Systems Comparison	
Project Name:	**New Caribou Police Facility**
Project Location:	**Caribou, ME**
Document Date:	**January 15, 2025**
Project #:	**530419L**

INTRODUCTION

Dubois & King, Inc. performed a mechanical system comparison analysis of the two options described in the initial narrative and a base option as requested during the 1/10/25 meeting. Refer to the systems narrative for a detailed description of option #1 and #2.

Option #1 consists of 4-pipe fan coils with air source heat pump, with 100% heating redundancy provided by an LP gas fired condensing boiler for temperatures below 10°F.

Option #2 consists of an air source hybrid VRF heat pump system with a supplemental LP gas fired condensing boiler plant. This provides heated water for radiant panels as a secondary heat source.

A code minimum "base" design was considered as a basis for comparison as requested in the 1/10/25 meeting. This base design consists of an LP gas fired boiler for heating and a Variable Air Volume Rooftop Unit with DX for cooling and VAV reheat terminals for heating and dehumidification.

First cost, annual energy costs, and maintenance costs were considered in the life cycle cost analysis.

RECOMMENDATION

Both Option #1 and Option #2 outcompeted the base design on overall cost. The long term payback of the two options depends on the cost of electricity and whether a solar PV array may be installed. Due to the ability of Option #2 to utilize the electricity produced by a PV array to heat the building to a lower outdoor air temperature allows for greater savings over Option #1. If only grid power is utilized at the current energy rates Option #1 is slightly less expensive to operate due to the lower per btuh cost of LPG.

Above air temperatures of 10°F, air source heat pumps are more economical to operate than LP gas boilers. At air temperatures of 10°F or below, the performance of the heat pump drops to a point that it becomes less expensive to operate the LP gas boiler than to use the heat pump. In most climates, the increased electricity cost at these low temperatures is outweighed by the low cost of operating a heat pump at more moderate temperatures (>10°F). However, in Caribou, ME, the number of annual hours expected to be colder than 10°F means that it is less expensive overall to install and operate a

100% redundant LP boiler system for use during those hours. Therefore, Option #1 is less expensive than the full VRF heat pump system of Option #2, assuming current electricity and LP gas prices.

If no PV panels are to be installed, DuBois & King recommends choosing Option #1. With current economical and climate conditions, the operating cost for Option #1 is lower than that of Option #2. The simple payback on Option #1 compared to the base design is 10 years. Additionally, Option #1 complies with the Build America, Buy America Act (BABA).

If PV panels are to be installed in the future, Option #2 becomes more economical than Option #1. This is because PV panels would decrease the cost of electricity to a point where it becomes more economical to operate the heat pump at its full operational temperature range than to use an LP gas boiler. This boiler is present to act as a secondary heating source when the outside air temperature is near or below the minimum operational temperature of the heat pump (-27°F).

DuBois & King would like to emphasize that the difference in life cycle cost for these two options is small. Both systems have their potential benefits and drawbacks.

Project

Project: Caribou PD
Location: Caribou, ME
Engineer: RCN
Date: 1/13/25

Nearest Climatological Location

State: : ME
City: CARIBOU MUNICIPAL ARPT

Building Dimensions

Length: 110 (ft)
Width: 110 (ft)
Perimeter Width: 15 (ft)
Height: 12 (ft)
Number of Floors: 1
Total Area: 12100 (ft^2)

Heat Loss

Total: 290400 (BtuH)
Heat Loss / Area: 24.0 ($BtuH/ft^2$)
Ventilation: 182952 (BtuH)
Envelope: 107448 (BtuH)

Heat Gain

Total: 254100 (BtuH)
Heat Gain / Area: 21.0
Ventilation Sensible: 19108 (BtuH)
Ventilation Latent: 33990 (BtuH)
People: 24200 (BtuH)
Light: 82280 (BtuH)
Equipment: 41140 (BtuH)
Envelope: 53382 (BtuH)

Energy Costs

Electricity Demand: .00 $/Kw
Electricity Consumption: .1665 $/KwHr
Fossil Fuel Oil: 5.00 $/Gal
Fossil Fuel Natural Gas: 1.74 $/Therm
Fossil Fuel Propane3.74 $/Gal

Life Cycle Cost

Cost of Money: 6.0 %
Inflation on Maintenance Cost: 5.0 %
Inflation on Energy Cost: 5.0 %
Project Life Cycle: 20 Years

Domestic Water System

Budiling Usage: None
Occupancy: ∞ People
Consumption / Person: .0 gpd
Supply Water Temperature: 45 °F
Storage Water Temperature: 0 °F

Base: LPG Boiler, VAV DX RTU

Heat Source 1
Heat Source: Boiler
Heat Type: Propane
Heat Efficiency: 90 %

Cool Source 1
Cool Source: Condensing Unit
Cool Auxiliary Source: Air Cooled
Cool Type: Air Cooled
Full Load EER: 12.40 (EER)
Part Load IEER: 20.20 (EER)
Part Load Adjusted IEER: 17.69 (EER)
Cooling Compresser HP: 27.46 Hp
Cooling Condenser Fan HP: 2.49 Hp

Hydronic Pipe Systems
Heating Pipe System: Two Pipe Standard
Heat Pipe Flow Control: Delta T
Heat Pipe HP: .87 HP

Air Duct System
System : Dual Duct Dual Fan
Air Flow Control: On Off
Heating Supply Fan Horsepower: 5.61 Hp
Heating Return Fan Horsepower: 1.33 Hp
Cooling Supply Fan Horsepower: 15.01 Hp
Cooling Return Fan Horsepower: 3.20 Hp

