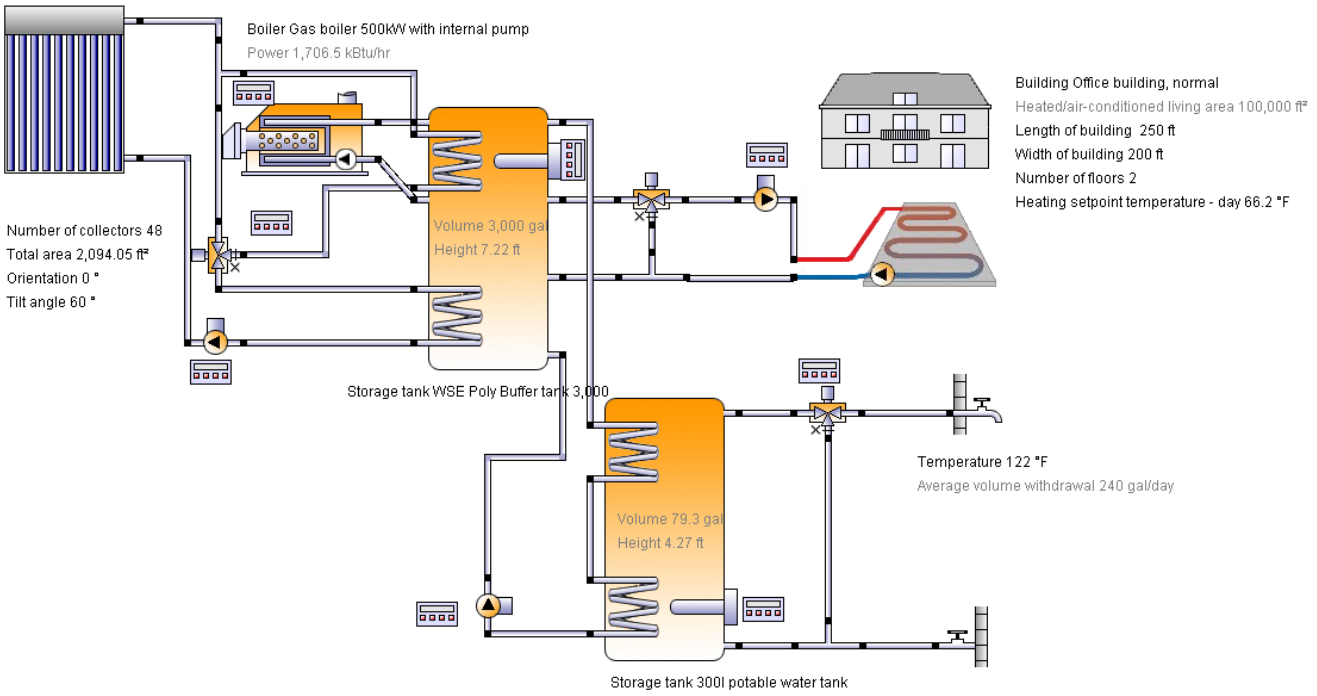
Financial Report

Project **9e: Space heating (solar thermal, 2 tanks)**



Location of the system

Fort St. John

Longitude: -120.872°

Latitude: 56.28°

Elevation: 2,405 ft

Map section

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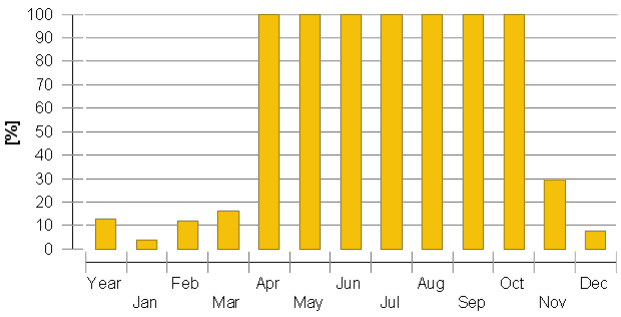
System overview (annual values)

Total fuel and/or electrical energy consumption of the system [Etot]	826,250.4 kBtu
Total energy consumption [Quse]	831,309.6 kBtu
System performance (Quse / Etot)	1.01
Comfort demand	Energy demand of the building not met

