Wood Frame Standard Construction
Energy Cost Analysis

for

Howe Construction
8404 East 56th Street
Newaygo, MI 49337

Prepared By:

HVAC Consulting, Inc.
3710 Cottonwood Lane
Valparaiso, IN 46385
(219) 548-7270
Thursday, January 26, 2006

Project Summary

General Project Information

Project Filename:	C:\Program Files\Elite\Auditw\Projects\Howe Construction, Standard Construction Practices.aud	Company Name:	HVAC Consulting, Inc.
		Company Address:	3710 Cottonwood Lane
		Company City:	Valparaiso, IN 46385
		Company Phone:	(219) 548-7270
Project Title:	Wood Frame Standard Construction	Company Fax:	(219) 548-7273
		Company E-Mail Address:	admin@HVAC-consult.com
Project Date:	Wednesday, January 18, 2006		
Project Comment:	For planning and budgeting only. Not for construction	Company Website:	www.HVAC-consult.com
		Company Comment:	For planning and budgeting only. Not for construction.
Client Name:	Howe Construction		
Client Address:	8404 East 56th Street		
Client City:	Newaygo, MI 49337		
Client Phone:	(231) 937-4825		
Client Fax:	Same		
Client E-Mail Address:	esh@pathwaynet.com		
Client Website:	www.arit.com		
Client Comment:	For planning and budgeting only. Not for construction		

Design Data

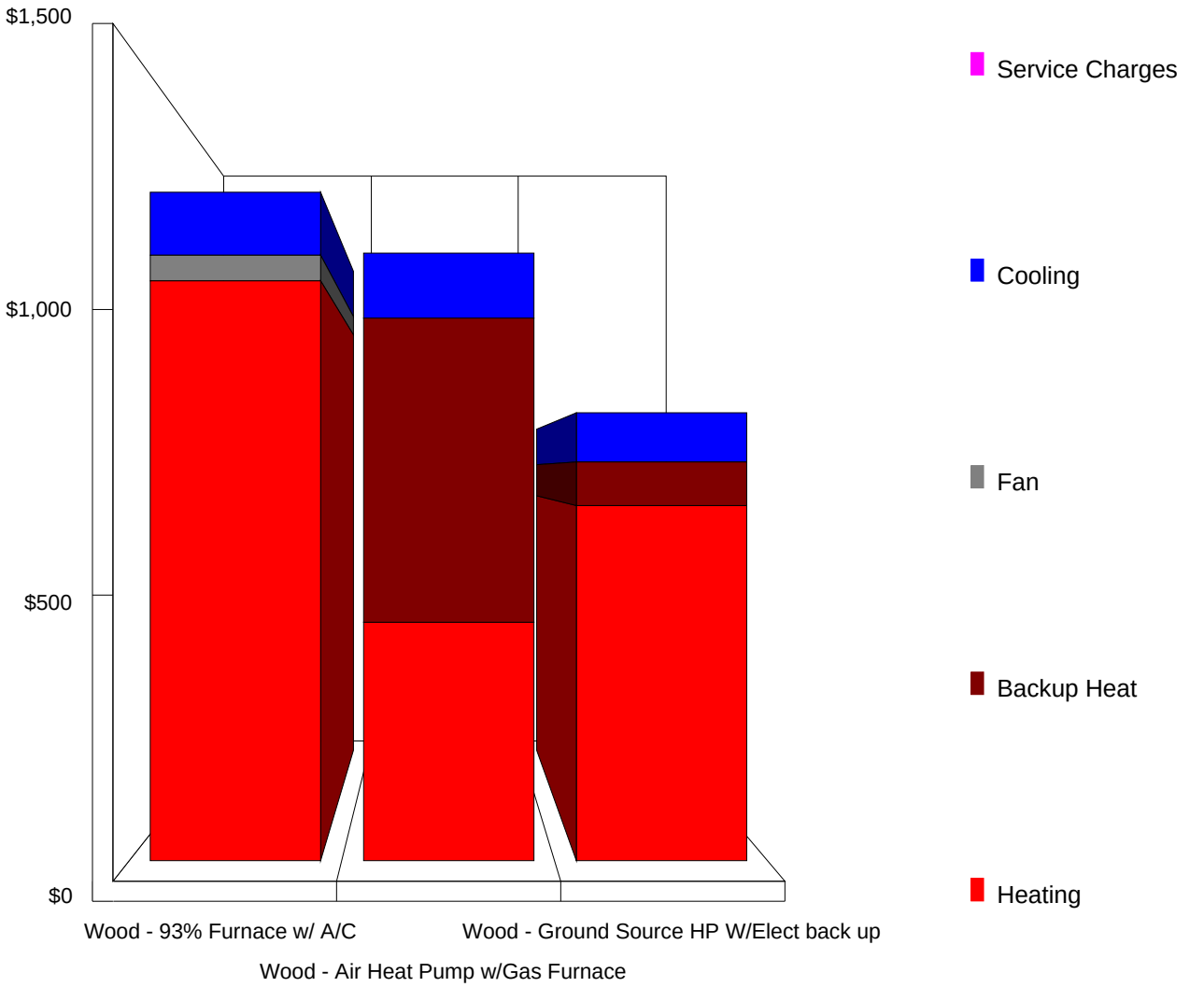
Building Area:	2,610 sq.ft.	Cooling Load:	26,154 Btuh
People:	3	Heating Load:	53,353 Btuh
Occupancy:	0	Loads Adj. Factor:	0.77
		AC On Temp.:	0 °F
Actual City:	Grand Rapids, Michigan		
Weather Ref. City:	Grand Rapids, Michigan		
Summer Outdoor:	88 °F	Winter Outdoor:	0 °F
Summer Indoor:	75 °F	Winter Indoor:	72 °F
Cooling Hours:	730	Degree Days:	6,800

Annual Operating Cost Estimate

System Description	Fuel Rates Set	Total Heating Cost	Total Cooling Cost	Annual Service Charges	Total Oper. Cost	Average Monthly Cost
Wood - 93% Furnace w/ A/C	1	$1,113	$116	$0	$1,229	$102
Wood - Air Heat Pump w/Gas Furnace	1	$998	$119	$0	$1,118	$93
Wood - Ground Source HP W/Elect back up	1	$733	$91	$0	$824	$69

