0.	0.	432.	432.	100.	2073.
1999	0.	0.	0.	463.	463.	99.	2173.
2000	0.	0.	0.	495.	495.	98.	2271.
2001	0.	0.	0.	530.	530.	97.	2369.
2002	0.	0.	0.	567.	567.	97.	2465.
2003	0.	0.	0.	607.	607.	96.	2561.
2004	0.	0.	0.	649.	649.	95.	2656.

Table G-32. Gross Income Data (x 1000), Green Bay, Two Mills and CBD Alternative, Utility Financing Option

DISCOUNT RATE = 17%
FUEL QUANTITY = 1418.33 x 10^9 Btu/yr
FUEL COST = \$1.80/10^6 Btu/yr
ESCALATION RATE = 17%

Year	Income	PV	Acc. PV
1980	2587.	2211.	2211.
1981	2949.	2154.	4366.
1982	3362.	2099.	6465.
1983	3833.	2045.	8510.
1984	4369.	1993.	10503.
1985	4981.	1942.	12445.
1986	5678.	1892.	14337.
1987	6473.	1844.	16180.
1988	7380.	1796.	17977.
1989	8413.	1750.	19727.
1990	9591.	1705.	21432.
1991	10933.	1662.	23094.
1992	12464.	1619.	24713.
1993	14209.	1577.	26290.
1994	16198.	1537.	27827.
1995	18466.	1498.	29325.
1996	21051.	1459.	30784.
1997	23999.	1422.	32206.
1998	27358.	1385.	33591.
1999	31188.	1350.	34941.
2000	35555.	1315.	36256.
2001	40533.	1281.	37538.
2002	46207.	1249.	38786.
2003	52676.	1217.	40003.
2004	60051.	1185.	41189.

DISCOUNT RATE = 17%
FUEL QUANTITY = 1418.33 x 10^9 Btu/yr
FUEL COST = \$1.80/10^6 Btu/yr
ESCALATION RATE = 14%

Year	Income	PV	Acc. PV
1980	2910.	2488.	2488.
1981	3318.	2424.	4911.
1982	3782.	2362.	7273.
1983	4312.	2301.	9574.
1984	4916.	2242.	11816.
1985	5604.	2185.	14001.
1986	6388.	2129.	16129.
1987	7283.	2074.	18203.
1988	8302.	2021.	20224.
1989	9465.	1969.	22193.
1990	10790.	1918.	24111.
1991	12300.	1869.	25981.
1992	14022.	1821.	27802.
1993	15985.	1775.	29577.
1994	18223.	1729.	31306.
1995	20774.	1685.	32991.
1996	23683.	1642.	34632.
1997	26998.	1600.	36232.
1998	30778.	1559.	37790.
1999	35087.	1519.	39309.
2000	39999.	1480.	40788.
2001	45599.	1442.	42230.
2002	51983.	1405.	43635.
2003	59261.	1369.	45003.
2004	67557.	1334.	46337.

Table G-33. Gross Income Data (x 1000), Green Bay, Two Mills and CBD Alternative, Municipal Financing Option

DISCOUNT RATE = 8%
FUEL QUANTITY = 1418.33 x 10^9 Btu/yr
FUEL COST = \$1.80/10^6 Btu
ESCALATION RATE = 17%

Year	Income	PV	Acc. PV
1980	2587.	2395.	2395.
1981	2949.	2528.	4924.
1982	3362.	2669.	7593.
1983	3833.	2817.	10410.
1984	4369.	2974.	13384.
1985	4981.	3139.	16523.
1986	5678.	3313.	19836.
1987	6473.	3497.	23333.
1988	7380.	3692.	27025.
1989	8413.	3897.	30922.
1990	9591.	4113.	35035.
1991	10933.	4342.	39377.
1992	12464.	4583.	43960.
1993	14209.	4838.	48798.
1994	16198.	5106.	53904.
1995	18466.	5390.	59294.
1996	21051.	5690.	64984.
1997	23999.	6006.	70989.
1998	27358.	6339.	77329.
1999	31188.	6691.	84020.
2000	35555.	7063.	91083.
2001	40533.	7456.	98539.
2002	46207.	7870.	106409.
2003	52676.	8307.	114716.
2004	60051.	8768.	123484.

DISCOUNT RATE = 8%
FUEL QUANTITY = 1418.33 x 10^9 Btu/yr
FUEL COST = \$1.80/10^6 Btu
ESCALATION RATE = 14%

Year	Income	PV	Acc. PV
1980	2910.	2695.	2695.
1981	3318.	2845.	5539.
1982	3782.	3003.	8542.
1983	4312.	3169.	11711.
1984	4916.	3345.	15057.
1985	5604.	3531.	18588.
1986	6388.	3727.	22316.
1987	7283.	3935.	26250.
1988	8302.	4153.	30403.
1989	9465.	4384.	34787.
1990	10790.	4627.	39415.
1991	12300.	4885.	44299.
1992	14022.	5156.	49455.
1993	15985.	5442.	54897.
1994	18223.	5745.	60642.
1995	20774.	6064.	66706.
1996	23683.	6401.	73107.
1997	26998.	6756.	79863.
1998	30778.	7132.	86995.
1999	35087.	7528.	94523.
2000	39999.	7946.	102469.
2001	45599.	8388.	110856.
2002	51983.	8854.	119710.
2003	59261.	9345.	129055.
2004	67557.	9865.	138920.

Table G-34. Gross Income Data (x 1000), Green Bay, Two Mills and CBD Alternative, Joint Financing Option, Utility Portion

DISCOUNT RATE = 17%
FUEL QUANTITY = 1342.08 x 10^9 Btu/yr
FUEL COST = \$1.80/10^6 Btu
ESCALATION RATE = 14%

Year	Income	PV	Acc. PV
1980	2754.	2354.	2354.
1981	3140.	2293.	4647.
1982	3579.	2235.	6882.
1983	4080.	2177.	9059.
1984	4651.	2122.	11181.
1985	5302.	2067.	13248.
1986	6045.	2014.	15262.
1987	6891.	1962.	17224.
1988	7856.	1912.	19137.
1989	8956.	1863.	21000.
1990	10209.	1815.	22815.
1991	11639.	1769.	24584.
1992	13268.	1723.	26307.
1993	15126.	1679.	27987.
1994	17243.	1636.	29623.
1995	19658.	1594.	31217.
1996	22410.	1553.	32770.
1997	25547.	1514.	34284.
1998	29123.	1475.	35759.
1999	33201.	1437.	37196.
2000	37849.	1400.	38596.
2001	43148.	1364.	39960.
2002	49188.	1329.	41289.
2003	56075.	1295.	42584.
2004	63925.	1262.	43846.

DISCOUNT RATE = 17%
FUEL QUANTITY = 1342.08 x 10^9 Btu/yr
FUEL COST = \$1.60/10^6 Btu
ESCALATION RATE = 14%

Year	Income	PV	Acc. PV
1980	2448.	2092.	2092.
1981	2791.	2039.	4131.
1982	3181.	1986.	6117.
1983	3627.	1935.	8053.
1984	4134.	1886.	9938.
1985	4713.	1837.	11776.
1986	5373.	1790.	13566.
1987	6125.	1744.	15311.
1988	6983.	1700.	17010.
1989	7961.	1656.	18666.
1990	9075.	1614.	20280.
1991	10346.	1572.	21852.
1992	11794.	1532.	23384.
1993	13445.	1493.	24877.
1994	15327.	1454.	26331.
1995	17473.	1417.	27748.
1996	19920.	1381.	29129.
1997	22708.	1345.	30475.
1998	25888.	1311.	31785.
1999	29512.	1277.	33063.
2000	33643.	1245.	34307.
2001	38354.	1213.	35520.
2002	43723.	1182.	36701.
2003	49844.	1151.	37853.
2004	56822.	1122.	38974.

Table G-35. Gross Income Data (x 1000), Green Bay, Two Mills and CBD Alternative, Joint Financing Option, Municipal Portion

DISCOUNT RATE = 8%
FUEL QUANTITY = 76.25 x 10^9 Btu/yr
FUEL COST = \$1.80/10^6 Btu
ESCALATION RATE = 14%

Year	Income	PV	Acc. PV
1980	156.	145.	145.
1981	178.	153.	298.
1982	203.	161.	459.
1983	232.	170.	630.
1984	264.	180.	809.
1985	301.	190.	999.
1986	343.	200.	1200.
1987	392.	212.	1411.
1988	446.	223.	1634.
1989	509.	236.	1870.
1990	580.	249.	2119.
1991	661.	263.	2382.
1992	754.	277.	2659.
1993	859.	293.	2951.
1994	980.	309.	3260.
1995	1117.	326.	3586.
1996	1273.	344.	3930.
1997	1451.	363.	4293.
1998	1655.	383.	4677.
1999	1886.	405.	5082.
2000	2150.	427.	5509.
2001	2451.	451.	5960.
2002	2795.	476.	6436.
2003	3186.	502.	6938.
2004	3632.	530.	7468.

DISCOUNT RATE = 8%
FUEL QUANTITY = 76.25 x 10^9 Btu/yr
FUEL COST = \$1.60/10^6 Btu
ESCALATION RATE = 14%

Year	Income	PV	Acc. PV
1980	139.	129.	129.
1981	159.	136.	265.
1982	181.	143.	408.
1983	206.	151.	560.
1984	235.	160.	720.
1985	268.	169.	888.
1986	305.	178.	1066.
1987	348.	188.	1254.
1988	397.	198.	1453.
1989	452.	209.	1662.
1990	516.	221.	1884.
1991	588.	233.	2117.
1992	670.	246.	2363.
1993	764.	260.	2623.
1994	871.	275.	2898.
1995	993.	290.	3188.
1996	1132.	306.	3494.
1997	1290.	323.	3816.
1998	1471.	341.	4157.
1999	1677.	360.	4517.
2000	1911.	380.	4897.
2001	2179.	401.	5297.
2002	2484.	423.	5721.
2003	2832.	447.	6167.
2004	3228.	471.	6639.

Table G-36. Annual Savings (x 1000), Green Bay, Two Mills and CBD Alternative, Utility Financing Option

GROSS INCOME	REV. REQ.	FUEL/O & M	ANNUAL SAVINGS	REAL FUEL ESCALATION RATES
28863 AT 2% 34564 AT 4% 41896 AT 6% 51404 AT 8% 63825 AT 10%	8810 ↓	14857 ↓	1596 7297 14629 24137 36558	CASE COAL 0 OIL 3
28863 34504 41896 51404 63825	↓	23780 ↓	-3727 1974 9306 18814 31235	COAL 0 OIL 10
28863 34564 41896 51404 63825	↓	27151 ↓	-7098 -1397 5935 15443 27864	COAL 7 OIL 3
28863 34564 41896 51404 63825	↓	32474 ↓	-12421 -6720 612 10120 22541	COAL 7 OIL 10
46337 AT 1.80% 41189 AT 1.60%	↓	23053 ↓	14474 9326	COAL 4 OIL 4.1 NATURAL GAS 7

Table G-37. Annual Savings (x 1000), Green Bay, Two Mills and CBD Alternative, Municipal Financing Option

GROSS INCOME	REV. REQ.	FUEL/O & M	ANNUAL SAVINGS	REAL FUEL ESCALATION RATES
72108 AT 9% 92923 AT 11% 121167 AT 13% 159663 AT 15% 212308 AT 17%	14083	44494	13531 34346 62590 101086 153731	COAL 0 OIL 3
72108 AT 9% 92923 AT 11% 121167 AT 13% 159663 AT 15% 212308 AT 17%		65617	-7592 13223 41467 79963 132608	COAL 0 OIL 10
72108 AT 9% 92923 AT 11% 121167 AT 13% 159663 AT 15% 212308 AT 17%		76811	-18786 2029 30273 68769 121414	COAL 7 OIL 3
72108 AT 9% 92923 AT 11% 121167 AT 13% 159663 AT 15% 212308 AT 17%		97933	-39908 -19093 9151 47647 100292	COAL 7 OIL 10
138920 AT 1.80% 123484 AT 1.60		60773	64064 48628	COAL 9 OIL 4.1 NATURAL GAS 7

Table G-38. Income Statement (x 1000), Green Bay, CBD and Two-Mill Alternative, Utility Financing Option

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
REVENUE													
GROSS INCOME	2910	3318	3782	4312	4916	5604	6388	7283	8302	9465	10790	12300	14022
EXPENSES													
OPERATION/MAINTENANCE	264	293	392	359	370	418	458	800	851	853	887	922	986
FUEL	1523	1918	2001	2086	2480	2862	3423	3807	3843	4185	4435	4924	5467
TAXES	411	266	257	241	226	213	199	188	177	168	159	152	146
ADVALOREM TAX	261	253	237	221	207	193	180	166	153	141	130	118	108
DEPRECIATION	274	530	505	489	472	456	440	423	407	390	374	357	341
INTEREST	925	897	840	786	734	684	636	589	543	501	460	420	381
TOTAL EXPENSES	3658	4157	4232	4182	4489	4826	5336	5973	5974	6238	6445	6893	7429
INCOME (BEFORE TAXES)	-748	-839	-450	130	427	778	1052	1310	2328	3227	4345	5407	6593
INCOME ($ 1979)	-639	-612	-281	69	194	303	350	372	565	669	770	819	853

Table G-38. Income Statement (x 1000), Green Bay, CBD and Two-Mill Alternative, Utility Financing Option (concluded)

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
REVENUE												
GROSS INCOME	15985	18223	20774	23683	26998	30778	35087	39999	45599	51983	59261	67557
EXPENSES												
OPERATION/MAINTENANCE	1056	1129	1208	1293	1384	1480	1584	1695	1814	1941	2076	2222
FUEL	6070	6740	7483	8308	9225	10242	11372	12626	14018	15564	17281	19187
TAXES	139	134	132	129	128	128	128	131	134	138	142	132
ADVALOREM TAX	97	88	78	70	61	54	46	40	33	27	22	17
DEPRECIATION	325	309	292	276	259	243	227	210	194	177	161	161
INTEREST	344	311	278	247	217	189	164	139	117	96	78	60
TOTAL EXPENSES	8031	8711	9471	10323	11274	12336	13521	14841	16310	17943	19760	21779
INCOME (BEFORE TAXES)	7954	9512	11303	13360	15724	18442	21566	25158	29289	34040	39501	45778
INCOME ($ 1979)	879	898	912	921	926	928	927	924	920	913	905	897

Table G-39. Balance Sheet ($ x 1000) as of December 31, 1980, District Heating System, Green Bay, CBD and Two-Mill Alternative, Utility Financing Option

Assets			Liabilities and Stockholders' Equity		
Fixed Assets:			Long-Term Liabilities:		
Property			Long-Term Debt		
Plant Retrofit	$2200		Bonds	$4089	
Distribution Network	5500				
Pipe Bridge	1000		Total Liabilities		$4089
Total Property		$8700	Stockholders' Equity		
			Preferred Stock - x par value	1044	
			Authorized - x shares Issued - x shares		
			Common Stock - x par value	3567	
			Authorized - x shares Issued - x shares		
			Total Stockholder Equity		$4611
Total Assets		$8700	Total Liabilities and Stockholders Equity		$8700

Table G-40. Income Statement (x 1000), Green Bay, CBD and Two-Mill Alternative, Municipal Financing Option

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
REVENUE													
GROSS INCOME	2910	3318	3782	4312	4916	5604	6388	7283	8302	9465	10790	12300	14022
EXPENSES													
OPERATION/MAINTENANCE	264	293	392	359	370	418	458	800	851	853	887	922	986
FUEL	1523	1918	2001	2086	2480	2862	3423	3807	3843	4185	4435	4924	5467
DEPRECIATION	322	322	322	322	322	322	322	322	322	322	322	322	322
INTEREST	696	670	644	619	593	567	541	516	490	464	438	412	387
TOTAL EXPENSES	2805	3203	3359	3386	3765	4169	4744	5445	5506	5824	6082	6580	7162
INCOME	105	115	423	926	1151	1435	1644	1838	2796	3641	4708	5720	6860
INCOME ($ 1979)	97	99	336	681	783	904	959	993	1399	1686	2019	2271	2522

Table G-40. Income Statement (x 1000), Green Bay, CBD and Two-Mill Alternative, Municipal Financing Option (concluded)

	1993	1994	1995	1996	1997	1993	1999	2000	2001	2002	2003	2004
REVENUE												
- GROSS INCOME	15985	18223	20774	23683	26998	30773	35087	39999	45599	51983	59261	67557
EXPENSES												
OPERATION/MAINTENANCE	1056	1129	1208	1293	1384	1480	1584	1695	1814	1941	2076	2222
FUEL	6070	6740	7483	8308	9225	10242	11372	12626	14018	15564	17281	19187
DEPRECIATION	322	322	322	322	322	322	322	322	322	322	322	322
INTEREST	361	335	309	284	258	232	206	180	155	129	103	77
TOTAL EXPENSES	7809	8526	9322	10207	11189	12276	13484	14823	16309	17956	19782	21808
INCOME	8176	9697	11452	13476	15809	18502	21603	25176	29290	34027	39479	45749
INCOME ($ 1979)	2784	3057	3343	3642	3956	4287	4635	5001	5388	5795	6226	6680

Table G-41. Balance Sheet ($ x 1000) as of December 31, 1980, District Heating System, Green Bay, CBD and Two-Mill Alternative, Municipal Financing Option

Assets			*Liabilities and Stockholders' Equity		
Fixed Assets:			Long-Term Liabilities		
Property			Long-Term Debt		
Plant Retrofit	$2200		Bonds	$8700	
Distribution Network	5500				
Pipe Bridge	1000		Total Liabilities		$8700
Total Property		$8700			
Total Assets		$8700	Total Liabilities		$8700