System Features
Economizer, Return Fan

Heating Perimeter Terminals
Terminal Type: VAV Reheat Coil

Heating Interior Terminals
Terminal Type: VAV Reheat Coil

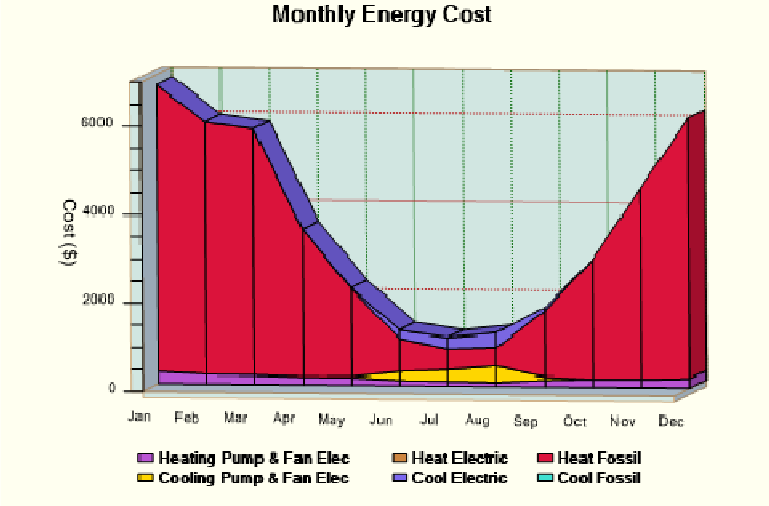
Cooling Perimeter Terminals
Terminal Type: VAV Box

Cooling Interior Terminals
Terminal Type: VAV Box

Terminal Flow Control
Pump Flow Control: Delta T
Fan Flow Control: Delta T

Energy Analysis System 1 Jan 13, 2025

Base: LPG Boiler, VAV DX RTU



Annual Energy Cost HVAC

Electrical Consumption:	23269 Kw
Electrical Consumption Cost:	$3874
Electrical Demand Cost:	$0
Total Electrical Cost:	$3874
Fossil Consumption:	945 MMBtu
Fossil Cost:	$39244
Total Cost:	$43119
Life Cycle Cost:	$1456899

Life Cycle Cost

First Cost:	$392127
Annual Maintenance Cost:	$8216
Replacement Cost:	$188221
Replacement Interval:	15 Years

Total Pump & Fan HP

Total Heating Pump & Fan HP: 7.81 Hp
Total Cooling Pump & Fan HP: 27.29 Hp
Cooling System BEER: 30.91 EER

Energy Analysis System 1 Jan 13, 2025

Base: LPG Boiler, VAV DX RTU

Monthly Energy Data

	Jan	Feb	Mar	Apr	May	Jun
Heating Pump & Fan Cost($)	270	215	203	169	165	111
Heating Other Electical Cost($)	0	0	0	0	0	0
Heating Fossil Cost Oil ($)	0	0	0	0	0	0
Heating Fossil Cost Natural Gas($)	0	0	0	0	0	0
Heating Fossil Cost Propane($)	6498	5720	5585	3359	1999	743
Heating Total Cost($)	6769	5935	5788	3528	2164	854
Cooling Pump & Fan Cost($)	0	0	0	0	22	211
Cooling Other Electical Cost($)	0	0	0	0	21	197
Cooling Fossil Cost Oil ($)	0	0	0	0	0	0
Cooling Fossil Cost Natural Gas($)	0	0	0	0	0	0
Cooling Fossil Cost Propane($)	0	0	0	0	0	0
Cooling Total Cost($)	0	0	0	0	43	408
Heating Pump & Fan Consumption (Kw)	1624	1292	1220	1014	993	667
Heating Other Consumption (Kw)	0	0	0	0	0	0
Heating Consumption Fossil Oil (Gal)	0	0	0	0	0	0
Heating Consumption Fossil Natural Gas(Therm)	0	0	0	0	0	0
Heating Consumption Fossil Propane (Gal)	1739	1531	1494	899	535	199
Cooling Pump & Fan Consumption (Kw)	0	0	0	0	131	1269
Cooling Other Consumption (Kw)	0	0	0	0	128	1180
Cooling Consumption Fossil Oil (Gal)	0	0	0	0	0	0
Cooling Consumption Fossil Natural Gas(Therm)	0	0	0	0	0	0
Cooling Consumption Fossil Propane (Gal)	0	0	0	0	0	0
Geothermal Heat Extraction (MMBTU)	0	0	0	0	0	0
Geothermal Heat Rejection (MMBTU)	0	0	0	0	0	0

Base: LPG Boiler, VAV DX RTU

	Jul	Aug	Sep	Oct	Nov	Dec
Heating Pump & Fan Cost($)	99	85	145	173	175	208
Heating Other Electical Cost($)	0	0	0	0	0	0
Heating Fossil Cost Oil ($)	0	0	0	0	0	0
Heating Fossil Cost Natural Gas($)	0	0	0	0	0	0
Heating Fossil Cost Propane($)	467	413	1493	2716	4341	5911
Heating Total Cost($)	567	499	1637	2889	4516	6119
Cooling Pump & Fan Cost($)	271	380	79	0	0	0
Cooling Other Electical Cost($)	258	341	76	0	0	0
Cooling Fossil Cost Oil ($)	0	0	0	0	0	0
Cooling Fossil Cost Natural Gas($)	0	0	0	0	0	0
Cooling Fossil Cost Propane($)	0	0	0	0	0	0
Cooling Total Cost($)	529	721	154	0	0	0
Heating Pump & Fan Consumption (Kw)	597	512	869	1037	1051	1252
Heating Other Consumption (Kw)	0	0	0	0	0	0
Heating Consumption Fossil Oil (Gal)	0	0	0	0	0	0
Heating Consumption Fossil Natural Gas(Therm)	0	0	0	0	0	0
Heating Consumption Fossil Propane (Gal)	125	111	399	727	1162	1582
Cooling Pump & Fan Consumption (Kw)	1627	2283	472	0	0	0
Cooling Other Consumption (Kw)	1548	2049	455	0	0	0
Cooling Consumption Fossil Oil (Gal)	0	0	0	0	0	0
Cooling Consumption Fossil Natural Gas(Therm)	0	0	0	0	0	0
Cooling Consumption Fossil Propane (Gal)	0	0	0	0	0	0
Geothermal Heat Extraction (MMBTU)	0	0	0	0	0	0
Geothermal Heat Rejection (MMBTU)	0	0	0	0	0	0