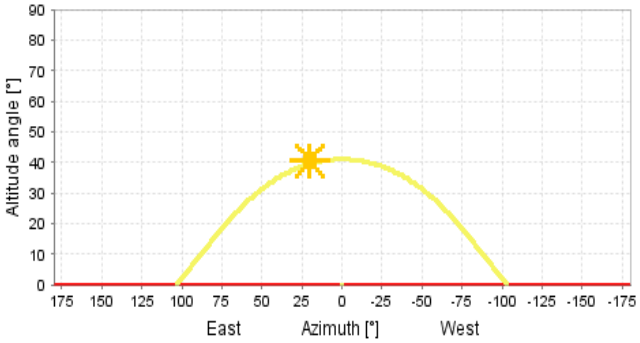
Overview solar thermal energy (annual values)

Collector area	2,094 ft²
Solar fraction total	12.9%
Solar fraction hot water [SFnHw]	84.1 %
Solar fraction building [SFnBd]	6.7 %
Total annual field yield	109,710 kBtu
Collector field yield relating to gross area	52 kBtu/ft²/Year
Collector field yield relating to aperture area	56 kBtu/ft²/Year
Max. fuel savings	92,865.2 ft³: [Natural gas H]
Max. energy savings	121,267.3 kBtu
Max. reduction in CO2 emissions	23,473.6 pound

Solar fraction: fraction of solar energy to system [SFn]



Horizon line



Meteorological data-Overview

Outdoor temperature 24h	36.1 °F
Annual global irradiance	377.4 kBtu/ft²
Annual diffuse irradiance	142.2 kBtu/ft²

Financial analysis - Solar thermal

Purchase costs	48,000 CAD
Life span	50 years
Proportional incentives	0 %
Incentives per area	0 CAD
Fixed incentives	0 CAD
Inflation	2 %
Interest	4 %
Increase of energy prices	5 %
Electricity	0.2 CAD/kWh
Natural gas H	0.031 CAD/ft³; 0.031 CAD/kBtu
Effective purchase cost after grants	48,000 CAD
Annual fuel cost savings	4,484.939 CAD
Solar energy cost per kWh	0.05 CAD
Payback period	10 years
Present value of the system	487,832.469 CAD
Net present value	439,832.469 CAD

Component overview (annual values)

Boiler 2	**Gas boiler 500kW with internal pump**	
Power	kBtu/hr	1,706.5
Total efficiency	%	89.5
Energy from/to the system [Qaux]	kBtu	738,612.1
Fuel and electrical energy consumption [Eaux]	kBtu	824,996.8
Energy savings solar thermal	kBtu	94,213.4
CO_2 savings solar thermal	pound	14,097.4
Fuel savings solar thermal	ft³	92,865.2

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Collector North America	WSE58ST	
Data Source		u138368
Number of collectors		48
Number of arrays		3
Total area	ft²	2,094.05
Total aperture area	ft²	1,960.754
Tilt angle	°	60
Orientation	°	0
Collector field yield [Qsol]	kBtu	109,709.9
Irradiance onto collector area [Esol]	kBtu	1,112,345.5
Collector efficiency [Qsol / Esol]	%	9.9
Direct irradiance after IAM	kBtu	833,761.9
Diffuse irradiance after IAM	kBtu	394,647.2

Building	Office building, normal	
Heated/air-conditioned living area	ft²	100,000
Heating setpoint temperature	°F	66.2
Heating energy demand excluding DHW [Qdem]	kBtu	782,538.9
Specific heating energy demand excluding DHW [Qdem]	kBtu/ft²	7.8
Solar gain through windows	kBtu	643,813.4
Total energy losses	kBtu	13,743,928

Convector Floor heating	Floor heating 2500 sq.ft.	
Number of heating/cooling modules	-	30
Power per heating module under standard conditions	kBtu/hr	61
Nominal inlet temperature	°F	113
Nominal return temperature	°F	95
Net energy from/to heating/cooling modules	kBtu	774,749.3

Hot water demand	Constant	
Withdraw volume	gal/d	240.5
Temperature setting	°F	122
Energy from/to the system [Quse]	kBtu	49,780.3

Pump Space heating loop pump	Pump, large	
Circuit pressure drop	psi	110.799
Flow rate	gpm	44
Fuel and electrical energy consumption [Epar]	kBtu	706.2

Pump Solar loop pump	Pump, medium	
Circuit pressure drop	psi	7.622
Flow rate	gpm	12
Fuel and electrical energy consumption [Epar]	kBtu	377.4

