AUTODESK.

Residence_TAN (1)

Residence_TAN Analysis

Analyzed at 12/14/2017 8:51:35 AM

Energy Analysis Result

Building Performance Factors

Location:	Creede, CO
Weather Station:	19405
Outdoor Temperature:	Max: 88°F/Min: -30°F
Floor Area:	3,077 sf
Exterior Wall Area:	2,674 sf
Average Lighting Power:	0.26 W / ft²
People:	1 people
Exterior Window Ratio:	0.11
Electrical Cost:	$0.11 / kWh
Fuel Cost:	$0.78 / Therm

Energy Use Intensity

Electricity EUI:	15 kWh / sf / yr
Fuel EUI:	13 kBtu / sf / yr
Total EUI:	66 kBtu / sf / yr

Life Cycle Energy Use/Cost

Life Cycle Electricity Use:	852,656 kWh
Life Cycle Fuel Use:	7,360 Therms
Life Cycle Energy Cost:	$44,270

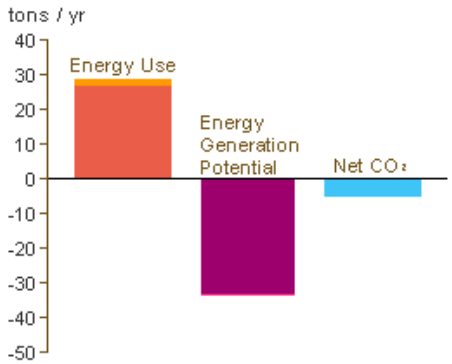
*30-year life and 6.1% discount rate for costs

Renewable Energy Potential

Roof Mounted PV System (Low efficiency):	11,504 kWh / yr
Roof Mounted PV System (Medium efficiency):	23,008 kWh / yr
Roof Mounted PV System (High efficiency):	34,512 kWh / yr
Single 15' Wind Turbine Potential:	893 kWh / yr

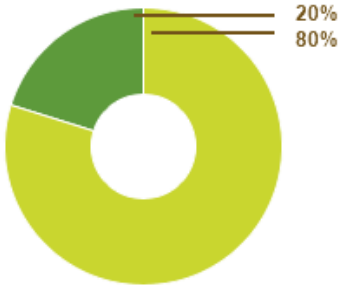
*PV efficiencies are assumed to be 5%, 10% and 15% for low, medium and high efficiency systems

Annual Carbon Emissions



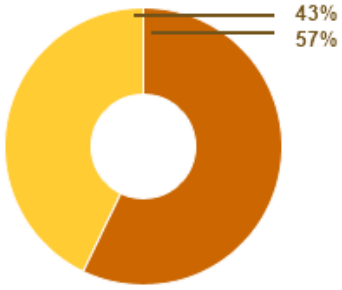
	(tons / yr)
Electricity Consumption	27
Fuel Consumption	1
Roof PV Potential (High Efficiency)	-32
Single 15' Wind Turbine Potential	0
Net CO2	-4

Annual Energy Use/Cost



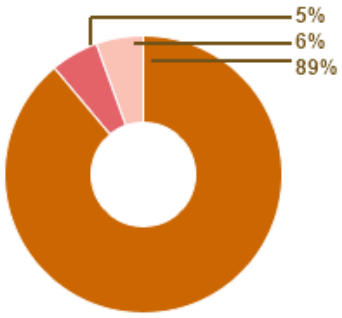
Electricity	80%	$3,058	28,421	kWh
Fuel	20%	$192	245	Therms
		$3,250		

Energy Use: Fuel



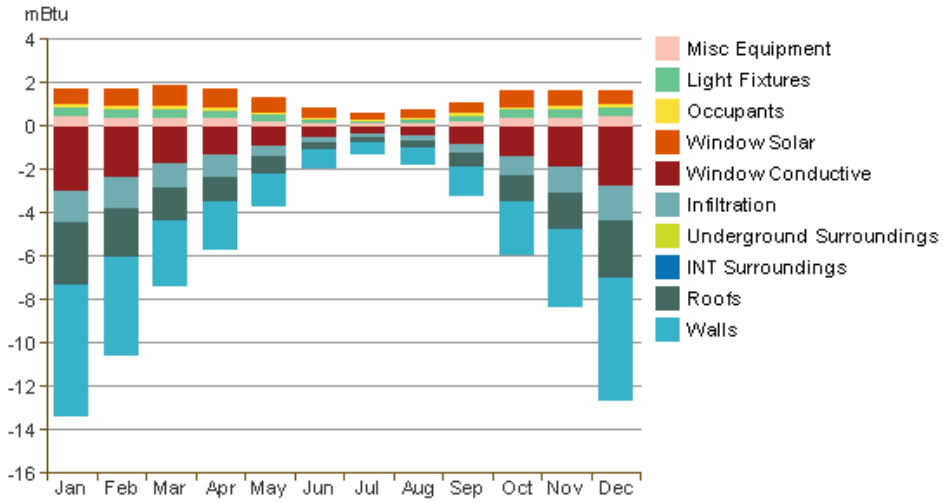
			(Therms)
HVAC	57%	$109	140
Domestic Hot Water	43%	$82	105
		$191	245

