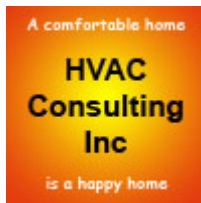


*ICF Alternative Construction
Energy Cost Analysis*

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

Design Data

Building Area:	2,610 sq.ft.	Cooling Load:	23,880 Btuh
People:	3	Heating Load:	36,561 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

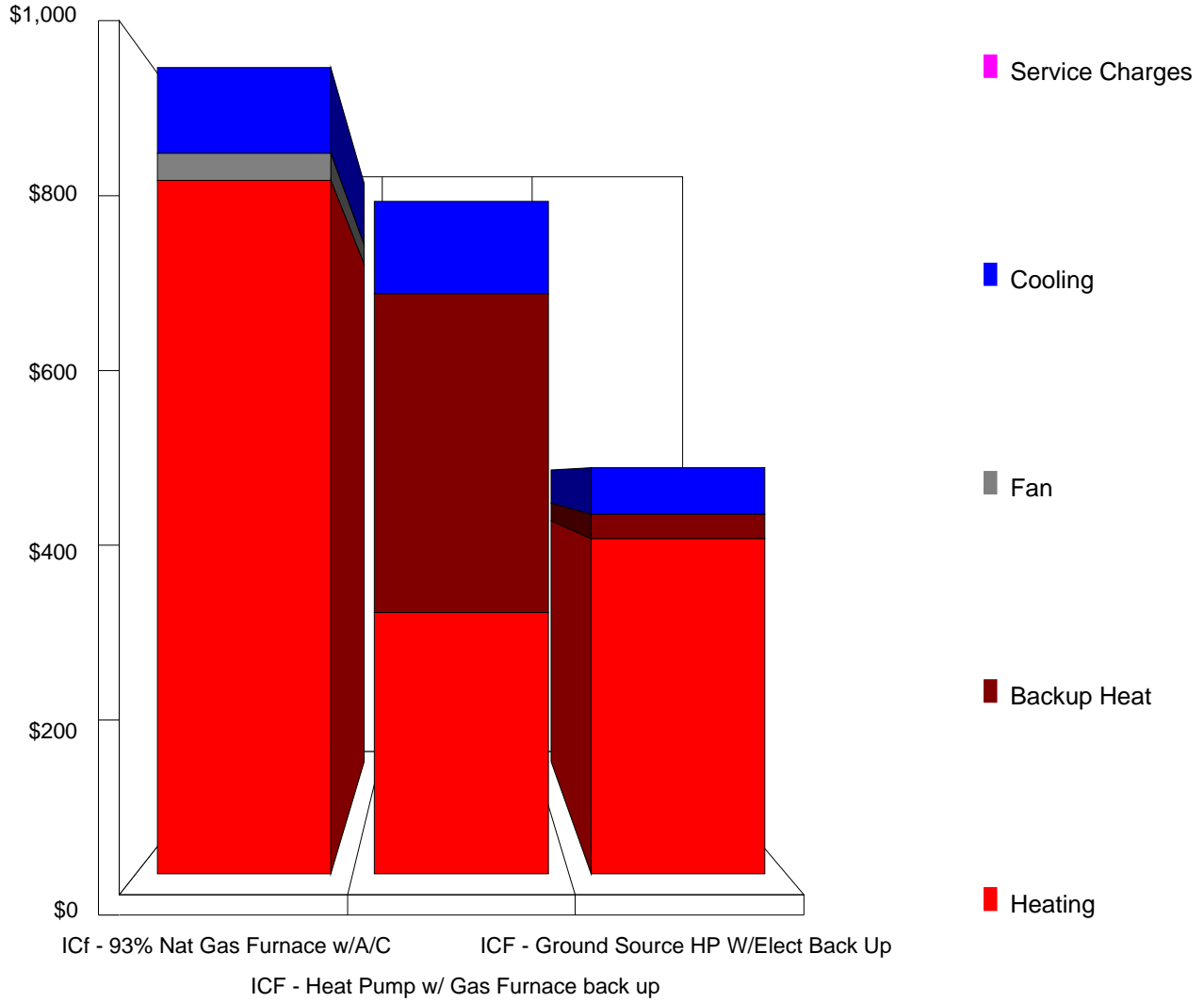
Annual Operating Cost Estimate

System Description	Fuel Rates Set	Total Heating Cost	Total Cooling Cost	Annual Service Charges	Total Oper. Cost	Average Monthly Cost
ICf - 93% Nat Gas Furnace w/A/C	1	\$867	\$103	\$0	\$970	\$81
ICF - Heat Pump w/ Gas Furnace back up	1	\$698	\$111	\$0	\$809	\$67
ICF - Ground Source HP W/Elect Back Up	1	\$433	\$56	\$0	\$489	\$41



Project Summary Bar Chart

System Operating Cost Comparison





Input Data - System 1 - ICf - 93% Nat Gas Furnace w/A/C

Estimated Cost

Cooling

System Type:	Standard Air Conditioner	
Model:	RANC-024JAZRGPL-05?BMK?+RCQC-2417	
ARI Ref. No.:	474119	
Efficiency:	14.70 SEER	
Capacity:	25,600 Btuh	
Cooling Load:	23,880 Btuh	
Annual Cost (Spec Cooling Hours Method):		\$103.17

Heating

System Type:	Natural Gas Furnace	
Model:	RGFD-06(EN)MCKS**	
Efficiency:	93.5 AFUE	
Capacity:	55,800 Btuh	\$743.24
Oversize Penalty:	1.14	\$123.73
Heating Load:	36,561 Btuh	
Fan or Pump Electric Usage:	373.7 kWh	\$32.51
Annual Cost (Degree Days Method):		\$866.97

Total Cost

Total Annual Operating Cost:		\$970.14
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Input Data - System 2 - ICF - Heat Pump w/ Gas Furnace back up

Estimated Cost

Cooling

System Type:	Air Source Heat Pump	
Model:	RPMM-024JAZRGPL-07?BRK?+RCHL-24A2	
ARI Ref. No.:	474824	
Efficiency:	13.65 SEER	
Capacity:	25,200 Btuh	
Cooling Load:	23,880 Btuh	
Annual Cost (Spec Cooling Hours Method):		\$111.11