Pump Potable water tank loading pump	Pump, small	
Circuit pressure drop	psi	0.121
Flow rate	gpm	2.6
Fuel and electrical energy consumption [Epar]	kBtu	169.8

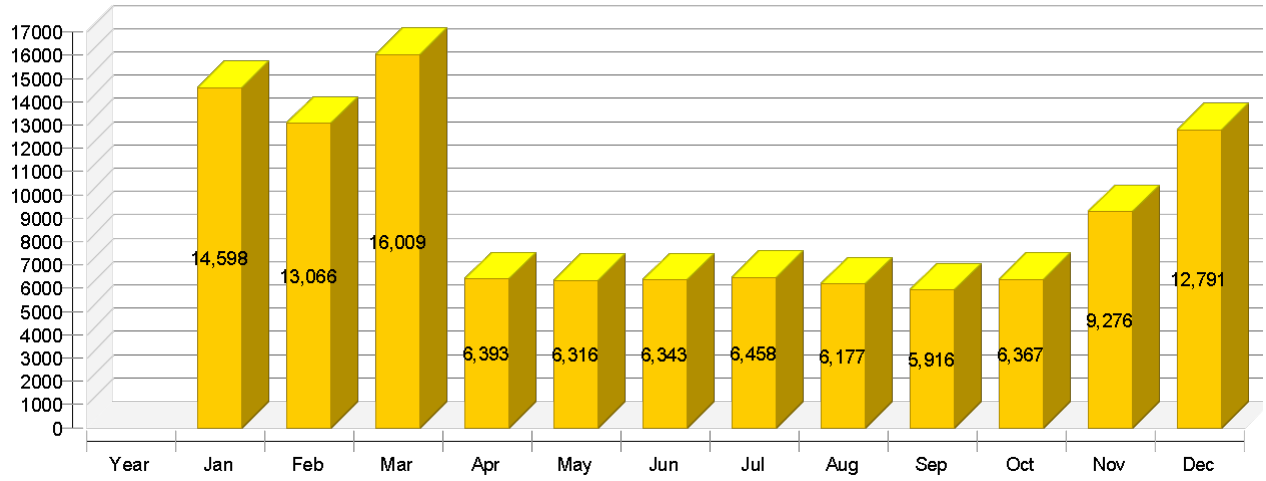
Storage tank Buffer tank	WSE Poly Buffer tank 3,000	
Volume	gal	3,000
Height	ft	7.22
Material		Enameled steel
Insulation		Flexible polyurethane foam
Thickness of insulation	in	4
Heat loss	kBtu	12,276.9
Connection losses	kBtu	4,448.9

Storage tank Potable water tank	300l potable water tank	
Volume	gal	79.3
Height	ft	4.27
Material		Stainless steel
Insulation		Rigid PU foam
Thickness of insulation	in	3.1
Heat loss	kBtu	1,827.1
Connection losses	kBtu	1,782.1