Energy Use: Electricity

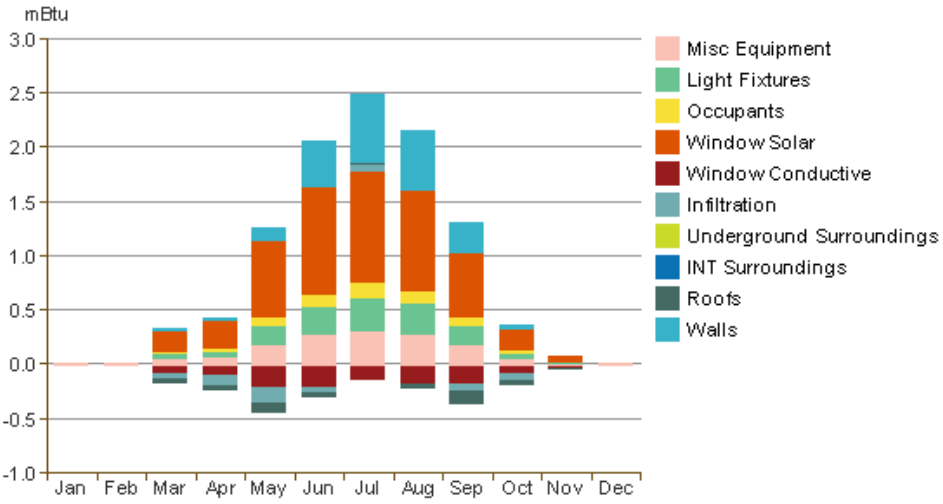


			(kWh)
HVAC	89%	$2,718	25,268
Lighting	5%	$170	1,584
Misc Equipment	6%	$168	1,568
		$3,056	28,420