Option #1: A2W Heat Pump with LPG Boiler

Heat Source 1
Heat Source: Heat Pump Air To Water
Full Load COP (47°F): 2.44 (COP)
Part Load COP (HPSF): 2.44 (COP)
Part Load Adjusted COP: 2.40 (COP)

Heat Source 2
Heat Source: Boiler
Heat Type: Propane
Heat Efficiency: 95 %

Heat Source 3
Heat Source: Boiler
Heat Type: Propane
Heat Efficiency: 95 %

Cool Source 1
Cool Source: Heat Pump Air To Water
Full Load EER: 10.28 (EER)
Part Load IEER: 17.06 (EER)
Part Load Adjusted IEER: 16.65 (EER)
Cooling Compresser HP: 33.12 Hp
Cooling Condenser Fan HP: 2.60 Hp

Hydronic Pipe Systems
Heating Pipe System: Two Pipe Standard
Heat Pipe Flow Control: Delta T
Heat Pipe HP: .83 HP

Cooling Pipe System: Two Pipe Standard
Cool Pipe Flow Control: Delta T
Cool Pipe HP: 2.18 HP

Air Duct System
System : Single Duct Single Fan Ventilation Only DOAS
Air Flow Control: On Off
Heating Supply Fan Horsepower: 1.64 Hp
Heating Return Fan Horsepower: 1.25 Hp
Cooling Supply Fan Horsepower: 1.71 Hp
Cooling Return Fan Horsepower: .75 Hp

System Features
Economizer, Return Fan

Heating Perimeter Terminals
Terminal Type: Fan Coil Unit Heating Coil
Terminal Fan Horsepower: .60 Hp

Heating Interior Terminals
Terminal Type: Fan Coil Unit Heating Coil
Terminal Fan Horsepower: .21 Hp

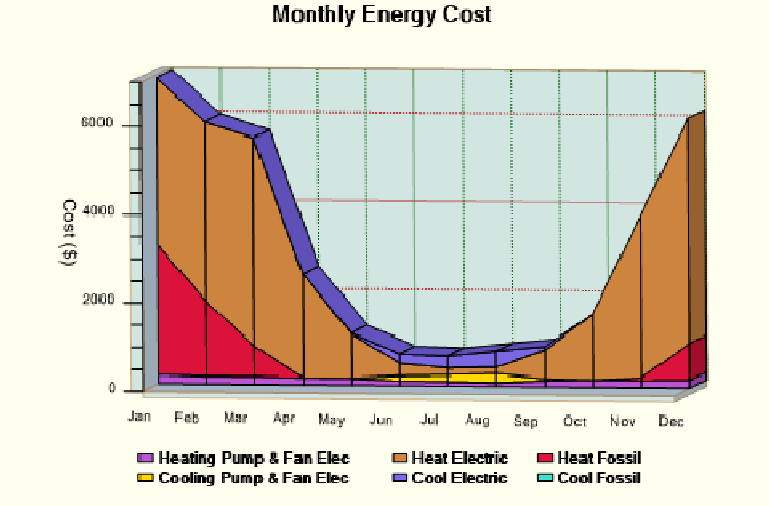
Cooling Perimeter Terminals
Terminal Type: Fan Coil Unit Cooling Coil
Terminal Fan Horsepower: .65 Hp

Cooling Interior Terminals
Terminal Type: Fan Coil Unit Cooling Coil
Terminal Fan Horsepower: 1.98 Hp

Terminal Flow Control
Pump Flow Control: Delta T
Fan Flow Control: Constant

Energy Analysis System 2 Jan 13, 2025

Option #1: A2W Heat Pump with LPG Boiler



Annual Energy Cost HVAC

Electrical Consumption:	184093 Kw
Electrical Consumption Cost:	$30651
Electrical Demand Cost:	$0
Total Electrical Cost:	$30651
Fossil Consumption:	151 MMBtu
Fossil Cost:	$6260
Total Cost:	$36911
Life Cycle Cost:	$1396684

Life Cycle Cost

First Cost:	$448145
Annual Maintenance Cost:	$8963
Replacement Cost:	$188221
Replacement Interval:	20 Years

Total Pump & Fan HP

Total Heating Pump & Fan HP: 4.52 Hp
Total Cooling Pump & Fan HP: 9.87 Hp
Cooling System BEER: 29.61 EER