Project Summary Bar Chart

System Operating Cost Comparison



Input Data - System 1 - Wood - 93% Furnace w/ A/C

		Estimated Cost
Cooling		
System Type:	Standard Air Conditioner	
Model:	RAPC-030JAZRGPL-07?BRQ?+RCHJ-36A1	
ARI Ref. No.:	474314	
Efficiency:	14.35 SEER	
Capacity:	29,200 Btuh	
Cooling Load:	26,154 Btuh	
Annual Cost (Spec Cooling Hours Method):		$115.75
Heating		
System Type:	Natural Gas Furnace	
Model:	RGFD-06(EN)MCKS**	
Efficiency:	93.5 AFUE	
Capacity:	55,800 Btuh	
Heating Load:	53,353 Btuh	
Fan or Pump Electric Usage:	545.3 kWh	$47.44
Annual Cost (Degree Days Method):		$1,113.08
Total Cost		
Total Annual Operating Cost:		$1,228.83

Input Data - System 2 - Wood - Air Heat Pump w/Gas Furnace

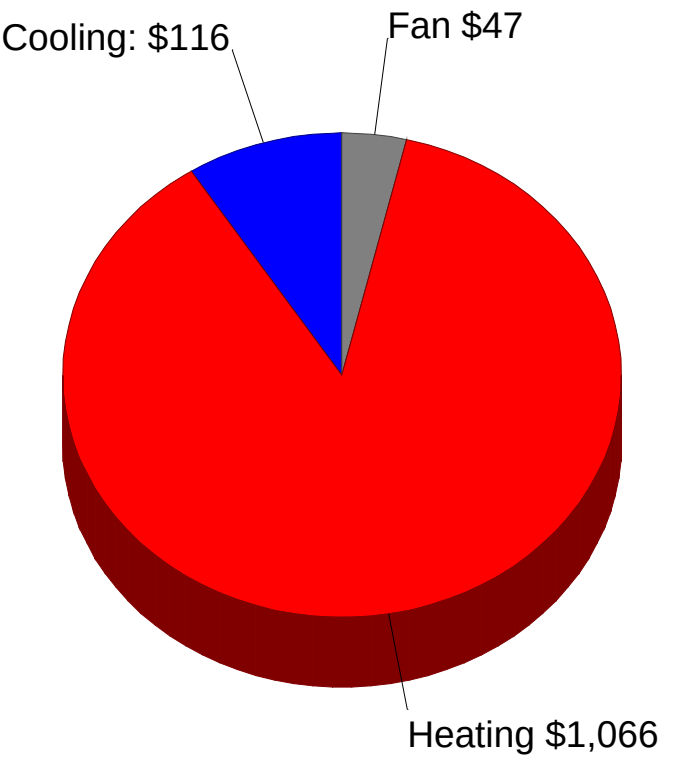
		Estimated Cost
Cooling		
System Type:	Air Source Heat Pump	
Model:	RPMM-030JAZRGLL-07?BRK?+RCHL-36A1	
ARI Ref. No.:	474829	
Efficiency:	13.90 SEER	
Capacity:	29,000 Btuh	
Cooling Load:	26,154 Btuh	
Annual Cost (Spec Cooling Hours Method):		$119.50
Heating		
System Type:	Air Source Heat Pump	
Model:	RPMM-030JAZRGLL-07?BRK?+RCHL-36A1	
Efficiency:	8.6 HSPF	
Capacity:	28,000 Btuh	
Heating Load:	53,353 Btuh	
47° Capacity:	28,000 Btuh	
17° Capacity:	18,200 Btuh	
47° COP:	3.6	
17° COP:	2.34	
Capacity Balance Point:	37 °F	
Cutoff Temperature:	30 °F	
Annual Cost (Bin Data Method):		$438.54
Backup		
System Type:	Natural Gas Furnace	
Model:	RGFD-06(EN)MCKS**	
Efficiency:	93.50	
Capacity:	55,800 Btuh	
Annual Cost:		$559.48
Total Cost		
Total Annual Operating Cost:		$1,117.52

Input Data - System 3 - Wood - Ground Source HP W/Elect back up

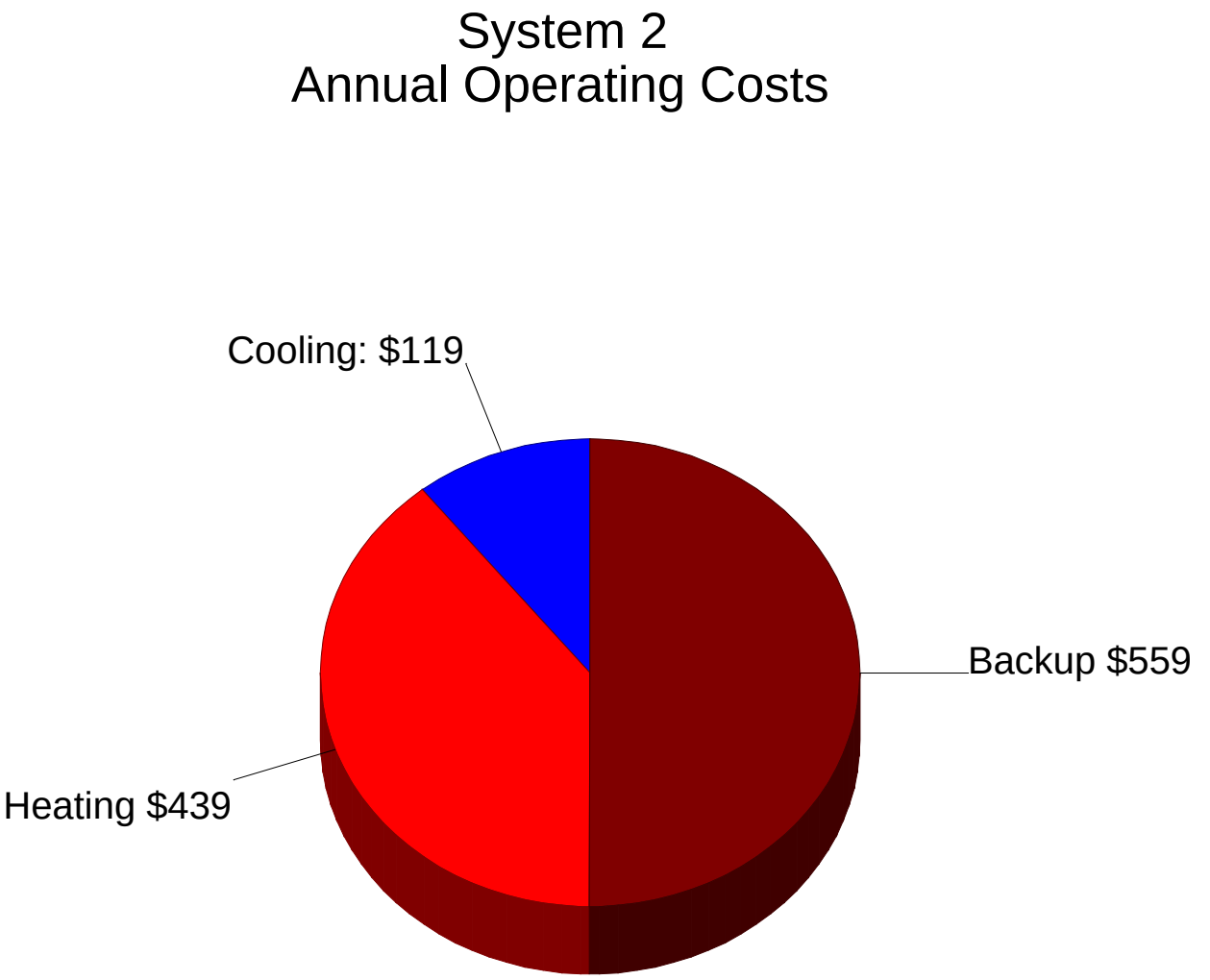
		Estimated Cost
Cooling		
System Type:	Ground Source Heat Pump	
Model:	TTV/TTH/TTD038	
Efficiency:	18.20 EER	
Capacity:	38,200 Btuh	
Cooling Load:	26,154 Btuh	
Annual Cost (Spec Cooling Hours Method):		$91.27
Heating		
System Type:	Ground Source Heat Pump	
Model:	TTV/TTH/TTD038	
Efficiency:	4 COP	
Capacity:	29,000 Btuh	
Heating Load:	53,353 Btuh	
47° Capacity:	36,700 Btuh	
17° Capacity:	36,700 Btuh	
47° COP:	4.7	
17° COP:	4.7	
Capacity Balance Point:	30 °F	
Cutoff Temperature:	0 °F	
Annual Cost (Bin Data Method):		$653.41
Backup		
System Type:	Electric Resistance	
Efficiency:	100.00	
Capacity:	51,182 Btuh	
Annual Cost:		$79.40
Total Cost		
Total Annual Operating Cost:		$824.08