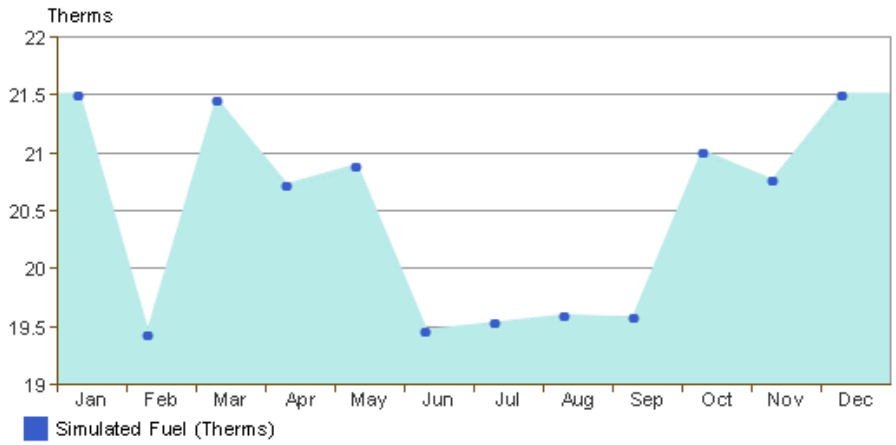
Monthly Heating Load



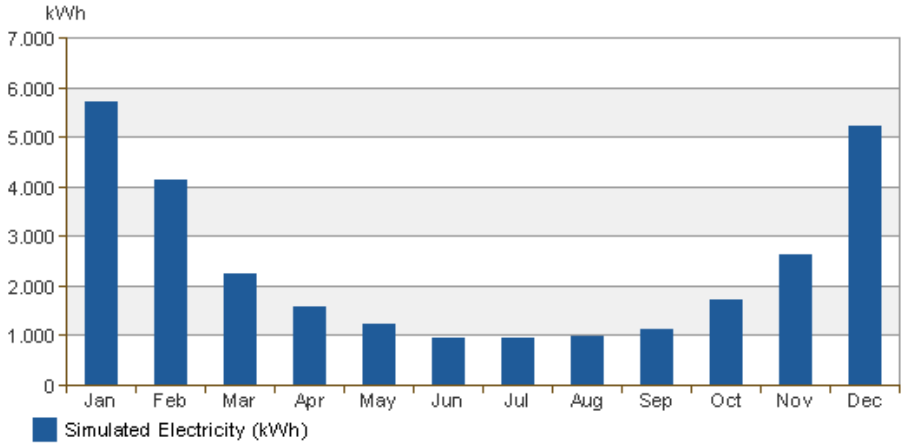
Monthly Cooling Load



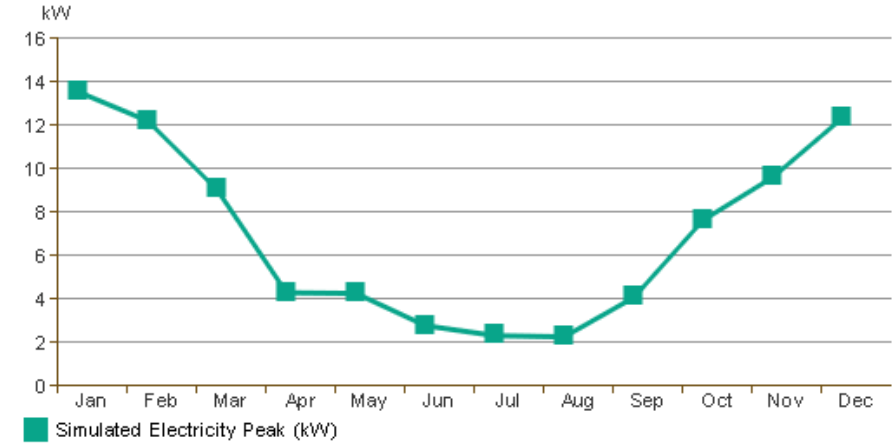
Monthly Fuel Consumption