* Dollars expressed in $1000

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JANESVILLE/BELOIT, ROCK RIVER TO INDUSTRIAL PARK

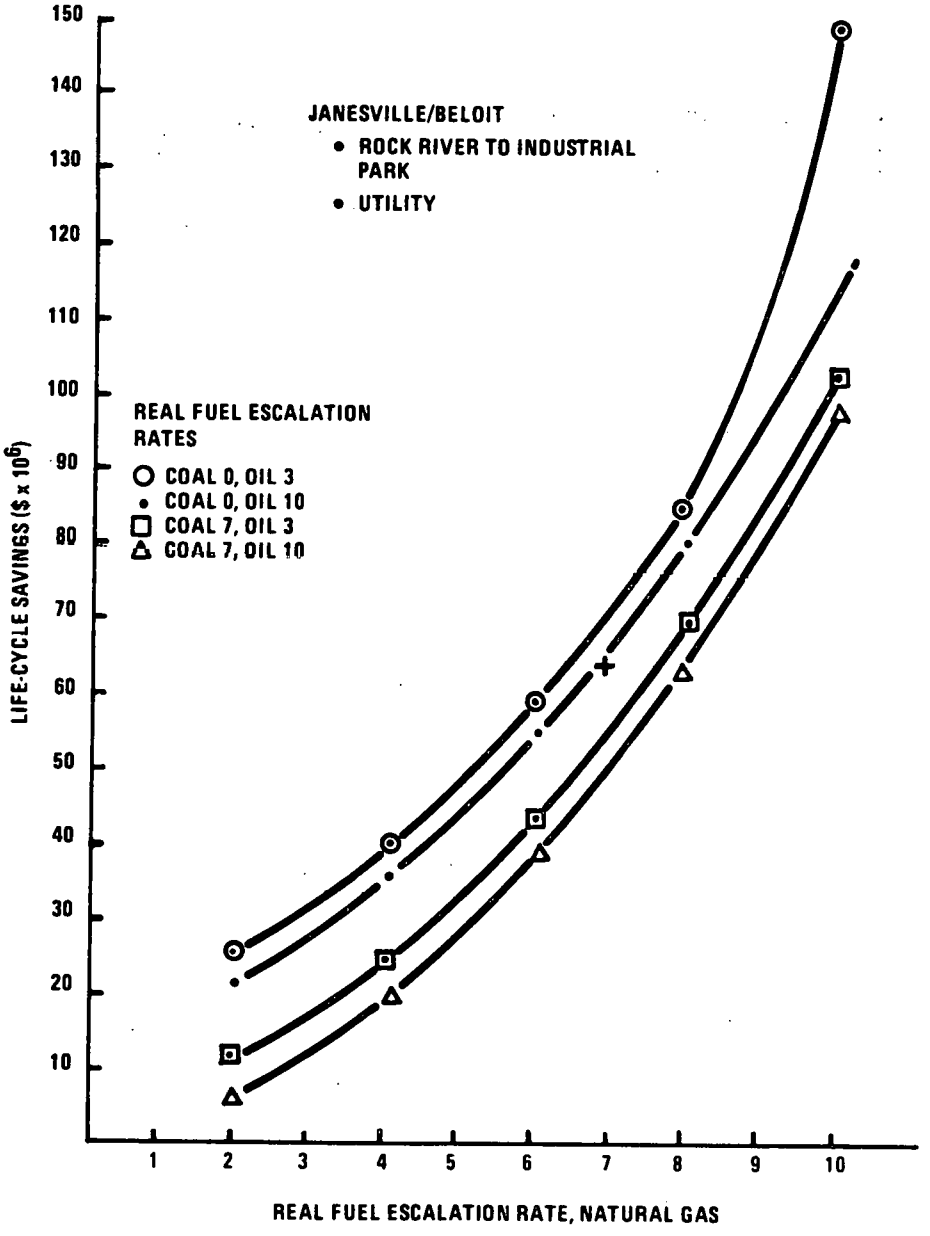

Figure G-12. Life-Cycle Savings versus Real Fuel Escalation Rates

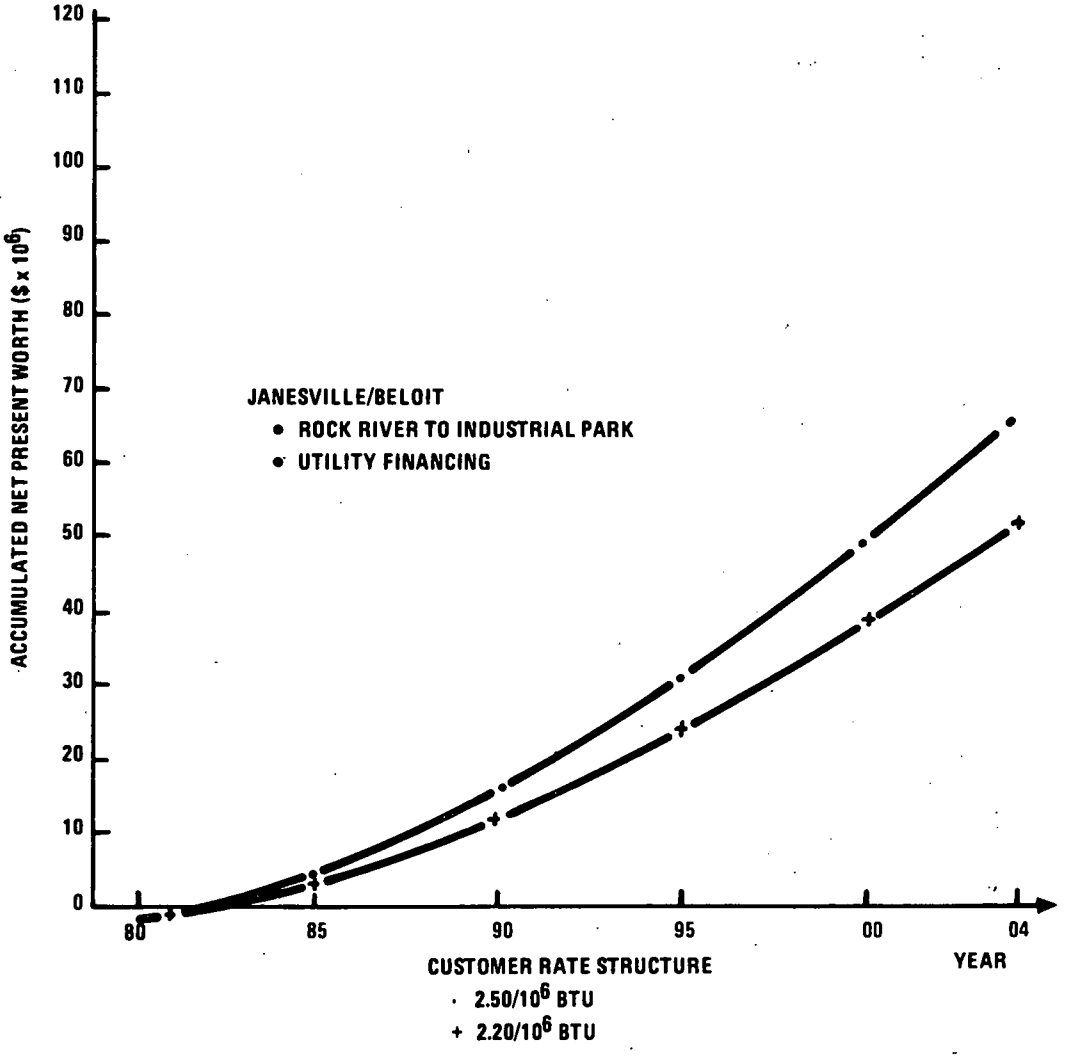

Figure G-13. Accumulated Net Present Worth versus Year

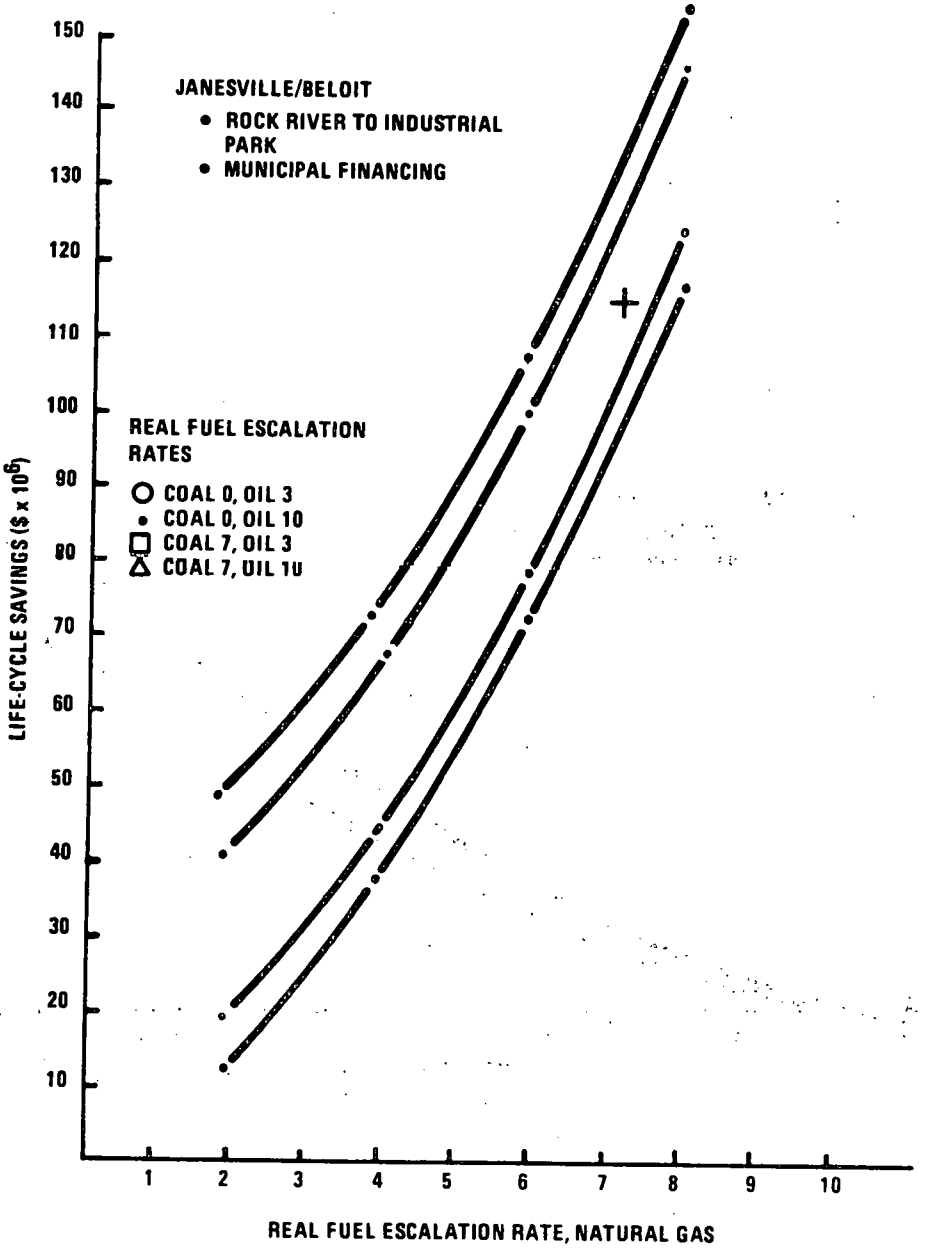

Figure G-14. Life-Cycle Savings versus Fuel and Escalation Rate, Natural Gas

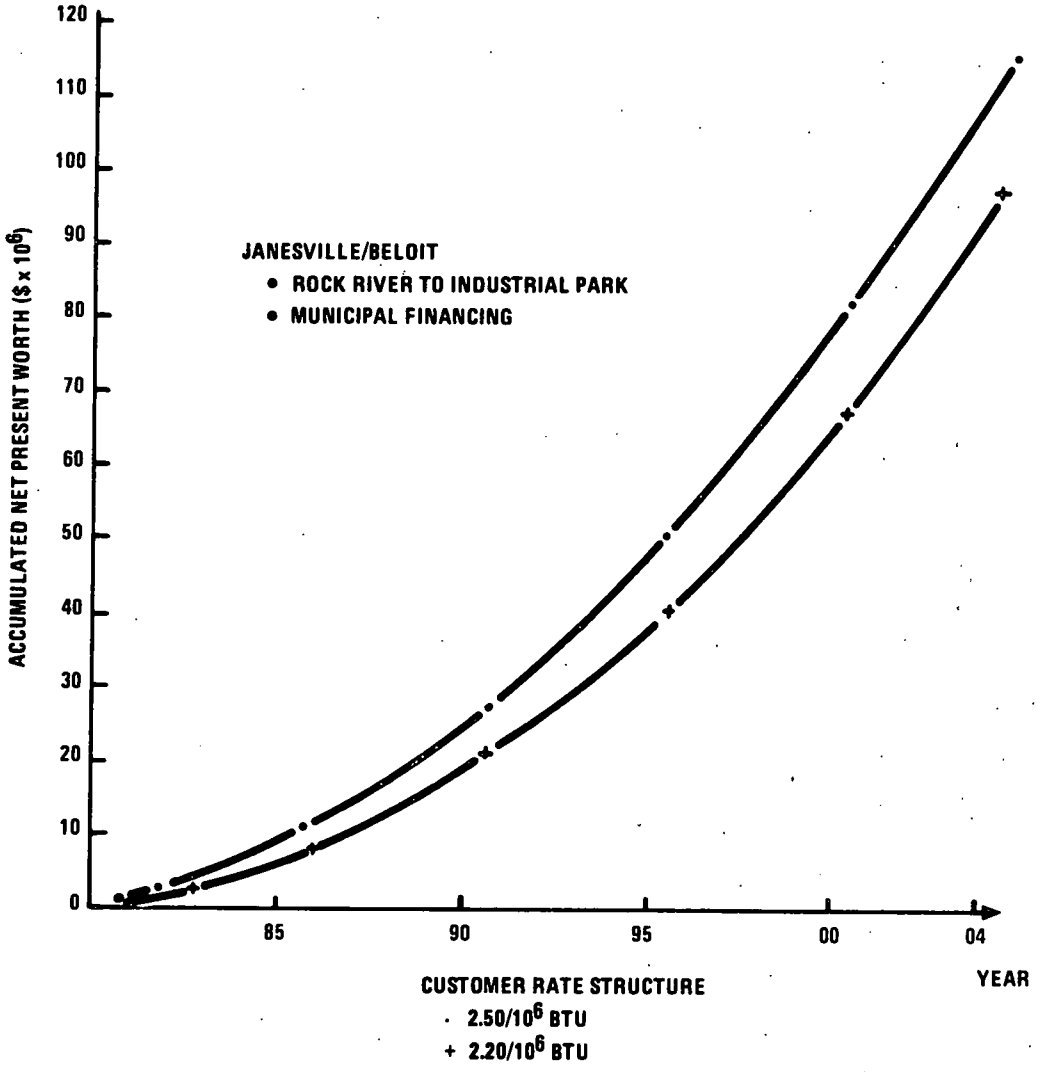

Figure G-15. Accumulated Net Present Worth versus Year

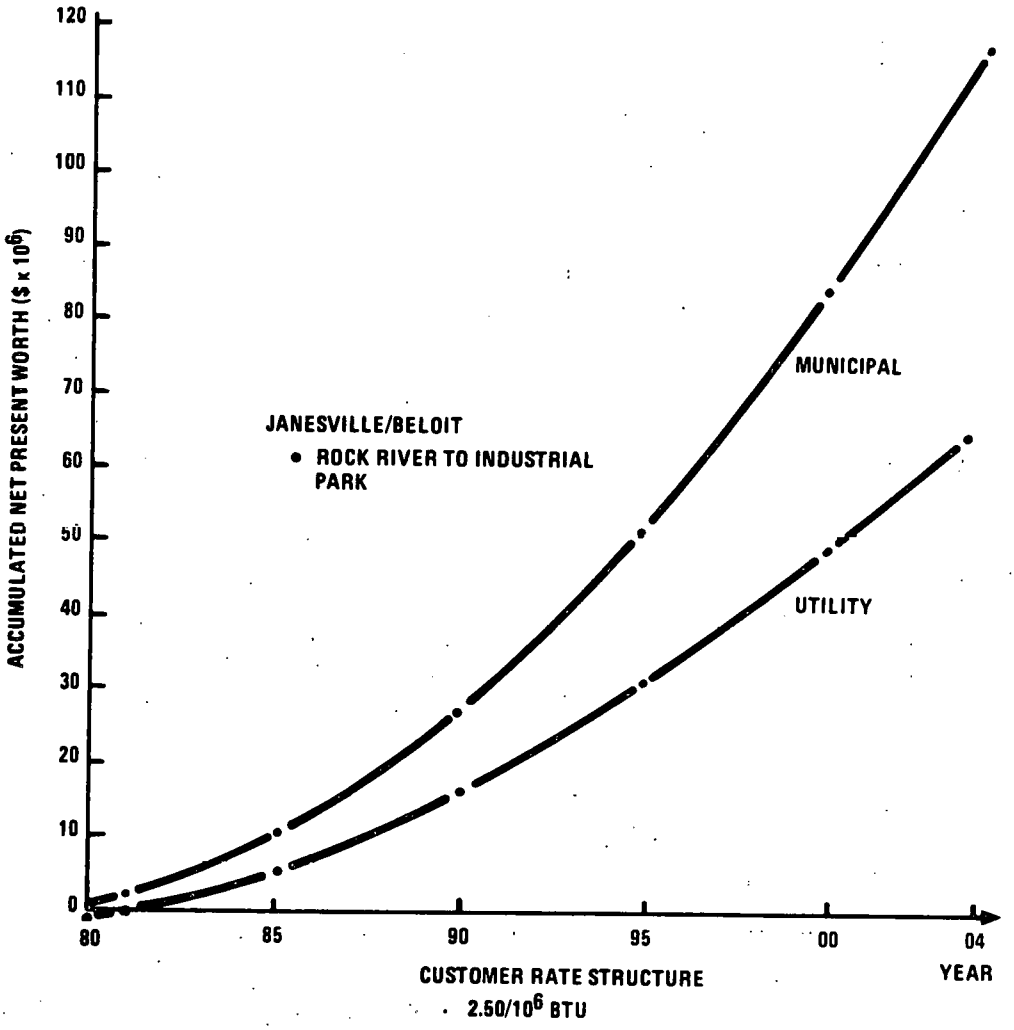

Figure G-16. Accumulated Net Present Worth versus Year

Table G-42. Operations and Maintenance Data (x 1000), Janesville/Beloit, Rock River to Industrial Park Alternative

Year	Maintenance 1% of Cost (1% of 5,200)	Insurance .2% of Costs (.2% of 5,200)	Operation 1.235×10^6 kWh/yr at .03 kWh	Total O&M for Distribution	Plant O&M Costs	Total O&M
1980	52	10	37	99	193	292
1981	56	11	40	97	186	283
1982	60	11	42	113	213	226
1983	64	12	45	121	314	435
1984	68	13	49	130	385	515
1985	73	14	52	139	396	535
1986	78	15	56	149	426	575
1987	84	16	59	159	434	593
1988	89	17	64	170	460	630
1989	96	18	68	182	501	783
1990	102	20	73	195	526	721
1991	109	21	78	208	564	772
1992	117	23	83	223	603	826
1993	125	24	89	238	645	883
1994	134	26	95	255	690	945
1995	143	28	102	273	738	1011
1996	154	30	109	293	790	1083
1997	164	32	117	313	845	1158
1998	176	34	125	335	905	1240
1999	188	36	134	358	967	1325
2000	201	39	143	383	1035	1418
2001	215	41	153	409	1107	1516
2002	230	44	164	438	1185	1623
2003	247	47	175	469	1268	1737
2004	264	51	188	503	1357	1860

Table G-43. Return Requirements (x 1000), Janesville/Beloit, Rock River to Industrial Park Alternative, Utility Financing Option

YEAR	CAPITAL COST COMPONENTS				
	EQUITY RETURN		DEBT RETURN	INCOME TAX	REVENUE REQUIREMENTS
	COMMON	PREFERRED			
1978	0.0	0.0	0.0	0.0	0.0
1979	213.5	34.4	141.4	-559.1	615.6
1980	408.6	65.5	268.9	326.2	1571.1
1981	386.9	61.7	253.4	314.9	1495.8
1982	365.9	58.1	238.5	299.4	1422.9
1983	345.4	54.6	224.0	284.7	1352.1
1984	325.5	51.1	210.0	270.5	1283.1
1985	306.1	47.8	196.3	257.0	1216.1
1986	287.2	44.6	183.1	244.1	1151.0
1987	268.9	41.5	170.4	231.9	1087.9
1988	251.1	38.5	158.0	220.3	1026.7
1989	233.8	35.6	146.1	209.4	967.5
1990	217.1	32.8	134.7	199.1	910.2
1991	200.9	30.1	123.6	189.4	854.8
1992	185.3	27.5	113.0	180.4	801.4
1993	170.1	25.0	102.8	172.0	749.9
1994	155.5	22.7	93.1	164.2	700.4
1995	141.5	20.4	83.8	157.1	652.8
1996	128.0	18.2	74.9	150.6	607.1
1997	115.0	16.2	66.4	144.2	563.4
1998	102.5	14.2	58.4	139.6	521.6
1999	90.6	12.4	50.8	135.0	481.8
2000	79.2	10.6	43.7	131.1	443.9
2001	68.4	9.0	36.9	127.6	407.9
2002	58.0	7.5	30.6	125.2	373.9
2003	48.2	6.0	24.7	120.3	341.5
2004	38.7	4.6	19.1	115.8	310.5

Table G-43. Return Requirements (x 1000), Janesville/Beloit, Rock River to Industrial Park Alternative, Utility Financing Option (Concluded)

ACCUMULATED	VALUE 12TH MONTH 1979	ACCUMULATED	YEAR
0.0	0.0	0.0	1978
615.6	615.6	615.6	1979
2186.7	1407.6	2023.1	1980
3682.5	1200.6	3223.7	1981
5105.4	1023.2	4246.9	1982
6457.5	871.0	5117.9	1983
7740.6	740.6	5858.5	1984
8956.7	628.8	6487.3	1985
10107.8	533.2	7020.5	1986
11195.7	451.5	7472.0	1987
12222.4	381.7	7853.8	1988
13189.9	322.3	8176.0	1989
14100.1	271.6	8447.6	1990
14954.9	228.5	8676.2	1991
15756.3	192.0	8868.1	1992
16506.2	160.9	9029.1	1993
17206.6	134.6	9163.7	1994
17859.3	112.4	9276.1	1995
18466.4	93.7	9369.8	1996
19029.8	77.9	9447.7	1997
19551.4	64.6	9512.3	1998
20033.2	53.5	9565.8	1999
20477.1	44.1	9609.9	2000
20885.0	36.3	9646.2	2001
21258.8	29.8	9676.1	2002
21600.4	24.4	9700.5	2003
21910.9	19.9	9720.4	2004

Table G-44. Return Requirement (x 1000), Janesville/Beloit, Rock River to Industrial Park Alternative, Municipal Financing Option

Capital Costs $6,700,000

Book Life 31 years

Depreciation Method: Straight Line

Bond Rate: 8%

Discount Rate: 8%

Year	Book Dep	Net Book Dep	Invest	Ret Req	Total Ret	PU	Acc PU
1980	216.	0.	6700.	536.	752.	696.	696.
1981	216.	216.	6484.	519.	735.	680.	1326.
1982	216.	432.	6268.	501.	718.	570.	1896.
1983	216.	648.	6052.	484.	700.	515.	2411.
1984	216.	865.	5835.	467.	683.	465.	2876.
1985	216.	1081.	5619.	450.	666.	419.	3295.
1986	216.	1297.	5403.	432.	648.	378.	3673.
1987	216.	1513.	5187.	415.	631.	341.	4014.
1988	216.	1729.	4971.	398.	614.	307.	4321.
1989	216.	1945.	4755.	380.	597.	276.	4598.
1990	216.	2161.	4539.	363.	579.	248.	4846.
1991	216.	2377.	4323.	346.	562.	223.	5069.
1992	216.	2594.	4106.	329.	545.	200.	5270.
1993	216.	2810.	3890.	311.	527.	180.	5449.
1994	216.	3026.	3674.	294.	510.	161.	5610.
1995	216.	3242.	3458.	277.	493.	144.	5754.
1996	216.	3458.	3242.	259.	475.	129.	5882.
1997	216.	3674.	3026.	242.	458.	115.	5997.
1998	216.	3890.	2810.	225.	441.	102.	6099.
1999	216.	4106.	2594.	207.	424.	91.	6190.
2000	216.	4323.	2377.	190.	406.	81.	6271.
2001	216.	4539.	2161.	173.	389.	72.	6342.
2002	216.	4755.	1945.	156.	372.	63.	6406.
2003	216.	4971.	1729.	138.	354.	56.	6461.
2004	216.	5187.	1513.	121.	337.	49.	6511.

Table G-45. Fuel/O & M Data (x 1000), Janesville/Beloit, Rock River to Industrial Park Alternative, Municipal Financing Option

COAL COST = 1.58/10-6 BTU
OIL COST = 2.67/10-6 BTU
COAL ESC RATE = 11.0%
OIL ESC RATE = 11.1%
DISCOUNT RATE = 8.00%

YEAR	COAL	OIL	TOTAL FUEL	O&M	TOTAL FUEL/O&M	PV	ACC PV
1980	1312.	27.	1339.	292.	1631.	1510.	1510.
1981	1184.	69.	1253.	283.	1536.	1317.	2826.
1982	1301.	81.	1381.	226.	1607.	1276.	4102.
1983	1326.	102.	1428.	435.	1863.	1369.	5472.
1984	1448.	113.	1561.	515.	2076.	1413.	6885.
1985	1421.	191.	1612.	535.	2147.	1353.	8238.
1986	1427.	340.	1767.	575.	2342.	1367.	9605.
1987	1981.	415.	2396.	593.	2989.	1615.	11220.
1988	2243.	599.	2842.	630.	3472.	1737.	12957.
1989	2400.	597.	2997.	783.	3780.	1751.	14707.
1990	2878.	442.	3320.	721.	4041.	1733.	16441.
1991	3195.	491.	3686.	772.	4458.	1770.	18211.
1992	3546.	546.	4092.	826.	4918.	1808.	20019.
1993	3936.	606.	4543.	883.	5426.	1847.	21866.
1994	4369.	673.	5043.	945.	5988.	1888.	23754.
1995	4850.	748.	5598.	1011.	6609.	1929.	25683.
1996	5384.	831.	6215.	1083.	7298.	1972.	27656.
1997	5976.	923.	6899.	1158.	8057.	2016.	29672.
1998	6633.	1026.	7659.	1240.	8899.	2062.	31734.
1999	7363.	1140.	8503.	1325.	9828.	2108.	33842.
2000	8173.	1266.	9439.	1418.	10857.	2157.	35999.
2001	9072.	1407.	10479.	1516.	11995.	2206.	38205.
2002	10070.	1563.	11633.	1623.	13256.	2258.	40463.
2003	11177.	1736.	12914.	1737.	14651.	2310.	42773.
2004	12407.	1929.	14336.	1860.	16196.	2365.	45138.

Table G-46. Fuel/O & M Data (x 1000), Janesville/Beloit, Rock River to Industrial Park Alternative, Utility Financing Option

COAL COST = 1.58/10-6 BTU
OIL COST = 2.67/10-6 BTU
COAL ESC RATE = 11.0%
OIL ESC RATE = 11.1%
DISCOUNT RATE = 11.62%

YEAR	COAL	OIL	TOTAL FUEL	O&M	TOTAL FUEL/O&M	PV	ACC PV
1980	1312.	27.	1339.	292.	1631.	1461.	1461.
1981	1184.	69.	1253.	283.	1536.	1233.	2693.
1982	1301.	81.	1381.	226.	1607.	1156.	3849.
1983	1326.	102.	1428.	435.	1863.	1200.	5050.
1984	1448.	113.	1561.	515.	2076.	1198.	6248.
1985	1421.	191.	1612.	535.	2147.	1110.	7358.
1986	1427.	340.	1767.	575.	2342.	1085.	8443.
1987	1981.	415.	2396.	593.	2989.	1240.	9684.
1988	2243.	599.	2842.	630.	3472.	1291.	10975.
1989	2400.	597.	2997.	783.	3780.	1259.	12234.
1990	2878.	442.	3320.	721.	4041.	1206.	13440.
1991	3195.	491.	3686.	772.	4458.	1192.	14632.
1992	3546.	546.	4092.	826.	4918.	1178.	15810.
1993	3936.	606.	4543.	883.	5426.	1164.	16974.
1994	4369.	673.	5043.	945.	5988.	1151.	18125.
1995	4850.	748.	5598.	1011.	6609.	1138.	19263.
1996	5384.	831.	6215.	1083.	7298.	1126.	20390.
1997	5976.	923.	6899.	1158.	8057.	1114.	21503.
1998	6633.	1026.	7659.	1240.	8899.	1102.	22606.
1999	7363.	1140.	8503.	1325.	9828.	1090.	23696.
2000	8173.	1266.	9439.	1418.	10857.	1079.	24775.
2001	9072.	1407.	10479.	1516.	11995.	1068.	25843.
2002	10070.	1563.	11633.	1623.	13256.	1058.	26901.
2003	11177.	1736.	12914.	1737.	14651.	1047.	27948.
2004	12407.	1929.	14336.	1860.	16196.	1037.	28985.

Table G-47. Gross Income Data (x 1000), Janesville/Beloit, Rock River to Industrial Park Alternative, Utility Financing Option

DISCOUNT RATE = 11.62%
FUEL QUANTITY = 1234.80/10-9 BTU/YR
FUEL COST = 2.20/10-6 BTU
ESCALATION RATE = 14.0%

YEAR	INCOME	PV	ACC PV
1980	3097.	2774.	2774.
1981	3530.	2834.	5608.
1982	4025.	2894.	8502.
1983	4588.	2956.	11458.
1984	5231.	3019.	14477.
1985	5963.	3083.	17560.
1986	6798.	3149.	20709.
1987	7749.	3216.	23925.
1988	8834.	3285.	27209.
1989	10071.	3355.	30564.
1990	11481.	3426.	33990.
1991	13088.	3499.	37490.
1992	14920.	3574.	41063.
1993	17009.	3650.	44713.
1994	19391.	3728.	48441.
1995	22105.	3807.	52249.
1996	25200.	3889.	56137.
1997	28728.	3971.	60109.
1998	32750.	4056.	64165.
1999	37335.	4143.	68307.
2000	42562.	4231.	72538.
2001	48521.	4321.	76860.
2002	55313.	4413.	81273.
2003	63057.	4507.	85780.
2004	71885.	4604.	90384.