Input Data Pie Chart - System 1 - Wood - 93% Furnace w/ A/C

System 1
Annual Operating Costs

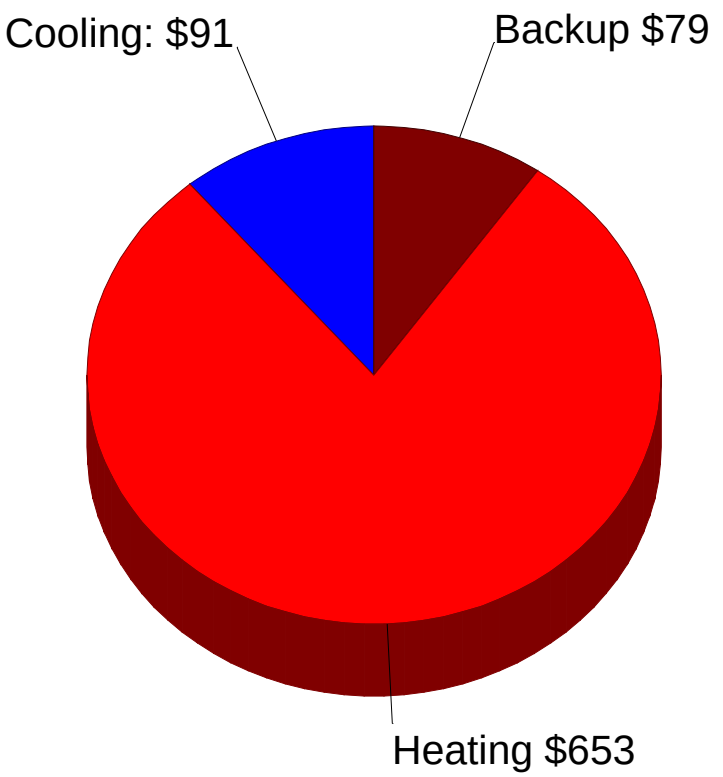


Input Data Pie Chart - System 2 - Wood - Air Heat Pump w/Gas Furnace



Input Data Pie Chart - System 3 - Wood - Ground Source HP W/Elect back up

System 3
Annual Operating Costs



Monthly Costs - System 1 - Wood - 93% Furnace w/ A/C

Monthly System Cost

	Cooling		Heating		Total
Month	Cost	%	Cost	%	Cost
January	$0.00	0.0%	$202.58	100.0%	$202.58
February	$0.00	0.0%	$185.69	100.0%	$185.69
March	$0.00	0.0%	$154.00	100.0%	$154.00
April	$4.15	4.3%	$91.29	95.7%	$95.44
May	$9.61	19.5%	$39.79	80.5%	$49.40
June	$23.82	63.1%	$13.95	36.9%	$37.77
July	$36.71	84.2%	$6.87	15.8%	$43.58
August	$24.79	70.4%	$10.45	29.6%	$35.24
September	$12.29	27.1%	$33.13	72.9%	$45.43
October	$3.78	5.6%	$63.72	94.4%	$67.50
November	$0.60	0.5%	$120.56	99.5%	$121.16
December	$0.00	0.0%	$191.06	100.0%	$191.06
Total	$115.75	9.4%	$1,113.08	90.6%	$1,228.83

Monthly Fuel Usage and Cost

	Electricity		Natural Gas		Propane		Fuel Oil	
Month	Cost	kWh	Cost	Therm	Cost	Gallons	Cost	Gallons
January	$8.63	99.2	$193.94	181.3	$0.00	0.0	$0.00	0.0
February	$7.91	91.0	$177.78	166.1	$0.00	0.0	$0.00	0.0
March	$6.56	75.4	$147.44	137.8	$0.00	0.0	$0.00	0.0
April	$8.04	92.4	$87.40	81.7	$0.00	0.0	$0.00	0.0
May	$11.31	130.0	$38.09	35.6	$0.00	0.0	$0.00	0.0
June	$24.42	280.7	$13.36	12.5	$0.00	0.0	$0.00	0.0
July	$37.00	425.3	$6.58	6.1	$0.00	0.0	$0.00	0.0
August	$25.24	290.1	$10.00	9.3	$0.00	0.0	$0.00	0.0
September	$13.70	157.5	$31.72	29.6	$0.00	0.0	$0.00	0.0
October	$6.49	74.6	$61.00	57.0	$0.00	0.0	$0.00	0.0
November	$5.74	65.9	$115.42	107.9	$0.00	0.0	$0.00	0.0
December	$8.14	93.6	$182.91	170.9	$0.00	0.0	$0.00	0.0
Total	$163.19	1,875.8	$1,065.64	995.9	$0.00	0.0	$0.00	0.0

Average Electric Cost Per kWh: $0.087/kWh
Average Natural Gas Cost Per Therm: $1.0700/Therm