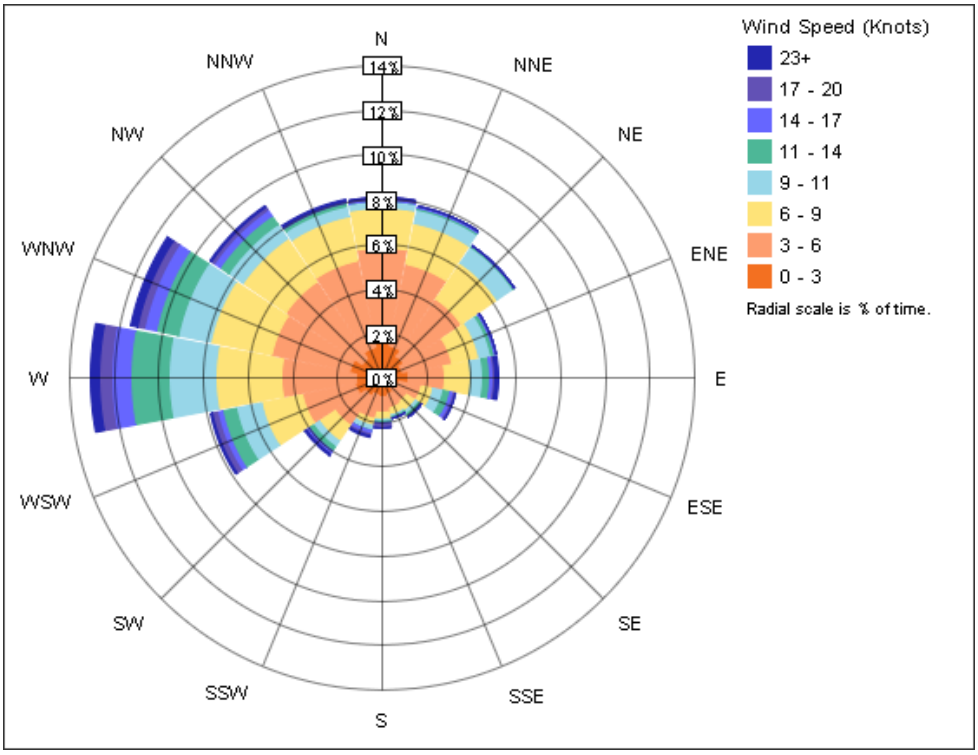
Monthly Electricity Consumption



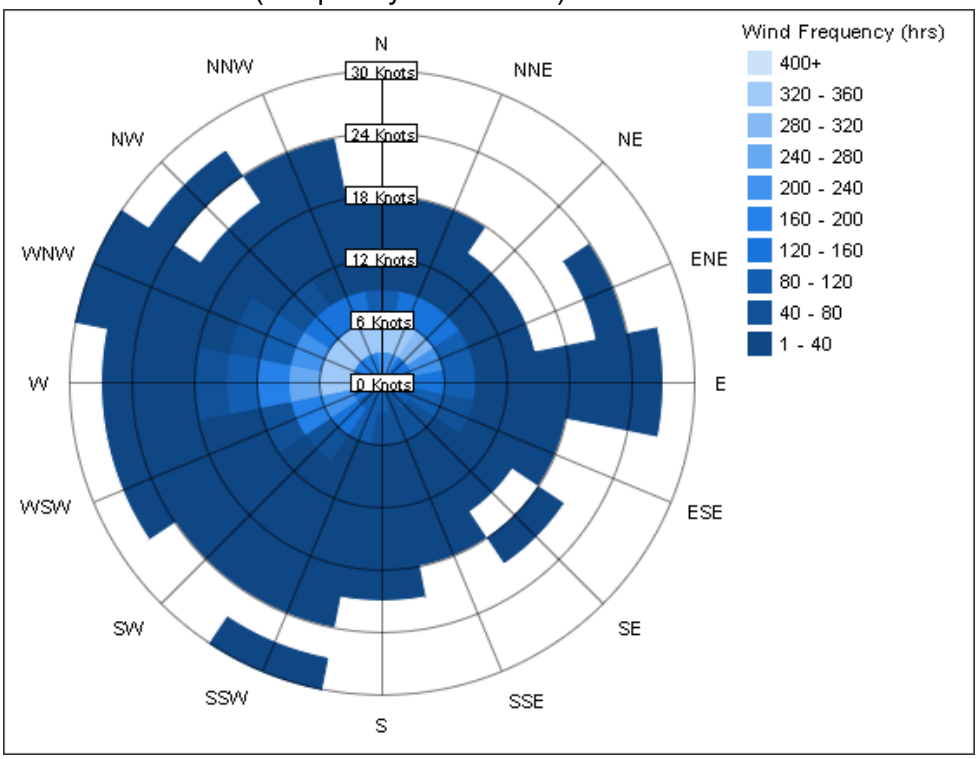
Monthly Peak Demand



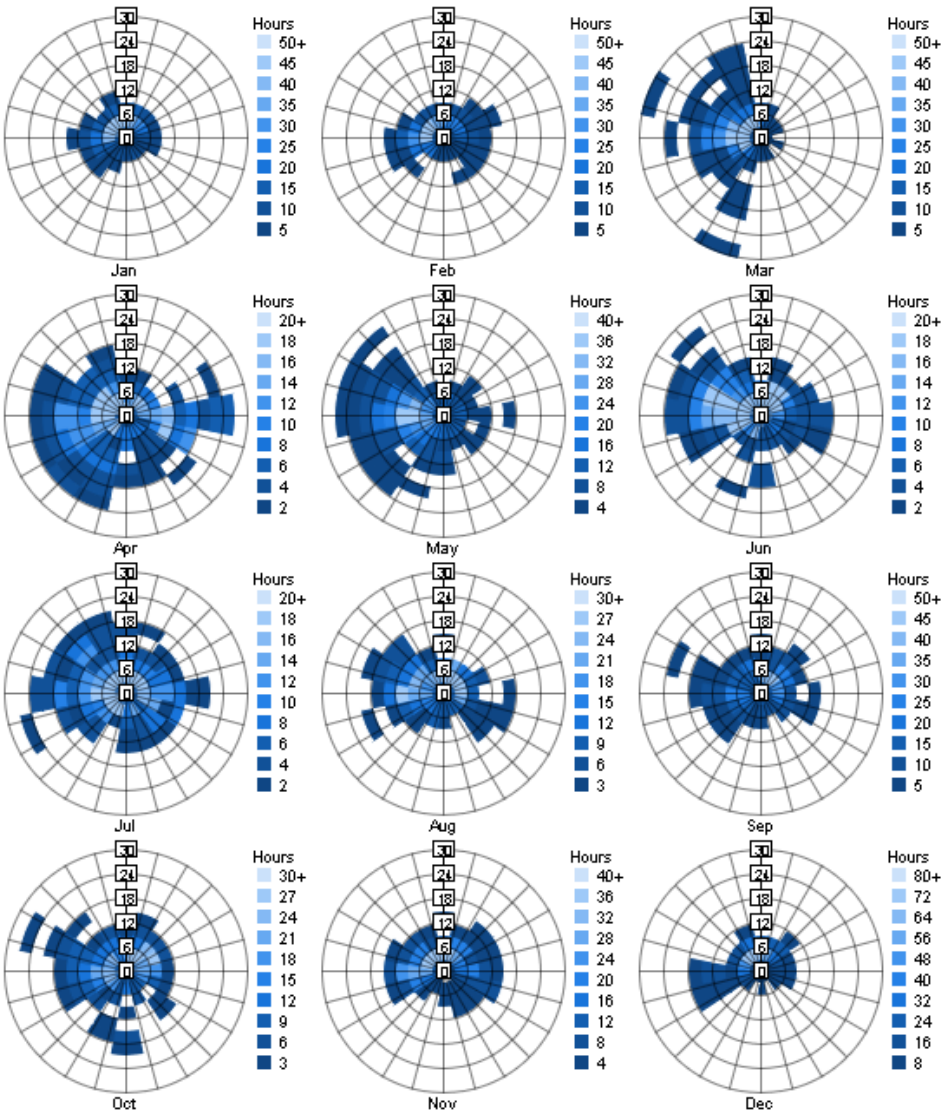
Annual Wind Rose (Speed Distribution)



