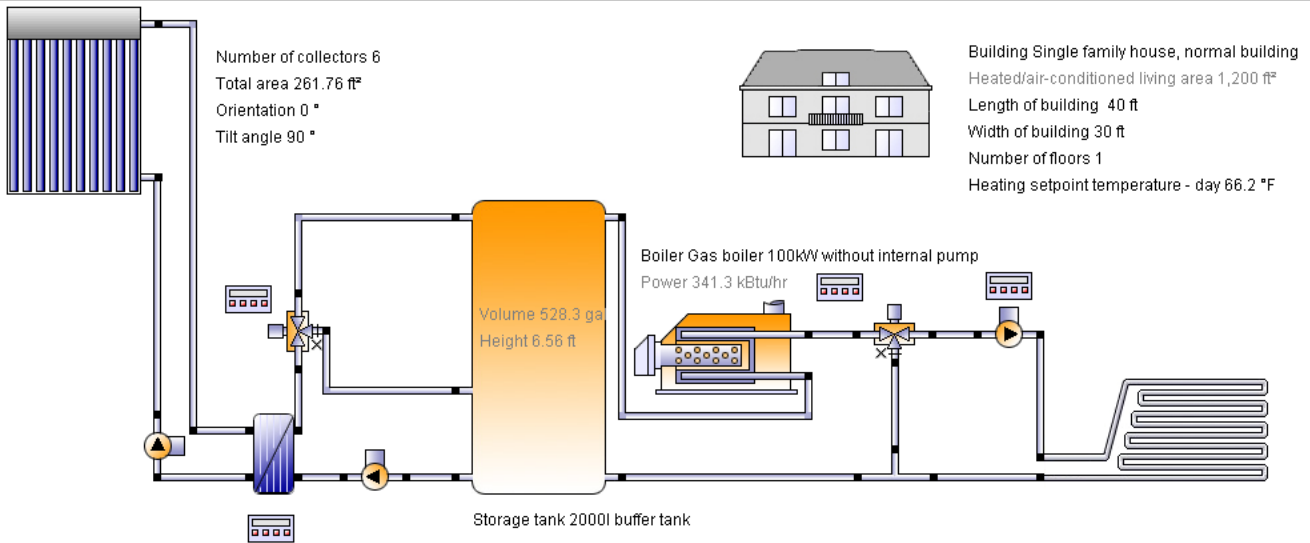


Project

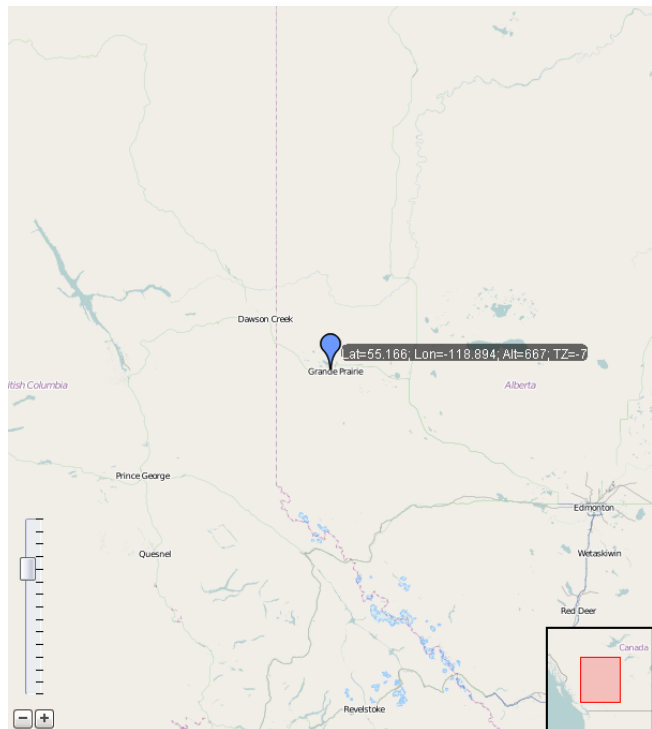
13a: Space heating (solar thermal, modular heat generator)