Monthly Costs - System 2 - Wood - Air Heat Pump w/Gas Furnace

Monthly System Cost

	Cooling		Heating		Total
Month	Cost	%	Cost	%	Cost
January	$0.00	0.0%	$205.43	100.0%	$205.43
February	$0.00	0.0%	$188.10	100.0%	$188.10
March	$0.00	0.0%	$138.82	100.0%	$138.82
April	$4.28	5.7%	$70.99	94.3%	$75.27
May	$9.92	27.6%	$26.03	72.4%	$35.95
June	$24.59	73.9%	$8.69	26.1%	$33.28
July	$37.90	90.1%	$4.17	9.9%	$42.06
August	$25.59	80.1%	$6.37	19.9%	$31.96
September	$12.69	36.6%	$21.97	63.4%	$34.66
October	$3.90	8.3%	$42.99	91.7%	$46.89
November	$0.62	0.7%	$94.32	99.3%	$94.94
December	$0.00	0.0%	$190.15	100.0%	$190.15
Total	$119.50	10.7%	$998.02	89.3%	$1,117.52

Monthly Fuel Usage and Cost

	Electricity		Natural Gas		Propane		Fuel Oil	
Month	Cost	kWh	Cost	Therm	Cost	Gallons	Cost	Gallons
January	$38.86	446.7	$166.57	155.7	$0.00	0.0	$0.00	0.0
February	$35.42	407.2	$152.68	142.7	$0.00	0.0	$0.00	0.0
March	$67.36	774.3	$71.46	66.8	$0.00	0.0	$0.00	0.0
April	$61.22	703.6	$14.05	13.1	$0.00	0.0	$0.00	0.0
May	$35.95	413.2	$0.00	0.0	$0.00	0.0	$0.00	0.0
June	$33.28	382.6	$0.00	0.0	$0.00	0.0	$0.00	0.0
July	$42.06	483.5	$0.00	0.0	$0.00	0.0	$0.00	0.0
August	$31.96	367.4	$0.00	0.0	$0.00	0.0	$0.00	0.0
September	$34.66	398.4	$0.00	0.0	$0.00	0.0	$0.00	0.0
October	$46.89	539.0	$0.00	0.0	$0.00	0.0	$0.00	0.0
November	$82.01	942.6	$12.93	12.1	$0.00	0.0	$0.00	0.0
December	$48.36	555.9	$141.78	132.5	$0.00	0.0	$0.00	0.0
Total	$558.04	6,414.3	$559.48	522.9	$0.00	0.0	$0.00	0.0

Average Electric Cost Per kWh: $0.087/kWh
Average Natural Gas Cost Per Therm: $1.0700/Therm

Monthly Costs - System 3 - Wood - Ground Source HP W/Elect back up

Monthly System Cost

	Cooling		Heating		Total
Month	Cost	%	Cost	%	Cost
January	$0.00	0.0%	$142.44	100.0%	$142.44
February	$0.00	0.0%	$142.08	100.0%	$142.08
March	$0.00	0.0%	$94.43	100.0%	$94.43
April	$3.27	5.6%	$55.22	94.4%	$58.49
May	$7.58	24.0%	$24.07	76.0%	$31.65
June	$18.78	69.0%	$8.44	31.0%	$27.22
July	$28.94	87.4%	$4.16	12.6%	$33.10
August	$19.55	75.6%	$6.32	24.4%	$25.87
September	$9.69	32.6%	$20.04	67.4%	$29.73
October	$2.98	7.2%	$38.54	92.8%	$41.52
November	$0.47	0.6%	$72.92	99.4%	$73.39
December	$0.00	0.0%	$124.17	100.0%	$124.17
Total	$91.27	11.1%	$732.81	88.9%	$824.08