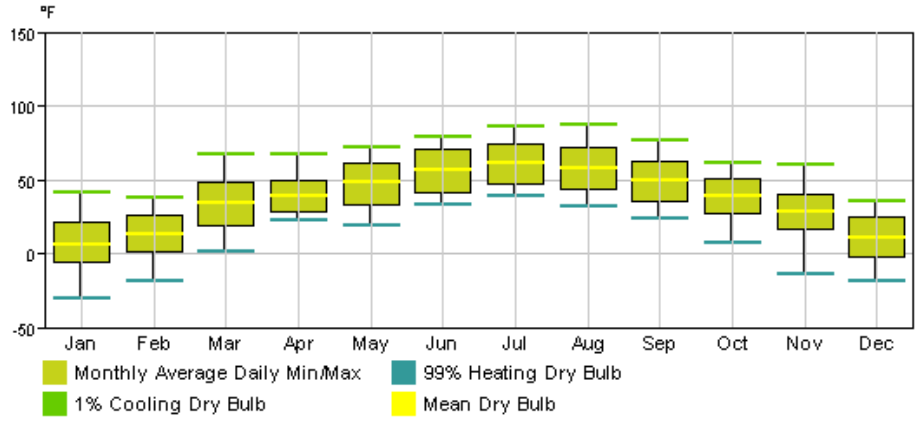
Annual Wind Rose (Frequency Distribution)