Energy Analysis System 2 Jan 13, 2025

Option #1: A2W Heat Pump with LPG Boiler

Monthly Energy Data

	Jan	Feb	Mar	Apr	May	Jun
Heating Pump & Fan Cost($)	202	168	169	149	147	98
Heating Other Electical Cost($)	3781	4065	4722	2355	1000	277
Heating Fossil Cost Oil ($)	0	0	0	0	0	0
Heating Fossil Cost Natural Gas($)	0	0	0	0	0	0
Heating Fossil Cost Propane($)	2944	1703	693	9	0	0
Heating Total Cost($)	6926	5936	5585	2514	1147	375
Cooling Pump & Fan Cost($)	0	0	0	0	15	130
Cooling Other Electical Cost($)	0	0	0	0	23	209
Cooling Fossil Cost Oil ($)	0	0	0	0	0	0
Cooling Fossil Cost Natural Gas($)	0	0	0	0	0	0
Cooling Fossil Cost Propane($)	0	0	0	0	0	0
Cooling Total Cost($)	0	0	0	0	37	338
Heating Pump & Fan Consumption (Kw)	1213	1012	1018	897	880	591
Heating Other Consumption (Kw)	22707	24412	28363	14146	6009	1664
Heating Consumption Fossil Oil (Gal)	0	0	0	0	0	0
Heating Consumption Fossil Natural Gas(Therm)	0	0	0	0	0	0
Heating Consumption Fossil Propane (Gal)	788	456	185	2	0	0
Cooling Pump & Fan Consumption (Kw)	0	0	0	0	89	778
Cooling Other Consumption (Kw)	0	0	0	0	136	1254
Cooling Consumption Fossil Oil (Gal)	0	0	0	0	0	0
Cooling Consumption Fossil Natural Gas(Therm)	0	0	0	0	0	0
Cooling Consumption Fossil Propane (Gal)	0	0	0	0	0	0
Geothermal Heat Extraction (MMBTU)	0	0	0	0	0	0
Geothermal Heat Rejection (MMBTU)	0	0	0	0	0	0

Option #1: A2W Heat Pump with LPG Boiler

	Jul	Aug	Sep	Oct	Nov	Dec
Heating Pump & Fan Cost($)	88	76	128	153	153	172
Heating Other Electical Cost($)	150	143	652	1509	3666	5097
Heating Fossil Cost Oil ($)	0	0	0	0	0	0
Heating Fossil Cost Natural Gas($)	0	0	0	0	0	0
Heating Fossil Cost Propane($)	0	0	0	0	73	839
Heating Total Cost($)	239	219	780	1662	3892	6108
Cooling Pump & Fan Cost($)	168	218	50	0	0	0
Cooling Other Electical Cost($)	274	363	80	0	0	0
Cooling Fossil Cost Oil ($)	0	0	0	0	0	0
Cooling Fossil Cost Natural Gas($)	0	0	0	0	0	0
Cooling Fossil Cost Propane($)	0	0	0	0	0	0
Cooling Total Cost($)	442	580	130	0	0	0
Heating Pump & Fan Consumption (Kw)	529	454	770	919	919	1034
Heating Other Consumption (Kw)	904	860	3915	9066	22018	30613
Heating Consumption Fossil Oil (Gal)	0	0	0	0	0	0
Heating Consumption Fossil Natural Gas(Therm)	0	0	0	0	0	0
Heating Consumption Fossil Propane (Gal)	0	0	0	0	19	224
Cooling Pump & Fan Consumption (Kw)	1011	1309	299	0	0	0
Cooling Other Consumption (Kw)	1645	2177	483	0	0	0
Cooling Consumption Fossil Oil (Gal)	0	0	0	0	0	0
Cooling Consumption Fossil Natural Gas(Therm)	0	0	0	0	0	0
Cooling Consumption Fossil Propane (Gal)	0	0	0	0	0	0
Geothermal Heat Extraction (MMBTU)	0	0	0	0	0	0
Geothermal Heat Rejection (MMBTU)	0	0	0	0	0	0

Option #2: VRF with Boiler Back up

Heat Source 1
Heat Source: VRF Air Source
Full Load COP (47°F): 4.01 (COP)
Part Load COP (HPSF): 4.01 (COP)
Part Load Adjusted COP: 3.95 (COP)

Heat Source 2
Heat Source: Boiler
Heat Type: Propane
Heat Efficiency: 95 %

Cool Source 1
Cool Source: VRF Air Source
Full Load EER: 11.50 (EER)
Part Load IEER: 22.00 (EER)
Part Load Adjusted IEER: 13.90 (EER)
Cooling Compresser HP: 29.61 Hp
Cooling Condenser Fan HP: 2.53 Hp

Air Duct System
System : Single Duct Single Fan Ventilation Only DOAS
Heating Supply Fan Horsepower: 1.64 Hp
Heating Return Fan Horsepower: 1.25 Hp
Cooling Supply Fan Horsepower: 1.71 Hp
Cooling Return Fan Horsepower: .75 Hp

System Features
Economizer, Return Fan

Cooling Perimeter Terminals
Terminal Type: Fan Coil Unit Cooling Coil
Terminal Fan Horsepower: .65 Hp

Cooling Interior Terminals
Terminal Type: Fan Coil Unit Cooling Coil
Terminal Fan Horsepower: 1.98 Hp

Terminal Flow Control
Pump Flow Control: Delta T
Fan Flow Control: Constant

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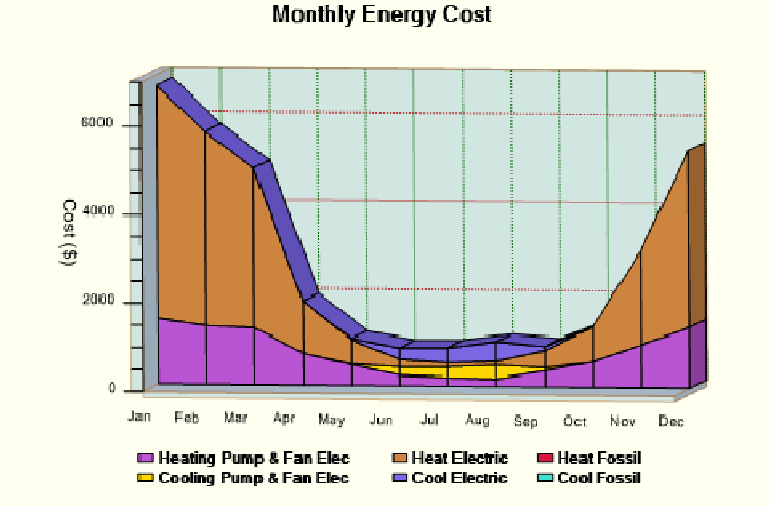
Option #2: VRF with Boiler Back up