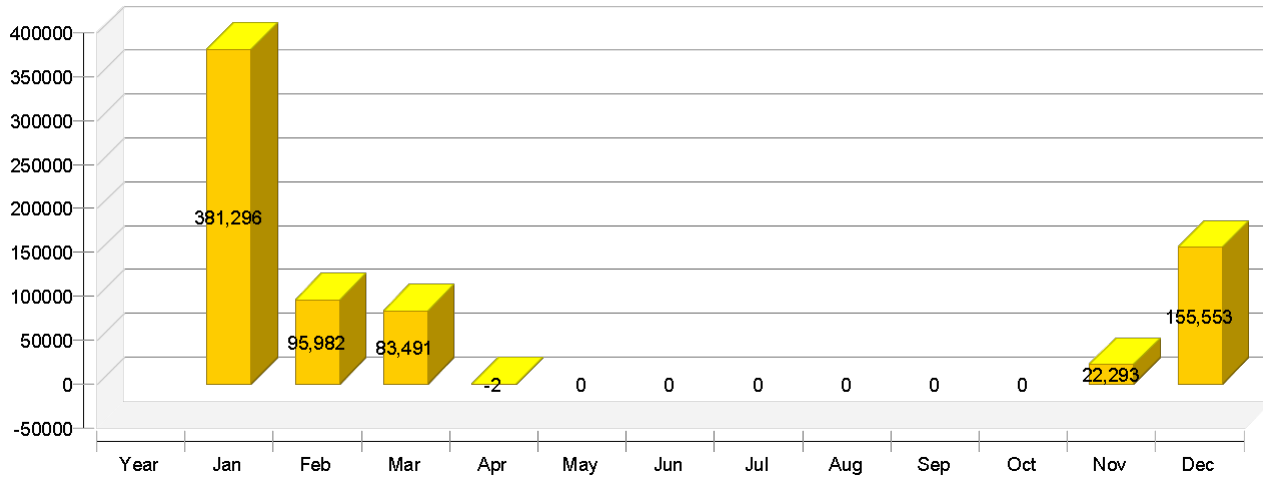
Loop

Solar loop		
Fluid mixture		Ethylene mixture
Fluid concentration	%	33.3
Fluid domains volume	gal	31.6
Pressure on top of the circuit	psi	58.016

Solar thermal energy to the system [Qsol] kBtu



Heat generator energy to the system (solar thermal energy not included) [Qaux] kBtu



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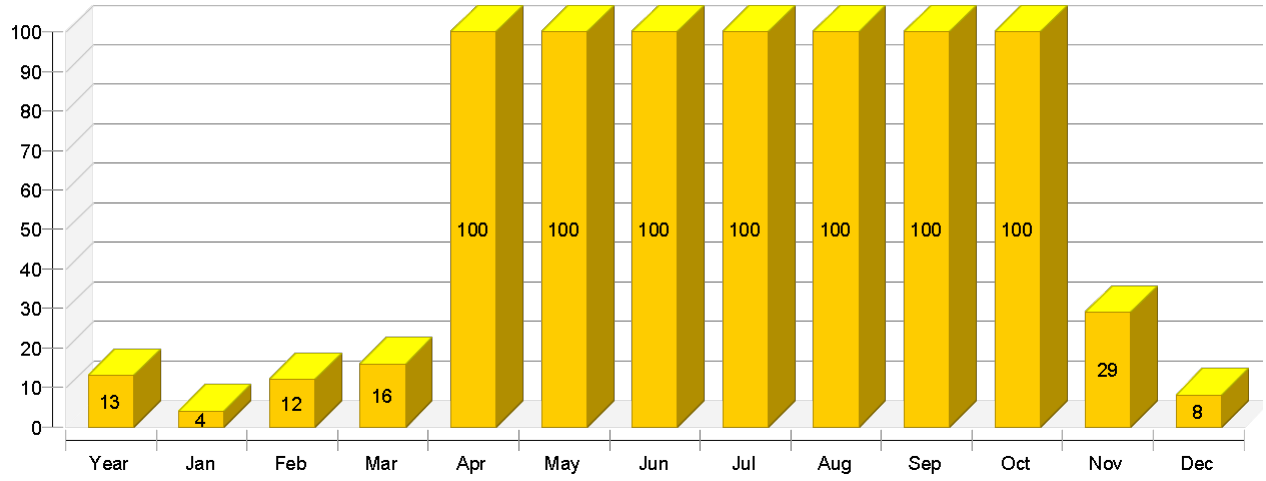
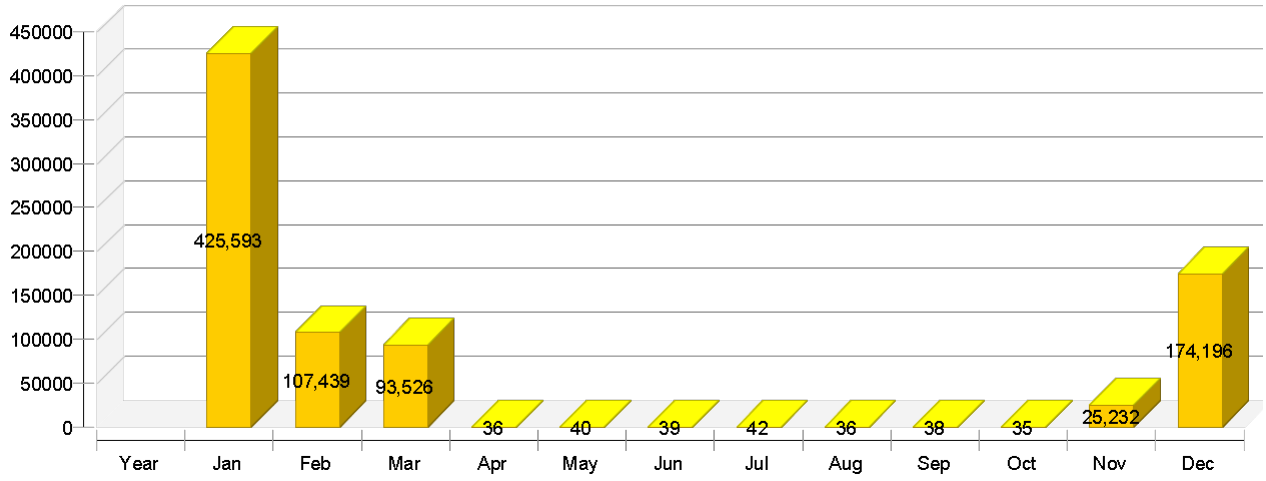
Solar fraction: fraction of solar energy to system [SFn] %



