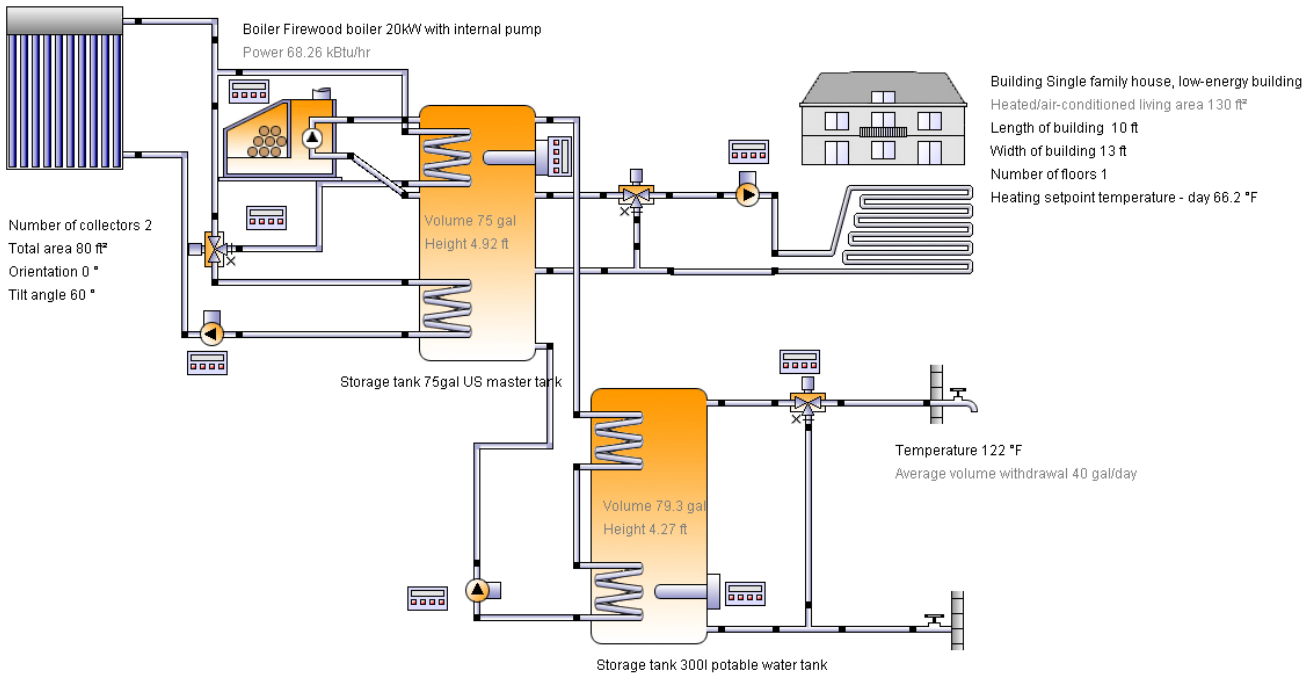


Project

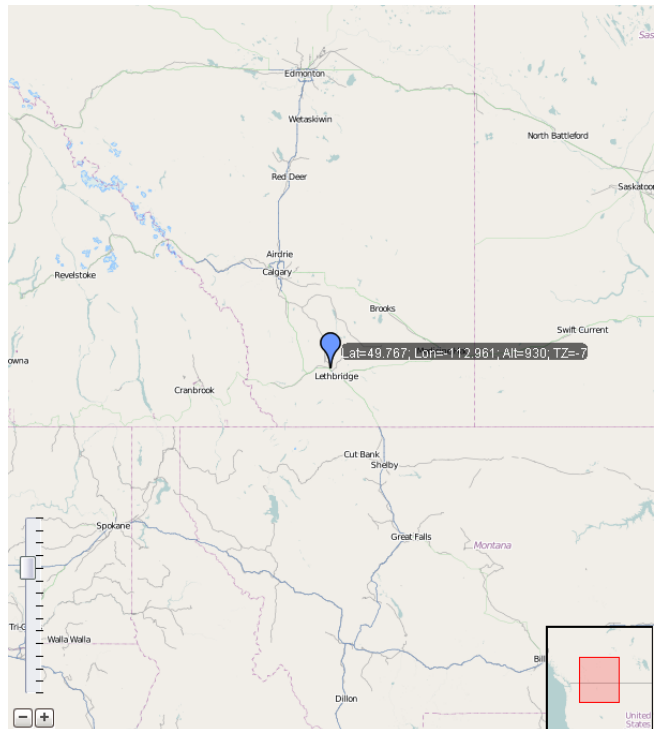
9e: Space heating (solar thermal, 2 tanks)