Annual Energy Cost HVAC

Electrical Consumption:	203027 Kw
Electrical Consumption Cost:	$33804
Electrical Demand Cost:	$0
Total Electrical Cost:	$33804
Fossil Consumption:	0 MMBtu
Fossil Cost:	$0
Total Cost:	$33804
Life Cycle Cost:	$1367302

Life Cycle Cost

First Cost:	$485491
Annual Maintenance Cost:	$13071
Replacement Cost:	$291294
Replacement Interval:	25 Years

Total Pump & Fan HP

Total Heating Pump & Fan HP: 9.71 Hp
Total Cooling Pump & Fan HP: 15.02 Hp
Cooling System BEER: 5.24 EER

Option #2: VRF with Boiler Back up

Monthly Energy Data

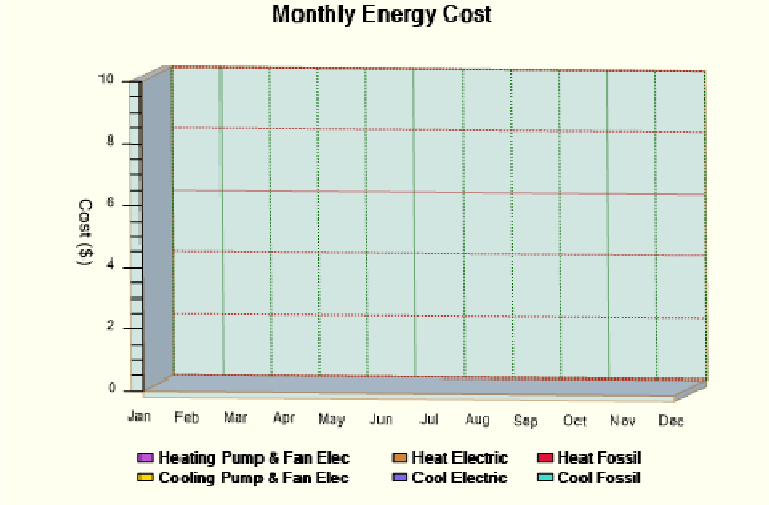
	Jan	Feb	Mar	Apr	May	Jun
Heating Pump & Fan Cost($)	1476	1318	1279	711	463	233
Heating Other Electical Cost($)	5278	4395	3620	1187	543	172
Heating Fossil Cost Oil ($)	0	0	0	0	0	0
Heating Fossil Cost Natural Gas($)	0	0	0	0	0	0
Heating Fossil Cost Propane($)	0	0	0	0	0	0
Heating Total Cost($)	6754	5713	4900	1898	1006	405
Cooling Pump & Fan Cost($)	0	0	0	0	22	194
Cooling Other Electical Cost($)	0	0	0	0	27	250
Cooling Fossil Cost Oil ($)	0	0	0	0	0	0
Cooling Fossil Cost Natural Gas($)	0	0	0	0	0	0
Cooling Fossil Cost Propane($)	0	0	0	0	0	0
Cooling Total Cost($)	0	0	0	0	49	444
Heating Pump & Fan Consumption (Kw)	8863	7913	7684	4273	2782	1398
Heating Other Consumption (Kw)	31702	26398	21743	7126	3263	1031
Heating Consumption Fossil Oil (Gal)	0	0	0	0	0	0
Heating Consumption Fossil Natural Gas(Therm)	0	0	0	0	0	0
Heating Consumption Fossil Propane (Gal)	0	0	0	0	0	0
Cooling Pump & Fan Consumption (Kw)	0	0	0	0	133	1164
Cooling Other Consumption (Kw)	0	0	0	0	162	1502
Cooling Consumption Fossil Oil (Gal)	0	0	0	0	0	0
Cooling Consumption Fossil Natural Gas(Therm)	0	0	0	0	0	0
Cooling Consumption Fossil Propane (Gal)	0	0	0	0	0	0
Geothermal Heat Extraction (MMBTU)	0	0	0	0	0	0
Geothermal Heat Rejection (MMBTU)	0	0	0	0	0	0

Option #2: VRF with Boiler Back up

	Jul	Aug	Sep	Oct	Nov	Dec
Heating Pump & Fan Cost($)	187	163	365	576	966	1369
Heating Other Electical Cost($)	99	91	379	792	2129	4014
Heating Fossil Cost Oil ($)	0	0	0	0	0	0
Heating Fossil Cost Natural Gas($)	0	0	0	0	0	0
Heating Fossil Cost Propane($)	0	0	0	0	0	0
Heating Total Cost($)	286	254	744	1368	3095	5382
Cooling Pump & Fan Cost($)	250	323	74	0	0	0
Cooling Other Electical Cost($)	328	434	96	0	0	0
Cooling Fossil Cost Oil ($)	0	0	0	0	0	0
Cooling Fossil Cost Natural Gas($)	0	0	0	0	0	0
Cooling Fossil Cost Propane($)	0	0	0	0	0	0
Cooling Total Cost($)	578	757	170	0	0	0
Heating Pump & Fan Consumption (Kw)	1123	981	2194	3459	5802	8222
Heating Other Consumption (Kw)	595	547	2274	4755	12788	24105
Heating Consumption Fossil Oil (Gal)	0	0	0	0	0	0
Heating Consumption Fossil Natural Gas(Therm)	0	0	0	0	0	0
Heating Consumption Fossil Propane (Gal)	0	0	0	0	0	0
Cooling Pump & Fan Consumption (Kw)	1502	1939	443	0	0	0
Cooling Other Consumption (Kw)	1971	2609	579	0	0	0
Cooling Consumption Fossil Oil (Gal)	0	0	0	0	0	0
Cooling Consumption Fossil Natural Gas(Therm)	0	0	0	0	0	0
Cooling Consumption Fossil Propane (Gal)	0	0	0	0	0	0
Geothermal Heat Extraction (MMBTU)	0	0	0	0	0	0
Geothermal Heat Rejection (MMBTU)	0	0	0	0	0	0