Total fuel and/or electrical energy consumption of the system [Etot] kBtu



	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Solar thermal energy to the system [Qsol]													
kBtu	109710	14598	13066	16009	6393	6316	6343	6458	6177	5916	6367	9276	12791
Heat generator energy to the system (solar thermal energy not included) [Qaux]													
kBtu	738612	381296	95982	83491	-2	0	0	0	0	0	0	22293	155553
Heat generator fuel and electrical energy consumption [Eaux]													
kBtu	824997	425154	107300	93393	0	0	0	0	0	0	0	25165	173984
Solar fraction: fraction of solar energy to system [SFn]													
%	12.9	3.7	12	16.1	100	100	100	100	100	100	100	29.4	7.6
Total fuel and/or electrical energy consumption of the system [Etot]													
kBtu	826250	425593	107439	93526	36	40	39	42	36	38	35	25232	174196

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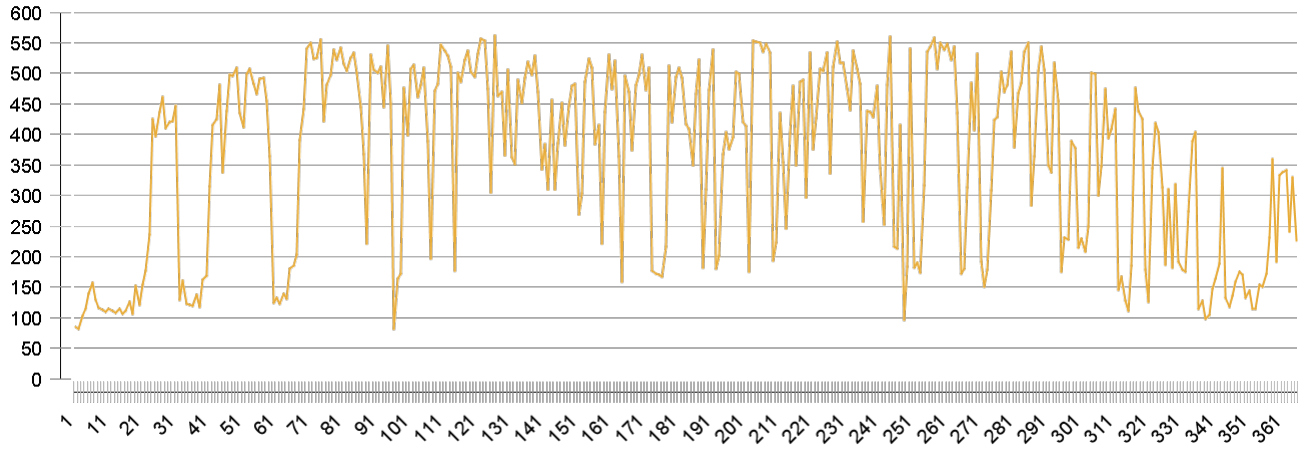
	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Irradiance onto collector area [Esol]													
kBtu	111234	65715	90625	128853	117368	109273	103581	104636	104459	87467	81651	62542	56177
Electrical energy consumption of pumps [Epar]													
kBtu	1253	439	139	133	36	40	39	42	36	38	35	67	211
Heat loss to indoor room (including heat generator losses) [Qint]													
kBtu	110263	45774	13099	11938	2017	2088	1990	2085	2106	1999	2107	4783	20278
Heat loss to surroundings (without collector losses) [Qext]													
kBtu	1107	99	98	115	87	92	81	86	82	79	92	95	101
Total energy consumption [Quse]													
kBtu	831310	394377	108896	96627	4614	4940	4980	5321	5218	4653	4455	30016	167212

Collector North America

Daily maximum temperature [°F]



Energy flow diagram