DISCOUNT RATE = 11.62%
FUEL QUANTITY = 1234.80/10-9 BTU/YR
FUEL COST = 2.50/10-6 BTU
ESCALATION RATE = 14.0%

YEAR	INCOME	PV	ACC PV
1980	3519.	3153.	3153.
1981	4012.	3220.	6373.
1982	4574.	3289.	9662.
1983	5214.	3359.	13020.
1984	5944.	3430.	16451.
1985	6776.	3504.	19954.
1986	7725.	3578.	23533.
1987	8806.	3655.	27187.
1988	10039.	3733.	30920.
1989	11444.	3812.	34732.
1990	13046.	3893.	38625.
1991	14873.	3976.	42602.
1992	16955.	4061.	46663.
1993	19329.	4148.	50811.
1994	22035.	4236.	55047.
1995	25120.	4327.	59374.
1996	28636.	4419.	63792.
1997	32646.	4513.	68305.
1998	37216.	4609.	72915.
1999	42426.	4708.	77622.
2000	48366.	4808.	82430.
2001	55137.	4910.	87340.
2002	62856.	5015.	92356.
2003	71656.	5122.	97478.
2004	81688.	5231.	102709.

Table G-48. Gross Income Data (x 1000), Janesville/Beloit, Rock River to Industrial Park Alternative, Municipal Financing Option

DISCOUNT RATE = 8.00%
FUEL QUANTITY = 1234.80/10-9 BTU/YR
FUEL COST = 2.50/10-6 BTU
ESCALATION RATE = 14.0%

YEAR	INCOME	PV	ACC PV	YEAR	INCOME	PV	ACC PV
1980	3519.	3259.	3259.	1980	3097.	2867.	2867.
1981	4012.	3440.	6698.	1981	3530.	3027.	5894.
1982	4574.	3631.	10329.	1982	4025.	3195.	9089.
1983	5214.	3832.	14161.	1983	4588.	3372.	12462.
1984	5944.	4045.	18206.	1984	5231.	3560.	16021.
1985	6776.	4270.	22476.	1985	5963.	3758.	19779.
1986	7725.	4507.	26983.	1986	6798.	3966.	23745.
1987	8806.	4758.	31741.	1987	7749.	4187.	27932.
1988	10039.	5022.	36763.	1988	8834.	4419.	32351.
1989	11444.	5301.	42064.	1989	10071.	4665.	37016.
1990	13046.	5595.	47659.	1990	11481.	4924.	41940.
1991	14873.	5906.	53565.	1991	13088.	5197.	47137.
1992	16955.	6234.	59800.	1992	14920.	5486.	52624.
1993	19329.	6581.	66380.	1993	17009.	5791.	58415.
1994	22035.	6946.	73327.	1994	19391.	6113.	64527.
1995	25120.	7332.	80659.	1995	22105.	6452.	70980.
1996	28636.	7740.	88398.	1996	25200.	6811.	77791.
1997	32646.	8170.	96568.	1997	28728.	7189.	84980.
1998	37216.	8623.	105191.	1998	32750.	7589.	92568.
1999	42426.	9102.	114294.	1999	37335.	8010.	100578.
2000	48366.	9608.	123902.	2000	42562.	8455.	109034.
2001	55137.	10142.	134044.	2001	48521.	8925.	117958.
2002	62856.	10705.	144749.	2002	55313.	9421.	127379.
2003	71656.	11300.	156049.	2003	63057.	9944.	137323.
2004	81688.	11928.	167977.	2004	71885.	10497.	147820.

Table G-49. Annual Savings (x 1000), Janesville/Beloit, Rock River to Industrial Park Alternative, Municipal Financing Option

GROSS INCOME	MUNICIPAL REV. REQ.	FUEL/O & M	TOTAL RETURN	ANNUAL SAVINGS	REAL FUEL ESCALATION RATES
87191 AT 9% 112360 AT 11% 146512 AT 13% 193060 AT 15% 256716 AT 17%	6511	31644	38155	49036 74205 108357 154905 218561	C - 0 O - 3
87191 AT 9% 112360 AT 11% 146512 AT 13% 193060 AT 15% 256716 AT 17%		38838	45349	41842 67011 101163 147711 210878	C - 0 O - 10
87191 AT 9% 112360 AT 11% 146512 AT 13% 193060 AT 15% 256716 AT 17%		60764	67275	19916 45085 79237 125785 189441	C - 7 O - 3
87191 AT 9% 112360 AT 11% 146512 AT 13% 193060 AT 15% 256716 AT 17%		67958	74469	12722 37891 72043 118591 182247	C - 7 O - 10
167977 147820		45138	51649	116328 96171	C - 4 O - 4.1 NG - 7

Table G-50. Annual Savings (x 1000), Janesville/Beloit, Rock River to Industrial Park Alternative, Utility Financing Option

GROSS INCOME	UTILITY REV. REQ.	FUEL/O & M	ANNUAL SAVINGS	REAL FUEL ESCALATION RATES
57503 AT 9%	9720	21262	26521	C - 0
71842 AT 11%			40860	O - 3
90898 AT 13%			59916	
116387 AT 15%			85405	
150656 AT 17%			150656	
57503 AT 9%		25207	22576	C - 0
71842 AT 11%			36915	O - 10
90898 AT 13%			55971	
116387 AT 15%			81460	
150656 AT 17%			115729	
57503 AT 9%		37619	10164	C - 7
71842 AT 11%			24503	O - 3
90898 AT 13%			43559	
116387 AT 15%			69048	
150656 AT 17%			103317	
57503 AT 9%		41563	6220	C - 7
71842 AT 11%			20559	O - 10
90898 AT 13%			39615	
116387 AT 15%			65104	
150656 AT 17%			99373	
102709		28985	64004	C - 4
90384			51679	O - 4
78059			39354	NG - 7

JANESVILLE/BELOIT, BLACK HAWK TO BELOIT

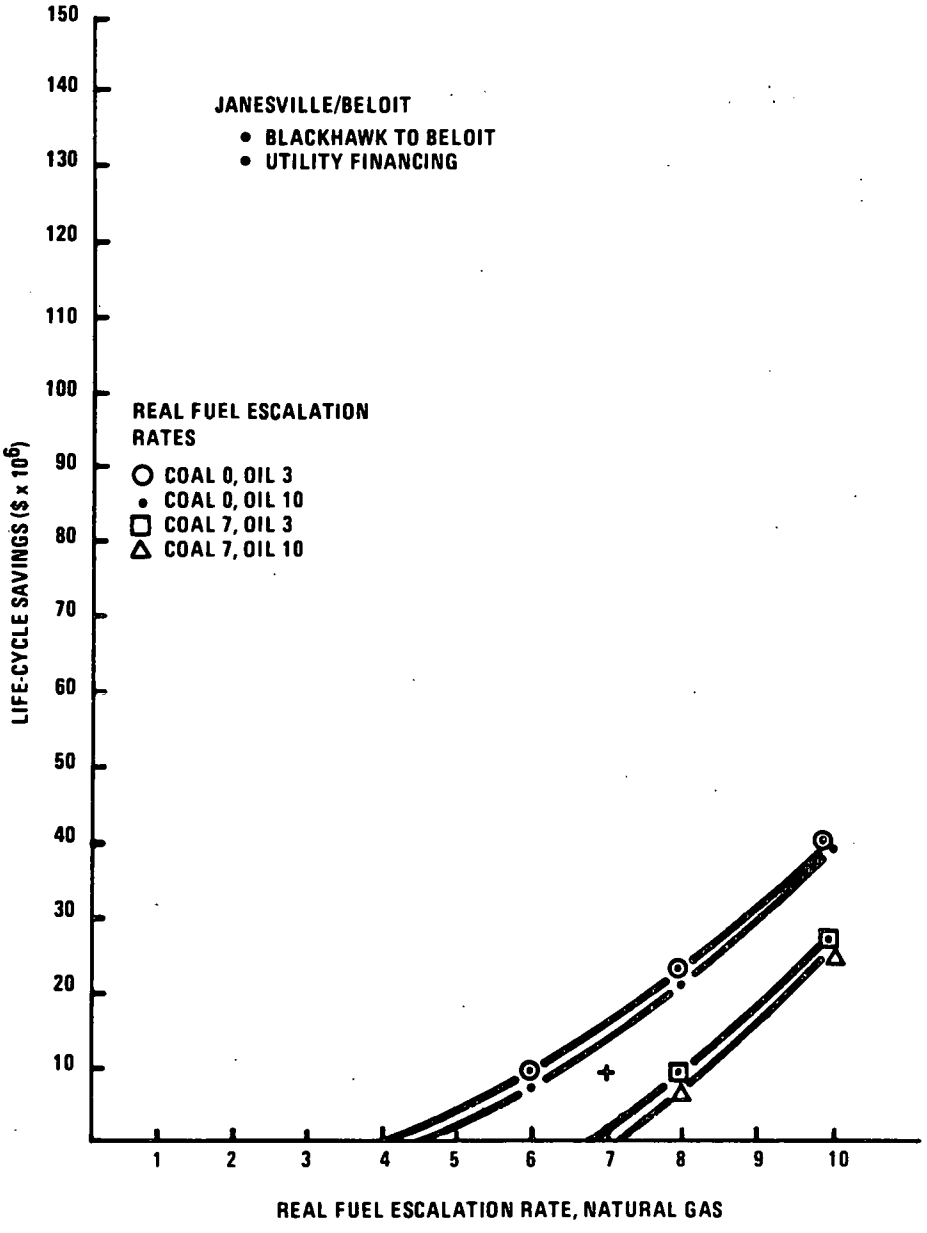

Figure G-17. Life-Cycle Savings versus Real Fuel Escalation Rate, Natural Gas

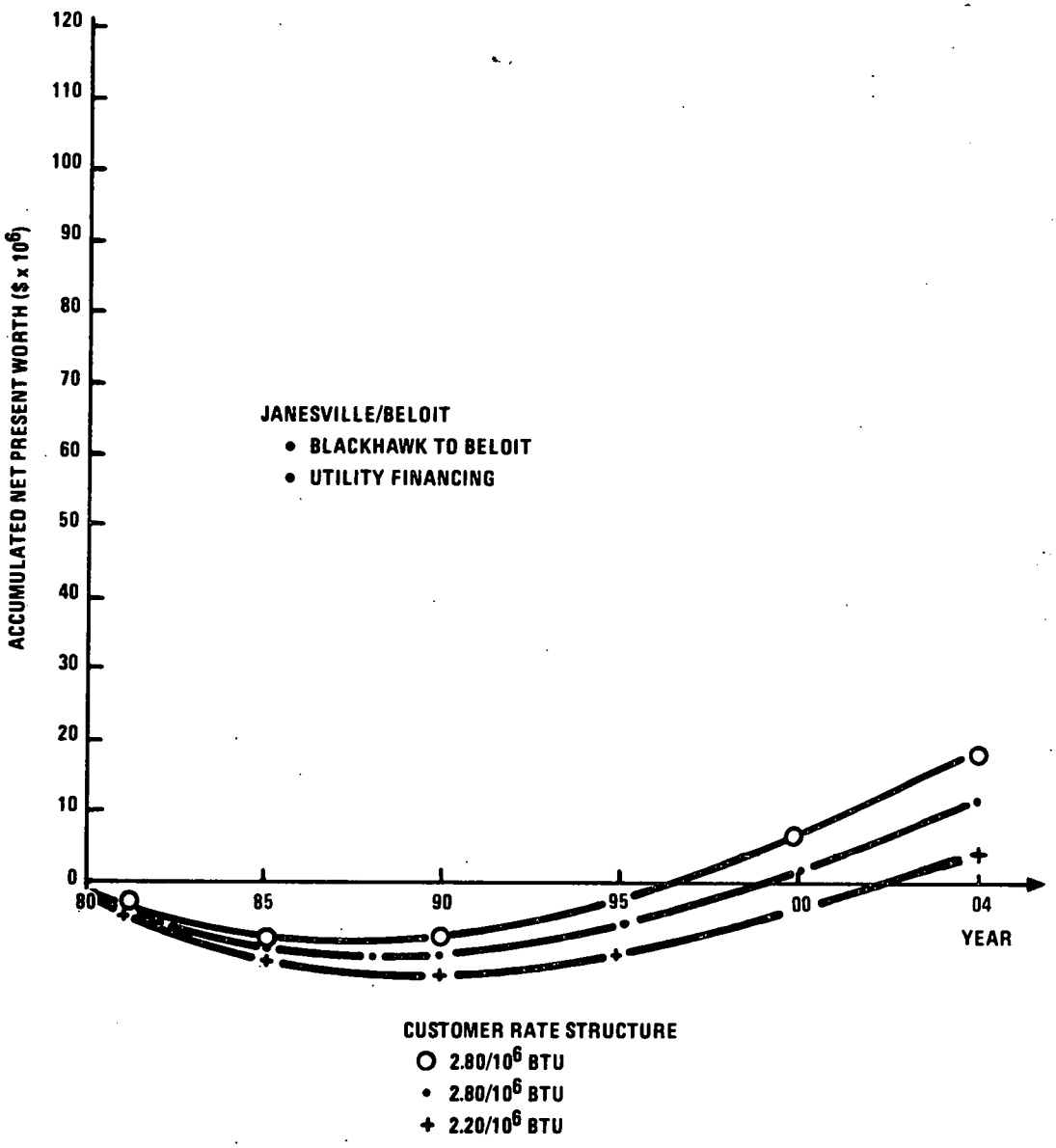

Figure G-18. Accumulated Net Present Worth versus Year

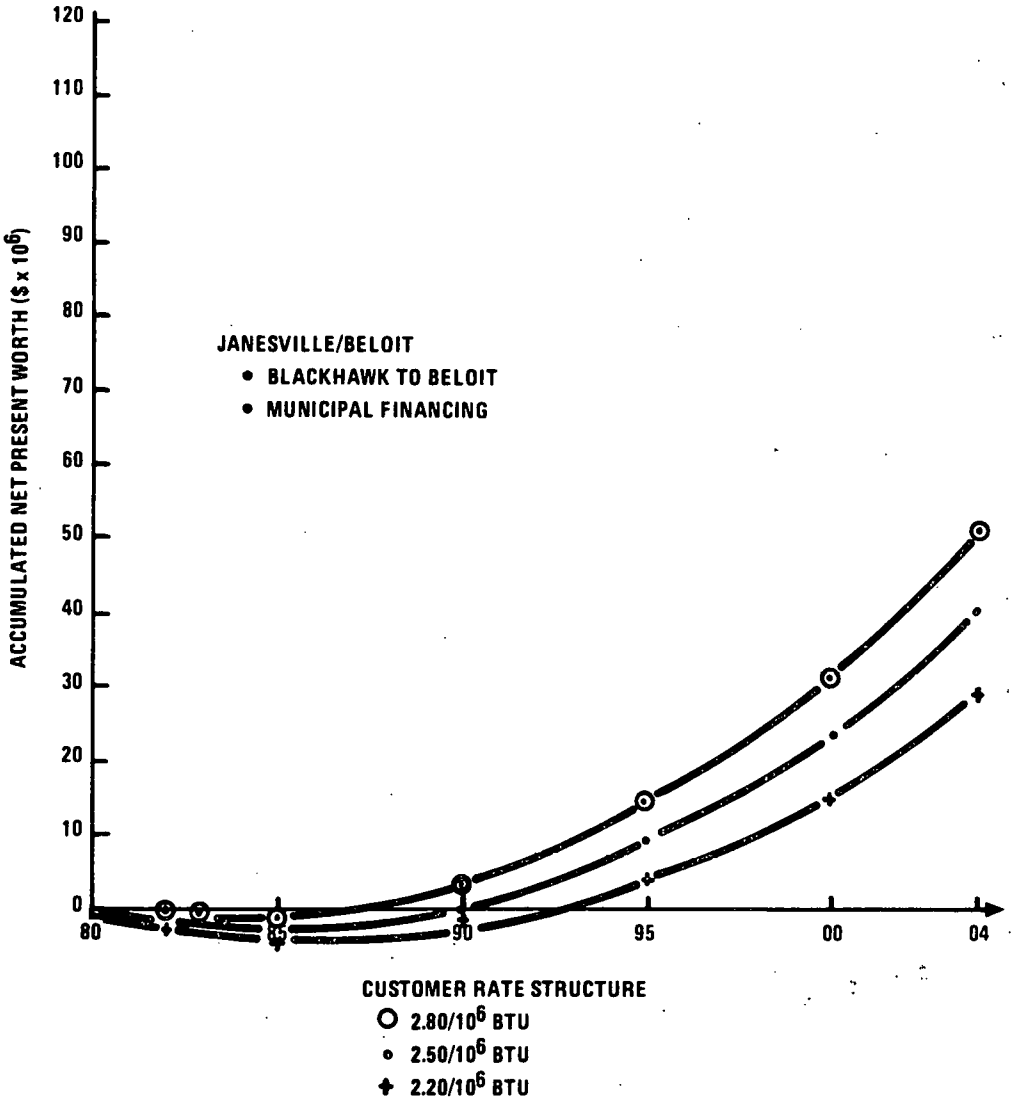

Figure G-19. Accumulated Net Present Worth versus Year

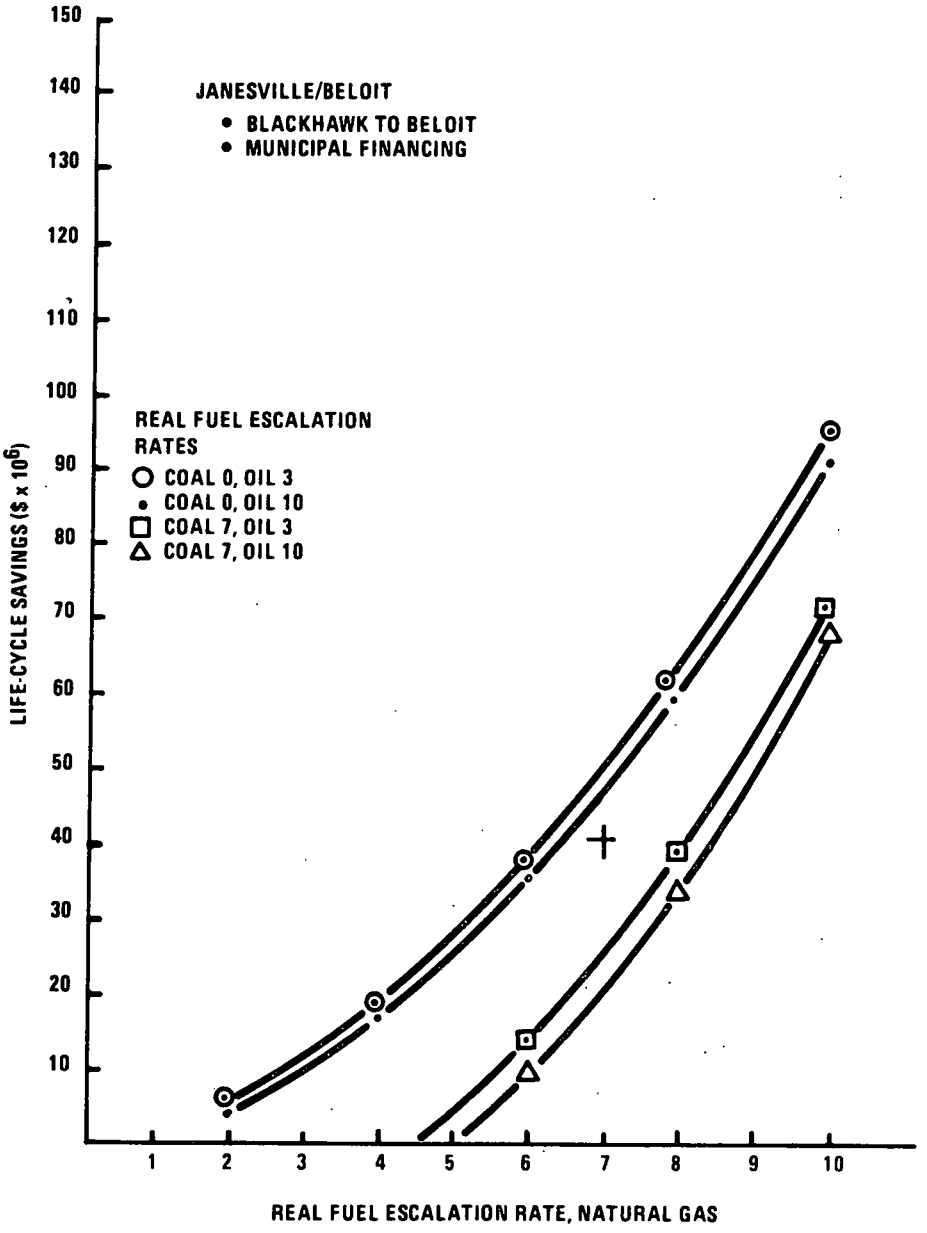

Figure G-20. Life-Cycle Savings versus Real Fuel Escalation Rate, Natural Gas

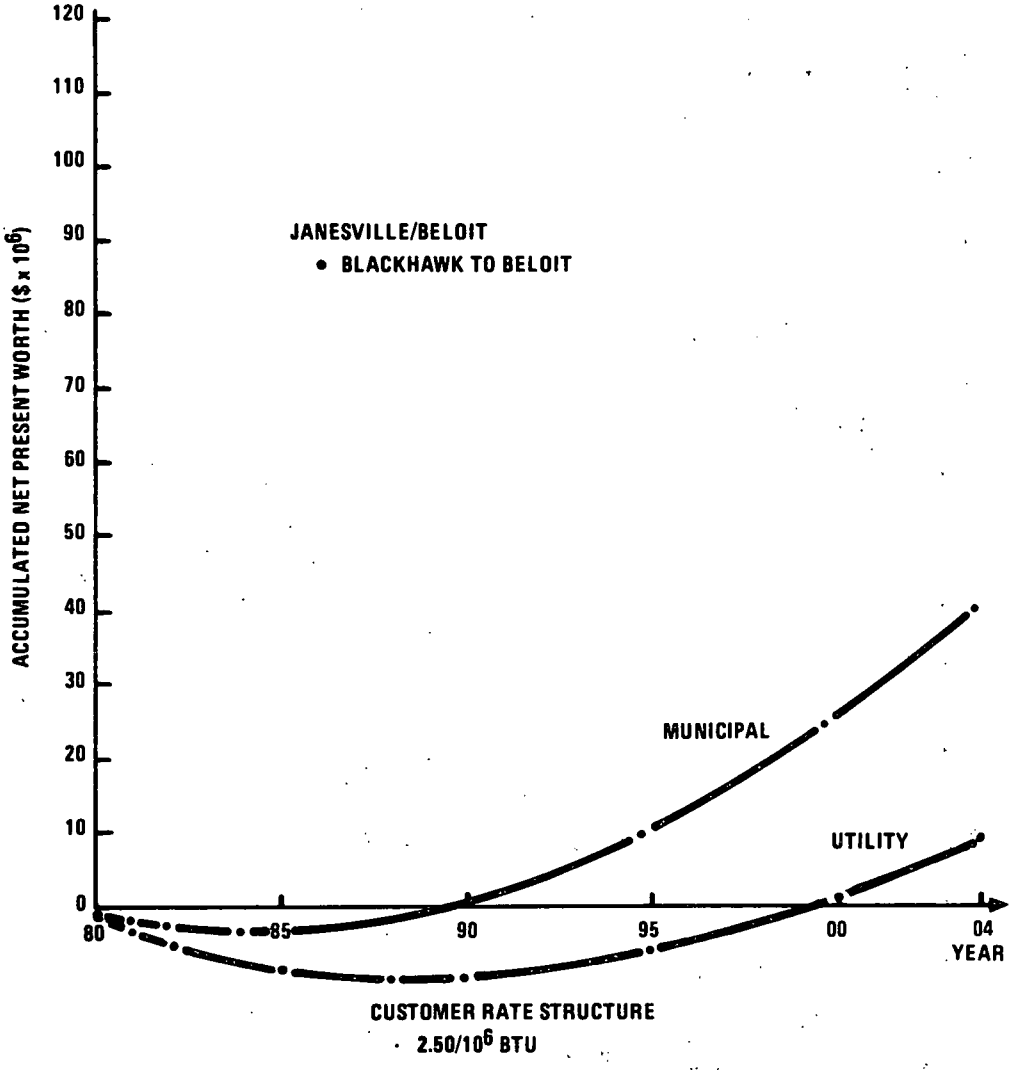

Figure G-21. Accumulated Net Present Worth versus Year

Table G- 51. Operations and Maintenance Data (x 1000), Janesville/Beloit, Blackhawk to Beloit Alternative

Year	Maintenance 1% of Cost (1% of 14,300)	Insurance .2% of Costs (.2% of 14,300)	Operation $.227 \times 10^6$ kWh/yr at .03 kWh	Total O&M for Distribution	Plant O&M Costs	Total O&M
1980	143	23	7	173	123	296
1981	153	25	7	185	109	294
1982	164	26	8	198	117	315
1983	175	28	9	212	131	343
1984	187	30	9	226	151	377
1985	201	32	10	243	149	392
1986	215	35	11	261	170	431
1987	230	37	11	285	177	462
1988	246	40	12	298	195	493
1989	263	42	13	318	201	519
1990	281	45	14	340	202	542
1991	301	48	14	363	216	579
1992	322	52	16	390	231	621
1993	345	55	17	417	248	665
1994	369	59	18	446	264	710
1995	395	63	19	477	283	760
1996	422	68	21	511	303	814
1997	452	73	22	547	325	872
1998	483	78	24	585	347	932
1999	517	83	25	625	371	996
2000	553	89	27	669	397	1066
2001	592	95	29	716	425	1141
2002	634	102	31	767	455	1222
2003	678	109	33	820	487	1307
2004	725	117	36	878	521	1399

Table G-52. Return Requirements (x 1000), Janesville/Beloit, Blackhawk to Beloit Alternative, Municipal Financing Option

Capital Cost $15,800,000

Book Life 31 years

Depreciation Method: Straight Line

Bond Rate 8%

Discount Rate 8%

Year	Book Dep	Net Dep	Invest	Ret Req	Total Return	PV	Acc PV
1980	510.	0.	15800.	1264.	1774.	1642.	1642.
1981	510.	510.	15290.	1223.	1733.	1486.	3128.
1982	510.	1019.	14781.	1182.	1692.	1343.	4471.
1983	510.	1529.	14271.	1142.	1651.	1214.	5685.
1984	510.	2039.	13761.	1101.	1611.	1096.	6781.
1985	510.	2548.	13252.	1060.	1570.	989.	7770.
1986	510.	3058.	12742.	1019.	1529.	892.	8663.
1987	510.	3568.	12232.	979.	1488.	804.	9467.
1988	510.	4077.	11723.	938.	1447.	724.	10191.
1989	510.	4587.	11213.	897.	1407.	652.	10842.
1990	510.	5097.	10703.	856.	1366.	586.	11428.
1991	510.	5606.	10194.	815.	1325.	526.	11954.
1992	510.	6116.	9684.	775.	1284.	472.	12427.
1993	510.	6626.	9174.	734.	1244.	423.	12850.
1994	510.	7135.	8665.	693.	1203.	379.	13229.
1995	510.	7645.	8155.	652.	1162.	339.	13568.
1996	510.	8155.	7645.	612.	1121.	303.	13872.
1997	510.	8665.	7135.	571.	1081.	270.	14142.
1998	510.	9174.	6626.	530.	1040.	241.	14383.
1999	510.	9684.	6116.	489.	999.	214.	14597.
2000	510.	10194.	5606.	449.	958.	190.	14787.
2001	510.	10703.	5097.	408.	917.	169.	14956.
2002	510.	11213.	4587.	367.	877.	149.	15106.
2003	510.	11723.	4077.	326.	836.	132.	15237.
2004	510.	12232.	3568.	285.	795.	116.	15353.