Heating

System Type:	Air Source Heat Pump	
Model:	RPMM-024JAZRGPL-07?BRK?+RCHL-24A2	
Efficiency:	8.8 HSPF	
Capacity:	26,000 Btuh	
Heating Load:	36,561 Btuh	
47° Capacity:	26,000 Btuh	
17° Capacity:	17,200 Btuh	
47° COP:	3.38	
17° COP:	2.4	
Capacity Balance Point:	31 °F	
Cutoff Temperature:	30 °F	
Annual Cost (Bin Data Method):		\$314.68

Backup

System Type:	Natural Gas Furnace	
Model:	RGFD-06(EN)MCKS**	
Efficiency:	93.50	
Capacity:	55,800 Btuh	
Annual Cost:		\$383.67

Total Cost

Total Annual Operating Cost:		\$809.46
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Input Data - System 3 - ICF - Ground Source HP W/Elect Back Up

Estimated Cost

Cooling

System Type:	Ground Source Heat Pump	
Model:	TTV/TTH/TTD038(P)	
Efficiency:	27.00 EER	
Capacity:	28,900 Btuh	
Cooling Load:	23,880 Btuh	
Annual Cost (Spec Cooling Hours Method):		\$56.17

Heating

System Type:	Ground Source Heat Pump	
Model:	TTV/TTH/TTD038(P)	
Efficiency:	4.5 COP	
Capacity:	22,100 Btuh	
Heating Load:	36,561 Btuh	
47° Capacity:	24,800 Btuh	
17° Capacity:	24,800 Btuh	
47° COP:	5.1	
17° COP:	5.1	
Capacity Balance Point:	26 °F	
Cutoff Temperature:	0 °F	
Annual Cost (Bin Data Method):		\$403.49

Backup

System Type:	Electric Resistance	
Efficiency:	100.00	
Capacity:	51,182 Btuh	
Annual Cost:		\$29.74

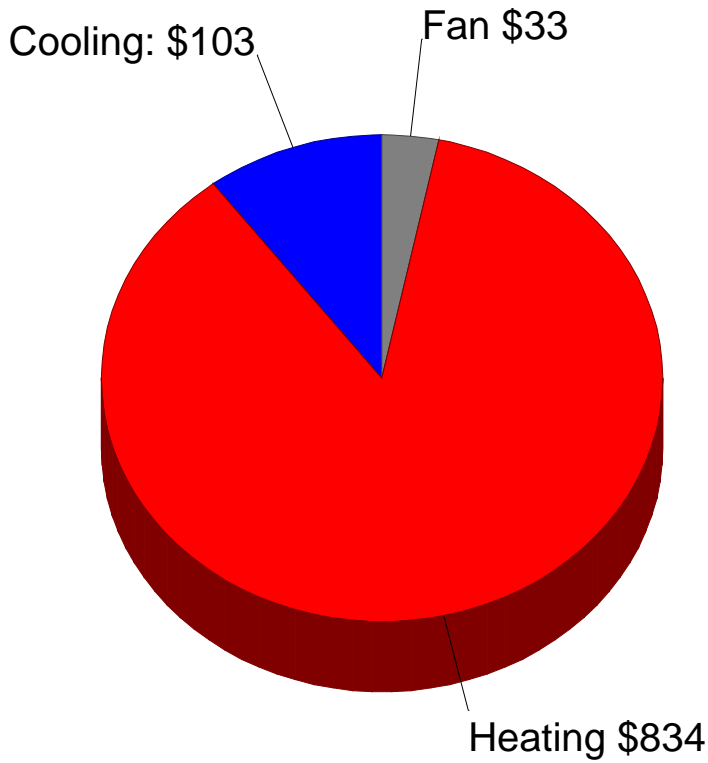
Total Cost

Total Annual Operating Cost:		\$489.40
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Input Data Pie Chart - System 1 - Icf - 93% Nat Gas Furnace w/A/C