Location of the system

Lethbridge
Longitude: -112.961°
Latitude: 49.767°
Elevation: 3,051 ft

Map section



This report has been created by:

Elliott William
303 47 Str.E
S7K 5H2 Saskatoon

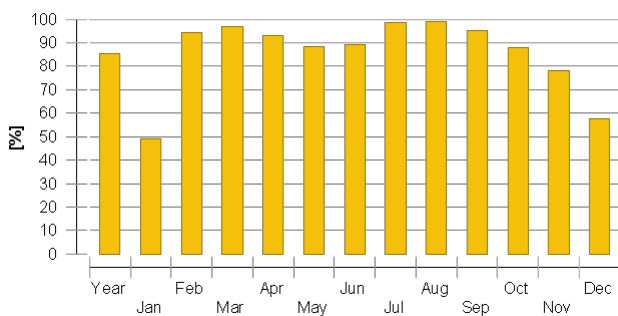
System overview (annual values)

Total fuel and/or electrical energy consumption of the system [Etot]	6,733.9 kBtu
Total energy consumption [Quse]	8,451.4 kBtu
System performance (Quse / Etot)	1.26
Comfort demand	Energy demand covered

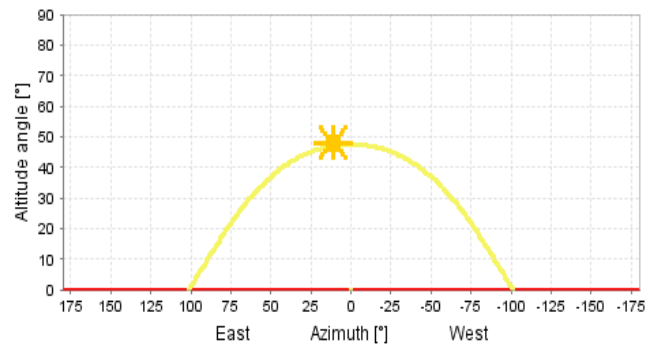
Overview solar thermal energy (annual values)

Collector area	80 ft ²
Solar fraction total	85.2%
Solar fraction hot water [SFnHw]	81.2 %
Solar fraction building [SFnBd]	46.3 %
Total annual field yield	16,649 kBtu
Collector field yield relating to gross area	208 kBtu/ft ² /Year
Collector field yield relating to aperture area	219 kBtu/ft ² /Year
Max. fuel savings	3,380.6 pound: [Firewood]
Max. energy savings	22,114.5 kBtu
Max. reduction in CO2 emissions	311.6 pound

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



Horizon line



Meteorological data-Overview

Outdoor temperature 24h	42.8 °F
Annual global irradiance	478.7 kBtu/ft ²
Annual diffuse irradiance	148.7 kBtu/ft ²

Financial analysis - Solar thermal

Purchase costs	2,800 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
Firewood	0.227 CAD/pound; 0.035 CAD/kBtu
Effective purchase cost after grants	2,800 CAD
Annual fuel cost savings	785.097 CAD
Solar energy cost per kWh	0.02 CAD
Payback period	4 years
Present value of the system	86,039.68 CAD
Net present value	83,239.672 CAD

Component overview (annual values)

Boiler 2	Firewood boiler 20kW with internal pump	
Power	kBtu/hr	68.26
Total efficiency	%	45.8
Energy from/to the system [Qaux]	kBtu	2,898
Fuel and electrical energy consumption [Eaux]	kBtu	6,328.8
Energy savings solar thermal	kBtu	21,800.7
CO savings solar thermal	pound	202.8
Fuel savings solar thermal	pound	3,380.6

Collector North America	WSE58ST	
Data Source		u138368
Number of collectors		2
Number of arrays		3
Total area	ft ²	80
Total aperture area	ft ²	76
Tilt angle	°	60
Orientation	°	0
Collector field yield [Qsol]	kBtu	16,648.7
Irradiance onto collector area [Esol]	kBtu	49,430.9
Collector efficiency [Qsol / Esol]	%	33.7
Direct irradiance after IAM	kBtu	39,006.8
Diffuse irradiance after IAM	kBtu	15,643.7

Building	Single family house, low-energy building	
Heated/air-conditioned living area	ft ²	130
Heating setpoint temperature	°F	66.2
Heating energy demand excluding DHW [Qdem]	kBtu	747.2
Specific heating energy demand excluding DHW [Qdem]	kBtu/ft ²	5.7
Solar gain through windows	kBtu	14,162
Total energy losses	kBtu	22,581.7