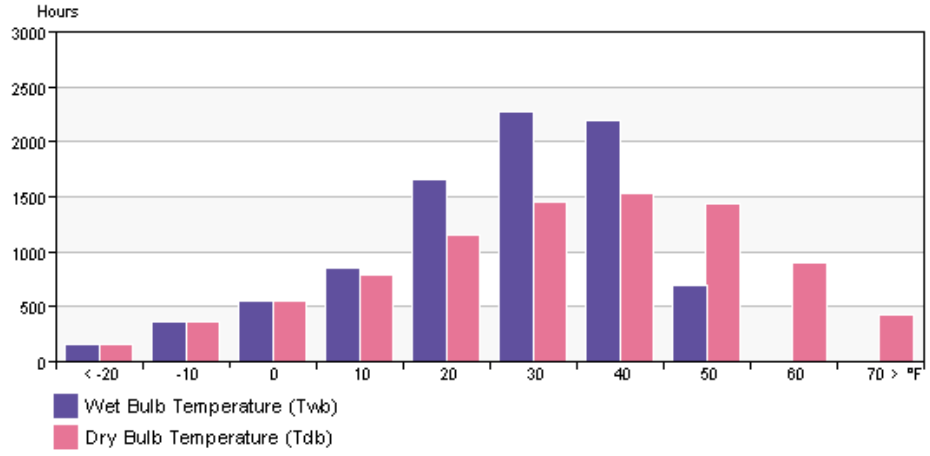
Monthly Wind Roses



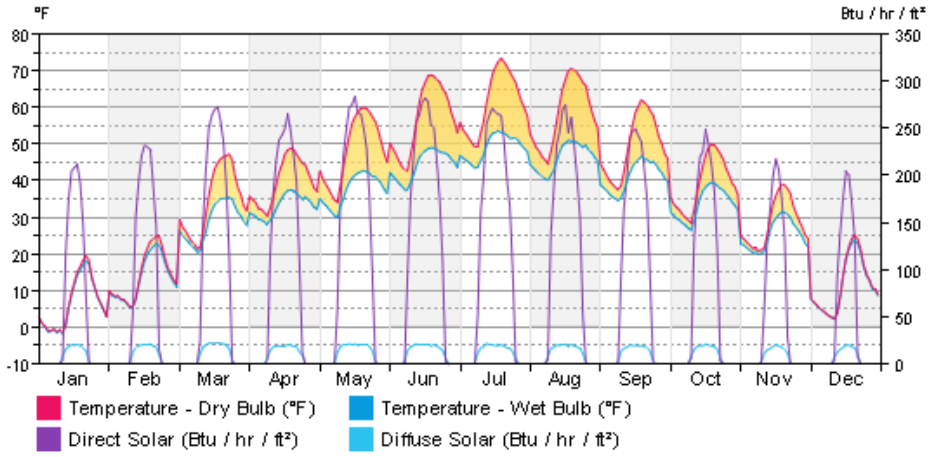
Monthly Design Data



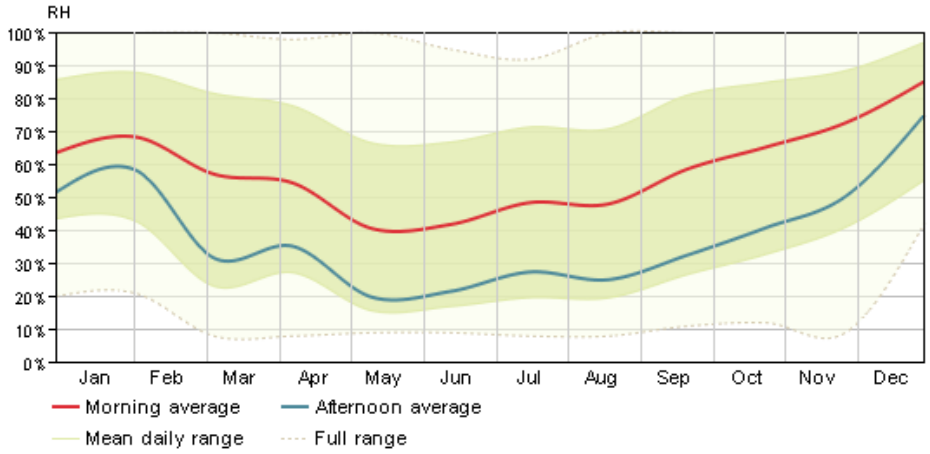
Annual Temperature Bins



Diurnal Weather Averages



Humidity



Energy Analysis Data

Project Summary

Location and Weather	
Project	Home Energy Analysis
Address	Creede, Colorado
Calculation Time	Thursday, December 07, 2017 11:25 AM
Report Type	Simple
Latitude	37.85°
Longitude	-106.93°
Summer Dry Bulb	86 °F
Summer Wet Bulb	60 °F
Winter Dry Bulb	-17 °F
Mean Daily Range	32 °F

Building Summary

Inputs	
Building Type	Single Family
Area (SF)	2,332
Volume (CF)	21,960
Calculated Results	
Peak Cooling Total Load (Btu/h)	**17,457.4**
Peak Cooling Month and Hour	July 4:00 PM
Peak Cooling Sensible Load (Btu/h)	18,523.3
Peak Cooling Latent Load (Btu/h)	-1,065.9
Maximum Cooling Capacity (Btu/h)	17,494.6
Peak Cooling Airflow (CFM)	772
Peak Heating Load (Btu/h)	**24,978.6**
Peak Heating Airflow (CFM)	2,142
Checksums	
Cooling Load Density (Btu/(h·ft²))	7.49
Cooling Flow Density (CFM/SF)	0.33
Cooling Flow / Load (CFM/ton)	530.49
Cooling Area / Load (SF/ton)	1,602.67
Heating Load Density (Btu/(h·ft²))	10.71
Heating Flow Density (CFM/SF)	0.92