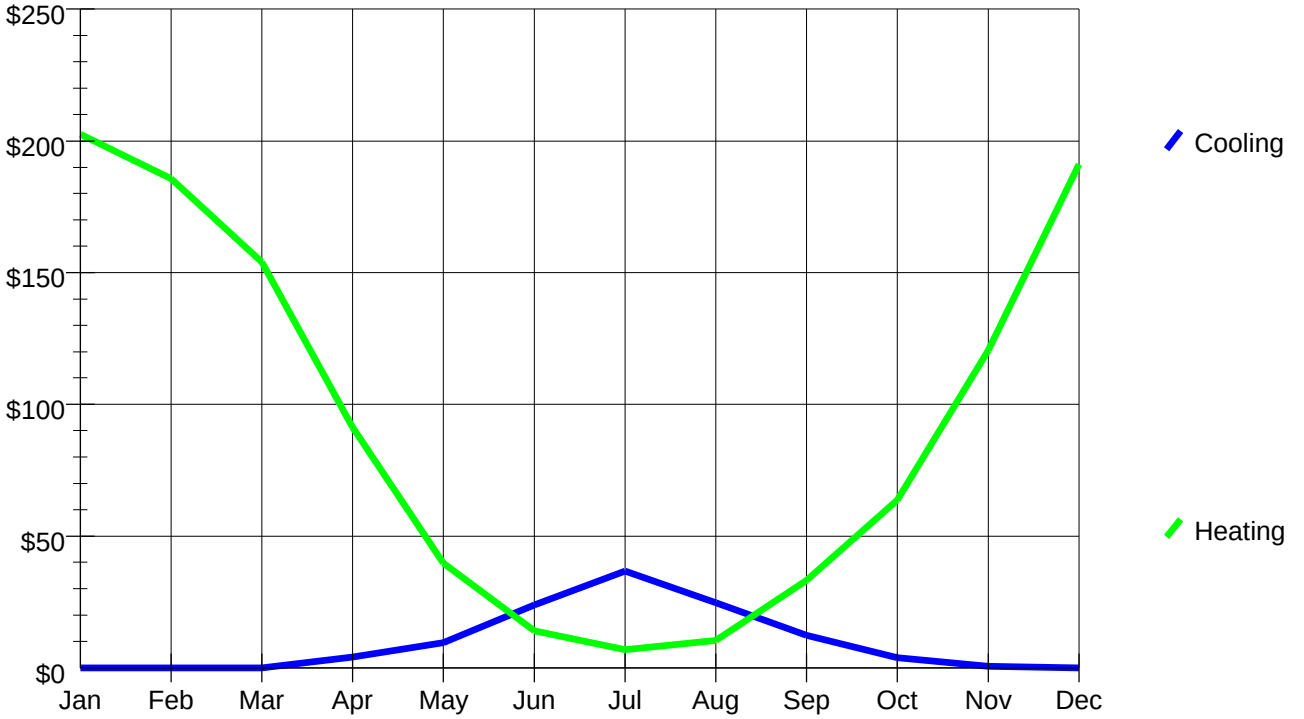
Monthly Fuel Usage and Cost

	Electricity		Natural Gas		Propane		Fuel Oil	
Month	Cost	kWh	Cost	Therm	Cost	Gallons	Cost	Gallons
January	$142.44	1,637.3	$0.00	0.0	$0.00	0.0	$0.00	0.0
February	$142.08	1,633.1	$0.00	0.0	$0.00	0.0	$0.00	0.0
March	$94.43	1,085.4	$0.00	0.0	$0.00	0.0	$0.00	0.0
April	$58.49	672.3	$0.00	0.0	$0.00	0.0	$0.00	0.0
May	$31.65	363.7	$0.00	0.0	$0.00	0.0	$0.00	0.0
June	$27.22	312.9	$0.00	0.0	$0.00	0.0	$0.00	0.0
July	$33.10	380.4	$0.00	0.0	$0.00	0.0	$0.00	0.0
August	$25.87	297.3	$0.00	0.0	$0.00	0.0	$0.00	0.0
September	$29.73	341.8	$0.00	0.0	$0.00	0.0	$0.00	0.0
October	$41.52	477.2	$0.00	0.0	$0.00	0.0	$0.00	0.0
November	$73.39	843.6	$0.00	0.0	$0.00	0.0	$0.00	0.0
December	$124.17	1,427.2	$0.00	0.0	$0.00	0.0	$0.00	0.0
Total	$824.08	9,472.2	$0.00	0.0	$0.00	0.0	$0.00	0.0

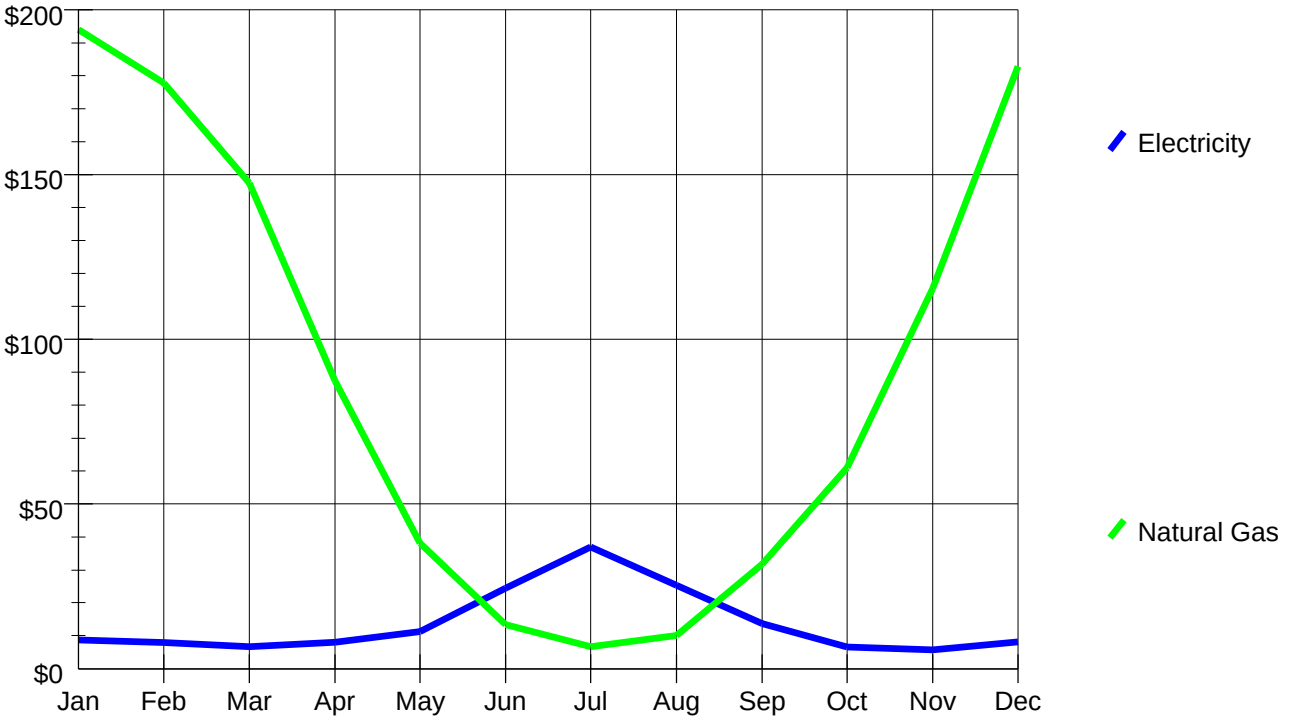
Average Electric Cost Per kWh: $0.087/kWh