Table G-53. Return Requirements (x 1000), Janesville/Beloit, Blackhawk to Beloit Alternative, Utility Financing Option

	CAPITAL COST COMPONENTS				
	EQUITY RETURN				
YEAR	COMMON	PREFERRED	DEBT RETURN	INCOME TAX	REVENUE REQUIREMENTS
1978	228.2	36.7	150.6	-450.2	680.3
1979	731.6	117.9	483.9	-329.7	2310.6
1980	964.5	154.6	634.9	789.9	3714.7
1981	914.0	145.9	598.9	762.0	3539.6
1982	865.1	137.4	564.2	725.0	3370.0
1983	817.3	129.2	530.5	689.5	3204.9
1984	770.8	121.2	497.7	655.3	3043.8
1985	725.4	113.5	465.8	622.6	2887.2
1986	681.2	106.0	435.0	591.2	2734.8
1987	638.2	98.7	405.0	561.3	2586.7
1988	596.3	91.6	376.0	532.8	2442.9
1989	555.7	84.8	348.0	505.7	2303.5
1990	516.2	78.2	320.9	480.0	2168.3
1991	477.9	71.8	294.8	455.9	2037.4
1992	440.8	65.7	269.7	432.9	1910.8
1993	404.9	59.8	245.5	411.5	1788.5
1994	370.1	54.1	222.2	391.5	1670.4
1995	336.6	48.7	199.9	372.9	1556.7
1996	304.2	43.5	178.6	355.7	1447.3
1997	273.0	38.5	158.2	339.9	1342.2
1998	243.0	33.8	138.7	325.6	1241.2
1999	214.2	29.3	120.3	312.6	1144.8
2000	186.5	25.0	102.7	301.1	1052.6
2001	160.1	21.0	86.2	291.0	964.6
2002	134.8	17.2	70.5	282.3	880.9
2003	110.6	13.6	55.8	272.1	801.3
2004	87.5	10.2	41.9	263.1	725.4

Table G-53. Return Requirements (x 1000), Janesville/Beloit, Blackhawk to Beloit Alternative, Utility Financing (concluded)

ACCUMULATED	VALUE 12TH MONTH 1979	ACCUMULATED	YEAR
680.3	759.3	759.3	1978
2990.9	2310.6	3069.9	1979
6705.6	3328.0	6397.9	1980
10245.2	2841.0	9238.9	1981
13615.2	2423.3	11662.2	1982
16820.0	2064.6	13726.8	1983
19863.8	1756.7	15483.5	1984
22751.0	1492.9	16976.4	1985
25485.8	1266.9	18243.3	1986
28072.5	1073.5	19316.8	1987
30515.4	908.3	20225.1	1988
32818.9	767.3	20992.4	1989
34987.2	647.1	21639.5	1990
37024.5	544.7	22184.2	1991
38935.3	457.7	22641.9	1992
40723.8	383.8	23025.6	1993
42394.2	321.1	23346.8	1994
43951.0	268.1	23614.9	1995
45398.3	223.3	23838.2	1996
46740.4	185.5	24023.8	1997
47981.8	153.7	24177.5	1998
49126.6	127.0	24304.5	1999
50179.1	104.6	24409.2	2000
51143.7	85.9	24495.1	2001
52024.7	70.3	24565.4	2002
52826.0	57.3	24622.7	2003
53551.4	46.5	24669.1	2004

Table G-54. Fuel/O & M Data (x 1000), Janesville/Beloit, Blackhawk to Beloit Alternative, Utility Financing Option

COAL COST = 1.58/10-6 BTU
OIL COST = 2.67/10-6 BTU
COAL ESC RATE = 11.0%
OIL ESC RATE = 11.1%
DISCOUNT RATE = 11.62%

YEAR	COAL	OIL	TOTAL FUEL	O&M	TOTAL FUEL/O&M	PV	ACC PV
1980	1152.	24.	1176.	296.	1472.	1319.	1319.
1981	1078.	46.	1125.	294.	1419.	1139.	2457.
1982	1098.	59.	1156.	315.	1471.	1058.	3515.
1983	1341.	77.	1418.	343.	1761.	1135.	4650.
1984	1392.	108.	1501.	377.	1878.	1084.	5734.
1985	1362.	166.	1528.	392.	1920.	993.	6726.
1986	1361.	324.	1685.	431.	2116.	980.	7707.
1987	1799.	260.	2059.	462.	2521.	1046.	8753.
1988	2025.	331.	2355.	493.	2848.	1059.	9812.
1989	2086.	367.	2453.	519.	2972.	990.	10802.
1990	2465.	127.	2592.	542.	3134.	935.	11737.
1991	2736.	142.	2878.	579.	3457.	924.	12662.
1992	3037.	157.	3194.	621.	3815.	914.	13576.
1993	3371.	175.	3546.	665.	4211.	904.	14479.
1994	3742.	194.	3936.	710.	4646.	893.	15372.
1995	4154.	216.	4369.	760.	5129.	883.	16256.
1996	4611.	240.	4850.	814.	5664.	874.	17130.
1997	5118.	266.	5384.	872.	6256.	865.	17995.
1998	5681.	296.	5977.	932.	6909.	856.	18851.
1999	6306.	329.	6634.	996.	7630.	847.	19697.
2000	6999.	365.	7364.	1066.	8430.	838.	20535.
2001	7769.	406.	8175.	1141.	9316.	830.	21365.
2002	8624.	451.	9074.	1222.	10296.	822.	22186.
2003	9572.	501.	10073.	1307.	11380.	813.	23000.
2004	10625.	556.	11182.	1399.	12581.	806.	23806.

Table G-55. Fuel/O & M Data (x 1000), Janesville/Beloit, Blackhawk to Beloit Alternative, Municipal Financing Option

COAL COST = 1.58/10-6 BTU
OIL COST = 2.67/10-6 BTU
COAL ESC RATE = 11.0%
OIL ESC RATE = 11.1%
DISCOUNT RATE = 8.00%

YEAR	COAL	OIL	TOTAL FUEL	O&M	TOTAL FUEL/O&M	PV	ACC PV
1980	1152.	24.	1176.	296.	1472.	1363.	1363.
1981	1078.	46.	1125.	294.	1419.	1216.	2579.
1982	1098.	59.	1156.	315.	1471.	1168.	3747.
1983	1341.	77.	1418.	343.	1761.	1294.	5042.
1984	1392.	108.	1501.	377.	1878.	1278.	6320.
1985	1362.	166.	1528.	392.	1920.	1210.	7530.
1986	1361.	324.	1685.	431.	2116.	1235.	8764.
1987	1799.	260.	2059.	462.	2521.	1362.	10126.
1988	2025.	331.	2355.	493.	2848.	1425.	11551.
1989	2086.	367.	2453.	519.	2972.	1377.	12928.
1990	2465.	127.	2592.	542.	3134.	1344.	14272.
1991	2736.	142.	2878.	579.	3457.	1373.	15645.
1992	3037.	157.	3194.	621.	3815.	1403.	17048.
1993	3371.	175.	3546.	665.	4211.	1434.	18482.
1994	3742.	194.	3936.	710.	4646.	1465.	19946.
1995	4154.	216.	4369.	760.	5129.	1497.	21444.
1996	4611.	240.	4850.	814.	5664.	1531.	22974.
1997	5118.	266.	5384.	872.	6256.	1566.	24540.
1998	5681.	296.	5977.	932.	6909.	1601.	26141.
1999	6306.	329.	6634.	996.	7630.	1637.	27778.
2000	6999.	365.	7364.	1066.	8430.	1675.	29453.
2001	7769.	406.	8175.	1141.	9316.	1714.	31166.
2002	8624.	451.	9074.	1222.	10296.	1754.	32920.
2003	9572.	501.	10073.	1307.	11380.	1795.	34714.
2004	10625.	556.	11182.	1399.	12581.	1837.	36551.

Table G-56. Gross Income Data (x 1000), Janesville/Beloit, Blackhawk to Beloit Alternative, Utility Financing Option

DISCOUNT RATE = 11.62%
FUEL QUANTITY = 670.41/10-9 BTU/YR
FUEL COST = 2.50/10-6 BTU
ESCALATION RATE = 14.0%

YEAR	INCOME	PV	ACC PV	YEAR	INCOME	PV	ACC PV
1980	1911.	1712.	1712.	1980	1681.	1506.	1506.
1981	2178.	1748.	3460.	1981	1917.	1538.	3045.
1982	2483.	1786.	5246.	1982	2185.	1571.	4616.
1983	2831.	1824.	7069.	1983	2491.	1605.	6221.
1984	3227.	1862.	8932.	1984	2840.	1639.	7860.
1985	3679.	1902.	10834.	1985	3237.	1674.	9534.
1986	4194.	1943.	12777.	1986	3691.	1710.	11243.
1987	4781.	1984.	14761.	1987	4207.	1746.	12990.
1988	5450.	2026.	16787.	1988	4796.	1783.	14773.
1989	6213.	2070.	18857.	1989	5468.	1821.	16594.
1990	7083.	2114.	20971.	1990	6233.	1860.	18454.
1991	8075.	2159.	23130.	1991	7106.	1900.	20354.
1992	9205.	2205.	25335.	1992	8101.	1940.	22295.
1993	10494.	2252.	27587.	1993	9235.	1982.	24276.
1994	11963.	2300.	29887.	1994	10528.	2024.	26300.
1995	13638.	2349.	32236.	1995	12002.	2067.	28367.
1996	15548.	2399.	34635.	1996	13682.	2111.	30479.
1997	17724.	2450.	37085.	1997	15597.	2156.	32635.
1998	20206.	2503.	39588.	1998	17781.	2202.	34837.
1999	23034.	2556.	42143.	1999	20270.	2249.	37086.
2000	26259.	2610.	44754.	2000	23108.	2297.	39383.
2001	29936.	2666.	47420.	2001	26343.	2346.	41729.
2002	34127.	2723.	50143.	2002	30031.	2396.	44126.
2003	38904.	2781.	52924.	2003	34236.	2447.	46573.
2004	44351.	2840.	55764.	2004	39029.	2499.	49072.

Table G-57. Gross Income Data (x 1000), Janesville/Beloit, Blackhawk to Beloit, Municipal Financing Option

DISCOUNT RATE = 8.00%
FUEL QUANTITY = 670.41/10-9 BTU/YR
FUEL COST = 2.50/10-6 BTU
ESCALATION RATE = 14.0%

YEAR	INCOME	PV	ACC PV	YEAR	INCOME	PV	ACC PV
1980	1911.	1769.	1769.	1980	1681.	1557.	1557.
1981	2178.	1867.	3637.	1981	1917.	1643.	3200.
1982	2483.	1971.	5608.	1982	2185.	1735.	4935.
1983	2831.	2081.	7688.	1983	2491.	1831.	6766.
1984	3227.	2196.	9885.	1984	2840.	1933.	8699.
1985	3679.	2318.	12203.	1985	3237.	2040.	10739.
1986	4194.	2447.	14650.	1986	3691.	2153.	12892.
1987	4781.	2583.	17233.	1987	4207.	2273.	15165.
1988	5450.	2727.	19960.	1988	4796.	2399.	17564.
1989	6213.	2878.	22838.	1989	5468.	2533.	20097.
1990	7083.	3038.	25876.	1990	6233.	2673.	22770.
1991	8075.	3207.	29082.	1991	7106.	2822.	25592.
1992	9205.	3385.	32467.	1992	8101.	2979.	28571.
1993	10494.	3573.	36040.	1993	9235.	3144.	31715.
1994	11963.	3771.	39811.	1994	10528.	3319.	35034.
1995	13638.	3981.	43792.	1995	12002.	3503.	38537.
1996	15548.	4202.	47994.	1996	13682.	3698.	42235.
1997	17724.	4435.	52430.	1997	15597.	3903.	46138.
1998	20206.	4682.	57111.	1998	17781.	4120.	50258.
1999	23034.	4942.	62053.	1999	20270.	4349.	54607.
2000	26259.	5217.	67270.	2000	23108.	4591.	59198.
2001	29936.	5506.	72776.	2001	26343.	4846.	64043.
2002	34127.	5812.	78589.	2002	30031.	5115.	69158.
2003	38904.	6135.	84724.	2003	34236.	5399.	74557.
2004	44351.	6476.	91200.	2004	39029.	5699.	80256.

Table G-58. Annual Savings (x 1000), Janesville/Beloit, Blackhawk to Beloit Alternative, Utility Financing Option

GROSS INCOME	UTILITY RET. REQ.	FUEL/O & M	TOTAL RETURN	ANNUAL SAVINGS	REAL FUEL ESCALATION RATES
31223 AT 9% 39006 AT 11% 49351 AT 13% 63190 AT 15% 81795 AT 17%	22920	17290	40210	-8987 -1205 9141 22980 41585	C - 0 O - 3
31223 AT 9% 39005 AT 11% 49351 AT 13% 63190 AT 15% 81795 AT 17%		18661	41581	-10358 -2576 7770 21609 40214	C - 0 O - 10
31223 AT 9% 39005 AT 11% 49351 AT 13% 63190 AT 15% 81795 AT 17%		31469	54389	-23166 -15384 -5038 8801 27406	C - 7 O - 3
31223 AT 9% 39005 AT 11% 49351 AT 13% 63190 AT 15% 81795 AT 17%		32839	55759	-24536 -16754 -6408 7431 26036	C - 7 O - 10
55764 49072 43280		23806	46726	9038 2346 -4346	C - 4 O - 4.1 NG - 7

Table G-59. Annual Savings (x 1000), Janesville/Beloit, Blackhawk to Beloit Alternative, Municipal Financing Option

GROSS INCOME	MUNICIPAL REV. REQ.	FUEL/O & M	ANNUAL SAVINGS	REAL FUEL ESCALATION RATE
47339 AT 9% 61003 AT 11% 79546 AT 13% 104818 AT 15% 139379 AT 17%	15353	25233	6753 20417 38960 64232 98793	C - 0 O - 3
47339 AT 9% 61003 AT 11% 79546 AT 13% 104818 AT 15% 139379 AT 17%		27609	4377 18041 36584 61856 96417	C - 0 O - 10
47339 AT 9% 61003 AT 11% 79546 AT 13% 104818 AT 15% 139379 AT 17%		50381	-18395 -4731 13812 39084 73645	C - 7 O - 3
47339 AT 9% 61003 AT 11% 79546 AT 13% 104818 AT 15% 139379 AT 17%		52757	-20771 -4731 11436 36708 71269	C - 7 O - 10
102144 91200 82056		36551	50240 39296 28352	C - 4 O - 4 NG - 7