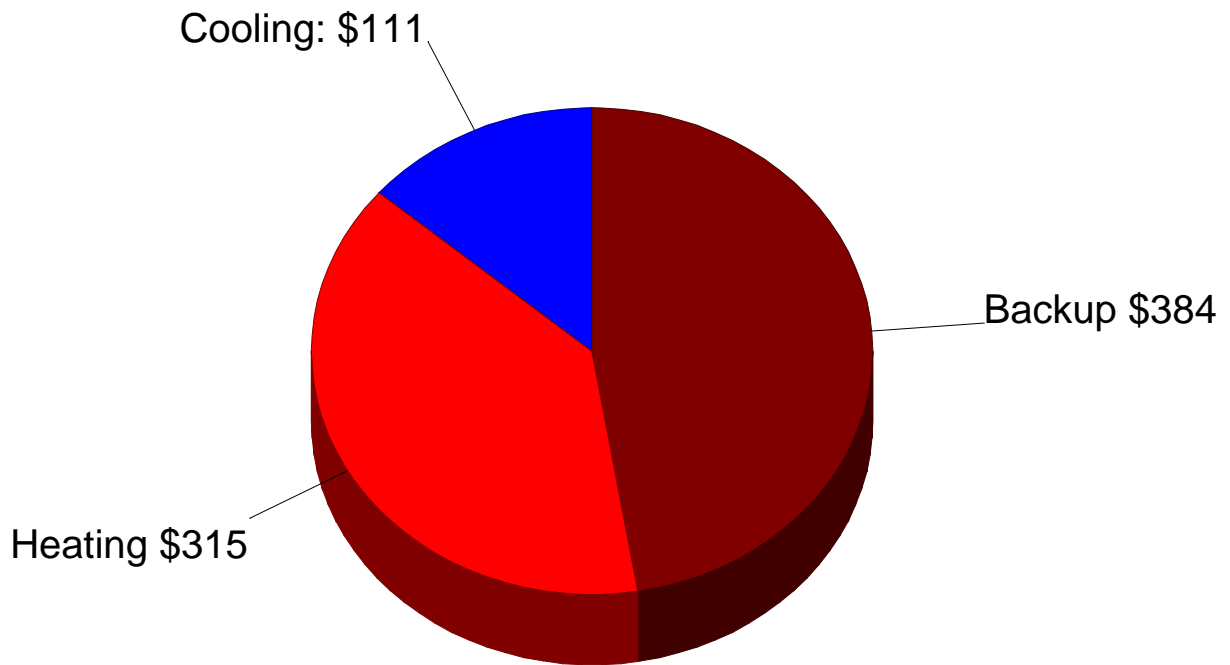
System 1 Annual Operating Costs





Input Data Pie Chart - System 2 - ICF - Heat Pump w/ Gas Furnace back up

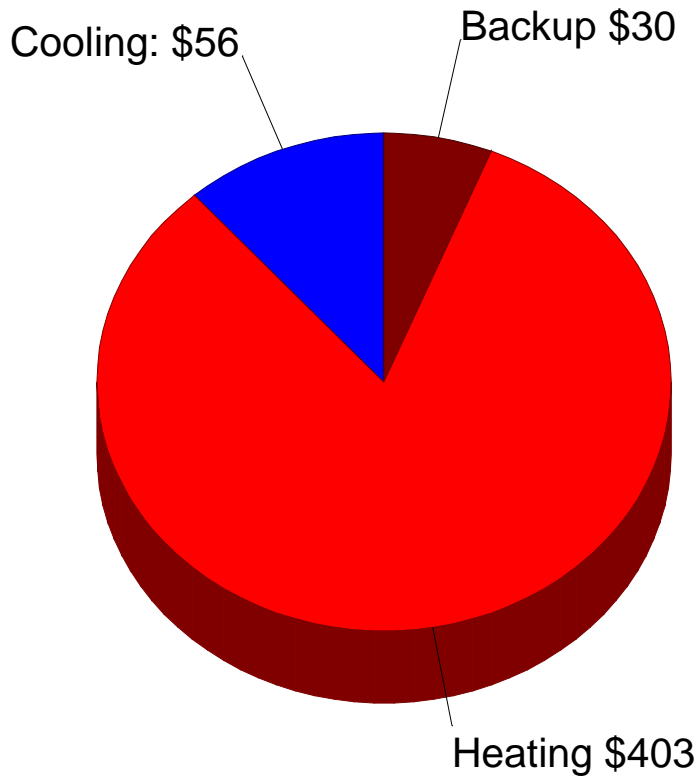
System 2 Annual Operating Costs





Input Data Pie Chart - System 3 - ICF - Ground Source HP W/Elect Back Up

System 3 Annual Operating Costs





Monthly Costs - System 1 - ICF - 93% Nat Gas Furnace w/A/C

Monthly System Cost

Month	Cooling		Heating		Total Cost
	Cost	%	Cost	%	
January	\$0.00	0.0%	\$157.79	100.0%	\$157.79
February	\$0.00	0.0%	\$144.63	100.0%	\$144.63
March	\$0.00	0.0%	\$119.95	100.0%	\$119.95
April	\$3.70	4.9%	\$71.10	95.1%	\$74.80
May	\$8.57	21.7%	\$30.99	78.3%	\$39.56
June	\$21.23	66.2%	\$10.87	33.8%	\$32.10
July	\$32.72	85.9%	\$5.35	14.1%	\$38.07
August	\$22.10	73.1%	\$8.14	26.9%	\$30.24
September	\$10.96	29.8%	\$25.81	70.2%	\$36.76
October	\$3.37	6.4%	\$49.63	93.6%	\$53.00
November	\$0.53	0.6%	\$93.90	99.4%	\$94.44
December	\$0.00	0.0%	\$148.81	100.0%	\$148.81
Total	\$103.17	10.6%	\$866.97	89.4%	\$970.14

Monthly Fuel Usage and Cost

Month	Electricity		Natural Gas		Propane		Fuel Oil	
	Cost	kWh	Cost	Therm	Cost	Gallons	Cost	Gallons
January	\$5.92	68.0	\$151.87	141.9	\$0.00	0.0	\$0.00	0.0
February	\$5.42	62.3	\$139.21	130.1	\$0.00	0.0	\$0.00	0.0
March	\$4.50	51.7	\$115.45	107.9	\$0.00	0.0	\$0.00	0.0
April	\$6.36	73.2	\$68.44	64.0	\$0.00	0.0	\$0.00	0.0
May	\$9.73	111.8	\$29.83	27.9	\$0.00	0.0	\$0.00	0.0
June	\$21.64	248.8	\$10.46	9.8	\$0.00	0.0	\$0.00	0.0
July	\$32.92	378.4	\$5.15	4.8	\$0.00	0.0	\$0.00	0.0
August	\$22.40	257.5	\$7.83	7.3	\$0.00	0.0	\$0.00	0.0
September	\$11.92	137.0	\$24.84	23.2	\$0.00	0.0	\$0.00	0.0
October	\$5.23	60.1	\$47.77	44.6	\$0.00	0.0	\$0.00	0.0
November	\$4.05	46.6	\$90.38	84.5	\$0.00	0.0	\$0.00	0.0
December	\$5.58	64.1	\$143.23	133.9	\$0.00	0.0	\$0.00	0.0
Total	\$135.68	1,559.5	\$834.47	779.9	\$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 - ICF - Heat Pump w/ Gas Furnace back up

Monthly System Cost

Month	Cooling		Heating		Total Cost
	Cost	%	Cost	%	
January	\$0.00	0.0%	\$141.75	100.0%	\$141.75
February	\$0.00	0.0%	\$129.80	100.0%	\$129.80
March	\$0.00	0.0%	\$97.02	100.0%	\$97.02
April	\$3.98	7.3%	\$50.59	92.7%	\$54.57
May	\$9.23	32.6%	\$19.07	67.4%	\$28.30
June	\$22.87	78.1%	\$6.42	21.9%	\$29.29
July	\$35.23	91.9%	\$3.09	8.1%	\$38.33
August	\$23.80	83.4%	\$4.72	16.6%	\$28.52
September	\$11.80	42.4%	\$16.06	57.6%	\$27.85
October	\$3.63	10.4%	\$31.33	89.6%	\$34.95
November	\$0.57	0.8%	\$67.09	99.2%	\$67.66
December	\$0.00	0.0%	\$131.43	100.0%	\$131.43
Total	\$111.11	13.7%	\$698.36	86.3%	\$809.46