Monthly Cost Line Graphs - System 1 - Wood - 93% Furnace w/ A/C

System 1 Monthly Energy Costs

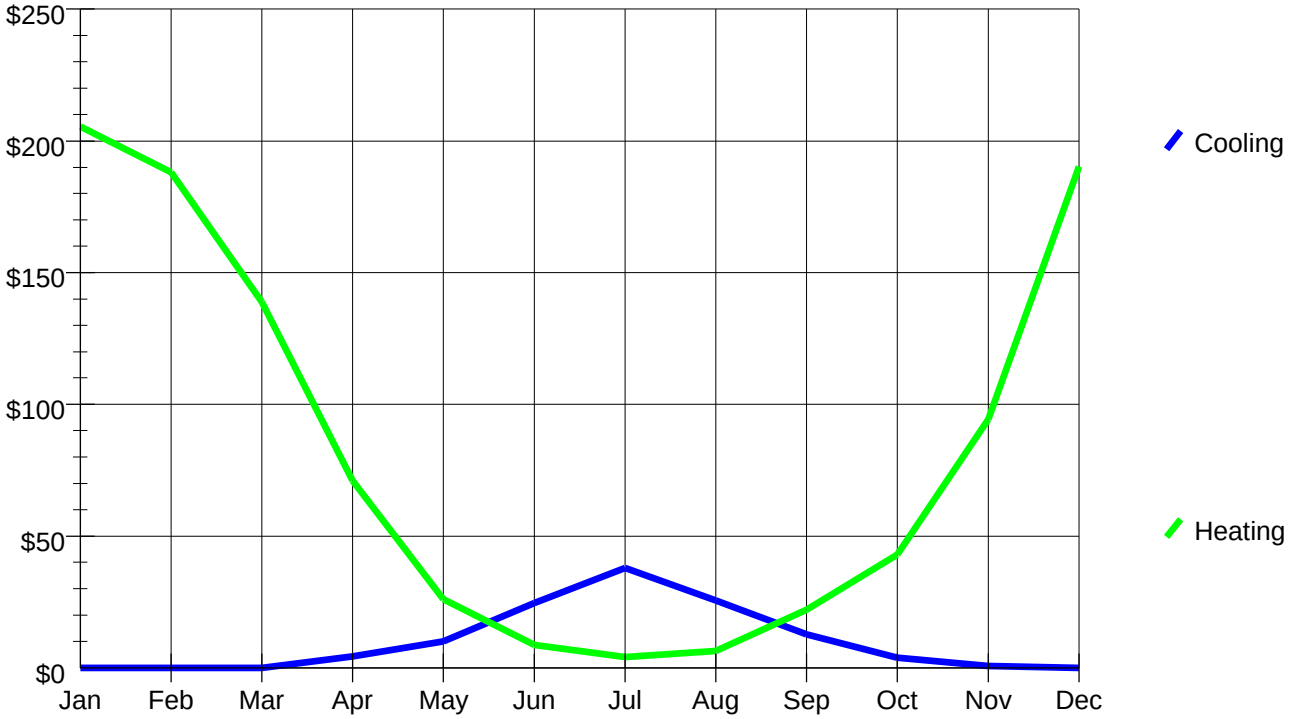


System 1 Monthly Fuel Costs

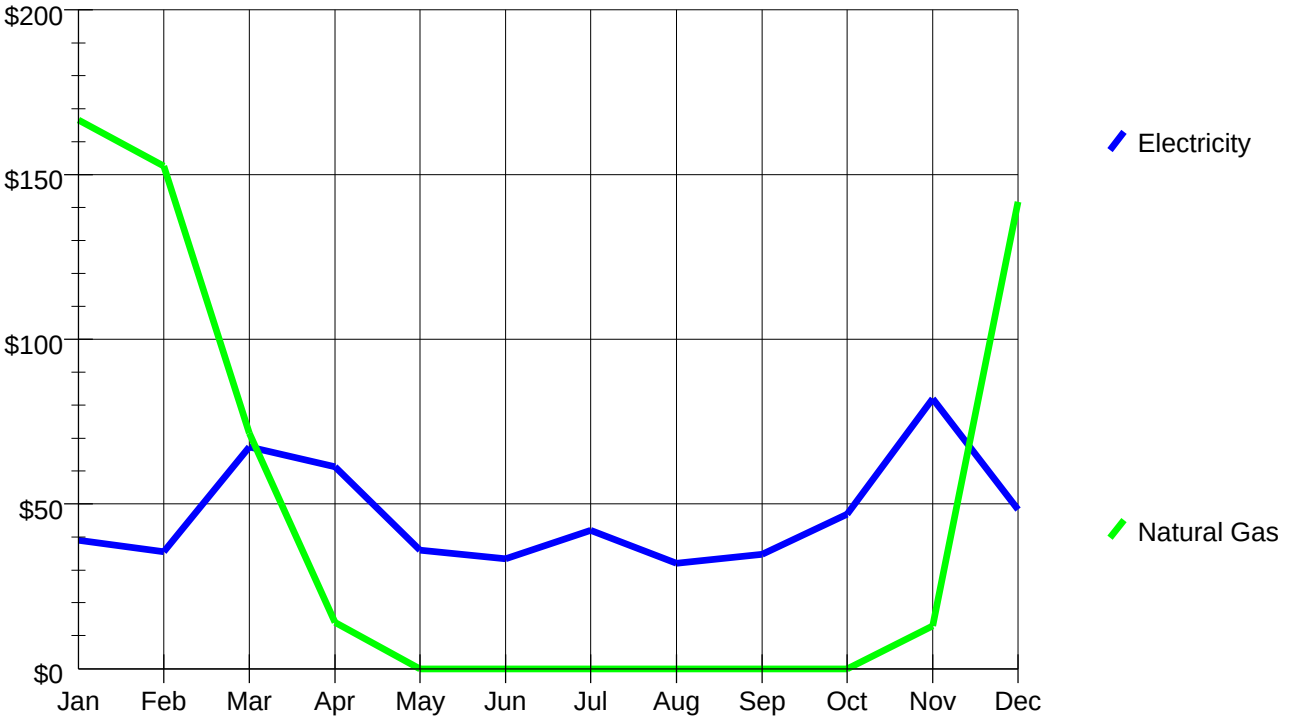


Monthly Cost Line Graphs - System 2 - Wood - Air Heat Pump w/Gas Furnace

System 2 Monthly Energy Costs

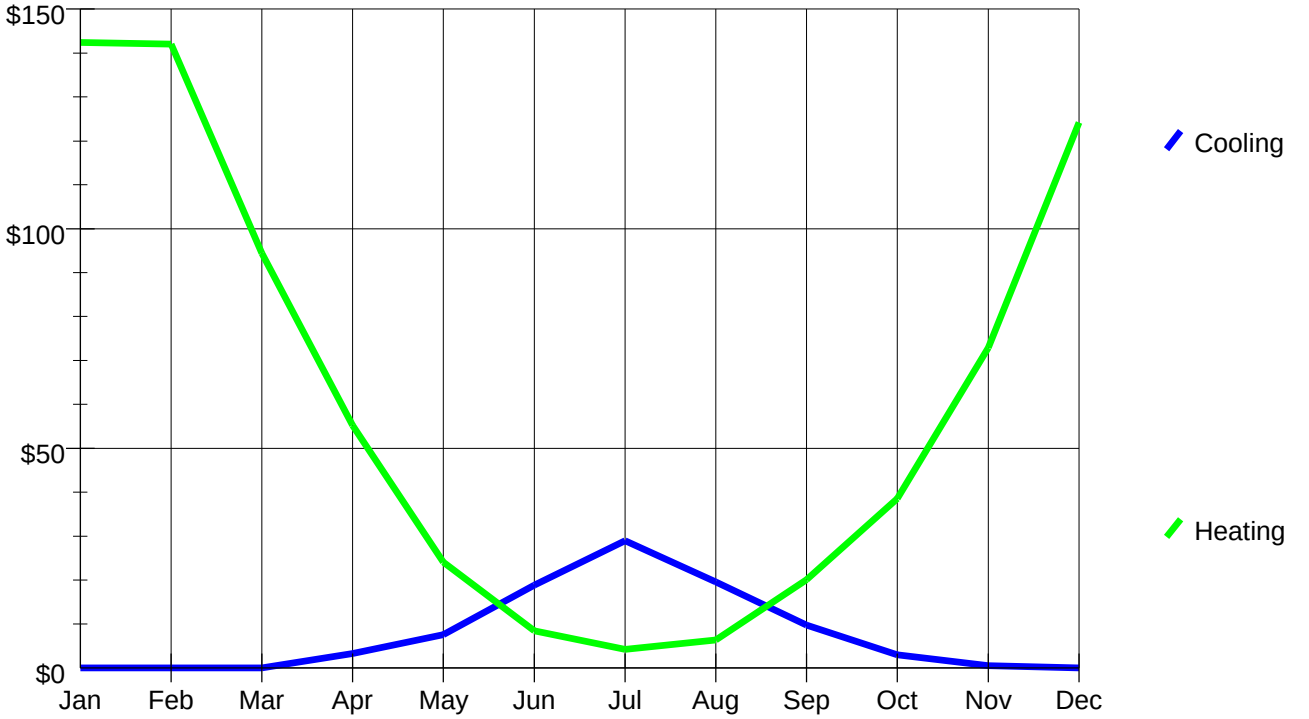


System 2 Monthly Fuel Costs

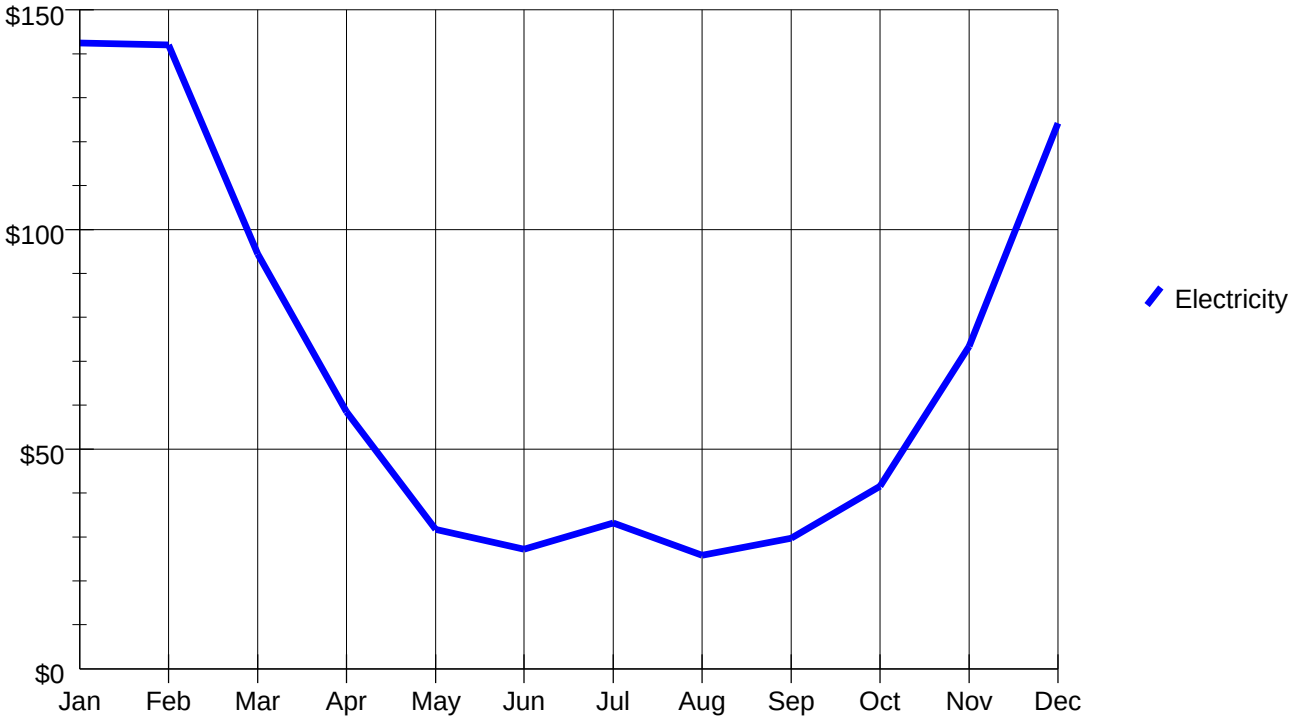


Monthly Cost Line Graphs - System 3 - Wood - Ground Source HP W/Elect back up

System 3 Monthly Energy Costs



System 3 Monthly Fuel Costs

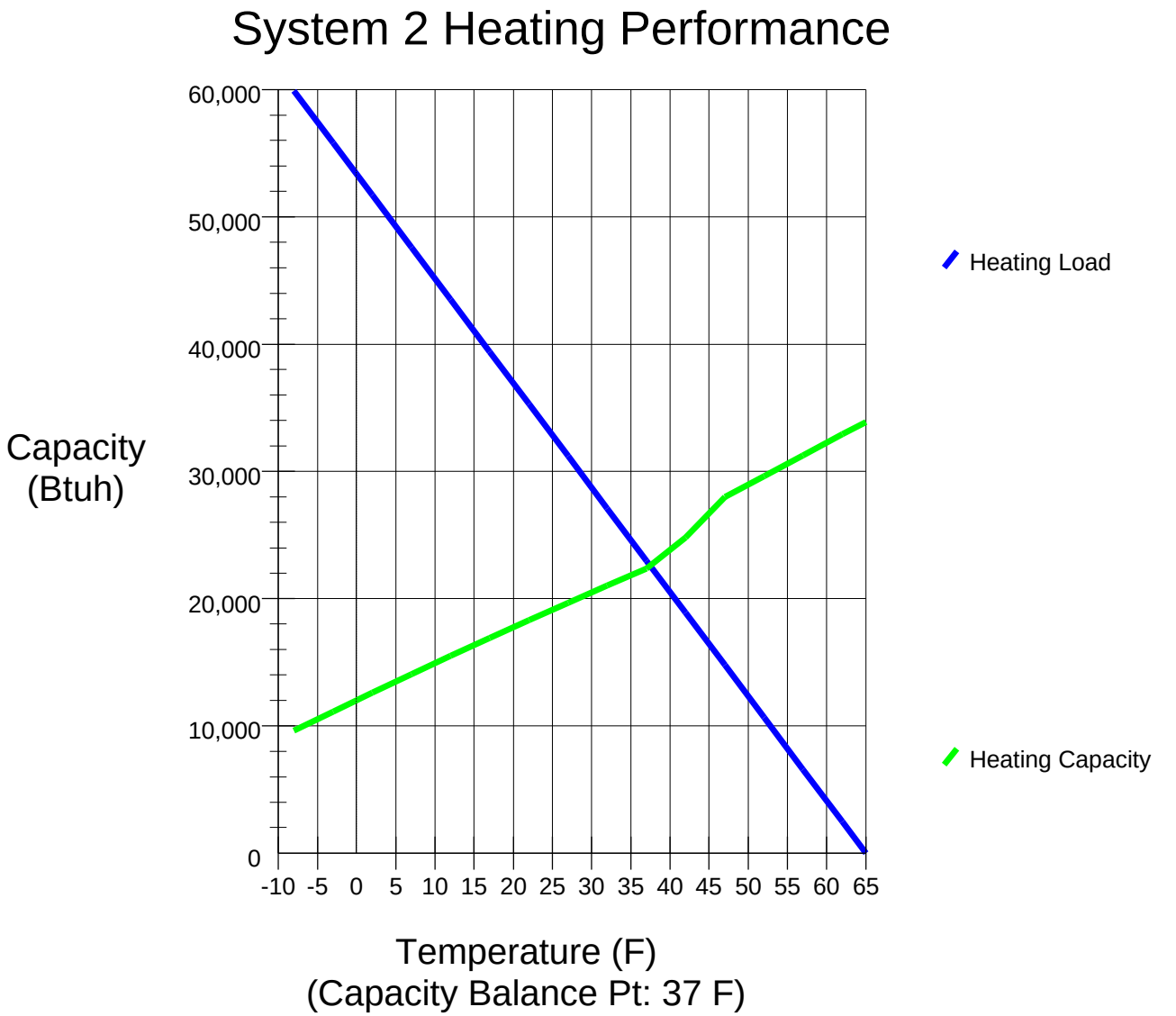


Bin Analysis Report - System 1 - Wood - 93% Furnace w/ A/C

Bin Temp Ranges Degree F	Hours Per Bin	Heating Load Btuh	Adjusted Load (x 0.77)	Energy Input kBtu	Heating Run Time Fraction	Dynamic Efficiency AFUE	Total Heating Cost
-10 to -5	1	59,920	46,138	46	1.000	93.50	0.53
-5 to 0	17	55,815	42,978	731	1.000	93.50	8.36
0 to 5	43	51,711	39,818	1,712	1.000	93.50	19.59
5 to 10	81	47,607	36,658	2,969	1.000	93.50	33.98
10 to 15	195	43,503	33,497	6,532	1.000	93.50	74.75
15 to 20	281	39,399	30,337	8,525	1.000	93.50	97.56
20 to 25	375	35,295	27,177	10,191	1.000	93.50	116.63
25 to 30	757	31,191	24,017	18,181	1.000	93.50	208.06
30 to 35	951	27,087	20,857	19,835	1.000	93.50	226.99
35 to 40	708	22,983	17,697	12,529	1.000	93.50	143.38