Location of the system

Grande Prairie
 Longitude: -118.894°
 Latitude: 55.166°
 Elevation: 2,188 ft

Map section



This report has been created by:

Elliott William
 303 47 Str.E
 S7K 5H2 Saskatoon

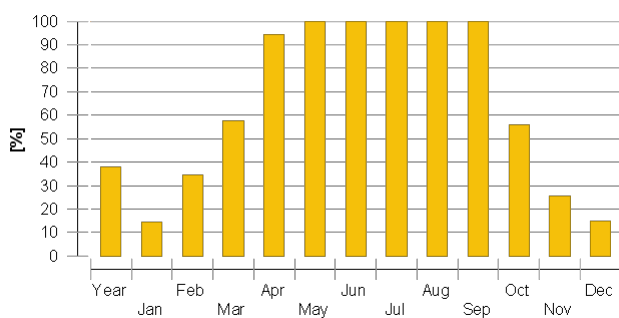
System overview (annual values)

Total fuel and/or electrical energy consumption of the system [Etot]	60,863.6 kBtu
Total energy consumption [Quse]	70,107.6 kBtu
System performance (Quse / Etot)	1.15
Comfort demand	Energy demand covered

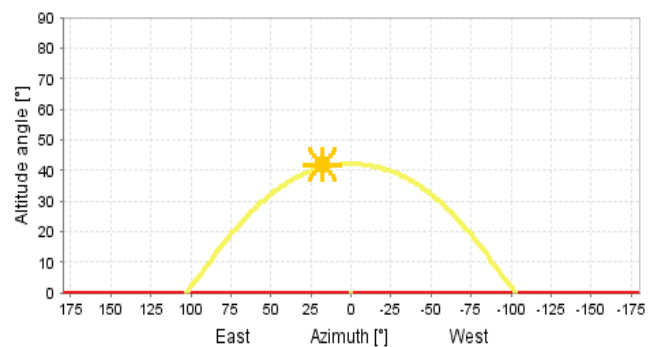
Overview solar thermal energy (annual values)

Collector area	262 ft ²
Solar fraction total	37.7%
Total annual field yield	29,463 kBtu
Collector field yield relating to gross area	113 kBtu/ft ² /Year
Collector field yield relating to aperture area	120 kBtu/ft ² /Year
Max. fuel savings	32,268.6 ft ³ : [Natural gas H]
Max. energy savings	32,737.1 kBtu
Max. reduction in CO2 emissions	4,898.5 pound

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



Horizon line



Meteorological data-Overview

Outdoor temperature 24h	36.4 °F
Annual global irradiance	390 kBtu/ft ²
Annual diffuse irradiance	148.4 kBtu/ft ²

Financial analysis - Solar thermal

Purchase costs	6,600 CAD
Life span	50 years

Financial analysis - Solar thermal

Proportional incentives	0 %
Incentives per area	0 CAD
Fixed incentives	0 CAD
Inflation	2 %
Interest	4 %
Increase of energy prices	5 %
Natural gas H	0.031 CAD/ft ³ ; 0.031 CAD/kBtu
Effective purchase cost after grants	6,600 CAD
Annual fuel cost savings	1,007.404 CAD
Solar energy cost per kWh	0.03 CAD
Payback period	7 years
Present value of the system	110,057.102 CAD
Net present value	103,457.102 CAD

Component overview (annual values)

Boiler	Gas boiler 100kW without internal pump	
Power	kBtu/hr	341.3
Total efficiency	%	83
Energy from/to the system [Qaux]	kBtu	48,625.7
Fuel and electrical energy consumption [Eaux]	kBtu	58,571.1
Energy savings solar thermal	kBtu	32,737.1
CO savings solar thermal	pound	4,898.5
Fuel savings solar thermal	ft ³	32,268.6

Collector North America	WSE58ST	
Data Source		u138368
Number of collectors		6
Number of arrays		8
Total area	ft ²	261.76
Total aperture area	ft ²	245.094
Tilt angle	°	90
Orientation	°	0
Collector field yield [Qsol]	kBtu	29,463.4
Irradiance onto collector area [Esol]	kBtu	116,680.8
Collector efficiency [Qsol / Esol]	%	25.3
Direct irradiance after IAM	kBtu	64,157.3
Diffuse irradiance after IAM	kBtu	41,020.7