Monthly Fuel Usage and Cost

Month	Electricity		Natural Gas		Propane		Fuel Oil	
	Cost	kWh	Cost	Therm	Cost	Gallons	Cost	Gallons
January	\$27.53	316.5	\$114.21	106.7	\$0.00	0.0	\$0.00	0.0
February	\$25.12	288.8	\$104.68	97.8	\$0.00	0.0	\$0.00	0.0
March	\$48.00	551.8	\$49.02	45.8	\$0.00	0.0	\$0.00	0.0
April	\$44.92	516.4	\$9.64	9.0	\$0.00	0.0	\$0.00	0.0
May	\$28.30	325.2	\$0.00	0.0	\$0.00	0.0	\$0.00	0.0
June	\$29.29	336.6	\$0.00	0.0	\$0.00	0.0	\$0.00	0.0
July	\$38.33	440.5	\$0.00	0.0	\$0.00	0.0	\$0.00	0.0
August	\$28.52	327.8	\$0.00	0.0	\$0.00	0.0	\$0.00	0.0
September	\$27.85	320.2	\$0.00	0.0	\$0.00	0.0	\$0.00	0.0
October	\$34.95	401.8	\$0.00	0.0	\$0.00	0.0	\$0.00	0.0
November	\$58.79	675.7	\$8.87	8.3	\$0.00	0.0	\$0.00	0.0
December	\$34.19	392.9	\$97.24	90.9	\$0.00	0.0	\$0.00	0.0
Total	\$425.79	4,894.2	\$383.67	358.6	\$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 - ICF - Ground Source HP W/Elect Back Up

Monthly System Cost

Month	Cooling		Heating		Total Cost
	Cost	%	Cost	%	
January	\$0.00	0.0%	\$80.28	100.0%	\$80.28
February	\$0.00	0.0%	\$82.74	100.0%	\$82.74
March	\$0.00	0.0%	\$56.93	100.0%	\$56.93
April	\$2.01	5.6%	\$33.63	94.4%	\$35.65
May	\$4.66	24.1%	\$14.66	75.9%	\$19.32
June	\$11.56	69.2%	\$5.14	30.8%	\$16.70
July	\$17.81	87.6%	\$2.53	12.4%	\$20.34
August	\$12.03	75.8%	\$3.85	24.2%	\$15.88
September	\$5.96	32.8%	\$12.21	67.2%	\$18.17
October	\$1.83	7.2%	\$23.48	92.8%	\$25.31
November	\$0.29	0.6%	\$44.42	99.4%	\$44.71
December	\$0.00	0.0%	\$73.37	100.0%	\$73.37
Total	\$56.17	11.5%	\$433.23	88.5%	\$489.40

Monthly Fuel Usage and Cost

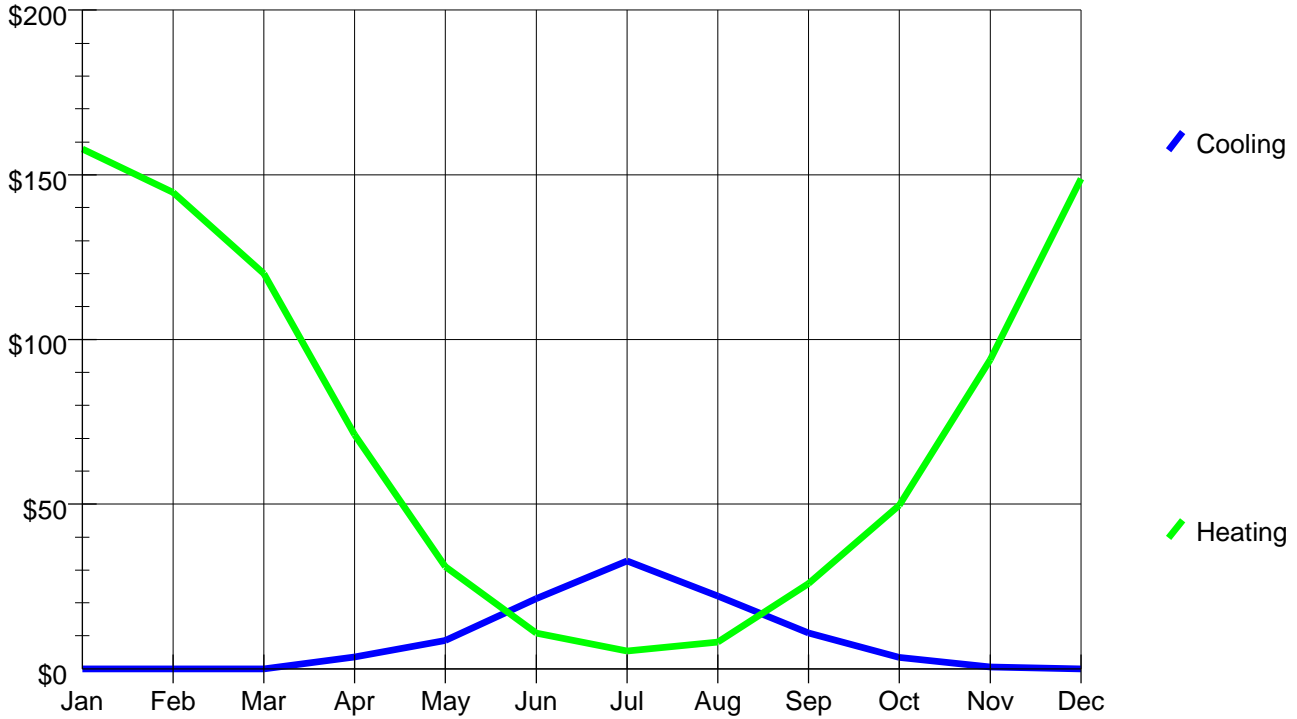
Month	Electricity		Natural Gas		Propane		Fuel Oil	
	Cost	kWh	Cost	Therm	Cost	Gallons	Cost	Gallons
January	\$80.28	922.7	\$0.00	0.0	\$0.00	0.0	\$0.00	0.0
February	\$82.74	951.0	\$0.00	0.0	\$0.00	0.0	\$0.00	0.0
March	\$56.93	654.3	\$0.00	0.0	\$0.00	0.0	\$0.00	0.0
April	\$35.65	409.7	\$0.00	0.0	\$0.00	0.0	\$0.00	0.0
May	\$19.32	222.1	\$0.00	0.0	\$0.00	0.0	\$0.00	0.0
June	\$16.70	192.0	\$0.00	0.0	\$0.00	0.0	\$0.00	0.0
July	\$20.34	233.8	\$0.00	0.0	\$0.00	0.0	\$0.00	0.0
August	\$15.88	182.5	\$0.00	0.0	\$0.00	0.0	\$0.00	0.0
September	\$18.17	208.9	\$0.00	0.0	\$0.00	0.0	\$0.00	0.0
October	\$25.31	290.9	\$0.00	0.0	\$0.00	0.0	\$0.00	0.0
November	\$44.71	513.9	\$0.00	0.0	\$0.00	0.0	\$0.00	0.0
December	\$73.37	843.4	\$0.00	0.0	\$0.00	0.0	\$0.00	0.0
Total	\$489.40	5,625.3	\$0.00	0.0	\$0.00	0.0	\$0.00	0.0