Terminal Flow Control

Pump Flow Control: Constant
Fan Flow Control: Constant



Annual Energy Cost HVAC

Electrical Consumption:	0 Kw
Electrical Consumption Cost:	$0
Electrical Demand Cost:	$0
Total Electrical Cost:	$0
Fossil Consumption:	0 MMBtu
Fossil Cost:	$0
Total Cost:	$0
Life Cycle Cost:	$0

Life Cycle Cost

First Cost:	$0
Annual Maintenance Cost:	$0
Replacement Cost:	$0
Replacement Interval:	0 Years

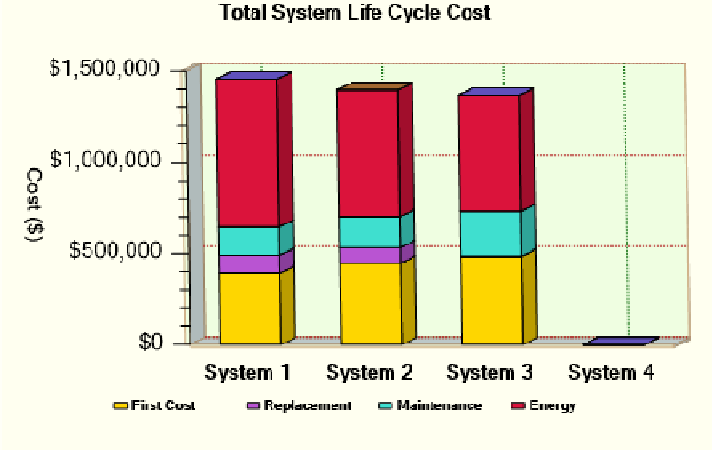
Total Pump & Fan HP

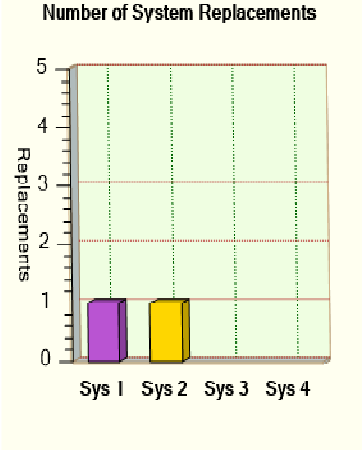
Total Heating Pump & Fan HP: .00 Hp
Total Cooling Pump & Fan HP: .00 Hp
Cooling System BEER: 0.00 EER

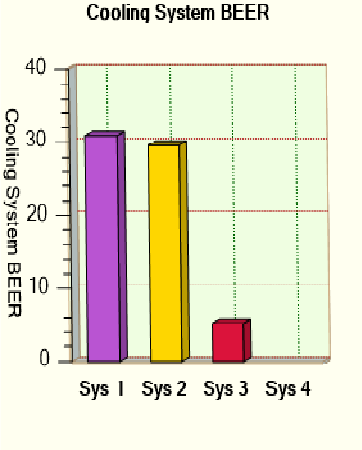
Monthly Energy Data

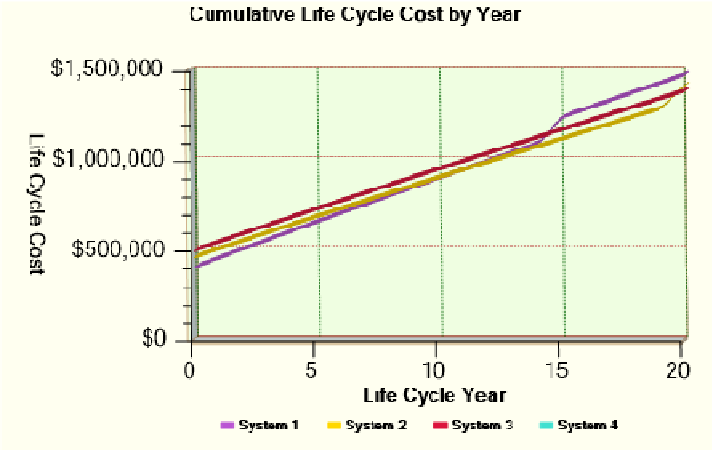
	Jan	Feb	Mar	Apr	May	Jun
Heating Pump & Fan Cost($)	0	0	0	0	0	0
Heating Other Electical Cost($)	0	0	0	0	0	0
Heating Fossil Cost Oil ($)	0	0	0	0	0	0
Heating Fossil Cost Natural Gas($)	0	0	0	0	0	0
Heating Fossil Cost Propane($)	0	0	0	0	0	0
Heating Total Cost($)	0	0	0	0	0	0
Cooling Pump & Fan Cost($)	0	0	0	0	0	0
Cooling Other Electical Cost($)	0	0	0	0	0	0
Cooling Fossil Cost Oil ($)	0	0	0	0	0	0
Cooling Fossil Cost Natural Gas($)	0	0	0	0	0	0
Cooling Fossil Cost Propane($)	0	0	0	0	0	0
Cooling Total Cost($)	0	0	0	0	0	0
Heating Pump & Fan Consumption (Kw)	0	0	0	0	0	0
Heating Other Consumption (Kw)	0	0	0	0	0	0
Heating Consumption Fossil Oil (Gal)	0	0	0	0	0	0
Heating Consumption Fossil Natural Gas(Therm)	0	0	0	0	0	0
Heating Consumption Fossil Propane (Gal)	0	0	0	0	0	0
Cooling Pump & Fan Consumption (Kw)	0	0	0	0	0	0
Cooling Other Consumption (Kw)	0	0	0	0	0	0
Cooling Consumption Fossil Oil (Gal)	0	0	0	0	0	0
Cooling Consumption Fossil Natural Gas(Therm)	0	0	0	0	0	0
Cooling Consumption Fossil Propane (Gal)	0	0	0	0	0	0
Geothermal Heat Extraction (MMBTU)	NaN	0	0	NaN	0	0
Geothermal Heat Rejection (MMBTU)	0	0	0	0	0	0