Building	Single family house, normal building	
Heated/air-conditioned living area	ft ²	1,200
Heating setpoint temperature	°F	66.2
Heating energy demand excluding DHW [Qdem]	kBtu	70,107.6
Specific heating energy demand excluding DHW [Qdem]	kBtu/ft ²	58.4
Solar gain through windows	kBtu	51,141
Total energy losses	kBtu	134,672.6

Convector Floor heating	Floor heating 1000W	
Number of heating/cooling modules	-	35
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	69,712.8

External heat exchanger Solar loop heat exchanger	Plate heat exchanger, huge	
Transfer capacity	W/K	30,000

Pump Solar loop pump 1	Pump, medium	
Circuit pressure drop	psi	0.137
Flow rate	gpm	1.5
Fuel and electrical energy consumption [Epar]	kBtu	804.7

Pump Space heating loop pump	Pump, large	
Circuit pressure drop	psi	11.202
Flow rate	gpm	13.9
Fuel and electrical energy consumption [Epar]	kBtu	683.2

Pump Solar loop pump 2	Pump, medium	
Circuit pressure drop	psi	0.076
Flow rate	gpm	1.5
Fuel and electrical energy consumption [Epar]	kBtu	804.7

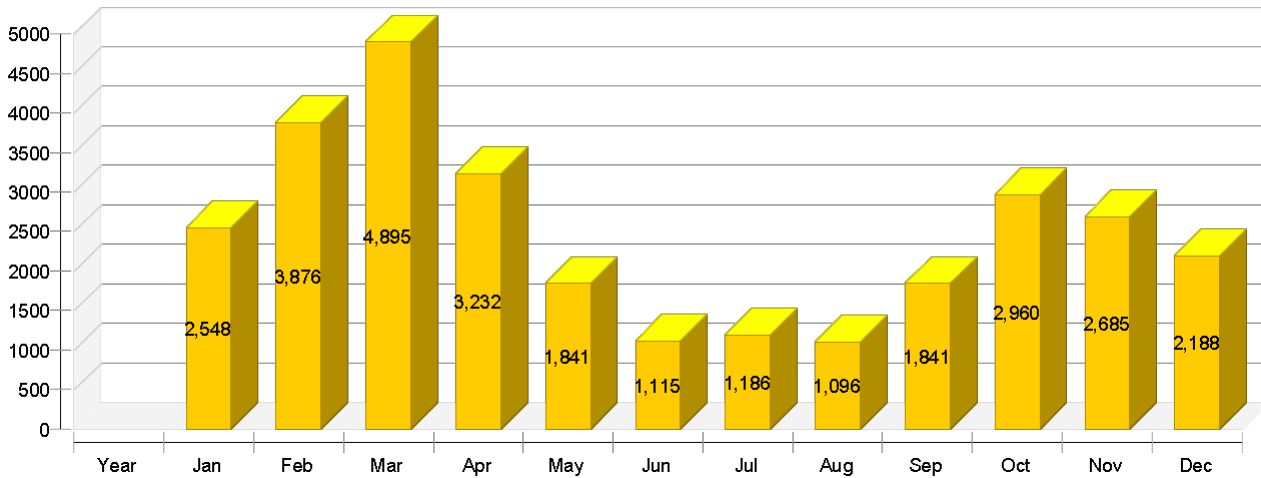
Storage tank Solar buffer tank	2000l buffer tank	
Volume	gal	528.3
Height	ft	6.56
Material		Steel
Insulation		Rigid PU foam
Thickness of insulation	in	3.1
Heat loss	kBtu	3,398.1
Connection losses	kBtu	1,069.9

Loop

Solar loop		
Fluid mixture		Ethylene mixture
Fluid concentration	%	33.3
Fluid domains volume	gal	8.3
Pressure on top of the circuit	psi	58.016

