Joseph Technology Corporation

GREATER BURLINGTON DISTRICT ENERGY STUDY

FINAL REPORT

Prepared for:

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University of Vermont and
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Burlington, Vermont

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With HTHW option, the district heating water will be also used to drive absorption chillers at the customer facilities.

Potential heat sales in the first stage are estimated at 394,000 MMBtu/yr for HTHW option. Capital cost in the first stage is estimated at $11.7 million, including the McNeil station retrofit to cogeneration, installation of the transmission piping from McNeil to UVM and FAHC and hook-ups.

With MTHW option, it is assumed that the retrofit of the UVM and FAHC to hot water will result in the reduction of annual heat consumption by 20% (reduction in underground piping losses, steam trap losses and improvement of building controls). Therefore, the potential heat sales in the first stage with MTHW option are estimated at 315,000 MMBtu/yr. Capital cost for the first stage with MTHW option is estimated at $8.5 million not including the cost of building retrofits.

In the second stage, connect the following customers to a MTHW system, supplied with HTHW from McNeil through the UVM boiler plant:

- UVM buildings currently not supplied from their central plant
- Champlain College
- Trinity College
- Mater Christi School
- Red Cross Building
- Taft School

Additional potential heat sales in this stage are estimated at 110,000 MMBtu/yr. Capital cost of this construction stage is estimated at $2.6 million, including the modification of the UVM plant, distribution piping and back-up boiler plant.

In the third stage, gradually expand the MTHW system to Downtown and Waterfront customers. The additional potential heat sales are estimated at 108,000

Currently McNeil is dispatched as part of NEPOOL on the basis of its operating expenses. Typically, it runs weekdays from 7 AM to 10 PM. Once McNeil supplies thermal energy, it must operate continuously. An analysis has been made to determine how the station will fare under impending deregulation of Vermont's electric utility industry. The analysis showed that the biomass-fired McNeil station will qualify for the "renewable energy credits" proposed in Vermont Senate Bill S-62 and, therefore, will remain a viable energy source. The cost of heat extraction from McNeil was also analyzed. It will be comprised of the additional cost of fuel, reimbursement costs for-must run operation (to assure district energy supply) and some additional operating and maintenance expenses. All these costs are included in the economic analysis.

Thermal Source Redundancy and Reliability

The redundancy and reliability of the heat supply will be provided by the UVM and FAHC boiler plants or a newly built in the second and third project stage boiler plant. Table S-1 presents the comparison of available heat supply capacity with peak heat demand with HTHW and MTHW options. The total McNeil boiler capacity is 521 MMBtu/hr, the maximum heat capacity which can be provided from McNeil turbine is 210 MMBtu/hr.

Table S-1
Heat Supply Redundancy

Implementation Stage	Peak Heat Demand MMBtu/hr		Available Capacity, MMBtu/hr.				
	HTHW	MTHW	McNeil	UVM	FAHC	Total	With McNeil Boiler Out of Service
First	193	155	521	148	74	743	222
Second	247	198	521	148	74	743	222
Third	300	241	521	148	74	743	222

UVM and FAHC Hook Ups

Two heat exchangers will be installed at the UVM central boiler plant in order to convert HTHW to steam. Two heat exchangers to convert the HTHW to steam will be also installed at the FAHC central boiler plant. The capital cost is estimated at $523,000 for UVM and $280,000 for FAHC. These costs will be borne by the district energy system.

MTHW Piping System

The MTHW system will be carbon steel pipe insulated with polyurethane and covered with polyethylene. The cost of MTHW piping from McNeil station is estimated at $4.9 million. The total stage two and three capital cost for the MTHW underground piping is estimated at $4.2 million.

Implementation Schedule

For the HTHW option, the first stage of the project is expected to be completed one year after financing becomes available. With the MTHW option, implementation of the project could not begin before the compleation of the retrofit of the UVM and FAHC buildings to hot water The second stage should be completed within five years thereafter. The third stage will be implemented gradually and should be completed within five more years.

Economic Analysis

The economic analysis is based on the following information:

- Financing is tax-exempt.
- Debt is 100%.

will be sufficient to pay the principal and interest on the bonds and cover all expenses, including the 3.5% city operating fee, and have the necessary debt coverage. The break-even cost after the implementation of the second stage is $7.61 per MMBtu, and at the end of the third stage is $7.93 per MMBtu.

MTHW option

For the first year, this cost is estimated at $8.76 per MMBtu and for the second year it is $7.79 per MMBtu. In other words, the heat price to all potential customers will be sufficient to pay the principal and interest on the bonds and cover all expenses, including the 3.5% city operating fee, and have the necessary debt coverage. The break-even cost after the implementation of the second stage is $7.21 per MMBtu, and at the end of the third stage is $7.65 per MMBtu.