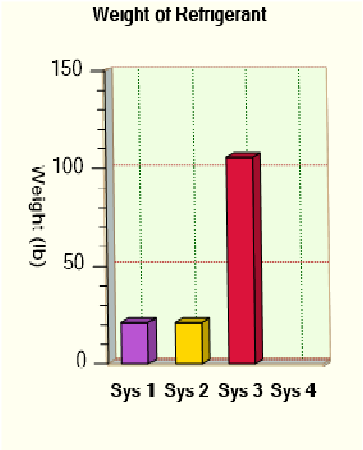
	Jul	Aug	Sep	Oct	Nov	Dec
Heating Pump & Fan Cost($)	0	0	0	0	0	0
Heating Other Electical Cost($)	0	0	0	0	0	0
Heating Fossil Cost Oil ($)	0	0	0	0	0	0
Heating Fossil Cost Natural Gas($)	0	0	0	0	0	0
Heating Fossil Cost Propane($)	0	0	0	0	0	0
Heating Total Cost($)	0	0	0	0	0	0
Cooling Pump & Fan Cost($)	0	0	0	0	0	0
Cooling Other Electical Cost($)	0	0	0	0	0	0
Cooling Fossil Cost Oil ($)	0	0	0	0	0	0
Cooling Fossil Cost Natural Gas($)	0	0	0	0	0	0
Cooling Fossil Cost Propane($)	0	0	0	0	0	0
Cooling Total Cost($)	0	0	0	0	0	0
Heating Pump & Fan Consumption (Kw)	0	0	0	0	0	0
Heating Other Consumption (Kw)	0	0	0	0	0	0
Heating Consumption Fossil Oil (Gal)	0	0	0	0	0	0
Heating Consumption Fossil Natural Gas(Therm)	0	0	0	0	0	0
Heating Consumption Fossil Propane (Gal)	0	0	0	0	0	0
Cooling Pump & Fan Consumption (Kw)	0	0	0	0	0	0
Cooling Other Consumption (Kw)	0	0	0	0	0	0
Cooling Consumption Fossil Oil (Gal)	0	0	0	0	0	0
Cooling Consumption Fossil Natural Gas(Therm)	0	0	0	0	0	0
Cooling Consumption Fossil Propane (Gal)	0	0	0	0	0	0
[illegible]	[illegible]	[illegible]	[illegible]	0	0	0
Geothermal Heat Rejection (MMBTU)	0	0	0	0	0	0









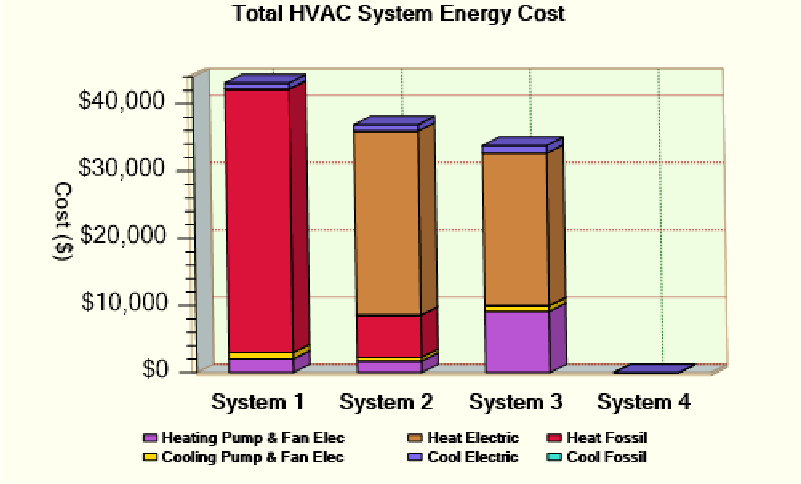


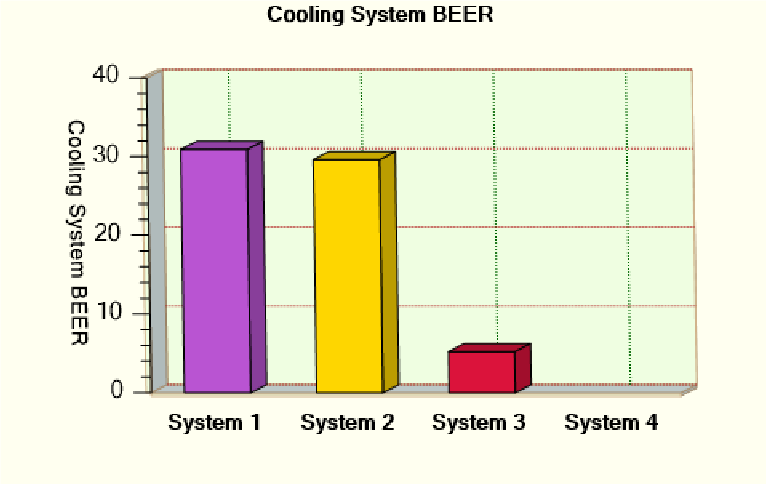
Consult ASHRAE Standard 34 Safety Classification of Refrigerants on allowable amounts of refrigerant and proper location of refrigerant sensors.