Convactor Floor heating	Floor heating 1000W	
Number of heating/cooling modules	-	13
Power per heating module under standard conditions	kBtu/hr	3
Nominal inlet temperature	°F	104
Nominal return temperature	°F	95
Net energy from/to heating/cooling modules	kBtu	524.2

Hot water demand	Constant	
Withdraw volume	gal/d	40.1
Temperature setting	°F	122
Energy from/to the system [Quse]	kBtu	7,704.2

Pump Space heating loop pump	Pump, medium	
Circuit pressure drop	psi	0.735
Flow rate	gpm	5
Fuel and electrical energy consumption [Epar]	kBtu	2.3

Pump Solar loop pump	Pump, small	
Circuit pressure drop	psi	0.034
Flow rate	gpm	0.5
Fuel and electrical energy consumption [Epar]	kBtu	352.7

Pump Potable water tank loading pump	Pump, small	
Circuit pressure drop	psi	0.125
Flow rate	gpm	2.6
Fuel and electrical energy consumption [Epar]	kBtu	45.6

Storage tank Buffer tank	75gal US master tank	
Volume	gal	75
Height	ft	4.92
Material		Enameled steel
Insulation		Flexible polyurethane foam
Thickness of insulation	in	4
Heat loss	kBtu	1,372.4
Connection losses	kBtu	2,894.9

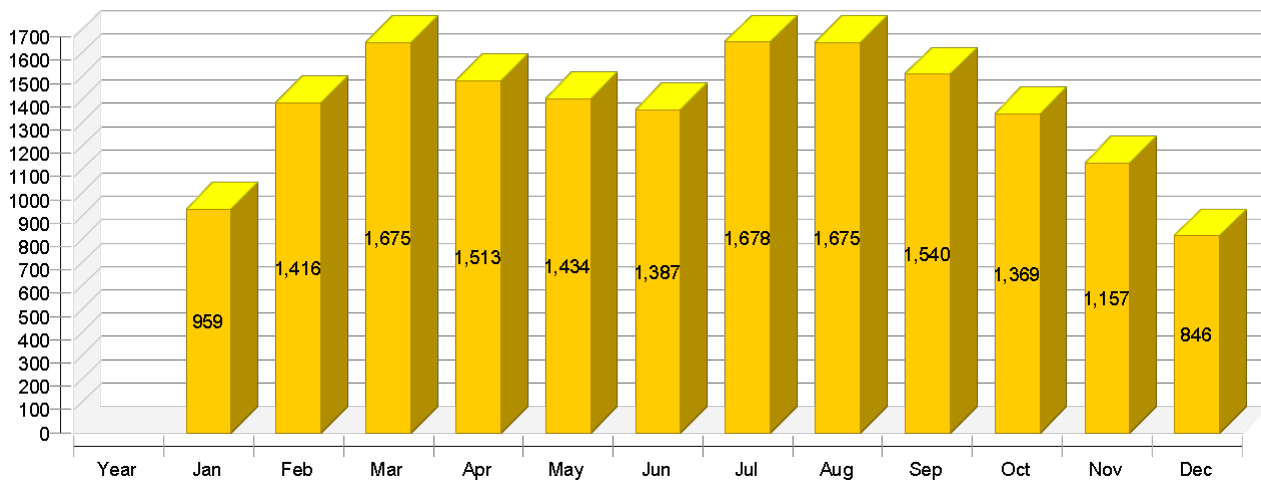
Storage tank Potable water tank	300l potable water tank	
Volume	gal	79.3
Height	ft	4.27
Material		Stainless steel
Insulation		Rigid PU foam
Thickness of insulation	in	3.1
Heat loss	kBtu	1,471.3
Connection losses	kBtu	1,512.7

Loop

Solar loop		
Fluid mixture		Ethylene mixture
Fluid concentration	%	33.3
Fluid domains volume	gal	8.1
Pressure on top of the circuit	psi	58.016