Zone Summary - Zone 1

Inputs	
Area (SF)	1,182
Volume (CF)	12,124
Cooling Setpoint	74 °F
Heating Setpoint	70 °F
Supply Air Temperature	54 °F
Air Volume Calculation Type	VAV - Single Duct
Relative Humidity	42.00% (Calculated)
Psychrometric Message	None
Calculated Results	
Peak Cooling Load (Btu/h)	**8,291.6**
Peak Cooling Month and Hour	July 5:00 PM
Peak Cooling Sensible Load (Btu/h)	8,777.6
Peak Cooling Latent Load (Btu/h)	-486.0
Peak Cooling Airflow (CFM)	365
Peak Heating Load (Btu/h)	**11,880.1**
Peak Heating Airflow (CFM)	1,019
Checksums	
Cooling Load Density (Btu/(h·ft²))	7.01
Cooling Flow Density (CFM/SF)	0.31
Cooling Flow / Load (CFM/ton)	528.21
Cooling Area / Load (SF/ton)	1,710.82
Heating Load Density (Btu/(h·ft²))	10.05
Heating Flow Density (CFM/SF)	0.86

Zone 1 Spaces

Space Name	Area (SF)	Volume (CF)	Peak Cooling Load (Btu/h)	Cooling Airflow (CFM)	Peak Heating Load (Btu/h)	Heating Airflow (CFM)
107 BEDROOM	203	2,032	1,679.6	45	2,435.0	209
121 CLOSET1	30	363	68.0	3	121.3	10
122 1/2 Hall	12	170	20.4	1	58.1	5
108 MECH	60	513	195.7	8	419.7	36
109 WIC	42	323	163.8	6	620.3	53
126 CLOSET2	32	395	73.6	3	126.9	11
110 LOFT	383	3,971	2,808.1	126	3,385.9	290
123 GREATROOM	395	4,047	3,959.2	172	4,712.9	404

Zone Summary - Zone 2

Inputs	
Area (SF)	1,183
Volume (CF)	10,216
Cooling Setpoint	74 °F
Heating Setpoint	70 °F
Supply Air Temperature	54 °F
Air Volume Calculation Type	VAV - Single Duct
Relative Humidity	42.00% (Calculated)
Psychrometric Message	None
Calculated Results	
Peak Cooling Load (Btu/h)	**9,203.0**
Peak Cooling Month and Hour	July 4:00 PM
Peak Cooling Sensible Load (Btu/h)	9,783.0
Peak Cooling Latent Load (Btu/h)	-579.9
Peak Cooling Airflow (CFM)	407
Peak Heating Load (Btu/h)	**13,098.5**
Peak Heating Airflow (CFM)	1,123
Checksums	
Cooling Load Density (Btu/(h·ft²))	7.78
Cooling Flow Density (CFM/SF)	0.34
Cooling Flow / Load (CFM/ton)	530.40
Cooling Area / Load (SF/ton)	1,542.54
Heating Load Density (Btu/(h·ft²))	11.07
Heating Flow Density (CFM/SF)	0.95

Zone 2 Spaces

Space Name	Area (SF)	Volume (CF)	Peak Cooling Load (Btu/h)	Cooling Airflow (CFM)	Peak Heating Load (Btu/h)	Heating Airflow (CFM)
114 MASTER BEDROOM	203	1,651	2,504.5	51	2,323.1	199
116 WIC	42	341	75.1	2	242.6	21
115 BATHROOM	60	492	1,204.2	16	928.9	80
118 1/2 BATH	24	194	22.9	1	0.0	0
117 LAUNDRY	50	407	117.9	4	347.2	30
7 1/2 Hall	17	140	16.6	1	0.0	0
112 DINING	175	1,749	3,680.7	161	2,136.4	183
113 GREAT ROOM	289	2,557	1,067.1	47	2,832.3	243
119 MUD ROOM	115	995	785.0	24	1,593.3	137
111 KITCHEN	199	1,621	2,390.7	101	2,694.7	231

Trautman Associates
Residence
Timberbuilt, Inc.
12/7/2017
Home Energy Analysis

Adam Scott,

Please see the following report summarizing the information found through our energy analysis.

