Cycle Cost Analysis
Utility Combinations

U.S. Department of Housing and Urban Development
Office of Public and Indian Housing

OMB. No. 2577-0024 (Exp. 10-31-86)

Part A—Summary

1. Public/Indian Housing Agency	2. Project Number	3. Date
HOUSING AUTHORITY OF LOUISVILLE		NOV. 24, 1997
4. By (Name and Title)	5. Prepared By:	
MARTIN WARFORD, MECH. ENGR.	E.R. RONALD AND ASSOCIATES	

Utility Combinations ►	Comb. No. 1		Comb. No. 2		Comb. No. ___		Comb. No. ___	
6. Domestic Hot Water Installation	INDIVIDUAL		INDIVIDUAL					
7a. Space Heating Installation	INDIVIDUAL		INDIVIDUAL					
b. Space Heating System	GAS-FIRED FURNACE		HEAT PUMP					
8. Space Air Conditioning Installation	SPLIT DX		SPLIT DX					
Fuel and Energy Types and Purchasing Methods	Tenant	Master-meter	Tenant	Master-meter	Tenant	Master-meter	Tenant	Master-meter
9. Lighting and Refrigeration	E	—	E	—				
10. Cooking	E	—	E	—				
11. Domestic Hot Water	G	—	E	—				
12. Space Heating	G	—	E	—				
13. Space Air Conditioning	E	—	E	—				
Initial Cost of Utility Installation								
14. Per Dwelling Unit	$ —		$ —		$		$	
15. Total	$ —		$ —		$		$	
Estimated Cost Per Unit Per Month								
16. Electricity	$ 59.33		$ 138.08		$		$	
17. Gas	$ 47.88		$ —		$		$	
18. Fuel and Heating/Cooling Supplies	$ 1.50		$ 1.50		$		$	
19. Heating/Cooling Labor	$ —		$ —		$		$	
20. Repairs, Maintenance and Replacements (20 year average)	$ 11.00		$ 11.00		$		$	
21. Interest	$ —		$ —		$		$	
22. Total Monthly Cost	$ 119.71		$ 150.58		$		$	

Recommended: Combination No. 1

Justification of Recommendation: ECONOMICS.

Part B

General Information

OMB No. 2577-0024 (Exp. 10-31-86)

1. Public Housing Agency	2. Project Number	3. Date
HOUSING AUTHORITY OF LOUISVILLE		NOV. 24, 1997

Please make sure the information on this form is as complete and accurate as possible. One Part B is required for each project. On lines 4 through 8, Column 1, indicate the number of dwelling units in each category listed. On lines 4 through 8, Column 4, indicate the number of buildings of the various heights entered in Column 3. Column 5 shows the total number of rooms in the buildings.

Dwelling Size	Number of Dwellings	Height of Buildings (Number of Stories)	Number of Buildings	Number of Rooms
4. One Bedroom	20	2	8	5
5. Two Bedrooms	72	2	46	7
6. Three Bedrooms	92	2	73	8
7. Four Bedrooms	9	2	22	9
8. Total	193			

Climatic Data. Winter/Summer design temperatures are the established base temperatures for design of heating/cooling installations in the locality. It may be obtained from the Handbook of the American Society of Heating, Refrigeration and Air-Conditioning Engineers. Annual Degree Days and Equivalent Full Load Hours may be obtained from the same source or from the Weather Bureau. Average Cold Water Temperature may be obtained from the local water utility.

12a. Winter Design Temperature 10 °F	13a. Annual Degree Days 4660	14. Average Cold Water Temp. 50 °F
12b. Summer Design Temperature 93 °F	13b. Equivalent Full Load Hours 2030	

Energy and Fuel Supplies. Enter names of suppliers of electricity, gas, fuel oil and coal, together with physical characteristics as indicated. Volts, cycles, and Btu contents per unit of measure may be obtained from the respective suppliers. In space provided, list any fuel or energy other than those listed.

15. Electricity Supplied By: LOUISVILLE GAS & ELECTRIC CO.	120 Volts 60 cycles
16. NATURAL Gas Supplied by: LOUISVILLE GAS & ELECTRIC CO.	1030 BTU per. / CU. FT.
17. No. Fuel Oil Supplied by: N/A	BTU per.
18. Coal Supplied by: N/A	BTU per.
19. (Other) Supplied by: N/A	BTU per.

Estimated Average Unit Costs. Enter the appropriate value for the combination recommended by the Public Housing Agency and the other three combinations of lowest cost. These values may be calculated from the quantities and costs shown in Part C. For retail purchases, divide costs from Line 11, Part C, by quantities from Line 8, Part C. For wholesale purchases, divide costs from Line 14 by quantities on Line 10 for the particular combination.