JANESVILLE/BELOIT, ROCK RIVER TO JANESVILLE AND BELOIT

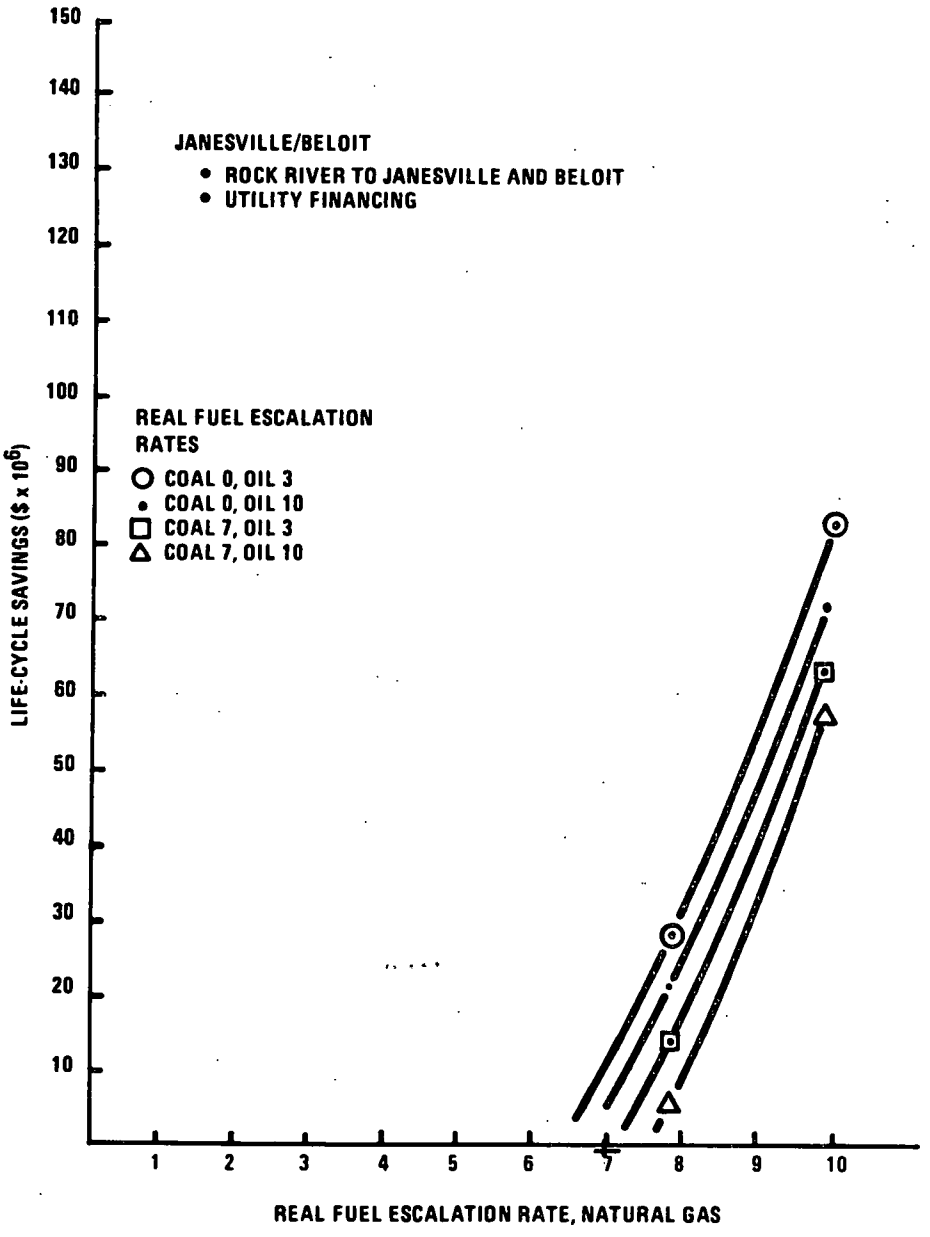

Figure G-22. Life-Cycle Savings versus Real Fuel Escalation Rates, Natural Gas

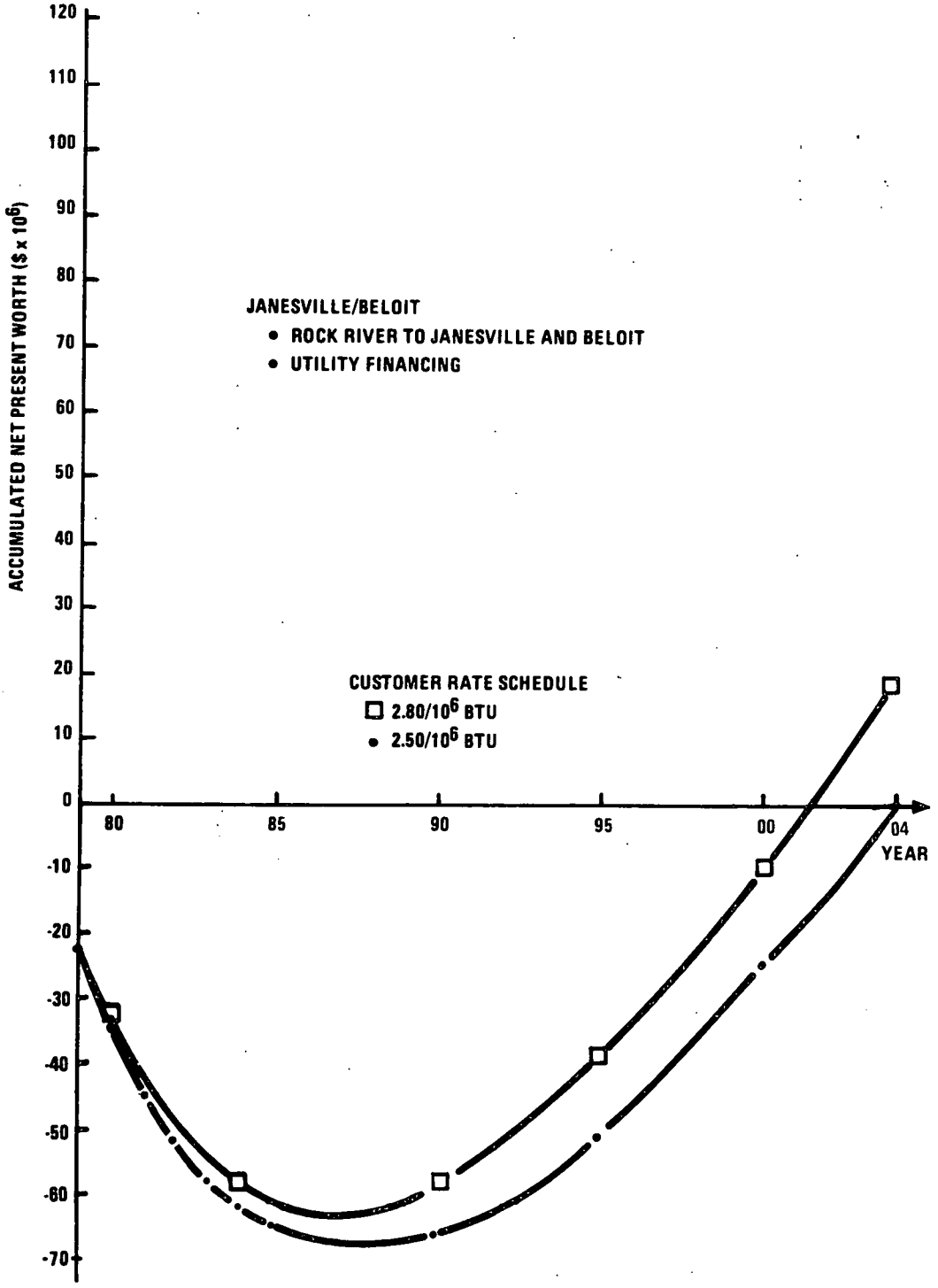

Figure G-23. Accumulated Net Present Worth versus Year

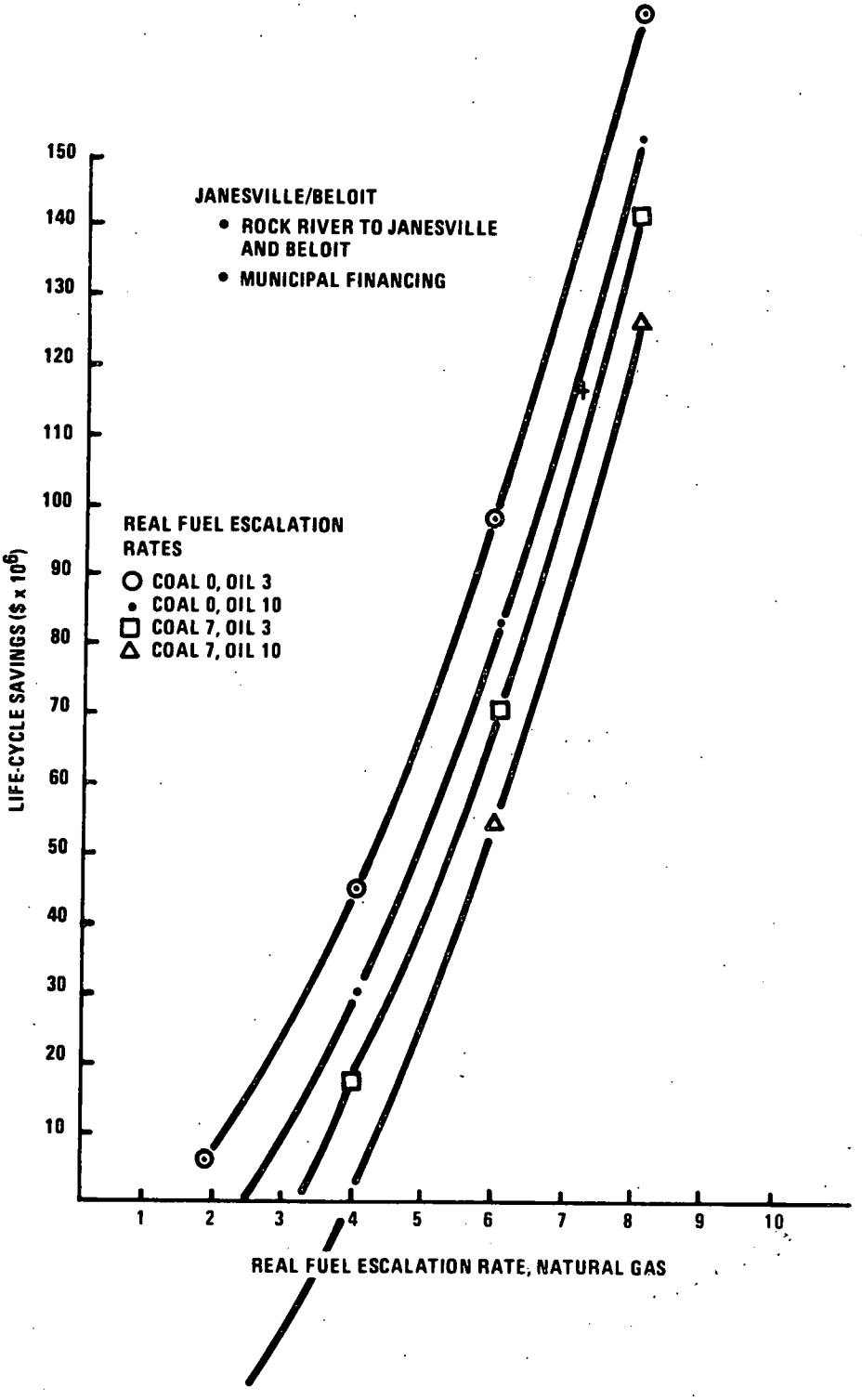

Figure G-24. Life-Cycle Savings versus Real Fuel Escalation Rate, Natural Gas

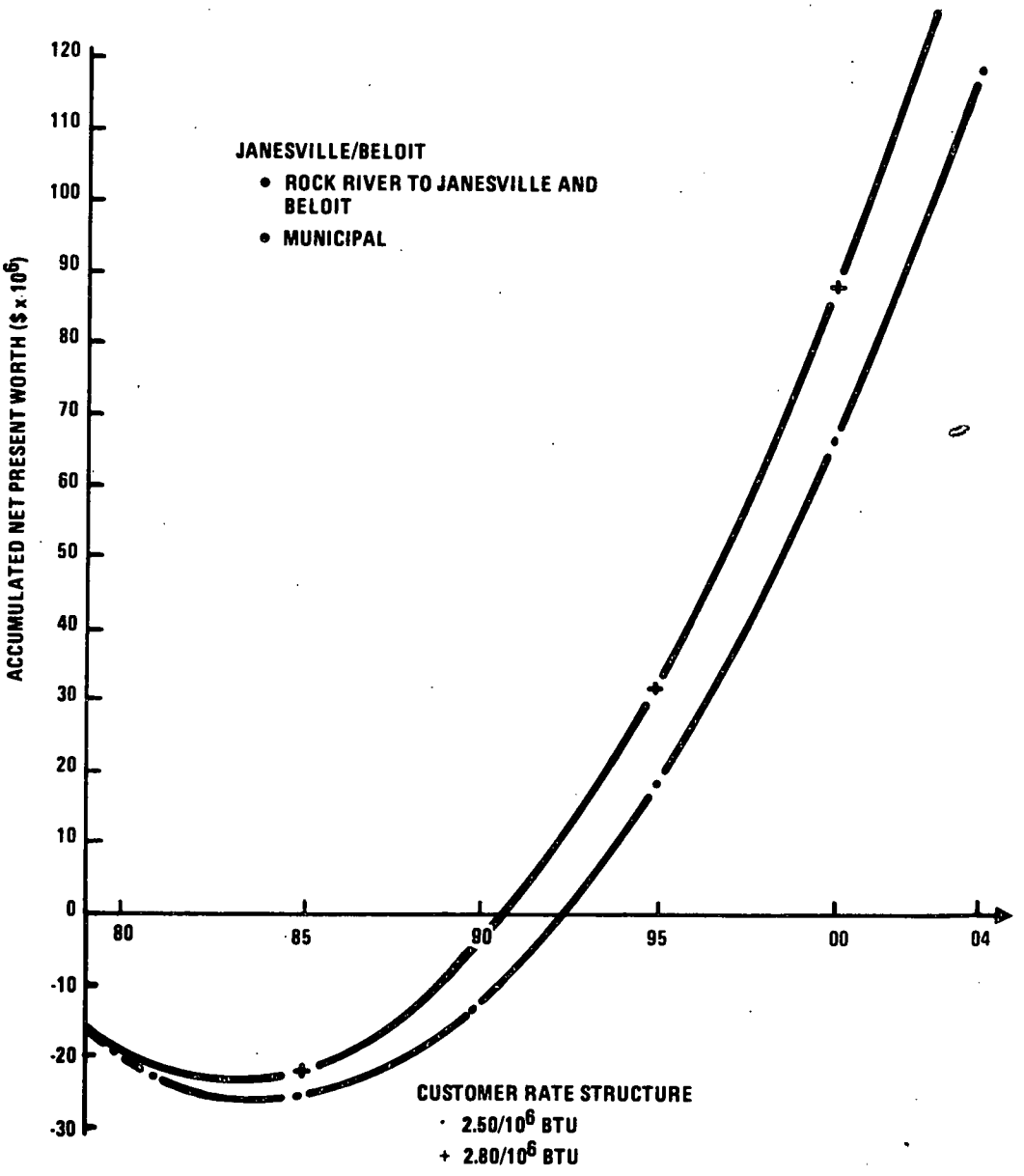

Figure G-25. Accumulated Net Present Worth versus Year

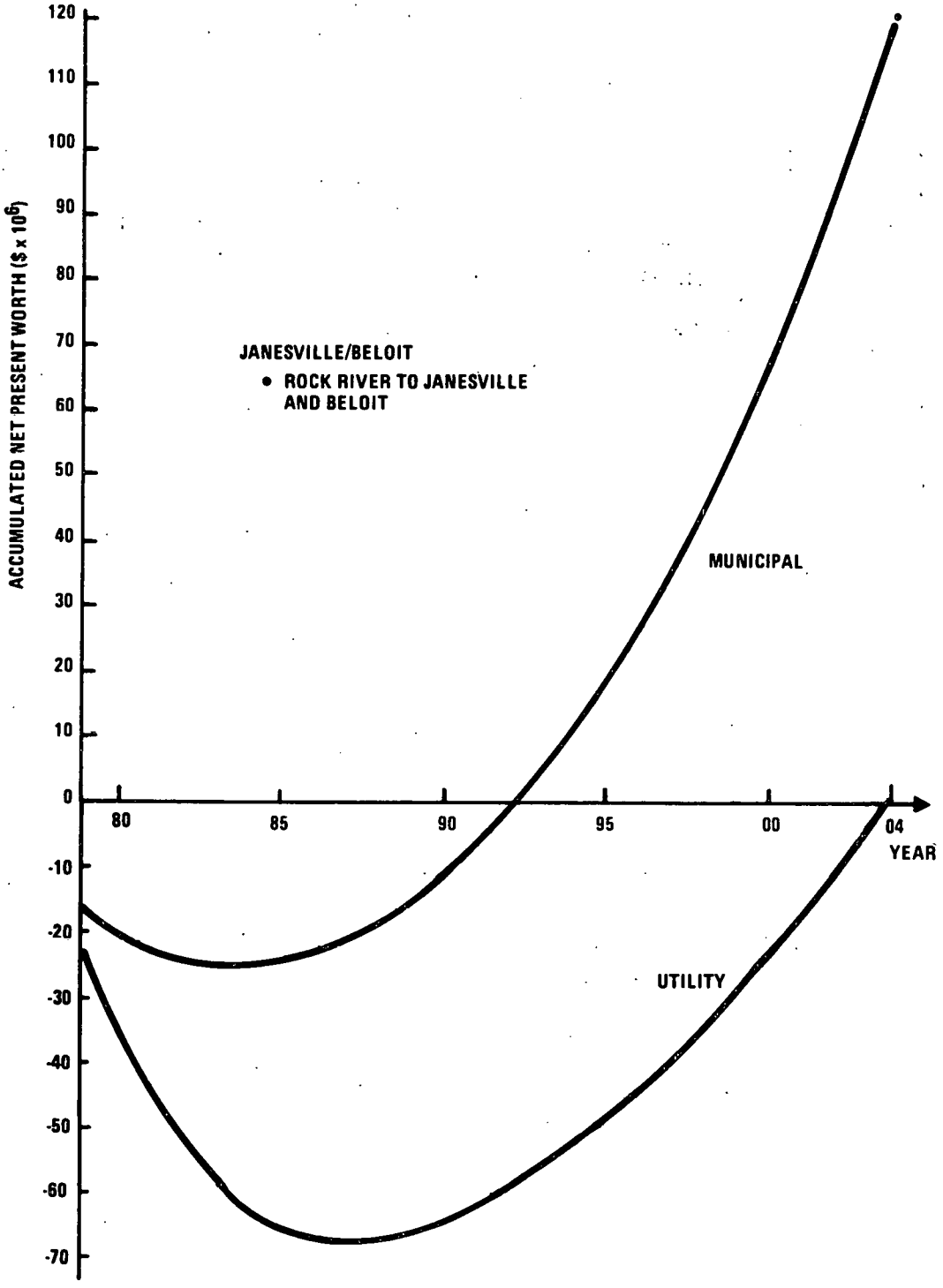

Figure G-26. Accumulated Net Present Worth versus Year

Table G-60. Operations and Maintenance Data (x 1000), Janesville/Beloit, Rock River to Janesville and Beloit Alternative

Year	Maintenance 1% of Cost (1% of 67,200)	Insurance .2% of Costs (.2% of 67,200)	Operation 3.954×10^6 kWh/yr at .03 kWh	Total O&M for Distribution	Plant O&M Costs	Total O&M
1980	672	134	119	925	193	1118
1981	719	143	127	989	186	1175
1982	769	153	136	1058	213	1271
1983	823	164	146	1133	314	1447
1984	881	176	156	1213	385	1598
1985	943	188	167	1298	396	1694
1986	1008	201	179	1388	426	1814
1987	1079	215	191	1485	434	1919
1988	1155	230	204	1589	460	2049
1989	1235	246	219	1700	501	2201
1990	1322	264	234	1820	526	2346
1991	1414	282	250	1946	564	2510
1992	1513	302	268	2083	603	2686
1993	1619	323	287	2229	645	2874
1994	1733	346	307	2386	690	3076
1995	1854	370	328	2552	738	3290
1996	1984	396	351	2731	790	3521
1997	2123	423	376	2922	845	3767
1998	2271	453	402	3126	905	4031
1999	2430	485	430	3345	967	4312
2000	2600	519	460	3579	1035	4614
2001	2782	555	492	3829	1107	4936
2002	2977	594	527	4098	1185	5283
2003	3186	635	564	4385	1268	5653
2004	3409	680	603	4692	1357	6049

Table G-61. Return Requirements (x 1000), Janesville/Beloit, Rock River to Janesville/Beloit Alternative, Utility Financing Option

	CAPITAL COST COMPONENTS				
	EQUITY RETURN				
YEAR	COMMON	PREFERRED	DEBT RETURN	INCOME TAX	REVENUE REQUIREMENTS
1977	714.8	114.9	471.7	-1410.3	2131.1
1978	2144.4	344.7	1415.2	249.1	6953.4
1979	3650.4	588.0	2414.0	380.5	11786.1
1980	4256.4	682.5	2802.0	3526.2	16406.6
1981	4035.2	644.2	2644.7	3401.1	15639.2
1982	3820.7	607.2	2492.6	3256.6	14895.7
1983	3611.1	571.1	2344.6	3078.2	14170.6
1984	3406.6	536.1	2200.6	2925.9	13463.8
1985	3207.1	502.0	2060.8	2779.6	12775.5
1986	3012.7	468.9	1925.0	2639.4	12105.5
1987	2823.4	436.8	1793.3	2505.2	11453.9
1988	2639.1	405.7	1665.7	2377.1	10820.6
1989	2459.9	375.7	1542.1	2255.0	10205.8
1990	2285.7	346.6	1422.7	2139.0	9609.3
1991	2116.6	318.5	1307.3	2029.1	9031.2
1992	1952.6	291.3	1196.0	1925.2	8471.4
1993	1793.6	265.2	1088.8	1827.3	7930.1
1994	1639.7	240.1	985.7	1735.5	7407.1
1995	1490.8	216.0	886.7	1649.8	6902.5
1996	1347.0	192.9	791.7	1570.1	6416.2
1997	1208.3	170.7	700.9	1496.5	5948.3
1998	1074.6	149.6	614.1	1428.9	5498.9
1999	946.0	129.4	531.4	1367.4	5067.7
2000	822.4	110.3	452.8	1312.0	4655.0
2001	703.9	92.1	378.3	1262.6	4260.6
2002	590.5	75.0	307.8	1219.2	3884.7
2003	482.0	58.8	241.3	1177.1	3526.6
2004	378.2	43.5	178.7	1140.6	3185.9

Table G-61. Return Requirements (x 1000), Janesville/Beloit, Rock River to Janesville/Beloit Alternative, Utility Financing Option (concluded)

ACCUMULATED	VALUE 12TH MONTH 1979	ACCUMULATED	YEAR
2131.1	2655.2	2655.2	1977
9084.5	7761.4	10416.6	1978
20870.6	11786.1	22202.6	1979
37277.2	14698.6	36901.2	1980
52916.3	12552.5	49453.7	1981
67812.0	10711.1	60164.8	1982
81982.5	9128.9	69293.7	1983
95446.4	7770.7	77064.4	1984
108221.8	6605.8	83670.2	1985
120327.3	5607.7	89277.9	1986
131781.1	4753.5	94031.4	1987
142601.8	4023.2	98054.6	1988
152807.5	3399.6	101454.2	1989
162416.8	2867.7	104321.9	1990
171447.9	2414.6	106736.4	1991
179919.3	2029.1	108765.6	1992
187849.4	1701.7	110467.3	1993
195256.5	1424.0	111891.3	1994
202158.9	1188.9	113080.2	1995
208575.1	990.1	114070.2	1996
214523.5	822.3	114892.5	1997
220022.3	681.0	115573.6	1998
225090.1	562.3	116135.9	1999
229745.1	462.7	116598.6	2000
234005.7	379.4	116978.1	2001
237890.4	309.9	117288.0	2002
241417.0	252.1	117540.1	2003
244603.0	204.0	117744.1	2004

Table G-62. Return Requirements (x 1000), Janesville/Beloit, Rock River to Janesville/Beloit Alternative, Municipal Financing Option

YEAR	BOOK DEP.	NET BOOK DEPRECIATION	NET INV.	RETURN REQUIREMENT	TOTAL RETURN	PV	ACC. PV
1977	723	0	22400	1792	2515	2934	2934
1978	1446	2169	42631	3410	4856	5244	8178
1980	2249	4418	65282	5223	7472	7472	15650
1981	2249	6667	63033	5043	7292	6752	22902
1982	2249	11165	58535	4683	6932	5503	34002
1983	2249	13414	56286	4503	6752	4473	43438
1984	2249	15663	54037	4323	6572	4473	43438
1985	2249	17912	51788	4143	6392	4028	47466
1985	2249	20161	49539	3963	6212	3625	51091
1986	2249	20161	49539	3963	6212	3625	51091
1987	2249	22410	47290	3783	6032	3259	54350
1988	2249	24659	45041	3603	5852	2927	57277
1989	2249	26908	42792	3423	5672	2627	59904
1990	2249	29157	40543	3243	5492	2355	62259
1991	2249	31406	38294	3063	5312	2109	64968
1992	2249	33655	35045	2883	5132	1887	66255
1993	2249	35904	33796	2703	4952	1686	67941
1994	2249	38153	31547	2523	4772	1405	59445
1995	2249	40402	29298	2343	4592	1340	70785
1996	2249	42651	27049	2163	4412	1192	71977
1997	2249	44900	24800	1983	4232	1059	73036
1998	2249	47149	22551	1803	4052	939	73975
1999	2249	49398	20302	1623	3872	831	74806
2000	2249	51647	18053	1443	3692	733	75539
2001	2249	53896	15804	1263	3512	646	76752
2003	2249	58394	11306	903	3152	497	77249
2004	2249	50543	9057	723	2972	434	77683

Table G-63. Fuel/O & M Data (x 1000), Janesville/Beloit, Rock River to Janesville and Beloit Alternative, Utility Financing Option

COAL COST = 1.58/10-6 BTU
OIL COST = 2.67/10-6 BTU
COAL ESC RATE = 11.0%
OIL ESC RATE = 11.1%
DISCOUNT RATE = 11.62%

YEAR	COAL	OIL	TOTAL FUEL	O&M	TOTAL FUEL/O&M	PV	ACC PV
1980	1568.	53.	1621.	1118.	2739.	2454.	2454.
1981	1213.	122.	1335.	1175.	2510.	2014.	4469.
1982	1333.	143.	1476.	1271.	2747.	1975.	6444.
1983	1367.	171.	1538.	1447.	2985.	1923.	8367.
1984	1467.	221.	1688.	1598.	3286.	1897.	10264.
1985	1416.	346.	1762.	1694.	3456.	1787.	12051.
1986	1417.	586.	2003.	1814.	3817.	1768.	13819.
1987	1955.	638.	2594.	1919.	4513.	1873.	15692.
1988	2162.	923.	3085.	2049.	5134.	1909.	17600.
1989	2852.	1033.	3885.	2201.	5486.	1827.	19428.
1990	2709.	952.	3661.	2346.	6007.	1793.	21220.
1991	3007.	1058.	4065.	2510.	6575.	1758.	22978.
1992	3338.	1175.	4513.	2686.	7199.	1724.	24702.
1993	3705.	1305.	5010.	2874.	7884.	1692.	26394.
1994	4112.	1450.	5563.	3076.	8639.	1661.	28055.
1995	4565.	1611.	6176.	3290.	9466.	1630.	29686.
1996	5067.	1790.	6857.	3521.	10378.	1601.	31287.
1997	5624.	1989.	7613.	3767.	11380.	1573.	32860.
1998	6243.	2210.	8453.	4031.	12484.	1546.	34406.
1999	6930.	2455.	9384.	4312.	13696.	1520.	35926.
2000	7692.	2727.	10419.	4614.	15033.	1494.	37420.
2001	8538.	3030.	11568.	4936.	16504.	1470.	38890.
2002	9477.	3366.	12844.	5283.	18127.	1446.	40336.
2003	10520.	3740.	14260.	5653.	19913.	1423.	41760.
2004	11677.	4155.	15832.	6049.	21881.	1401.	43161.
			146604.	75934.			

Table G-64. Fuel/O & M Data (x 1000), Janesville/Beloit, Rock River to Janesville/Beloit Alternative, Municipal Financing Option

COAL COST = 1.58/10-6 BTU
OIL COST = 2.67/10-6 BTU
COAL ESC RATE = 11.0%
OIL ESC RATE = 11.1%
DISCOUNT RATE = 8.00%

YEAR	COAL	OIL	TOTAL FUEL	O&M	TOTAL FUEL/O&M	PV	ACC PV
1980	1568.	53.	1621.	1118.	2739.	2536.	2536.
1981	1213.	122.	1335.	1175.	2510.	2152.	4688.
1982	1333.	143.	1476.	1271.	2747.	2181.	6869.
1983	1367.	171.	1538.	1447.	2985.	2194.	9063.
1984	1467.	221.	1688.	1598.	3286.	2237.	11300.
1985	1416.	346.	1762.	1694.	3456.	2178.	13477.
1986	1417.	586.	2003.	1814.	3817.	2227.	15705.
1987	1955.	638.	2594.	1919.	4513.	2438.	18143.
1988	2162.	923.	3085.	2049.	5134.	2568.	20711.
1989	2252.	1033.	3285.	2201.	5486.	2541.	23252.
1990	2709.	952.	3661.	2346.	6007.	2576.	25828.
1991	3007.	1058.	4065.	2510.	6575.	2611.	28439.
1992	3338.	1175.	4513.	2686.	7199.	2647.	31086.
1993	3705.	1305.	5010.	2874.	7884.	2684.	33770.
1994	4112.	1450.	5563.	3076.	8639.	2723.	36493.
1995	4565.	1611.	6176.	3290.	9466.	2763.	39256.
1996	5067.	1790.	6857.	3521.	10378.	2805.	42061.
1997	5624.	1989.	7613.	3767.	11380.	2848.	44909.
1998	6243.	2210.	8453.	4031.	12484.	2893.	47802.
1999	6930.	2455.	9384.	4312.	13696.	2939.	50740.
2000	7692.	2727.	10419.	4614.	15033.	2986.	53727.
2001	8538.	3030.	11568.	4936.	16504.	3036.	56763.
2002	9477.	3366.	12844.	5283.	18127.	3087.	59850.
2003	10520.	3740.	14260.	5653.	19913.	3140.	62990.
2004	11677.	4155.	15832.	6049.	21881.	3195.	66185.
			146604.	75084.			