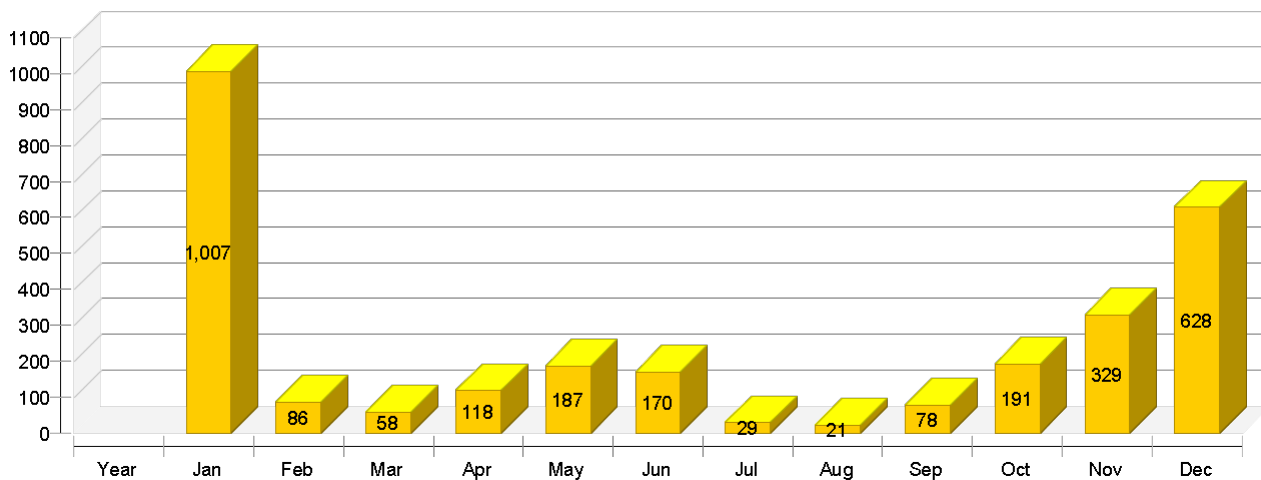
Solar thermal energy to the system [Qsol]

kBtu



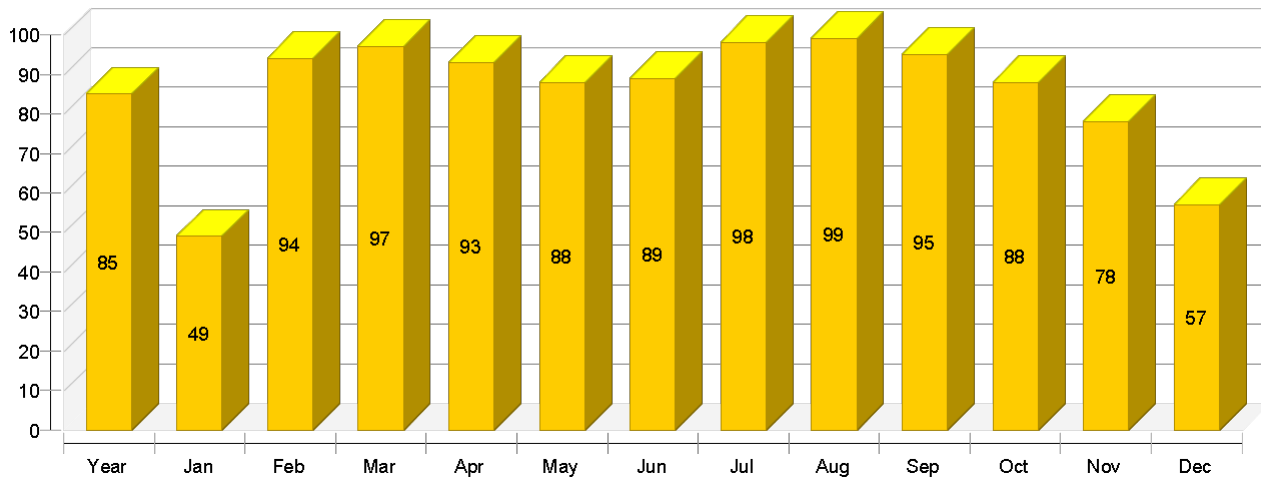
Heat generator energy to the system (solar thermal energy not included) [Qaux]