Average Electric Cost Per kWh: \$0.087/kWh

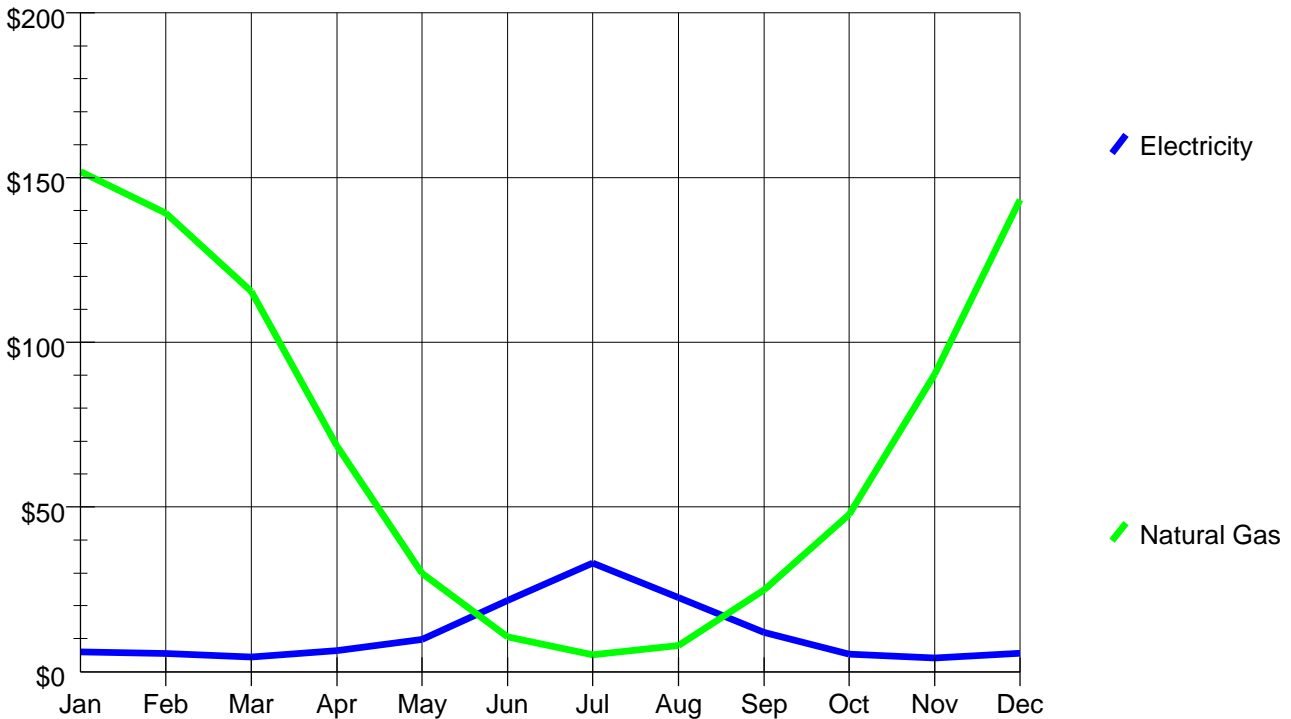


Monthly Cost Line Graphs - System 1 - ICF - 93% Nat Gas Furnace w/A/C

System 1 Monthly Energy Costs



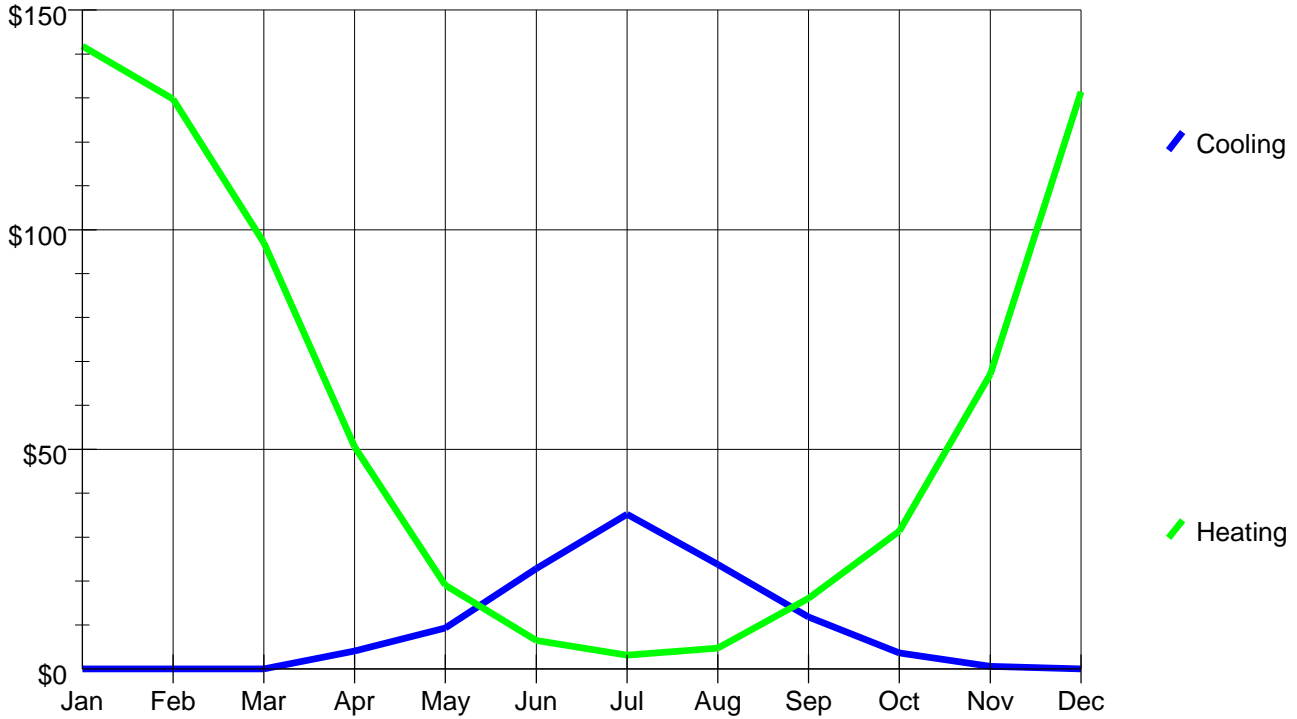
System 1 Monthly Fuel Costs



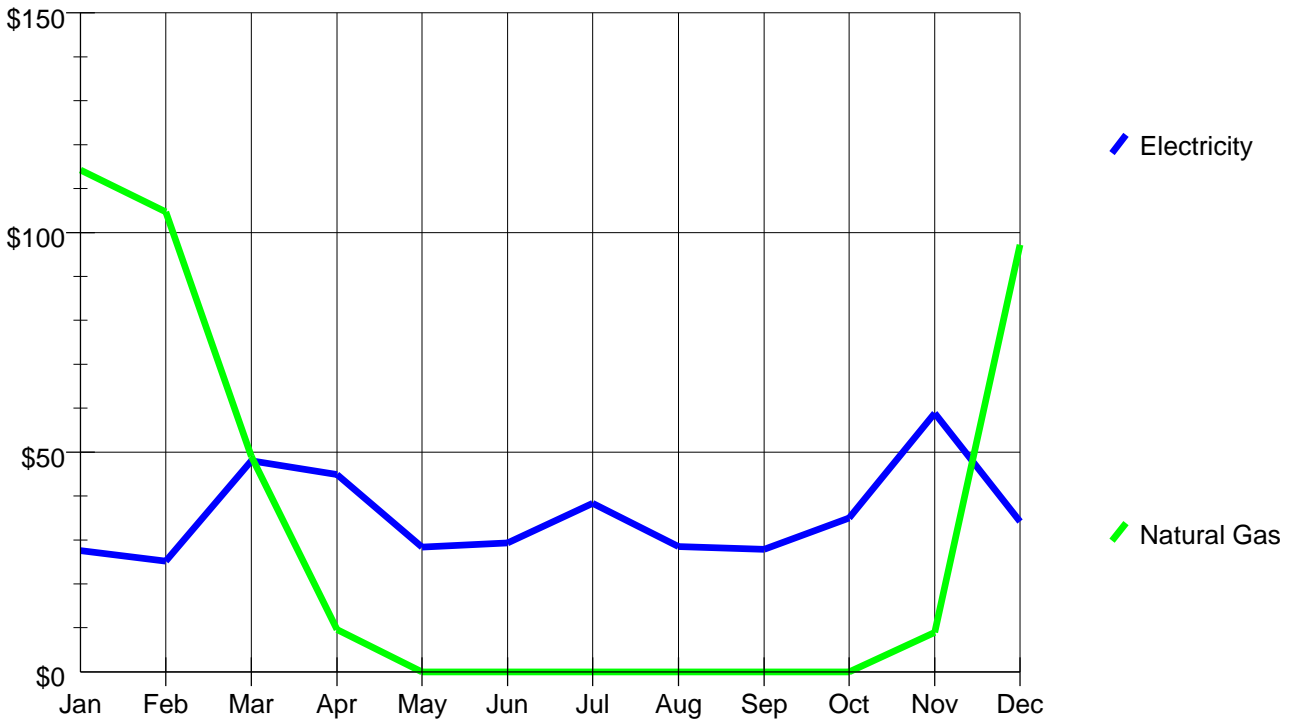


Monthly Cost Line Graphs - System 2 - ICF - Heat Pump w/ Gas Furnace back up

System 2 Monthly Energy Costs



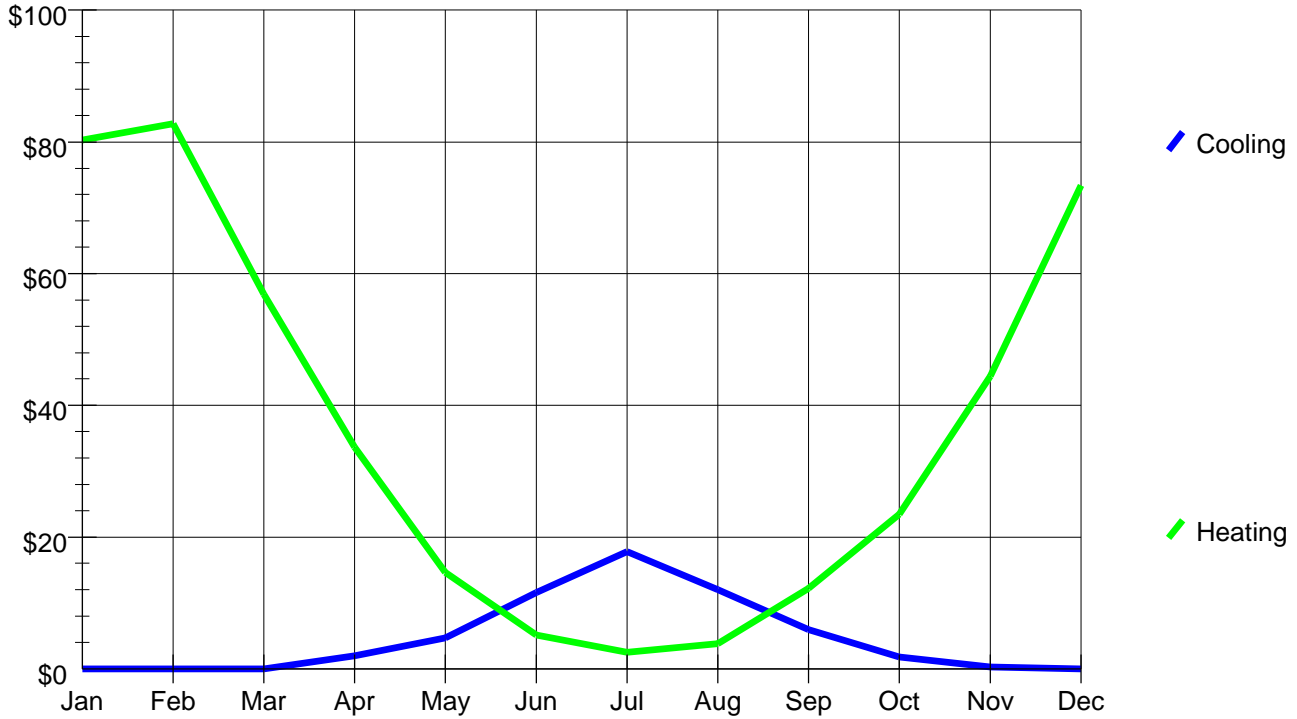
System 2 Monthly Fuel Costs



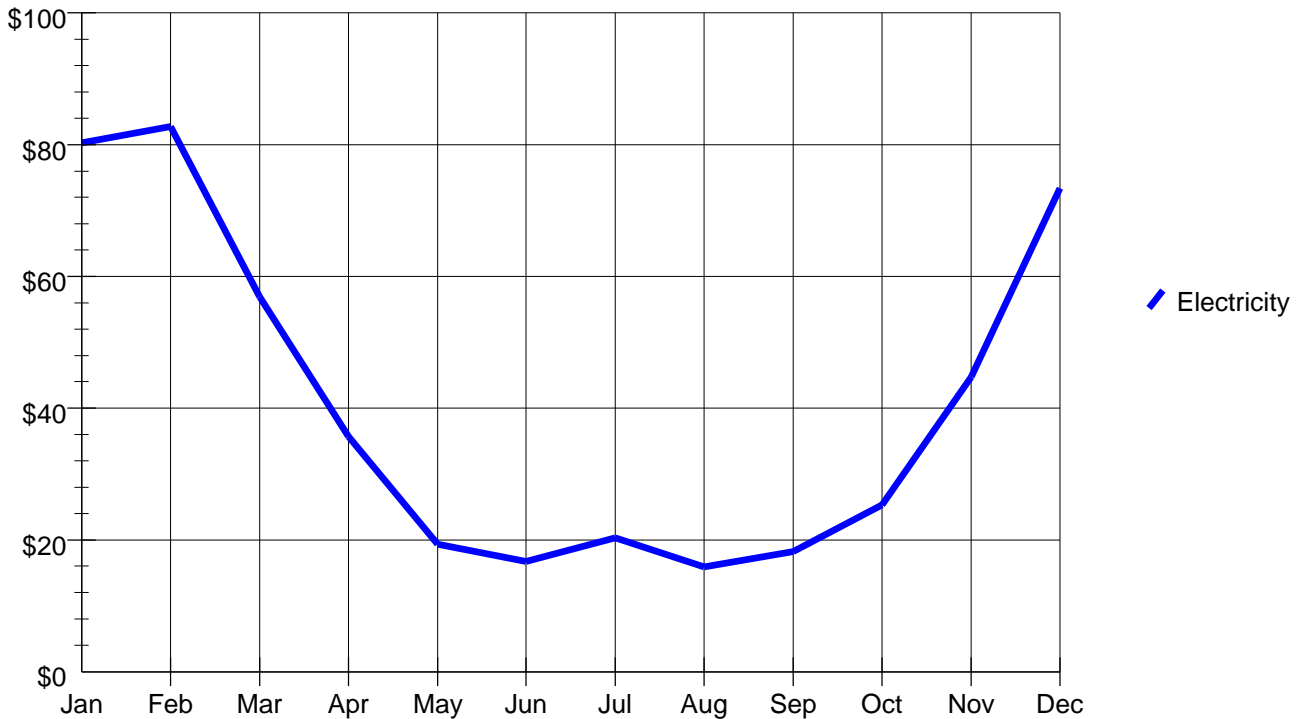


Monthly Cost Line Graphs - System 3 - ICF - Ground Source HP W/Elect Back Up

System 3 Monthly Energy Costs



System 3 Monthly Fuel Costs





Bin Analysis Report - System 1 - ICF - 93% Nat Gas Furnace w/A/C

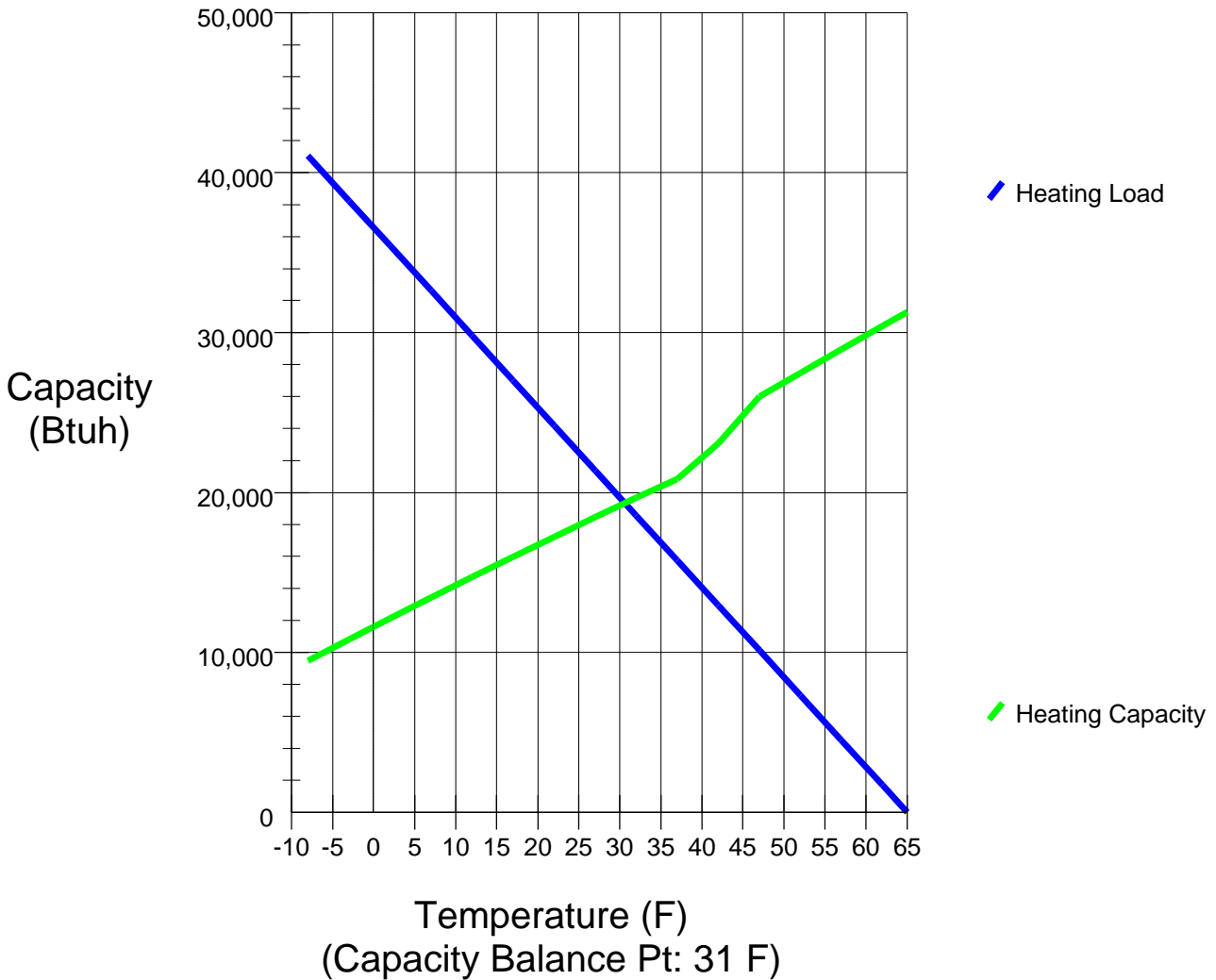
Bin Temp Ranges Degree F	Hours Per Bin	Heating Load Btuh	Adjusted Load (x 0.77)	Energy Input kBtu	Heating Run Time Fraction	Dynamic Efficiency AFUE	Total Heating Cost