Table G-65 Gross Income Data (x 1000), Janesville/Beloit, Rock River to Janesville/Beloit Alternative, Utility Financing Option

DISCOUNT RATE =	11.62%	DISCOUNT RATE =	11.62%
FUEL QUANTITY =	1928.61/10-9 BTU/YR	FUEL QUANTITY =	1928.61/10-9 BTU/YR
FUEL COST =	2.80/10-6 BTU	FUEL COST =	2.50/10-6 BTU
ESCALATION RATE =	14.0%	ESCALATION RATE =	14.0%

YEAR	INCOME	PV	ACC PV	YEAR	INCOME	PV	ACC PV
1980	6156.	5515.	5515.	1980	5497.	4924.	4924.
1981	7018.	5633.	11148.	1981	6266.	5029.	9954.
1982	8000.	5753.	16901.	1982	7143.	5137.	15090.
1983	9121.	5876.	22777.	1983	8143.	5246.	20336.
1984	10397.	6001.	28778.	1984	9283.	5358.	25694.
1985	11853.	6129.	34906.	1985	10583.	5472.	31166.
1986	13513.	6260.	41166.	1986	12065.	5589.	36755.
1987	15404.	6393.	47559.	1987	13754.	5708.	42463.
1988	17561.	6529.	54088.	1988	15679.	5830.	48293.
1989	20019.	6669.	60757.	1989	17874.	5954.	54247.
1990	22822.	6811.	67568.	1990	20377.	6081.	60328.
1991	26017.	6956.	74524.	1991	23230.	6211.	66539.
1992	29660.	7104.	81628.	1992	26482.	6343.	72882.
1993	33812.	7256.	88884.	1993	30189.	6478.	79360.
1994	38546.	7410.	96294.	1994	34416.	6616.	85977.
1995	43942.	7568.	103862.	1995	39234.	6758.	92734.
1996	50094.	7730.	111592.	1996	44727.	6902.	99636.
1997	57107.	7895.	119487.	1997	50988.	7049.	106685.
1998	65102.	8063.	127550.	1998	58127.	7199.	113884.
1999	74216.	8235.	135785.	1999	66265.	7353.	121236.
2000	84607.	8411.	144195.	2000	75542.	7509.	128746.
2001	96452.	8590.	152785.	2001	86117.	7669.	136415.
2002	109955.	8773.	161558.	2002	98174.	7833.	144248.
2003	125348.	8960.	170518.	2003	111918.	8000.	152248.
2004	142897.	9151.	179669.	2004	127587.	8171.	160419.

Table G-66. Gross Income Data (x 1000), Janesville/Beloit, Rock River to Janesville/Beloit Alternative, Municipal Financing Option

DISCOUNT RATE = 8.00%
FUEL QUANTITY = 1928.61/10-9 BTU/YR
FUEL COST = 2.50/10-6 BTU
ESCALATION RATE = 14.0%

YEAR	INCOME	PV	ACC PV
1980	5497.	5089.	5089.
1981	6266.	5372.	10462.
1982	7143.	5671.	16132.
1983	8143.	5986.	22118.
1984	9283.	6318.	28436.
1985	10583.	6669.	35105.
1986	12065.	7040.	42145.
1987	13754.	7431.	49575.
1988	15679.	7844.	57419.
1989	17874.	8279.	65698.
1990	20377.	8739.	74438.
1991	23230.	9225.	83662.
1992	26482.	9737.	93400.
1993	30189.	10278.	103678.
1994	34416.	10849.	114527.
1995	39234.	11452.	125979.
1996	44727.	12088.	138068.
1997	50988.	12760.	150827.
1998	58127.	13469.	164296.
1999	66265.	14217.	178513.
2000	75542.	15007.	193520.
2001	86117.	15840.	209360.
2002	98174.	16721.	226081.
2003	111918.	17649.	243730.
2004	127567.	18630.	262360.

DISCOUNT RATE = 8.00%
FUEL QUANTITY = 1928.61/10-9 BTU/YR
FUEL COST = 2.80/10-6 BTU
ESCALATION RATE = 14.0%

YEAR	INCOME	PV	ACC PV
1980	6156.	5700.	5700.
1981	7018.	6017.	11717.
1982	8000.	6351.	18068.
1983	9121.	6704.	24772.
1984	10397.	7076.	31848.
1985	11853.	7469.	39318.
1986	13513.	7884.	47202.
1987	15404.	8322.	55525.
1988	17561.	8785.	64309.
1989	20019.	9273.	73582.
1990	22822.	9788.	83370.
1991	26017.	10332.	93702.
1992	29660.	10906.	104608.
1993	33812.	11512.	116119.
1994	38548.	12151.	128271.
1995	43942.	12826.	141097.
1996	50094.	13539.	154636.
1997	57107.	14291.	168927.
1998	65102.	15085.	184012.
1999	74216.	15923.	199935.
2000	84607.	16808.	216742.
2001	96452.	17741.	234484.
2002	109955.	18727.	253210.
2003	125348.	19767.	272978.
2004	142897.	20866.	293843.

Table G-67. Annual Savings (x 1000), Janesville/Beloit, Park River to Janesville/Beloit Alternative, Municipal Financing Option

GROSS INCOME	MUNICIPAL REV. REG.	FUEL/O & M	ANNUAL SAVINGS	REAL FUEL ESCALATION RATES
136182 AT 9% 175492 AT 11% 228834 AT 13% 301536 AT 15% 400960 AT 17%	77683	52615	5884 45194 98536 171238 270662	C - 0 O - 3
136182 AT 9% 175492 AT 11% 228834 AT 13% 301536 AT 15% 400960 AT 17%		67729	-9230 30080 83422 56124 255548	C - 0 O - 10
136182 AT 9% 175492 AT 11% 228834 AT 13% 301536 AT 15% 400960 AT 17%		80185	-21686 17624 70966 143668 243092	C - 7 O - 3
136182 AT 9% 175492 AT 11% 228834 AT 13% 301536 AT 15% 400960 AT 17%		95300	-36801 2509 55851 128553 227977	C - 7 O - 10
293843 262360		66185	149975 118492	C - 4 O - 7 NG - 7

Table G-68. Annual Savings (x 1000), Janesville/Beloit, Rock River to Janesville/Beloit Alternative, Utility Financing Option

GROSS INCOME	UTILITY REV. REQ.	FUEL/O & M	ANNUAL SAVINGS	REAL FUEL ESCALATION RATES
89820	117744	35385	-63309	C - 0
112209	↓	↓	-40920	O - 3
141972			-11157	
181783			28654	
235306			82177	
89820		43591	-71515	C - 0
112209		↓	-49126	O - 10
141972			-19363	
181783			20448	
235306			73971	
89820		50918	-78842	C - 7
112209		↓	-56453	O - 3
141972			-26690	
181783			13121	
235306			66644	
89820		59124	-87048	C - 7
112209		↓	-64659	O - 10
141972			-34896	
181783			4915	
235306			58438	
179669	↓	43161	18764	C - 4
160419		↓	-486	O - 4.1
141169			-19736	NG - 7

MADISON, CBD AND CAPITOL HEATING COMPLEX

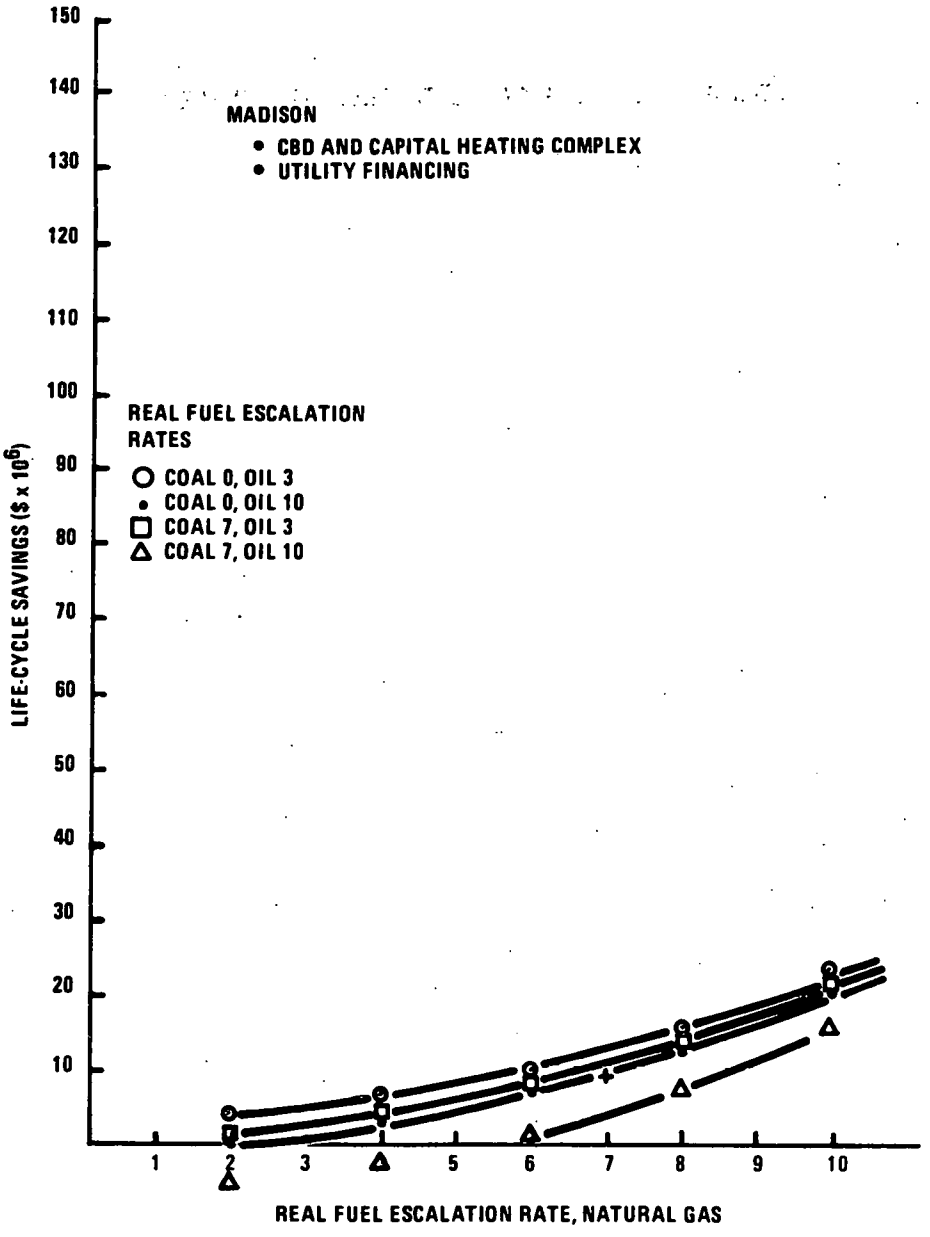

Figure G-27. Life-Cycle Savings versus Real Fuel Escalation Rate, Natural Gas

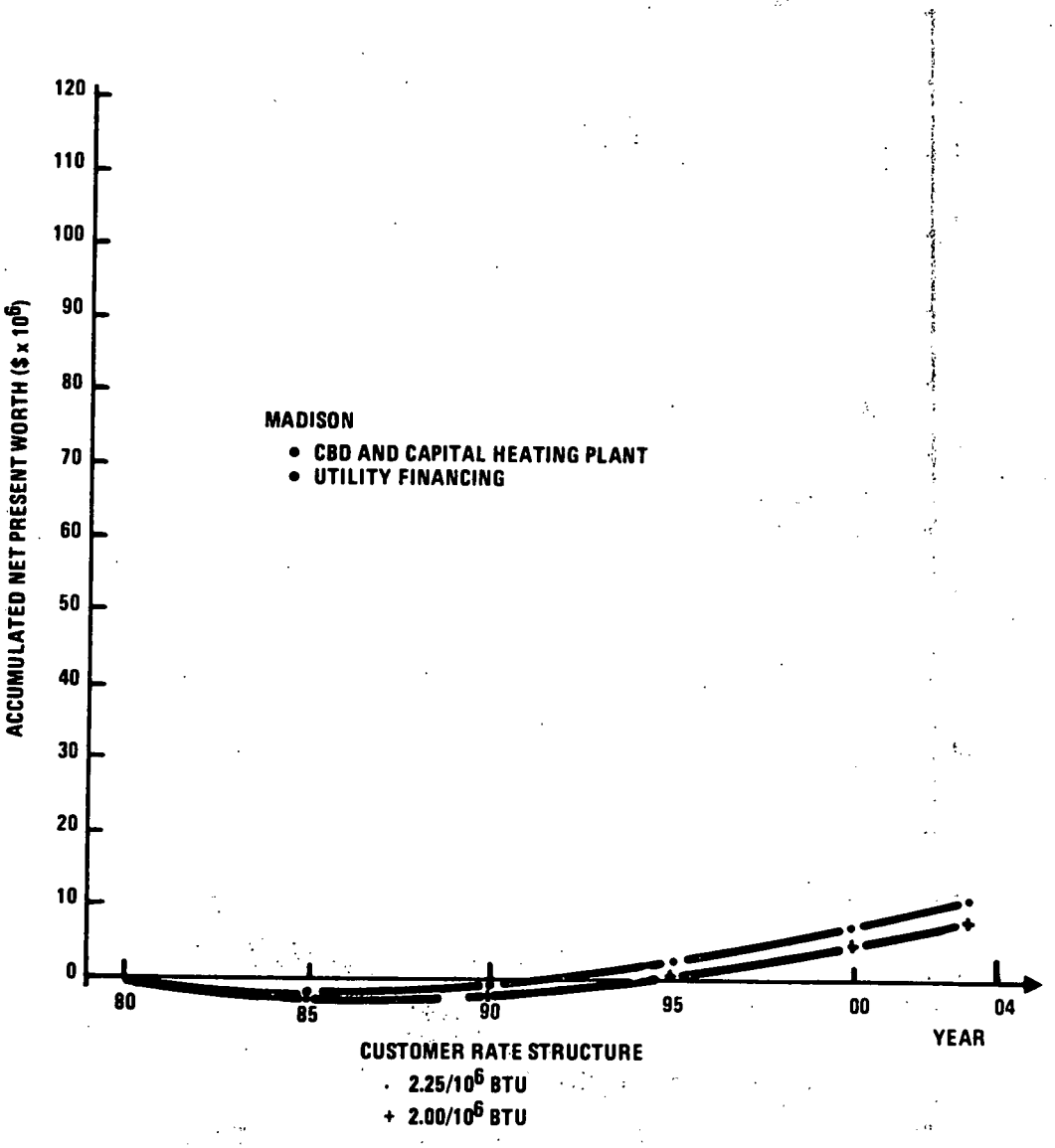

Figure G-28. Accumulated Net Present Worth versus Year

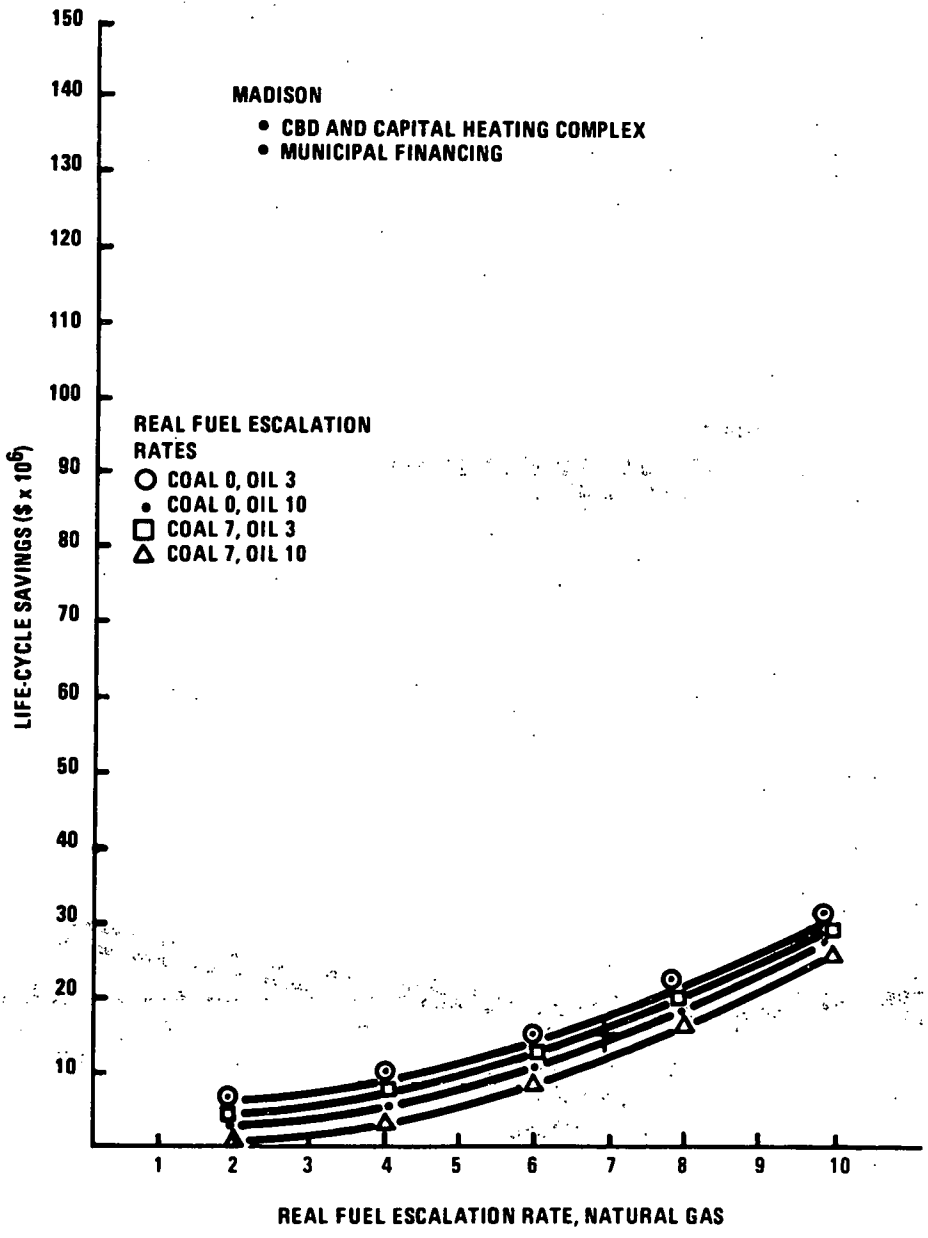

Figure G-29. Life-Cycle Savings versus Real Fuel Escalation Rate, Natural Gas

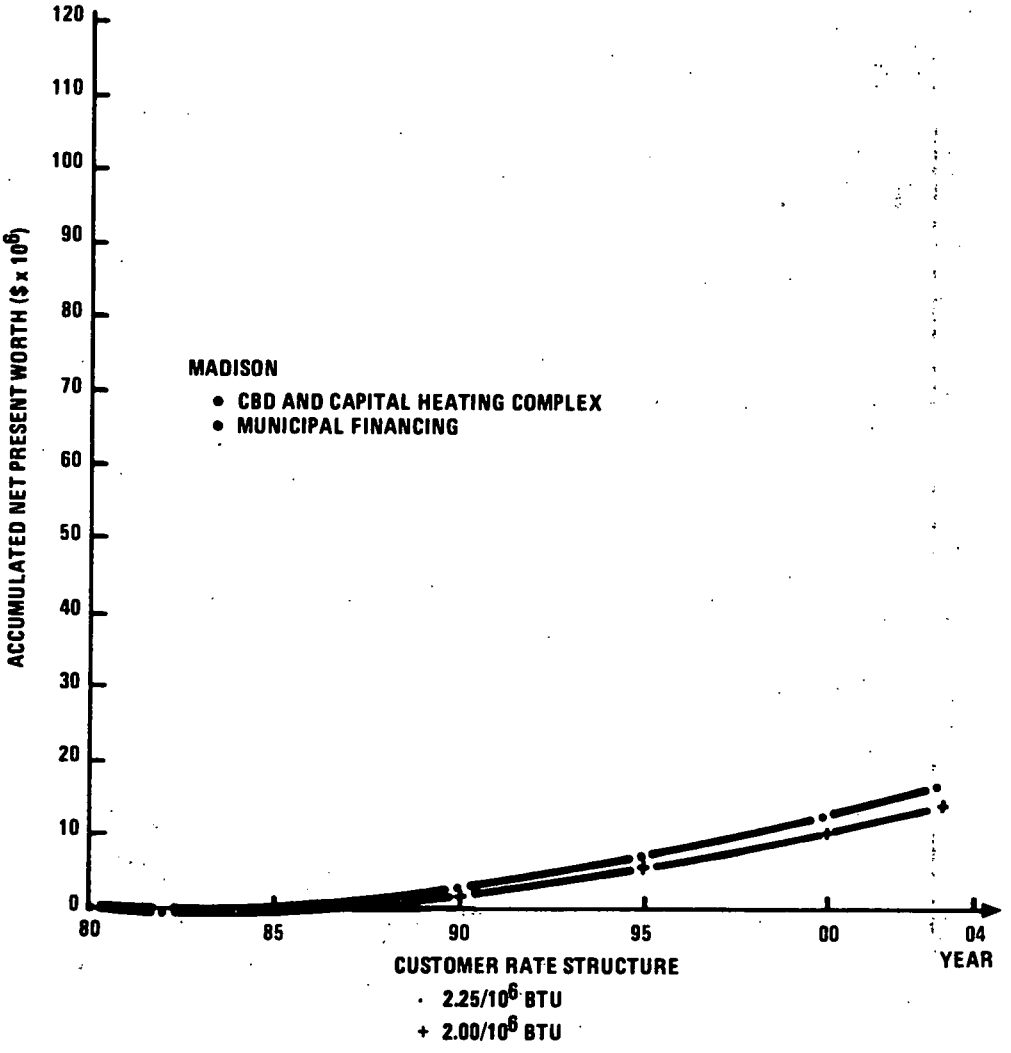

Figure G-30. Accumulated Net Present Worth versus Year

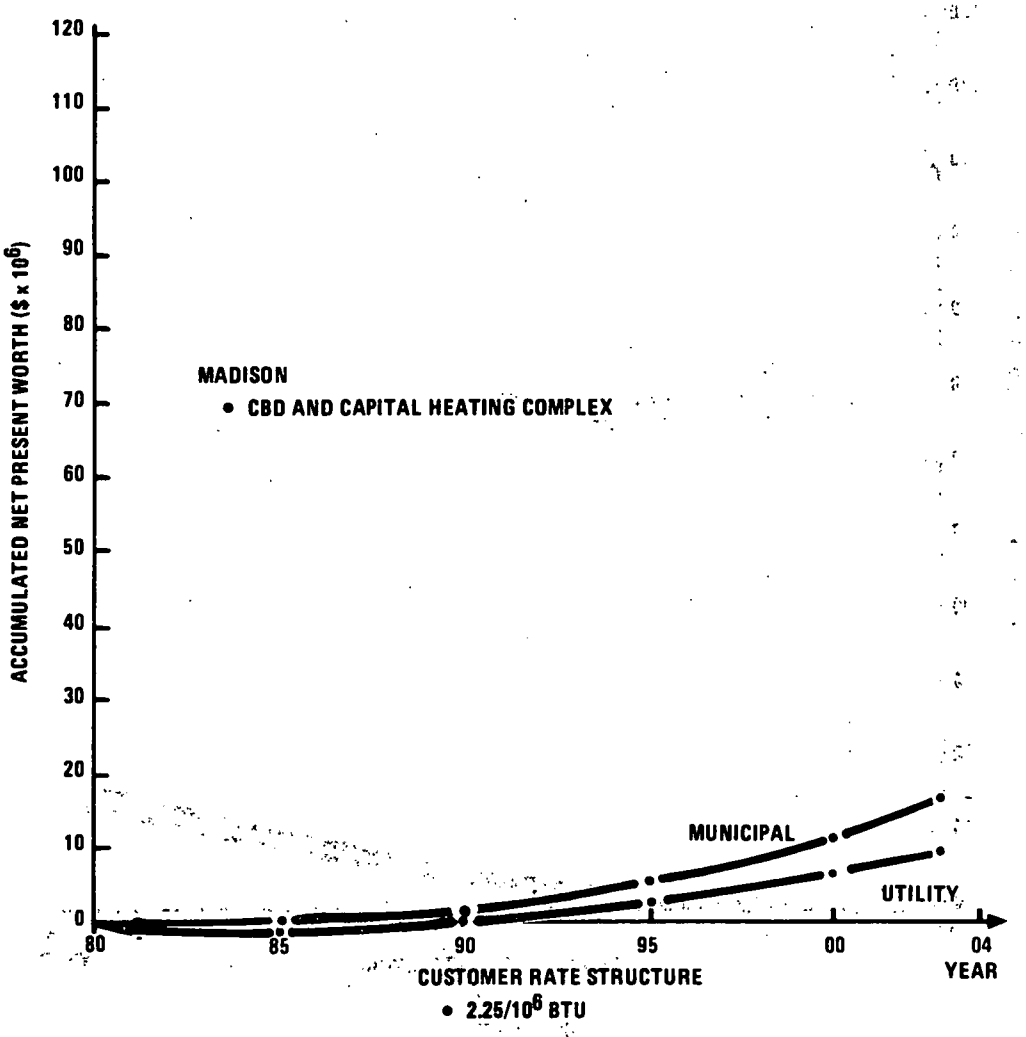

Figure G-31. Accumulated Net Present Worth versus Year

Table G-69. Operations and Maintenance Data (x 1000), Madison CBD and Capitol Heating Complex Alternative