kBtu



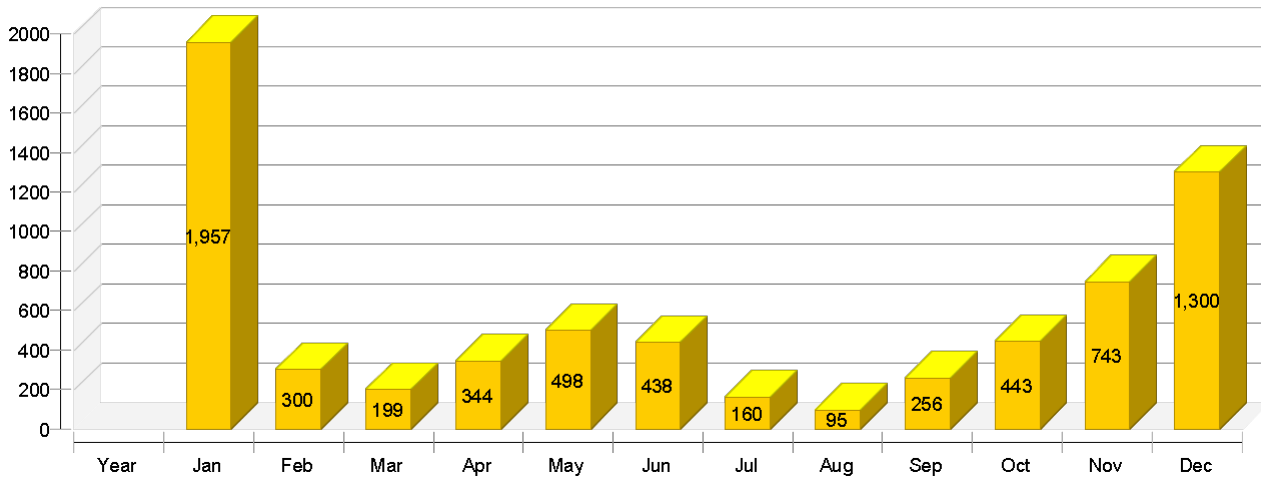
Solar fraction: fraction of solar energy to system [SFn]

%



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
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Solar thermal energy to the system [Qsol]

kBtu	16649	959	1416	1675	1513	1434	1387	1678	1675	1540	1369	1157	846
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Heat generator energy to the system (solar thermal energy not included) [Qaux]

kBtu	2902	1007	86	58	118	187	170	29	21	78	191	329	628
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Heat generator fuel and electrical energy consumption [Eaux]

kBtu	6333	1929	268	163	310	460	400	120	59	222	412	715	1276
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Solar fraction: fraction of solar energy to system [SFn]

%	85.2	48.8	94.3	96.7	92.8	88.5	89.1	98.3	98.7	95.2	87.8	77.8	57.4
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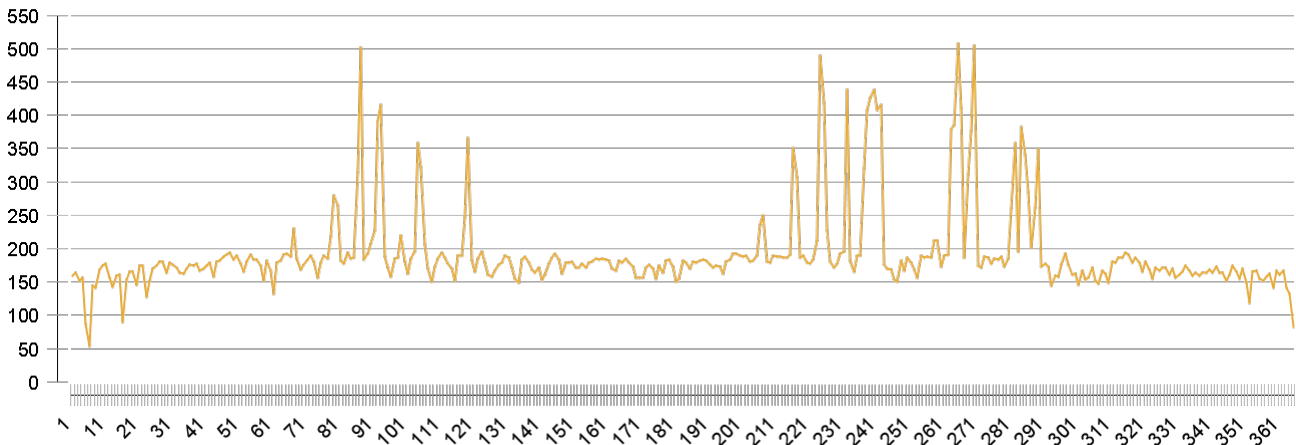
Total fuel and/or electrical energy consumption of the system [Etot]

kBtu	6734	1957	300	199	344	498	438	160	95	256	443	743	1300
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Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Irradiance onto collector area [Esol]													
kBtu	49431	2924	4084	5028	4623	4353	4166	4779	4967	4524	3970	3351	2661
Electrical energy consumption of pumps [Epar]													
kBtu	401	28	33	36	34	39	37	40	36	35	32	28	25
Heat loss to indoor room (including heat generator losses) [Qint]													
kBtu	13547	1663	960	1023	1069	1126	1061	1022	1010	1031	1091	1146	1346
Heat loss to surroundings (without collector losses) [Qext]													
kBtu	1603	111	148	170	149	138	126	134	136	134	133	121	103
Total energy consumption [Quse]													
kBtu	8451	1134	620	696	674	692	663	671	663	636	652	631	719

Collector North America

Daily maximum temperature [°F]



Energy flow diagram