-10 to -5	1	41,061	31,617	32	1.000	93.50	0.36
-5 to 0	17	38,248	29,451	501	1.000	93.50	5.73
0 to 5	43	35,436	27,286	1,173	1.000	93.50	13.43
5 to 10	81	32,624	25,120	2,035	1.000	93.50	23.29
10 to 15	195	29,811	22,955	4,476	1.000	93.50	51.22
15 to 20	281	26,999	20,789	5,842	1.000	93.50	66.85
20 to 25	375	24,187	18,624	6,984	1.000	93.50	79.92
25 to 30	757	21,374	16,458	12,459	1.000	93.50	142.58
30 to 35	951	18,562	14,293	13,592	1.000	93.50	155.55
35 to 40	708	15,749	12,127	8,586	1.000	93.50	98.26
40 to 45	569	12,937	9,961	5,668	1.000	93.50	64.86
45 to 50	573	10,125	7,796	4,467	1.000	93.50	51.12
50 to 55	644	7,312	5,630	3,626	1.000	93.50	41.50
55 to 60	586	4,500	3,465	2,030	1.000	93.50	23.24
60 to 65	713	1,687	1,299	926	1.000	93.50	10.60
Totals:	6,494						\$866.97



Bin Analysis Report - System 2 - ICF - Heat Pump w/ Gas Furnace 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	41,061	31,617	0	0.000	31,617	0.00	0.36	0.36