Estimated Average Unit Costs	Comb. No. 1		Comb. No. 2		Comb. No. ___		Comb. No. ___	
	Tenant	Mastermeter	Tenant	Mastermeter	Tenant	Mastermeter	Tenant	Mastermeter
20. Electricity 6.4 ¢ per kwh	59.33	—	138.08	—				
60 ¢ per Mcf or Therm.	47.88	—	—	—				
22. Fuel Oil ¢ per gallon or $ per barrel	—	—	—	—				
23. Coal ¢ per ton	—	—	—	—				
	—	—	—	—				

C

and Energy Heating Supplies, Heating Labor

OMB No. 2577-0024 (Exp. 10-31-86)

1. Public/Indian Housing Agency	2. Project Number	3. Date
HOUSING AUTHORITY OF LOU.		NOV. 24, 1997
	4. Combination No. 1	

Fuel and Energy ►	Electricity		Gas	Oil	Coal	Other
Method of Purchase (Mastermeter or Tenant)	N/A	TENANT	TENANT	N/A	N/A	N/A
Rate Schedule Designation (Rates used in determining cost on Lines 15, 17 & 18)		$0.064	$0.60			
Average Monthly Consumption per Dwelling Unit For:	KW Demand	KWH Consumption	MCF or Therms	Gallons	Tons	Other
5. Lighting and Refrigeration	—	312.5	—			
6. Space Air Conditioning	—	302.0	—			
7. Cooking and clothes drying	—	312.5	—			
8. Domestic Hot Water	—	—	22.72			
9. Space Heating	—	—	57.08			
10. Street Lighting	—	—	—			
11. General Project Use	—	—	—			
12. Net Total	—	927	79.8			
13. On-Site Losses	—	—	—			
14. Total Fuel and Energy Per Dwelling Unit	—		79.8			
Tenant Purchases 15. Average Cost Per DU Per Month		$59.33	$47.88	$	$	$
Mastermeter Purchases 16. Average Project Demand and Consumption Per Month						
17. Average Project Cost Per Month		$	$	$	$	$
18. Average Cost Per DU Per Month		$	$	$	$	$

Heating/Cooling Supplies 19. Estimated Total Per Year	$	18.00
20. Cost Per DU Per Month		1.50

Heating/Cooling Labor

21.	Chief Engineer	for	months, at	$	$
22.	Engineers	for	months, at	$	$
23.	Firemen	for	months, at	$	$
24	Other	for	months, at	$	$

C

el and Energy Heating Supplies, Heating Labor

OMB No. 2577-0024 (Exp. 10-31-86)

1. Public/Indian Housing Agency	2. Project Number	3. Date
HOUSING AUTHORITY OF LOU.		NOV. 24, 1997
	4. Combination No.: 2	

Fuel and Energy ►	Electricity		Gas	Oil	Coal	Other
Method of Purchase (Mastermeter or Tenant)	N/A	TENANT	N/A	N/A	N/A	N/A
Rate Schedule Designation (Rates used in determining cost on Lines 15, 17 & 18)		$ 0.064	—			
Average Monthly Consumption per Dwelling Unit For:	KW Demand	KWH Consumption	MCF or Therms	Gallons	Tons	Other
5. Lighting and Refrigeration	—	312.5	—			
6. Space Air Conditioning	—	302.0	—			
7. Cooking	—	312.5	—			
8. Domestic Hot Water	—	798.9	—			
9. Space Heating	—	431.6	—			
10. Street Lighting	—	—	—			
11. General Project Use	—	—	—			
12. Net Total	—	2157.5	—			
13. On-Site Losses	—	—	—			
14. Total Fuel and Energy Per Dwelling Unit	—	2157.5	—			
Tenant Purchases 15. Average Cost Per DU Per Month		$ 138.08	$ —	$	$	$
Mastermeter Purchases 16. Average Project Demand and Consumption Per Month						
17. Average Project Cost Per Month		$	$	$	$	$
18. Average Cost Per DU Per Month		$	$	$	$	$

Heating/Cooling Supplies
19. Estimated Total Per Year $ 18.00

20. Cost Per DU Per Month 1.50

Heating/Cooling Labor

	Chief Engineer	for	months, at	$	$
22.	Engineers	for	months, at	$	$
23.	Firemen	for	months, at	$	$
24	Other	for	months, at	$	$

5W

11-25-97
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*
* RESIDENTIAL HEATPUMP COMPARISON *
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Prepared For: PARK DUVALLE