YEAR	MAINTENANCE 1% OF COST	INSURANCE 0.2% OF COST	OPERATION 73,100 KWH/YR AT 0.03/KWH	TOTAL O & M DISTRIBTUION	PLANT RETROFIT O & M	TOTAL O & M
1980	35	7	2	44	13	57
1981	37	7	2	46	13	59
1982	40	8	2	50	15	65
1983	43	9	2	54	22	76
1984	46	9	3	58	27	85
1985	49	10	3	62	28	90
1986	53	11	3	67	32	99
1987	56	11	3	70	32	102
1988	60	12	3	75	35	110
1989	64	13	4	81	39	120
1990	69	14	4	87	42	129
1991	74	15	4	93	45	138
1992	79	16	5	100	48	148
1993	84	17	5	106	51	157
1994	90	18	5	113	55	168
1995	97	19	6	122	59	181
1996	103	21	6	130	63	193
1997	111	22	6	139	67	206
1998	118	24	7	149	72	221
1999	127	25	7	159	77	236
2000	135	27	8	170	83	253
2001	144	29	8	181	88	269
2002	155	31	9	195	95	180
2003	166	33	9	208	101	309
2004	178	35	10	223	108	331

Table G-70. Revenue Requirements (x 1000), Madison, CBD and Capitol Complex Alternative, Municipal Financing Option

Capital Costs $4,500,000

Book Life 27 years

Depreciation Method: Straight Line

Bond Rate 8%

Discount Rate 8%

Year	Book Dep	Net Dep	Invest	Ret	Total Ret	PU	Acc PU
1980	167.	0.	4500.	360.	527.	488.	488.
1981	167.	167.	4333.	347.	513.	440.	928.
1982	167.	333.	4167.	333.	500.	397.	1325.
1983	167.	500.	4000.	320.	487.	358.	1682.
1984	167.	667.	3833.	307.	473.	322.	2005.
1985	167.	833.	3667.	293.	460.	290.	2294.
1986	167.	1000.	3500.	280.	447.	261.	2555.
1987	167.	1167.	3333.	267.	433.	234.	2789.
1988	167.	1333.	3167.	253.	420.	210.	2999.
1989	167.	1500.	3000.	240.	407.	188.	3188.
1990	167.	1667.	2833.	227.	393.	169.	3356.
1991	167.	1833.	2667.	213.	380.	151.	3507.
1992	167.	2000.	2500.	200.	367.	135.	3642.
1993	167.	2167.	2333.	187.	353.	120.	3762.
1994	167.	2333.	2167.	173.	340.	107.	3870.
1995	167.	2500.	2000.	160.	327.	95.	3965.
1996	167.	2667.	1833.	147.	313.	85.	4050.
1997	167.	2833.	1667.	133.	300.	75.	4125.
1998	167.	3000.	1500.	120.	287.	66.	4191.
1999	167.	3167.	1333.	107.	273.	59.	4250.
2000	167.	3333.	1167.	93.	260.	52.	4301.
2001	167.	3500.	1000.	80.	247.	45.	4347.
2002	167.	3667.	833.	67.	233.	40.	4386.
2003	167.	3833.	667.	53.	220.	35.	4421.
2004	167.	4000.	500.	40.	207.	30.	4451.

Table G-71. Return Requirements (x 1000), Madison, CBD and Capitol Heating Complex Alternative, Utility Financing Option

YEAR	RETURN PV	ACC. PV
1980	798	798
1981	763	1561
1982	660	2221
1983	570	2791
1984	491	3282
1985	423	3705
1986	364	4069
1987	312	4381
1988	267	4648
1989	229	4877
1990	195	5072
1991	167	5239
1992	142	5381
1993	122	5503
1994	103	5606
1995	87	5693
1996	74	5767
1997	62	5829
1998	53	5882
1999	44	5926
2000	38	5964
2001	32	5996
2002	27	6023
2003	27	6046
2004	19	6065

Table G-72. Fuel/O & M Data (x 1000), Madison, CBD and Capitol Complex Alternative, Utility Financing Option

COAL COST = 1.58/10-6 BTU
OIL COST = 2.67/10-6 BTU
COAL ESC RATE = 11.0%
OIL ESC RATE = 11.1%
DISCOUNT RATE = 9.54%

YEAR	COAL	OIL	TOTAL FUEL	O&M	TOTAL FUEL/O&M	PV	ACC PV
1980	165.	9.	174.	57.	231.	211.	211.
1981	103.	16.	120.	59.	179.	149.	360.
1982	115.	22.	136.	65.	201.	153.	513.
1983	120.	24.	144.	76.	220.	153.	666.
1984	122.	36.	159.	85.	244.	154.	820.
1985	115.	50.	165.	90.	255.	148.	968.
1986	115.	84.	198.	99.	297.	157.	1125.
1987	157.	87.	243.	102.	345.	167.	1292.
1988	166.	124.	290.	110.	400.	176.	1468.
1989	166.	145.	311.	120.	431.	173.	1641.
1990	199.	153.	352.	129.	481.	177.	1818.
1991	221.	170.	391.	138.	529.	177.	1995.
1992	245.	189.	434.	148.	582.	178.	2173.
1993	272.	210.	482.	157.	639.	178.	2352.
1994	302.	233.	535.	168.	703.	179.	2531.
1995	336.	259.	595.	181.	776.	180.	2712.
1996	373.	288.	660.	193.	853.	181.	2893.
1997	414.	320.	733.	206.	939.	182.	3075.
1998	459.	355.	814.	221.	1035.	183.	3258.
1999	510.	395.	904.	236.	1140.	184.	3443.
2000	566.	438.	1004.	253.	1257.	185.	3628.
2001	628.	487.	1115.	269.	1384.	186.	3815.
2002	697.	541.	1238.	180.	1418.	174.	3989.
2003	774.	601.	1375.	309.	1684.	189.	4178.
2004	859.	668.	1526.	331.	1857.	190.	4368.

Table G-73. Fuel/O & M Data (x 1000), Madison, CBD and Capitol Complex Alternative, Municipal Financing Option

COAL COST = 1.58/10-6 BTU
OIL COST = 2.67/10-6 BTU
COAL ESC RATE = 11.0%
OIL ESC RATE = 11.1%
DISCOUNT RATE = 8.00%

YEAR	COAL	OIL	TOTAL FUEL	O$M	TOTAL FUEL/O$M	PV	ACC PV
1980	165.	9.	174.	57.	231.	214.	214.
1981	103.	16.	120.	59.	179.	153.	367.
1982	115.	22.	136.	65.	201.	160.	527.
1983	120.	24.	144.	76.	220.	162.	689.
1984	122.	36.	159.	85.	244.	166.	855.
1985	115.	50.	165.	90.	255.	161.	1016.
1986	115.	84.	198.	99.	297.	174.	1189.
1987	157.	87.	243.	102.	345.	187.	1376.
1988	166.	124.	290.	110.	400.	200.	1576.
1989	166.	145.	311.	120.	431.	200.	1775.
1990	199.	153.	352.	129.	481.	206.	1982.
1991	221.	170.	391.	138.	529.	210.	2192.
1992	245.	189.	434.	148.	582.	214.	2406.
1993	272.	210.	482.	157.	639.	218.	2624.
1994	302.	233.	535.	168.	703.	222.	2845.
1995	336.	259.	595.	181.	776.	226.	3072.
1996	373.	288.	660.	193.	853.	231.	3302.
1997	414.	320.	733.	206.	939.	235.	3537.
1998	459.	355.	814.	221.	1035.	240.	3777.
1999	510.	395.	904.	236.	1140.	245.	4022.
2000	566.	438.	1004.	253.	1257.	250.	4272.
2001	628.	487.	1115.	269.	1384.	255.	4526.
2002	697.	541.	1238.	180.	1418.	241.	4768.
2003	774.	601.	1375.	309.	1684.	265.	5033.
2004	859.	668.	1526.	331.	1857.	271.	5304.

Table G-74. Gross Income Data (x 1000), Madison, CBD and Capitol Complex Alternative, Utility Financing Option

DISCOUNT RATE = 9.54%
FUEL QUANTITY = 215.10/10-9 BTU/YR
FUEL COST = 2.00/10-6 BTU
ESCALATION RATE = 14.0%

YEAR	INCOME	PV	ACC PV	YEAR	INCOME	PV	ACC PV
1980	490.	448.	448.	1980	552.	504.	504.
1981	559.	466.	914.	1981	629.	524.	1028.
1982	637.	485.	1399.	1982	717.	546.	1573.
1983	727.	505.	1903.	1983	817.	568.	2141.
1984	828.	525.	2428.	1984	932.	591.	2732.
1985	944.	547.	2975.	1985	1062.	615.	3347.
1986	1076.	569.	3544.	1986	1211.	640.	3987.
1987	1227.	592.	4136.	1987	1381.	666.	4653.
1988	1399.	616.	4752.	1988	1574.	693.	5346.
1989	1595.	641.	5393.	1989	1794.	721.	6067.
1990	1818.	667.	6061.	1990	2045.	751.	6818.
1991	2073.	694.	6755.	1991	2332.	781.	7599.
1992	2363.	723.	7478.	1992	2658.	813.	8412.
1993	2694.	752.	8230.	1993	3030.	846.	9259.
1994	3071.	783.	9013.	1994	3455.	881.	10139.
1995	3501.	815.	9827.	1995	3938.	917.	11056.
1996	3991.	848.	10675.	1996	4490.	954.	12010.
1997	4549.	882.	11558.	1997	5118.	993.	13002.
1998	5186.	918.	12476.	1998	5835.	1033.	14035.
1999	5912.	956.	13432.	1999	6652.	1075.	15111.
2000	6740.	995.	14426.	2000	7583.	1119.	16229.
2001	7684.	1035.	15461.	2001	8644.	1164.	17394.
2002	8760.	1077.	16538.	2002	9854.	1212.	18606.
2003	9986.	1121.	17660.	2003	11234.	1261.	19867.
2004	11384.	1167.	18826.	2004	12807.	1313.	21180.

Table G-75. Gross Income Data (x 1000), Madison, CBD and Capitol Heating Complex Alternative, Municipal Financing Option

DISCOUNT RATE = 8.00%
FUEL QUANTITY = 215.10/10-9 BTU/YR
FUEL COST = 2.00/10-6 BTU
ESCALATION RATE = 14.0%

YEAR	INCOME	PV	ACC PV	YEAR	INCOME	PV	ACC PV
1980	490.	454.	454.	1980	552.	511.	511.
1981	559.	479.	933.	1981	629.	539.	1050.
1982	637.	506.	1439.	1982	717.	569.	1619.
1983	727.	534.	1973.	1983	817.	601.	2220.
1984	828.	564.	2537.	1984	932.	634.	2854.
1985	944.	595.	3132.	1985	1062.	669.	3524.
1986	1076.	628.	3760.	1986	1211.	707.	4230.
1987	1227.	663.	4423.	1987	1381.	746.	4976.
1988	1399.	700.	5123.	1988	1574.	787.	5764.
1989	1595.	739.	5862.	1989	1794.	831.	6595.
1990	1818.	780.	6642.	1990	2045.	877.	7472.
1991	2073.	823.	7465.	1991	2332.	926.	8398.
1992	2363.	869.	8334.	1992	2658.	977.	9375.
1993	2694.	917.	9251.	1993	3030.	1032.	10407.
1994	3071.	968.	10219.	1994	3455.	1089.	11496.
1995	3501.	1022.	11240.	1995	3938.	1150.	12646.
1996	3991.	1079.	12319.	1996	4490.	1213.	13859.
1997	4549.	1138.	13458.	1997	5118.	1281.	15140.
1998	5186.	1202.	14659.	1998	5835.	1352.	16492.
1999	5912.	1269.	15928.	1999	6652.	1427.	17919.
2000	6740.	1339.	17267.	2000	7583.	1506.	19425.
2001	7684.	1413.	18680.	2001	8644.	1590.	21015.
2002	8760.	1492.	20172.	2002	9854.	1678.	22694.
2003	9986.	1575.	21747.	2003	11234.	1772.	24465.
2004	11384.	1662.	23409.	2004	12807.	1870.	26335.

Table G-76. Annual Savings (x 1000), Madison, CBD and Capitol Complex Alternative, Utility Financing Option

GROSS INCOME	UTILITY REV. REQ.	FUEL/O & M	ANNUAL SAVINGS	REAL FUEL ESCALATION RATES
11354 AT 9%	6065	3481	1808	C - 0
14438 AT 11%	↓	↓	4892	O - 3
18587 AT 13%			9041	
24198 AT 15%			14652	
31819 AT 17%			22273	
11354 AT 9%		5320	-31	C - 0
14438 AT 11%		↓	3053	O - 10
18587 AT 13%			7202	
24198 AT 15%			12813	
31819 AT 17%			20434	
11354 AT 9%		5081	208	C - 7
14438 AT 11%		↓	3292	O - 10
18587 AT 13%			7441	
24198 AT 15%			13052	
31819 AT 17%			20673	
11354 AT 9%		6919	-5111	C - 7
14438 AT 11%		↓	-2027	O - 10
18587 AT 13%			2122	
24198 AT 15%			7733	
31819 AT 17%			15354	
23533	↓	4368	13100	C - 4
21180		↓	10747	O - 4.1
18826			8393	NG - 7

Table G-77. Annual Savings (x 1000), Madison, CBD and Capitol Heating Complex Alternative, Municipal Financing Option

GROSS INCOME	MUNICIPAL REV. REQ.	FUEL/O & M	ANNUAL SAVINGS	REAL FUEL ESCALATION RATES
13670 AT 9% 17616 AT 11% 22970 AT 13% 30268 AT 15% 40248 AT 17%	4451	4172	5047 8993 14347 21645 31625	C - 0 O - 3
13670 AT 9% 17616 AT 11% 22970 AT 13% 30268 AT 15% 40248 AT 17%		6575	2644 6590 11944 19242 29222	C - 0 O - 10
13670 AT 9% 17616 AT 11% 22970 AT 13% 30268 AT 15% 40248 AT 17%		6224	2995 6941 12295 19593 29573	C - 7 O - 3
13670 AT 9% 17616 AT 11% 22970 AT 13% 30268 AT 15% 40248 AT 17%		8627	592 4538 9892 17190 27170	C - 7 O - 10
26335 23409		5304	16580 13654	C - 4 O - 4.1 NG - 7

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MADISON, UNIVERSITY OF WISCONSIN