40 to 45	569	18,879	14,537	8,271	1.000	93.50	94.66
45 to 50	573	14,775	11,377	6,519	1.000	93.50	74.60
50 to 55	644	10,671	8,216	5,291	1.000	93.50	60.55
55 to 60	586	6,567	5,056	2,963	1.000	93.50	33.91
60 to 65	713	2,462	1,896	1,352	1.000	93.50	15.47
Totals:	6,494						$1,113.08

Bin Analysis Report - System 2 - Wood - Air Heat Pump w/Gas Furnace

Bin Temp Ranges Degree F	Hours Per Bin	Heating Load Btuh	Adjusted Load (x 0.77)	Heat Pump Output Btuh	H. Pump Run Time Fraction	Backup Output Btuh	H.Pump Heating Cost	Backup Heating Cost	Total Heating Cost
-10 to -5	1	59,920	46,138	0	0.000	46,138	0.00	0.53	0.53
-5 to 0	17	55,815	42,978	0	0.000	42,978	0.00	8.36	8.36
0 to 5	43	51,711	39,818	0	0.000	39,818	0.00	19.59	19.59
5 to 10	81	47,607	36,658	0	0.000	36,658	0.00	33.98	33.98
10 to 15	195	43,503	33,497	0	0.000	33,497	0.00	74.75	74.75
15 to 20	281	39,399	30,337	0	0.000	30,337	0.00	97.56	97.56
20 to 25	375	35,295	27,177	0	0.000	27,177	0.00	116.63	116.63
25 to 30	757	31,191	24,017	0	0.000	24,017	0.00	208.08	208.08
30 to 35	951	27,087	20,857	20,857	0.986	0	169.04	0.00	169.04
35 to 40	708	22,983	17,697	17,697	0.783	0	99.78	0.00	99.78
40 to 45	569	18,879	14,537	14,537	0.579	0	61.81	0.00	61.81
45 to 50	573	14,775	11,377	11,377	0.404	0	45.89	0.00	45.89
50 to 55	644	10,671	8,216	8,216	0.276	0	35.21	0.00	35.21
55 to 60	586	6,567	5,056	5,056	0.161	0	18.69	0.00	18.69