-5 to 0	17	38,248	29,451	0	0.000	29,451	0.00	5.73	5.73
0 to 5	43	35,436	27,286	0	0.000	27,286	0.00	13.43	13.43
5 to 10	81	32,624	25,120	0	0.000	25,120	0.00	23.29	23.29
10 to 15	195	29,811	22,955	0	0.000	22,955	0.00	51.23	51.23
15 to 20	281	26,999	20,789	0	0.000	20,789	0.00	66.87	66.87
20 to 25	375	24,187	18,624	0	0.000	18,624	0.00	79.97	79.97
25 to 30	757	21,374	16,458	0	0.000	16,458	0.00	142.79	142.79
30 to 35	951	18,562	14,293	14,293	0.723	0	119.21	0.00	119.21
35 to 40	708	15,749	12,127	12,127	0.576	0	71.30	0.00	71.30
40 to 45	569	12,937	9,961	9,961	0.427	0	44.69	0.00	44.69
45 to 50	573	10,125	7,796	7,796	0.298	0	33.53	0.00	33.53
50 to 55	644	7,312	5,630	5,630	0.204	0	25.97	0.00	25.97
55 to 60	586	4,500	3,465	3,465	0.119	0	13.90	0.00	13.90
60 to 65	713	1,687	1,299	1,299	0.043	0	6.09	0.00	6.09
Totals:	6,494						\$314.68	\$383.67	\$698.36

System 2 Heating Performance





Bin Analysis Report - System 3 - ICF - 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	41,061	31,617	0	0.000	31,617	0.00	0.81	0.81