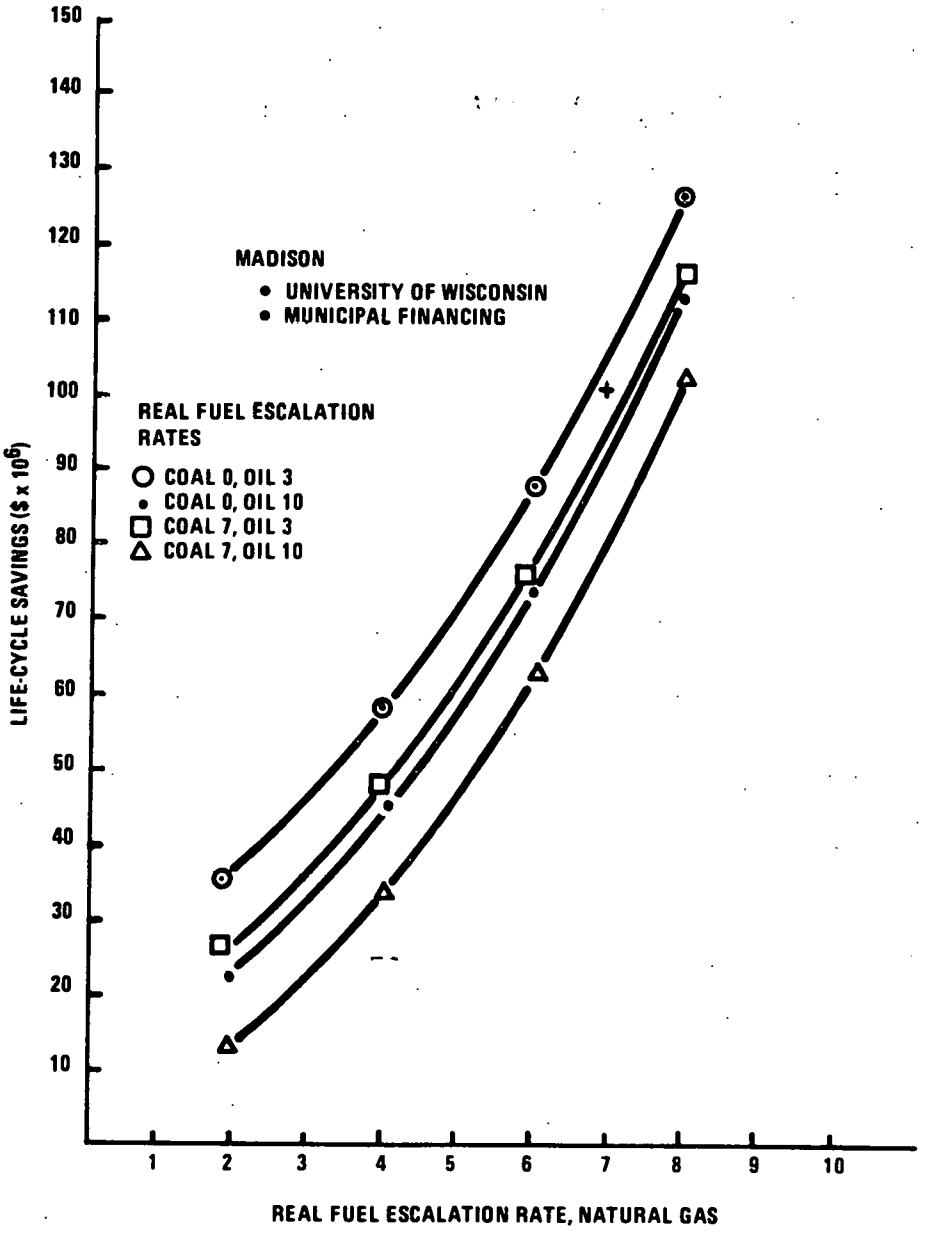

Figure G-32. Life-Cycle Savings versus Real Fuel Escalation Rate, Natural Gas

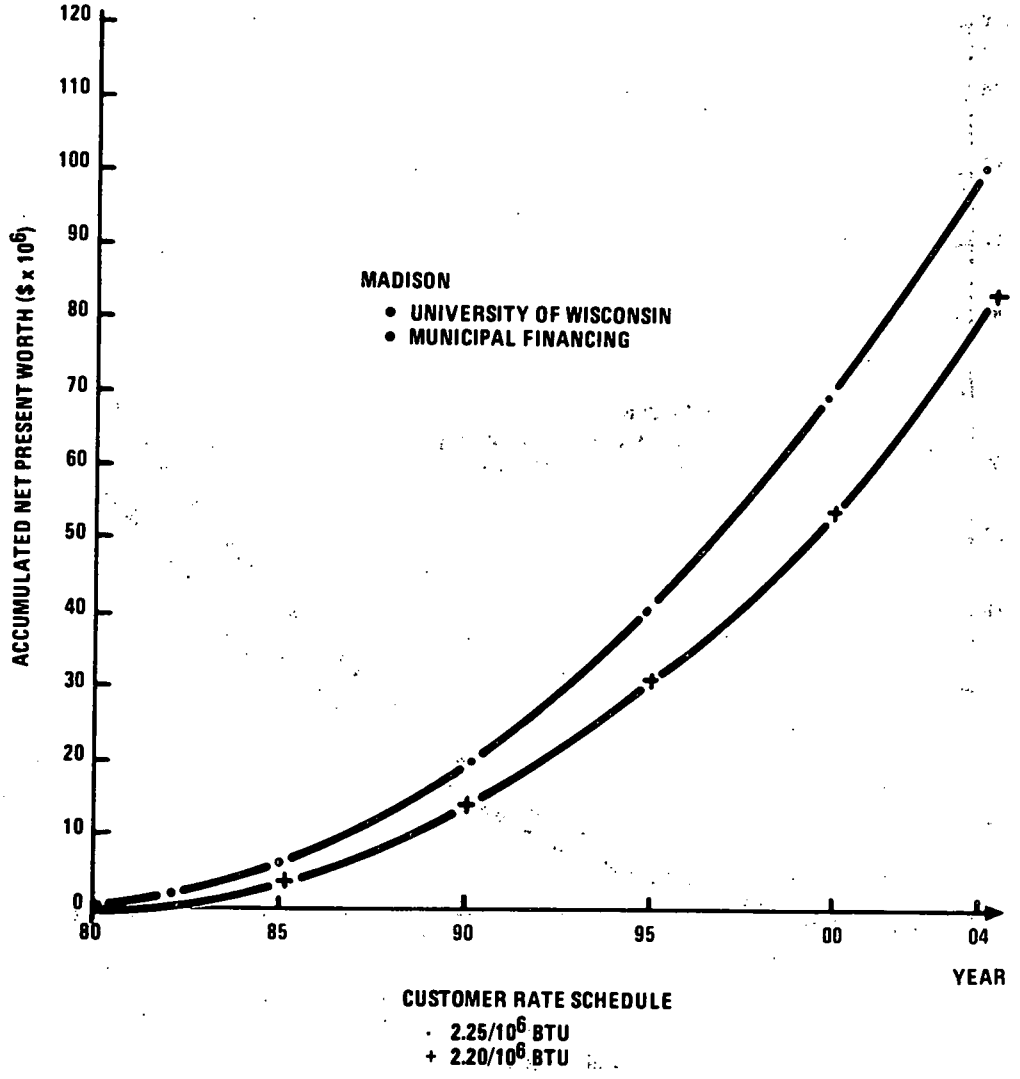

Figure G-33. Accumulated Net Present Worth versus Year

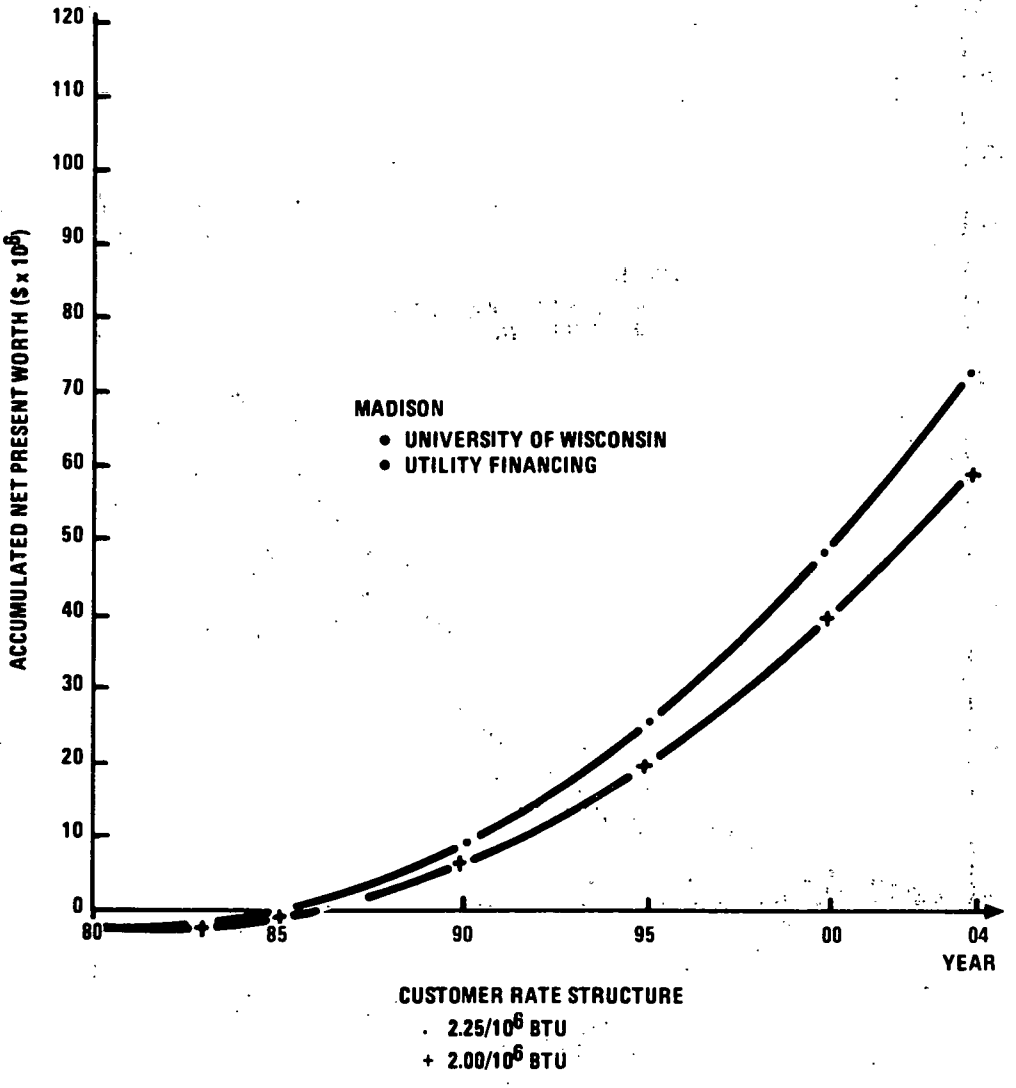

Figure G-34. Accumulated Net Present Worth versus Year

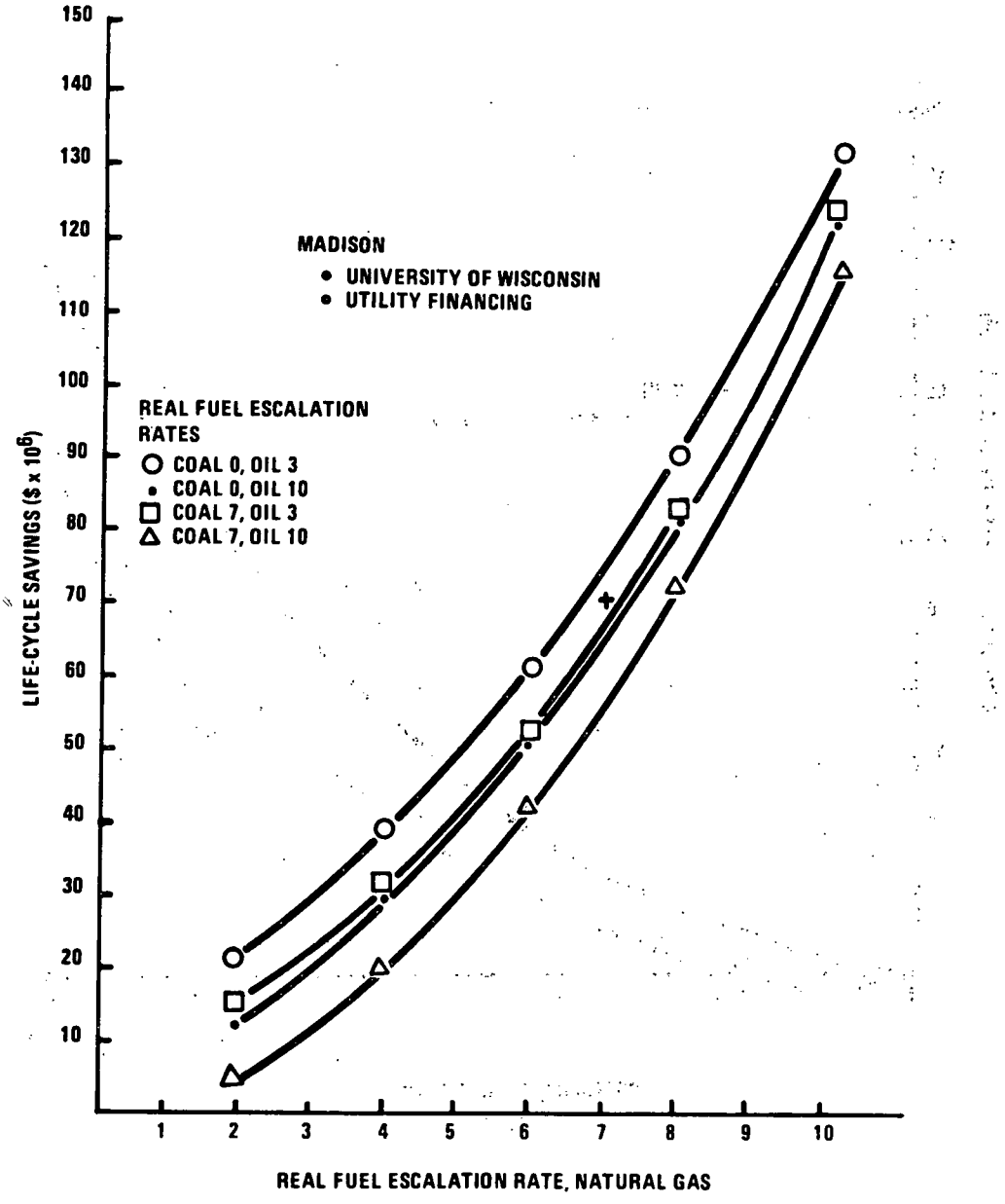

Figure G-35. Life-Cycle Costs versus Real Fuel Escalation Rate, Natural Gas

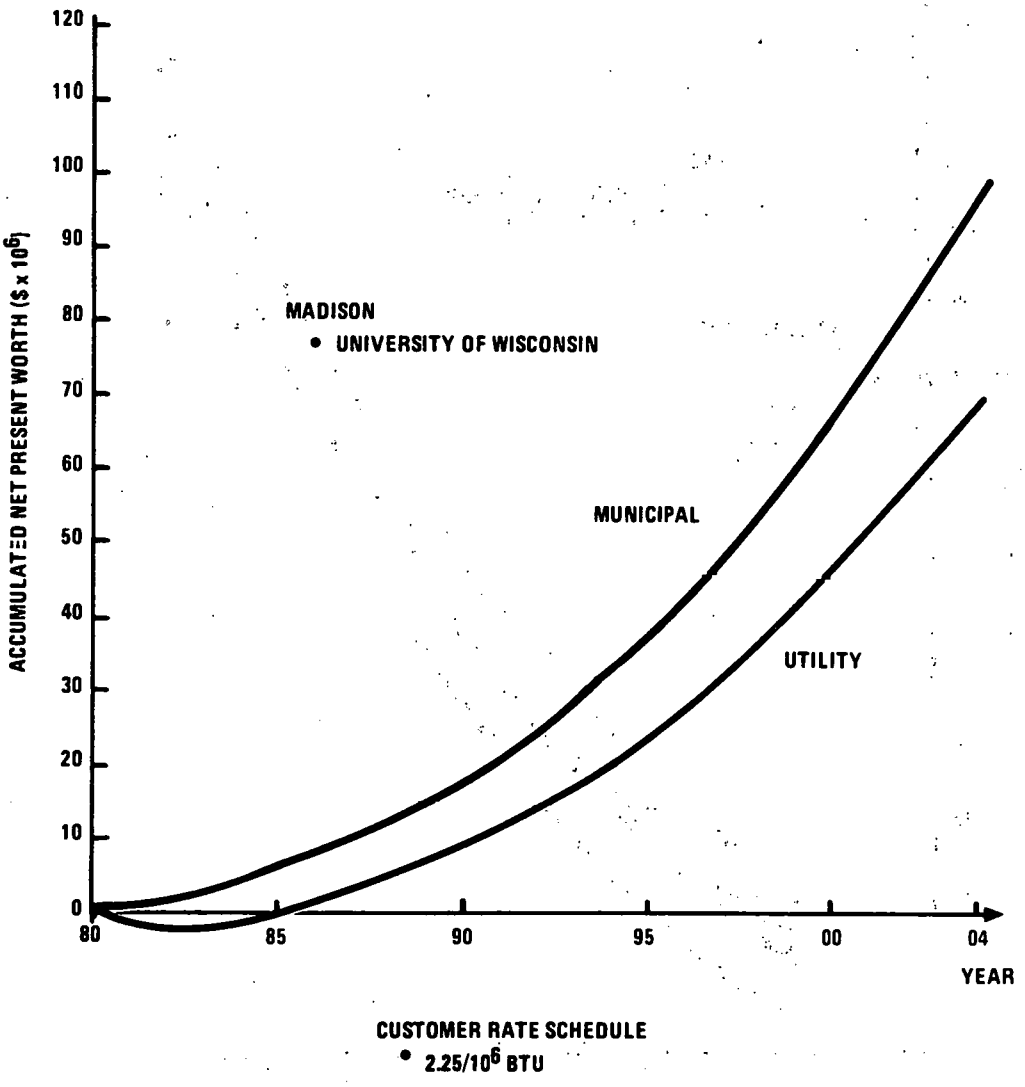

Figure G-36. Accumulated Net Present Worth versus Year

Table G-78. Operations and Maintenance Data (x 1000), Madison University of Wisconsin Alternative

YEAR	MAINTENANCE 1% OF COST (14.2×10^6)	INSURANCE 0.2% OF COST (2.4×10^6)	OPERATION 293,900 KHW/YR AT 0.03/KWH	TOTAL O & M DISTRIBUTION	PLANT RETROFIT O & M	TOTAL O & M
1980	142	28	9	179	74	253
1981	152	30	10	192	69	261
1982	163	32	10	205	82	287
1983	174	34	11	219	120	339
1984	186	37	12	235	145	380
1985	199	39	13	251	153	404
1986	213	42	14	269	173	442
1987	228	45	14	287	176	463
1988	244	48	15	307	193	500
1989	261	51	17	329	212	541
1990	279	55	18	352	228	580
1991	299	59	19	377	244	621
1992	320	63	20	403	261	664
1993	342	67	22	431	279	710
1994	366	72	23	461	299	760
1995	392	77	25	494	320	814
1996	419	83	27	529	342	853
1997	448	88	28	564	866	930
1998	480	95	30	605	392	997
1999	513	101	33	647	419	1066
2000	550	108	35	693	449	1142
2001	588	116	37	741	480	1221
2002	629	124	40	793	514	1307
2003	673	133	43	849	549	1398
2004	720	142	46	908	588	1496

Table G-79. Return Requirements (x 1000), Madison, University of Wisconsin Alternative, Utility Financing Option

YEAR	RETURN PV	ACC. PV
1980	2945	2945
1981	2815	5760
1982	2434	8194
1983	2102	10296
1984	1813	12109
1985	1560	13669
1986	1341	15010
1987	1152	16162
1988	986	17148
1989	843	17991
1990	720	18711
1991	618	19329
1992	525	19854
1993	448	20302
1994	378	20680
1995	322	21002
1996	272	21274
1997	299	21503
1998	196	21699
1999	163	21862
2000	139	22001
2001	116	22117
2002	100	22217
2003	83	22300
2004	70	22373

Table G-80. Revenue Requirements (x 1000), Madison, University of Wisconsin Alternative, Municipal Financing Option

CAPITAL COSTS $16,600,000
BOOK LIFE 27 years
DEPRECIATION METHOD: STRAIGHT LINE
BOND RATE 8%
DISCOUNT RATE 8%

Year	Book Dep	Net Dep	Invest	Ret	Total Ret	PU	Acc PU
1980	615.	0.	16600.	1328.	1943.	1799.	1799.
1981	615.	615.	15985.	1279.	1894.	1623.	3422.
1982	615.	1230.	15370.	1230.	1844.	1464.	4887.
1983	615.	1844.	14756.	1180.	1795.	1320.	6206.
1984	615.	2459.	14141.	1131.	1746.	1188.	7394.
1985	615.	3074.	13526.	1082.	1697.	1069.	8464.
1986	615.	3689.	12911.	1033.	1648.	961.	9425.
1987	615.	4304.	12296.	984.	1599.	864.	10289.
1988	615.	4919.	11681.	935.	1549.	775.	11064.
1989	615.	5533.	11067.	885.	1500.	695.	11759.
1990	615.	6148.	10452.	836.	1451.	622.	12381.
1991	615.	6763.	9837.	787.	1402.	557.	12938.
1992	615.	7378.	9222.	738.	1353.	497.	13435.
1993	615.	7993.	8607.	689.	1303.	444.	13879.
1994	615.	8607.	7993.	639.	1254.	395.	14274.
1995	615.	9222.	7378.	590.	1205.	352.	14626.
1996	615.	9837.	6763.	541.	1156.	312.	14938.
1997	615.	10452.	6148.	492.	1107.	277.	15215.
1998	615.	11067.	5533.	443.	1057.	245.	15460.
1999	615.	11681.	4919.	393.	1008.	216.	15677.
2000	615.	12296.	4304.	344.	959.	191.	15867.
2001	615.	12911.	3689.	295.	910.	167.	16035.
2002	615.	13526.	3074.	246.	861.	147.	16181.
2003	615.	14141.	2459.	197.	812.	128.	16309.
2004	615.	14756.	1844.	148.	762.	111.	16420.

Table G-81. Fuel/O & M Data (x 1000), Madison, University of Wisconsin, Alternative, Utility Financing Option

COAL COST = 1.58/10-6 BTU
OIL COST = 2.67/10-6 BTU
COAL ESC RATE = 11.0%
OIL ESC RATE = 11.1%
DISCOUNT RATE = 9.54%

YEAR	COAL	OIL	TOTAL FUEL	O&M	TOTAL FUEL/O&M	PV	ACC PV
1980	905.	44.	949.	253.	1202.	1098.	1098.
1981	568.	96.	664.	261.	925.	771.	1869.
1982	627.	114.	740.	287.	1027.	781.	2650.
1983	648.	130.	778.	339.	1117.	776.	3426.
1984	674.	185.	859.	380.	1239.	786.	4211.
1985	635.	266.	901.	404.	1305.	756.	4967.
1986	630.	452.	1082.	442.	1524.	805.	5772.
1987	863.	459.	1322.	463.	1785.	861.	6633.
1988	909.	675.	1584.	500.	2084.	918.	7551.
1989	902.	803.	1705.	541.	2246.	903.	8454.
1990	1086.	824.	1910.	580.	2490.	914.	9368.
1991	1205.	916.	2121.	621.	2742.	919.	10287.
1992	1338.	1018.	2355.	664.	3019.	923.	11210.
1993	1485.	1131.	2615.	710.	3325.	929.	12139.
1994	1648.	1256.	2904.	760.	3664.	934.	13073.
1995	1829.	1395.	3225.	814.	4039.	940.	14013.
1996	2031.	1550.	3581.	853.	4434.	942.	14954.
1997	2254.	1722.	3976.	930.	4906.	952.	15906.
1998	2502.	1914.	4415.	997.	5412.	958.	16864.
1999	2777.	2126.	4903.	1066.	5969.	965.	17829.
2000	3082.	2362.	5444.	1142.	6586.	972.	18801.
2001	3422.	2624.	6046.	1221.	7267.	979.	19780.
2002	3798.	2915.	6713.	1307.	8020.	986.	20766.
2003	4216.	3239.	7455.	1398.	8853.	994.	21760.
2004	4679.	3599.	8278.	1496.	9774.	1002.	22762.

Table G-82. Fuel/O & M Data (x 1000), Madison, University of Wisconsin Alternative, Municipal Financing Option

COAL COST = 1.58/10-6 BTU
OIL COST = 2.67/10-6 BTU
COAL ESC RATE = 11.0%
OIL ESC RATE = 11.1%
DISCOUNT RATE = 8.00%

YEAR	COAL	OIL	TOTAL FUEL	O&M	TOTAL FUEL/O&M	PV	ACC PV
1980	905.	44.	949.	253.	1202.	1113.	1113.
1981	568.	96.	664.	261.	925.	793.	1906.
1982	627.	114.	740.	287.	1027.	815.	2722.
1983	648.	130.	778.	339.	1117.	821.	3543.
1984	674.	185.	859.	380.	1239.	843.	4386.
1985	635.	266.	901.	404.	1305.	823.	5209.
1986	630.	452.	1082.	442.	1524.	889.	6098.
1987	863.	459.	1322.	463.	1785.	964.	7062.
1988	909.	675.	1584.	500.	2084.	1043.	8104.
1989	902.	803.	1705.	541.	2246.	1040.	9145.
1990	1086.	824.	1910.	580.	2490.	1068.	10213.
1991	1205.	916.	2121.	621.	2742.	1089.	11301.
1992	1338.	1018.	2355.	664.	3019.	1110.	12412.
1993	1485.	1131.	2615.	710.	3325.	1132.	13544.
1994	1648.	1256.	2904.	760.	3664.	1155.	14699.
1995	1829.	1395.	3225.	814.	4039.	1179.	15878.
1996	2031.	1550.	3581.	853.	4434.	1198.	17076.
1997	2254.	1722.	3976.	930.	4906.	1228.	18304.
1998	2502.	1914.	4415.	997.	5412.	1254.	19558.
1999	2777.	2126.	4903.	1066.	5969.	1281.	20838.
2000	3082.	2362.	5444.	1142.	6586.	1308.	22147.
2001	3422.	2624.	6046.	1221.	7267.	1337.	23484.
2002	3798.	2915.	6713.	1307.	8020.	1366.	24850.
2003	4216.	3239.	7455.	1398.	8853.	1396.	26246.
2004	4679.	3599.	8278.	1496.	9774.	1427.	27673.

Table G-83. Gross Income Data (x 1000), Madison, University of Wisconsin Alternative, Utility Financing Option

DISCOUNT RATE = 8.00%
FUEL QUANTITY = 215.10/10-9 BTU/YR
FUEL COST = 2.25/10-6 BTU
ESCALATION RATE = 14.0%

YEAR	INCOME	PV	ACC PV	YEAR	INCOME	PV	ACC PV
1980	2681.	2448.	2448.	1980	3017.	2754.	2754.
1981	3057.	2548.	4995.	1981	3439.	2866.	5620.
1982	3485.	2651.	7647.	1982	3920.	2983.	8602.
1983	3973.	2759.	10406.	1983	4469.	3104.	11707.
1984	4529.	2872.	13277.	1984	5095.	3230.	14937.
1985	5163.	2988.	16266.	1985	5808.	3362.	18299.
1986	5886.	3110.	19376.	1986	6621.	3499.	21798.
1987	6710.	3237.	22613.	1987	7548.	3641.	25439.
1988	7649.	3369.	25981.	1988	8605.	3790.	29229.
1989	8720.	3506.	29487.	1989	9810.	3944.	33173.
1990	9941.	3648.	33136.	1990	11183.	4105.	37277.
1991	11332.	3797.	36933.	1991	12749.	4272.	41549.
1992	12919.	3952.	40884.	1992	14534.	4446.	45995.
1993	14727.	4112.	44997.	1993	16568.	4627.	50621.
1994	16789.	4280.	49277.	1994	18888.	4815.	55436.
1995	19140.	4454.	53731.	1995	21532.	5011.	60447.
1996	21819.	4636.	58366.	1996	24547.	5215.	65662.
1997	24874.	4824.	63191.	1997	27983.	5427.	71089.
1998	28356.	5021.	68211.	1998	31901.	5648.	76738.
1999	32326.	5225.	73436.	1999	36367.	5878.	82616.
2000	36852.	5438.	78874.	2000	41458.	6118.	88734.
2001	42011.	5659.	84534.	2001	47262.	6367.	95100.
2002	47892.	5890.	90423.	2002	53879.	6626.	101726.
2003	54597.	6130.	96553.	2003	61422.	6896.	108622.
2004	62241.	6379.	102932.	2004	70021.	7176.	115798.

Table G-84. Gross Income Data (x 1000), Madison, University of Wisconsin Alternative, Municipal Financing Option

DISCOUNT RATE = 8.00%
FUEL QUANTITY = 1176.05/10-9 BTU/YR
FUEL COST = 2.00/10-6 BTU
ESCALATION RATE = 14.0%

YEAR	INCOME	PV	ACC PV	YEAR	INCOME	PV	ACC PV
1980	2681.	2483.	2483.	1980	3017.	2793.	2793.
1981	3057.	2621.	5103.	1981	3439.	2948.	5741.
1982	3485.	2766.	7870.	1982	3920.	3112.	8853.
1983	3973.	2920.	10790.	1983	4469.	3285.	12138.
1984	4529.	3082.	13872.	1984	5095.	3467.	15606.
1985	5163.	3253.	17125.	1985	5808.	3660.	19266.
1986	5886.	3434.	20560.	1986	6621.	3863.	23130.
1987	6710.	3625.	24185.	1987	7548.	4078.	27208.
1988	7649.	3826.	28011.	1988	8605.	4305.	31512.
1989	8720.	4039.	32050.	1989	9810.	4544.	36056.
1990	9941.	4263.	36313.	1990	11183.	4796.	40852.
1991	11332.	4500.	40813.	1991	12749.	5063.	45915.
1992	12919.	4750.	45564.	1992	14534.	5344.	51259.
1993	14727.	5014.	50578.	1993	16568.	5641.	56900.
1994	16789.	5293.	55870.	1994	18888.	5954.	62854.
1995	19140.	5587.	61457.	1995	21532.	6285.	69139.
1996	21819.	5897.	67354.	1996	24547.	6634.	75773.
1997	24874.	6225.	73579.	1997	27983.	7003.	82776.
1998	28356.	6570.	80149.	1998	31901.	7392.	90168.
1999	32326.	6935.	87085.	1999	36367.	7802.	97970.
2000	36852.	7321.	94405.	2000	41458.	8236.	106206.
2001	42011.	7728.	102133.	2001	47262.	8693.	114900.
2002	47892.	8157.	110290.	2002	53879.	9176.	124076.
2003	54597.	8610.	118900.	2003	61422.	9686.	133762.
2004	62241.	9088.	127988.	2004	70021.	10224.	143987.

Table G-85. Annual Savings (x 1000), Madison, University of Wisconsin Alternative, Utility Financing Option

GROSS INCOME	UTILITY REV. REQ.	FUEL/O & M	ANNUAL SAVINGS	REAL FUEL ESCALATION RATES
62076 AT 9% 78937 AT 11% 101622 AT 13% 132303 AT 15% 173968 AT 17%	22373	17932	21771 38632 61317 91998 133663	C - 0 O - 3
62076 AT 9% 78937 AT 11% 101622 AT 13% 132303 AT 15% 173968 AT 17%		27843	11860 28721 51406 82087 123752	C - 0 O - 10
62076 AT 9% 78937 AT 11% 101622 AT 13% 132303 AT 15% 173968 AT 17%		26657	13046 29907 52592 83273 124938	C - 7 O - 3
62076 AT 9% 78937 AT 11% 101622 AT 13% 132303 AT 15% 173968 AT 17%		36568	3134 19995 42680 73361 115026	C - 7 O - 10
115798 102932		22762	70663 57797	C - 4 O - 4.1 NG - 7

Table G-86. Annual Savings (x 1000), Madison, University of Wisconsin Alternative, Municipal Financing Option

GROSS INCOME	MUNICIPAL REV. REQ.	FUEL/O & M	ANNUAL SAVINGS	REAL FUEL ESCALATION RATES
74738 AT 9% 96312 AT 11% 125587 AT 13% 165487 AT 15% 220052 AT 17%	16420	21514	36804 58378 87653 127553 182118	C - 0 O - 3
74738 AT 9% 96312 AT 11% 125587 AT 13% 165487 AT 15% 220052 AT 17%		34466	23852 45426 74701 114601 169166	C - 0 O - 10
74738 AT 9% 96312 AT 11% 125587 AT 13% 165487 AT 15% 220052 AT 17%		32702	25616 47190 76465 116365 170930	C - 7 O - 3
74738 AT 9% 96312 AT 11% 125587 AT 13% 165487 AT 15% 220052 AT 17%		45654	12664 34238 63513 103413 157978	C - 7 O - 10
143987 127988		27673	99894 83895	C - 4 O - 4 NG - 7