LOUISVILLE KENTUCKY 40202

Job Name: PARK DUVALLE

DESIGN WEATHER CONDITIONS:
City.....LOUISVILLE, KY.
Summer Design Temperature..... 93
Winter Design Temperature..... 10

DESIGN LOADS:
HEATING LOAD
40000 BTUH

COOLING LOAD
30000 BTUH

PRESENT SYSTEM:
FURNACE TYPE..... Nat. Gas
FURNACE EFFICIENCY.. .8
FURNACE CAPACITY.... 50000
FUEL COST..... 60.00 (Cents/Therm)
SEER..... 12

HEATPUMP SYSTEM:
REPLACEMENT/NEW HEATPUMP
CAPACITY..... 35000
COP..... 3.4
ELECTRIC RATE..... 6.40Cents/KWH
SEER..... 11.5

Thermal Balance Point 28 F
Economic Balance Points Calculated on a Yearly Basis.

SIX YEAR RESULTS

	HEATING COSTS			COOLING COSTS		
Year	Present System	Heatpump & Strip Heat	Savings	Present System	Heatpump System	Savings
1997	$ 412	$ 332	$ 80	$ 232	$ 242	$ -10
1998	$ 420	$ 338	$ 82	$ 236	$ 247	$ -11
1999	$ 428	$ 345	$ 83	$ 241	$ 252	$ -11
2000	$ 437	$ 352	$ 85	$ 246	$ 257	$ -11
2001	$ 446	$ 358	$ 88	$ 251	$ 262	$ -11
2002	$ 455	$ 366	$ 89	$ 256	$ 267	$ -11
TOTAL	$ 2,598	$ 2,091	$ 507	$ 1,462	$ 1,527	$ -65

PARK DuVALLE — NOV. 24, 1997

BLOCK HTG/COOL. LOADS

THREE BEDROOM, SINGLE UNIT (AUG. UNIT)

SOLAR GLASS:

NORTH	10 x 98	=	980
SOUTH	70 x 67	=	4,690
EAST	10 x 64	=	640
WEST	105 x 15	=	1,575
GLASS TRANS.	10 x 244	=	2,440
WALL TRANS.	1.4 x 1456	=	2,040
FLOOR	1.0 x 625	=	625
ROOF	3.2 x 625	=	2,000
LIGHTS	6.8 x 625	=	4250
EQUIP.	3.4 x 2000	=	6,800
PEOPLE	230 x 6	=	1,380
SENSIBLE COOLING			27,420
PEOPLE	130 x 6	=	780
TOTAL COOLING.			28,200 BTUH

HEATING

GLASS	36 x 244	=	8,785
WALL	5 x 1456	=	7,280
FLOOR	2 x 625	=	1,250
ROOF	3 x 625	=	1,875
INFL.	1.1 x 11,250	=	12,375
			31,565
10% S.F		=	3155

PARK DUVALLE

NOV. 24, 1997

DOMESTIC HOT WATER

20 GALLONS PER CAPITA PER DAY

6 OCCUPANTS PER UNIT AVG.

$$\text{YEARLY BTU's} = \frac{Q \times \Delta T}{E} \qquad 1 \text{ GAL.} = 8.3 \text{ LBS.}$$

$Q = 6 \text{ occup.} \times 20 \text{ GAL./DAY/occup.} \times 365 \text{ DAYS/YR.}$

$Q = 43{,}800 \text{ GAL/YR}$

$\text{YEARLY BTU's} = 43{,}800 \text{ GAL/YR} \times 8.3 \text{ LBS/GAL} \times (140^\circ - 50^\circ)$

$= 32{,}718{,}600 \text{ BTU's/YEAR}$

YEARLY FUEL COST:

$$\text{NATURAL GAS} = \frac{32{,}718{,}600 \text{ BTU}}{0.8 \text{ EFFIC} \times \text{YEAR}} \times \frac{60¢}{\text{THERM}} = \$245.39/\text{YR.}$$

$\$20.45/\text{mo}$

$$\text{ELECTRIC} = \frac{32{,}718{,}600 \text{ BTU}}{\text{YEAR}} \times \frac{6.4¢}{\text{KWH}} \times \frac{\text{KW}}{3413 \text{ BTU}} = \$613.53$$

$\$51.13/\text{mo.}$

LIGHTING

0.5 WATTS/FT²

$$\frac{0.5 \text{ WATTS}}{\text{FT}^2} \times 1250 \text{ FT}^2 \times \frac{\text{KW}}{1000 \text{ WATTS}} \times \frac{\$0.064}{\text{KWH}} \times \frac{2920 \text{ HRS}}{\text{YR}} = \$116.8/\text{YR}$$

$\$9.73/\text{mo}$