Project Information:
Residence, New Construction
Client·
Location- Creede, Colorado

Building performance-
Single Family Home
Area - 2360 sq. ft.
Climate Zone – Zone 7

The building loads from the heating and cooling calculation shows an extremely energy efficient home that exceeds 1000 sq. ft. per ton of cooling. Our calculation states that your home will be running at 1500 sf per ton. The recommended HVAC unit size for the Saunders residence would be a 2 ton unit. We would recommend an efficient HVAC system as in a VRF system to utilize the most utility savings opportunities. Some savings opportunities were analyzed to reduce energy use and save the home owner energy costs.

Saving opportunities:
Below are the highest opportunities to save on energy cost and energy intensity usage based on our energy model. As you can see below, the savings opportunities on the building design are not great due to the efficiency of the current design.

1) Roof Construction:

By increasing the thermal resistance values on the current roof construction, the heat loss across the wall can be reduced leading to higher energy savings.

A 10 ¼ SIP can create an efficient home but by doubling the R value of the roof construction to an R60, this can create energy savings, roughly 2 cents per sq. foot per year. This savings value equates to roughly 50$ per year. The payback is minimal for the construction change and we believe the current design now is optimal.

2) Wall construction:

By increasing the thermal resistance values on the current wall construction, the heat loss across the wall can be reduced leading to higher energy savings.

By doubling the size of the structurally insulated panel system to 12 ¼" SIP, the savings would roughly be 8-10 cents per sq. foot per year. This savings could lead to roughly 200$ per year in energy savings. This is a large change in wall construction for a minimal payback and we believe the current wall construction is optimal.

3) Window Composition:

Major heat loss occurs through the windows in residential homes. By upgrading windows, the cost savings is more effective compared to other construction factors.

The emissivity of window is another energy factor to consider. A low-e Pella Proline Series window is expected to be installed. Double pane windows with a low-e (e= 0.05) can reduce the heat loss by over 8000 Btu/hr in the entire home resulting in energy savings compared to a higher emissivity rating (e=0.2). Consider costs of materials when upgrading the composition of the windows. Upgrading rooms with greater window area or in path of direct sunlight will lead to even higher energy savings and/or HVAC system sizing reduction.

Windows Emissivity and Cooling Capacity:

- Double Pane
  - e = 0.2/0.1/0.05 → 18,284.6/18,292.9/13,461.7 Btu/hr
- Triple pane
  - e = 0.2/0.1/0.05 → 16,914.0/13,104.9/10,518.0 Btu/hr

*All other construction elements are maintained according to the construction drawings.

By upgrading windows, the recommended 2 ton unit can be reduced to a 1 ½ ton unit and possibly a 1 ton unit. The sizing may be reduced based on owner preference and usage.

4) Electrical Design:

These are savings shown to us on assumed values for electrical load. Energy savings on the home based on electrical inputs can be large and should be considered.

Based on the electrical input (1 W/sf) that was selected for this model the energy analysis shows that by having a lighting efficiency of .3 W/sf could allow the owners to save 10 cents/sf/year in energy costs. That is a savings of over 236$ per year in energy costs.

The model also takes into account plug load efficiency. Our input for plug load efficiency chosen was 1 W/sf. By lowering this value to .6 W/sf, the owners may save up to 10 cents/sf/year, which will greatly impact energy savings on the home. This savings could yield up to a 236$ savings per year in energy costs.

The energy savings listed must be evaluated vs the increased cost to make the change, as these changes could only lead to minimal return if the construction cost is large. Based on our modeling we believe that the designed home is extremely energy efficient, and should only require a 2 ton HVAC unit to make the space comfortable. An important point to make to the owner is that they should be selecting the correct HVAC system and size for optimal energy savings.

Performance Recommendations:

The following recommendations are to be considered when designing the home for even greater energy and utilities savings

- Avoiding oversized HVAC system leads to mechanical cost savings.
- Install Energy Star rated appliances including but not limited to water heaters, washing and drying machines, refrigerators, and dishwashing machines.
- Use low flow plumbing fixtures to reduce water consumption.
- Roof construction materials and light reflective options to reduce heat transfer and absorption through the roof.

HVAC Load Breakdown:

- Upper Floor
  - Cooling
    - 9800 Btu/hr (54% of total load)
  - Heating
    - 12600 Btu/hr
- Lower Floor
  - Cooling
    - 8500 Btu/hr (46% of total load)
  - Heating
    - 12000 Btu/hr

- Total Load
  - Cooling
    - 18300 Btu/hr (roughly 1.52 tons → 2 ton unit)
  - Heating
    - 25000 Btu/hr

If there are any other factors that you would think about changing we can add them into the model and compare the results.

Thank you.

John F. Daly, P.E.
Vice President