Cooling Load Supply

HTHW district heating system also permits the supply of cooling by means of absorption chillers. This alternative can reduce electric cost for customers who have electric chilling. Operating cost comparisons between absorption chillers (with discount district heating rate) and electric chillers have demonstrated the advantage of absorption chillers.

District Heating and Cooling Rates

It is proposed to offer UVM and FAHC a heat rate equal to the break-even cost determined by the economic analysis. It is also proposed to offer them a discount heat rate for absorption cooling in the amount of $5/MMBtu. With the increase of the "renewable energy credits" to McNeil, in the coming years it may be possible to keep the district heating rate constant or even lower over a period as long as 10 years.

- Reduced pollution and elimination of smoke stacks. The McNeil station has an efficient pollution control system with a high stack height. The district energy system will permit elimination of CO_2 emissions (32,000 tons/year) and reduce other pollutants otherwise emitted by oil and natural gas fired heating plants. The McNeil station also provides added benefit of the ability to accurately measure emissions through it's state-of-the-art continuous emission monitoring system. The externality cost savings from pollutant reduction is estimated for HTHW system at $7.3 million and for MTHW system at $9.6 milliion over 20 years.

- Lower capital costs for customers, who need not purchase boilers, stacks, oil tanks, etc., and who can save valuable capital which they can invest elsewhere.

- Increased building space. Without boilers, customers (with the exception of UVM and FAHC) will have more space for lease or storage.

- Improved fire safety. No fuel is delivered, stored or fired at the customer buildings

- Increased reliability of energy supply. Twenty-four hour operation of the system by energy professionals provide high quality heat and cooling supply.

- Increased flexibility of fuel supply. McNeil fires Biomass in addition to natural gas and fuel oil presently used by the customers. The most economically available fuel can be easily used in the future after the distribution piping network is developed.

- Customer insurance costs are expected to go down

- Option 1 used the annual component of $280,172 for the total cost of replacement of the existing 4,800 hp UVM plant at $1,500/hp, and 2,800 hp back-up boilers at $1000/hp for the total cost of $9.97 million (1997 money). The annual component is an amount that has to be deposited in a 6.5% bearing account to accumulate the total cost with 3% escalation in 30 years. Option 2 assumes $189,610 for both: boiler retubing and equipment replacement.

Operation and Maintenance

- Five people were allocated for operation of the UVM central plant in accordance with UVM estimates.

The total first year savings are estimated at $2,450,941 based on option 1 assumptions and $1,159,137 with option 2 assumptions. The total second year savings are estimated at $15,692 based on option 1 assumptions and –400,120 with option 2 assumptions. JTC considers the option 1 assumptions to be conservative and expects the UVM savings with district heating to be higher. Net present value of savings for 20 years is estimated at $7.6 million for option 1 assumptions and $1.6 million for option 2 assumptions.

The net present value of pollutant externality cost savings for UVM is estimated at $3.7 million with HTHW. And at 4.9 million with MTHW.

Advantages for FAHC

The FAHC first and second year energy cost with and without the district heating is presented in Table 3a based on option 1 assumptions and in Table 3b for option 2 assumptions. The major assumptions are as follows:

- Overall boiler seasonal efficiency is 70% for both options

- Obtain official permission to waive the excavation fee issue by the City of Burlington.