System 1: Base: LPG Boiler, VAV DX RTU
System 2: Option #1: A2W Heat Pump with LPG Boiler
System 3: Option #2: VRF with Boiler Back up
System 4:

Energy Analysis System Comparison Jan 13, 2025

	System 1	System 2	System 3	System 4	
Heating Pump & Fan HP:	7.81	4.52	9.71	0.00	HP
Cooling Pump & Fan HP:	27.29	9.87	15.02	0.00	HP
Cooling System BEER:	30.91	29.61	5.24	0.00	EER
Electrical Consumption:	23,269	184,093	203,027	0	KWHr
Electrical Consumption Cost:	3,874	30,651	33,804	0	$
Electrical Demand Cost:	0	0	0	0	$
Total Electrical Cost:	3,874	30,651	33,804	0	$
Fossil Fuel Consumption Natural Gas:	0	0	0	0	Therm
Fossil Fuel Consumption Oil:	0	0	0	0	Gal
Fossil Fuel Consumption Propane:	10,502	1,675	0	0	Gal
Fossil Fuel Cost:	39,244	6,260	0	0	$
Total Cost:	43,119	36,911	33,804	0	$
Savings for System 3:	9,315	3,107			$



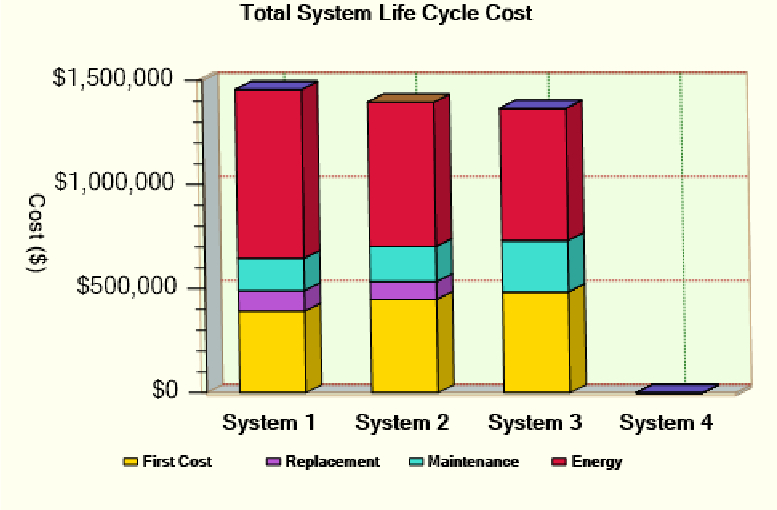


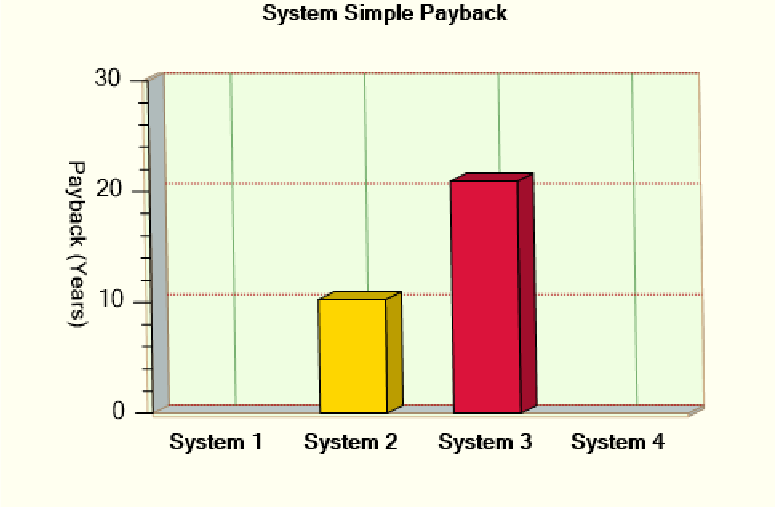
System 1: Base: LPG Boiler, VAV DX RTU
System 2: Option #1: A2W Heat Pump with LPG Boiler
System 3: Option #2: VRF with Boiler Back up
System 4:

Energy Analysis System Life Cycle Cost Comparison

Jan 13, 2025

	System 1	System 2	System 3	System 4	
Life Cycle Present Worth:	1,456,899	1,396,684	1,367,302	0	$
Life Cycle Cost Savings for System 3	89,596	29,381			$
Annualized Life Cycle Cost:	127,019	121,769	119,208	0	$
Annualized Life Cycle Cost Savings for System 3	7,811	2,562			$
First Cost:	392,127	448,145	485,491	0	$
Additional First Cost Against System 1		56,018	93,364		$
Annual Energy & Maintenance Cost:	51,335	45,874	46,875	0	$
Annual Energy & Maintenance Cost Savings Over System 1		5,461	4,460		$
SimplePayback:		10	21		Years





System 1: Base: LPG Boiler, VAV DX RTU
System 2: Option #1: A2W Heat Pump with LPG Boiler
System 3: Option #2: VRF with Boiler Back up
System 4:

	System 1	System 2	System 3	System 4
ASHRAE Design Cooling Temperature	84.4	84.4	84.4	84.4
Cooling Compressor Demand (KW)	14.4	15.3	18.3	.0
Cooling Condenser Fan Demand (KW)	1.4	1.4	1.4	.0
Cooling Pump & Fan Demand (KW)	20.4	7.4	11.2	.0
Cooling System Demand (KW)	34.7	22.6	29.5	.0
Cooling System BEER	30.9	29.6	5.2	.0
ASHRAE Design Heating Temperature	-15.0	-15.0	-15.0	-15.0
HeatCompressor Demand (KW)	.0	26.5	16.1	.0
Heating Pump & Fan Demand (KW)	5.8	3.4	7.2	.0
Resistance Heating System Demand (KW)	.0	.0	.0	.0
Max Heating System Demand (KW)	5.8	29.9	23.3	.0
Heating System Fossil Fuel Consumption				
Oil (Gal)	.0	.0	.0	.0
Natural Gas (Therm)	.0	.0	.0	.0
Propane (Gal)	10501.6	1675.1	.0	.0
Energy Utilization Index, EUI (KBtu/Ft²/Year)	84.7	64.4	57.3	.0