60 to 65	713	2,462	1,896	1,896	0.057	0	8.12	0.00	8.12
Totals:	6,494						$438.54	$559.48	$998.02



Bin Analysis Report - System 3 - Wood - Ground Source HP W/Elect back up

Bin Temp Ranges Degree F	Hours Per Bin	Heating Load Btuh	Adjusted Load (x 0.77)	Heat Pump Output Btuh	H. Pump Run Time Fraction	Backup Output Btuh	H.Pump Heating Cost	Backup Heating Cost	Total Heating Cost
-10 to -5	1	59,920	46,138	0	0.000	46,138	0.00	1.18	1.18
-5 to 0	17	55,815	42,978	0	0.000	42,978	0.00	18.62	18.62
0 to 5	43	51,711	39,818	29,000	1.000	10,818	7.95	11.86	19.80
5 to 10	81	47,607	36,658	29,000	1.000	7,658	14.97	15.81	30.78
10 to 15	195	43,503	33,497	29,000	1.000	4,497	36.04	22.36	58.39
15 to 20	281	39,399	30,337	29,000	1.000	1,337	51.93	9.58	61.51
20 to 25	375	35,295	27,177	27,177	0.937	0	64.95	0.00	64.95
25 to 30	757	31,191	24,017	24,017	0.828	0	115.86	0.00	115.86
30 to 35	951	27,087	20,857	20,857	0.719	0	126.40	0.00	126.40
35 to 40	708	22,983	17,697	17,697	0.610	0	79.85	0.00	79.85
40 to 45	569	18,879	14,537	14,537	0.501	0	52.71	0.00	52.71
45 to 50	573	14,775	11,377	11,377	0.392	0	41.54	0.00	41.54
50 to 55	644	10,671	8,216	8,216	0.283	0	33.72	0.00	33.72
55 to 60	586	6,567	5,056	5,056	0.174	0	18.88	0.00	18.88
60 to 65	713	2,462	1,896	1,896	0.065	0	8.62	0.00	8.62
Totals:	6,494						$653.41	$79.40	$732.81

System 3 Heating Performance