-5 to 0	17	38,248	29,451	0	0.000	29,451	0.00	12.76	12.76
0 to 5	43	35,436	27,286	22,100	1.000	5,186	5.38	5.68	11.07
5 to 10	81	32,624	25,120	22,100	1.000	3,020	10.14	6.24	16.38
10 to 15	195	29,811	22,955	22,100	1.000	855	24.41	4.25	28.66
15 to 20	281	26,999	20,789	20,789	0.941	0	33.09	0.00	33.09
20 to 25	375	24,187	18,624	18,624	0.843	0	39.56	0.00	39.56
25 to 30	757	21,374	16,458	16,458	0.745	0	70.57	0.00	70.57
30 to 35	951	18,562	14,293	14,293	0.647	0	76.99	0.00	76.99
35 to 40	708	15,749	12,127	12,127	0.549	0	48.64	0.00	48.64
40 to 45	569	12,937	9,961	9,961	0.451	0	32.11	0.00	32.11
45 to 50	573	10,125	7,796	7,796	0.353	0	25.30	0.00	25.30
50 to 55	644	7,312	5,630	5,630	0.255	0	20.54	0.00	20.54
55 to 60	586	4,500	3,465	3,465	0.157	0	11.50	0.00	11.50
60 to 65	713	1,687	1,299	1,299	0.059	0	5.25	0.00	5.25
Totals:	6,494						\$403.49	\$29.74	\$433.23

System 3 Heating Performance