Table S-2b
UVM HTHW, low savings assumption

Annual Expenditures for the UVM Central Plant	*Without District Heating (1st year)*		*Without District Heating (2nd year)*		*With District Heating (1st year)*		*With District Heating (2nd year)*		*Savings*	
	Total	*Unit Cost, $/MMBtu*	*Total*	*Unit Cost, $/MMBtu*	*Total*	*Unit Cost, $/MMBtu*	*Total*	*Unit Cost, $/MMBtu*	*1st year*	*2nd year*
FUEL										
Annual Fuel Cost, including:	1,457,362	5.41	1,493,796	5.55	56,643	0.21	58,059	0.22	1,400,719	1,435,737
Gas	1,244,033		1,275,134		-		-		1,244,033	1,275,134
Oil	156,686		160,603		-		-		156,686	160,603
Back-up Boiler Fuel	56,643		58,059		56,643		58,059		-	-
CAPITAL COMPONENT										
New Backup Boiler 1,195 HP to be installed	1,800,000		-		-				1,800,000	
Boiler Retubing and Control: in 15 years	-		-		-				-	-
Capital Allocation for Equipment Replacement	189,610		189,610		70,000		70,000		119,610	119,610
Annual Debt Service for Existing Plant	190,000		190,000		190,000		190,000		-	
Total Capital Component	2,179,610	8.09	379,610	1.41	260,000	0.97	260,000	0.97	1,919,610	119,610
MAINTENANCE/OPERATIONS (NON-FUEL)										
Labor Cost	450,000		461,250		250,000		256,250		200,000	205,000
Annual Service Contracts	29,696		30,439		29,696		30,438		0	0
Annual Chemicals	22,588		23,153		22,588		23,153		0	0
Annual Parts Cost	99,797		102,292		99,797		102,292		-	-
Annual Insurance	17,184		17,614		17,184		17,614		-	-
Annual Water & Sewer	117,956		120,905		117,956		120,905		0	0
Annual Electric Cost	174,163		178,517		140,250		143,756		33,913	34,761
Annual Staff Training Cost	1,534		1,572		1,534		1,572		-	-
Annual Infrastructure Cost	129,823		133,068		129,823		133,068		-	-
Back-up Boiler O&M	10,000		10,250		10,000		10,250		-	-
Total Maintenance/Operations (non-fuel)	1,052,742	3.91	1,079,060	4.01	818,828	3.04	839,298	3.12	233,914	239,762
DISTRICT HEATING COST										
District Heating Cost[1]	-	0.00	-	0.00	2,395,106	8.89	2,195,229	8.15	(2,395,106)	(2,195,229)
TOTAL ANNUAL COST	4,689,714	17.41	2,952,466	10.96	3,530,577	13.11	3,352,586	12.44	1,159,137	(400,120)

low savings assumption represent judgement of UVM

[1] The district heating rate of $8.89/MMBtu for the first year and $8.15 for the second year is based on UVM estimates for $72,000 to keep UVM boilers in stand-by and $53,000 natural gas cost for boiler room operation during McNeil shut-down

Table S-3b
FAHC HTHW, low savings assumptions

1994 - 96 Annual Expenditures for the FAHC Central Plant	*Without District Heating (1st year)*		*Without District Heating (2nd year)*		*With District Heating (1st year)*		*With District Heating (2nd year)*		*Savings*	
	Total	*Unit Cost, $/MMBtu*	*Total*	*Unit Cost, $/MMBtu*	*Total*	*Unit Cost, $/MMBtu*	*Total*	*Unit Cost, $/MMBtu*	*1st year*	*2nd year*
FUEL										
Annual Fuel Cost, including:	703,272	5.95	720,854	6.10	3,863	0.03	3,960	0.03	699,409	716,894
Gas	689,947		707,196		3,863		3,960		686,084	703,236
Oil	13,325		13,658		-		-		13,325	13,658
CAPITAL COMPONENT										
Replace 2 - 600 BHP boilers (MCHV)	500,000				-		-		500,000	500,000
New 500 BHP boilers (for ACF)	200,000				-		-		200,000	200,000
Replace 100 BHP with 350 BHP (UHC)	150,000				-		-		150,000	150,000
Replace 500 BHP with 350 BHP (UHC)	175,000				-		-		175,000	175,000
Feedwater/Deaeration	300,000		300,000		-		-		300,000	300,000
Miscellaneous Improvements	260,000		210,000		-		-		260,000	260,000
Total First Year Capital Cost	1,585,000		510,000		-		-		1,585,000	1,585,000
Ammortized Annual Capital Cost, 6.5%, 20 years	143,849		143,849		-		-		143,849	143,849
Capital Allocation for Existing Equipment Replacement in 20 years	13,025		13,025		-				13,025	13,025
Annual Capital Component: 6.5%, 20 years	156,874	1.33	156,874.18	1.33	-	0.00	-	0.00	156,874	156,874
MAINTENANCE/OPERATIONS (NON-FUEL)										
Labor Cost	109,272		112,004		-		-		109,272	112,004
Annual Service Contracts	4,333		4,442		2,000		2,050		2,333	2,392
Annual Chemicals	25,196		25,826		25,196		25,826		0	0
Annual Parts Cost	2,439		2,500		488		500		1,951	2,000
Annual Insurance	10,674		10,941		5,337		5,470		5,337	5,471
Annual Water & Sewer	61,600		63,140		61,600		63,140		-	-
Annual Electric Cost	12,000		12,300		1,200		1,230		10,800	11,070
Total Maintenance/Operations (non-fuel)	225,515	1.91	231,153	1.96	95,821	0.81	98,216	0.83	129,694	132,936
DISTRICT HEATING COST	-	0.00	-	0.00	1,037,036	8.77	939,547	7.95	(1,037,036)	(939,547)
TOTAL ANNUAL COST	1,085,661	9.19	1,108,880	9.38	1,136,720	9.62	1,041,720	8.81	-51,059	67,157

The low savings assumptions represent the judgement of FAHC