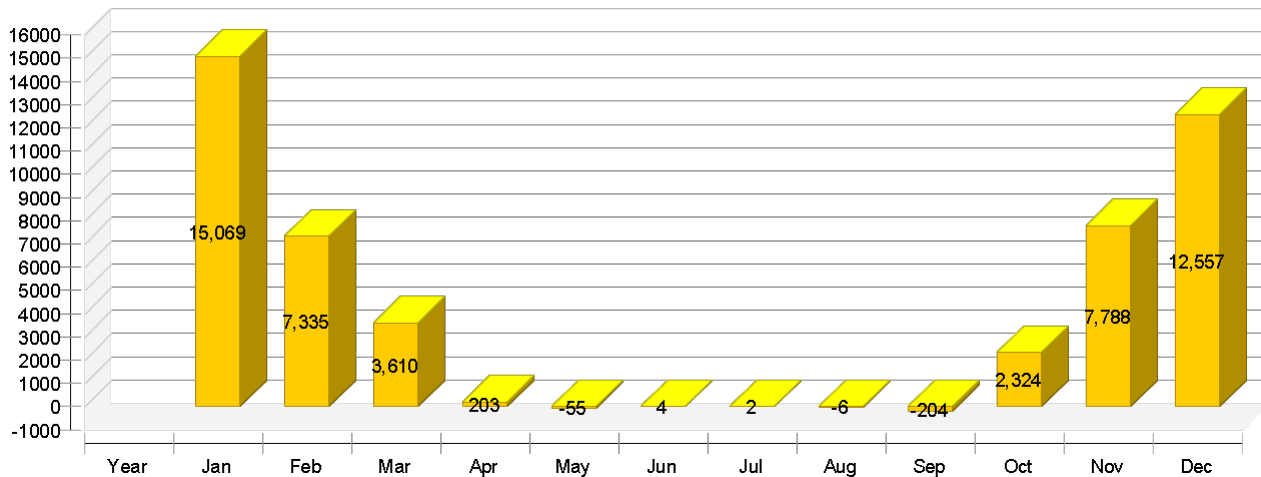
Solar thermal energy to the system [Qsol]

kBtu



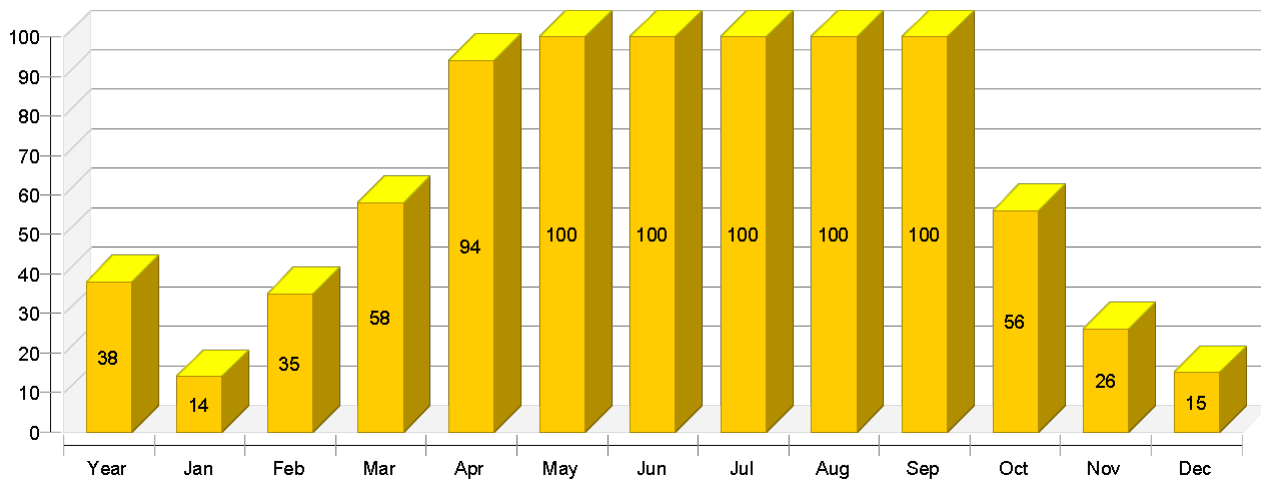
Heat generator energy to the system (solar thermal energy not included) [Qaux]

kBtu



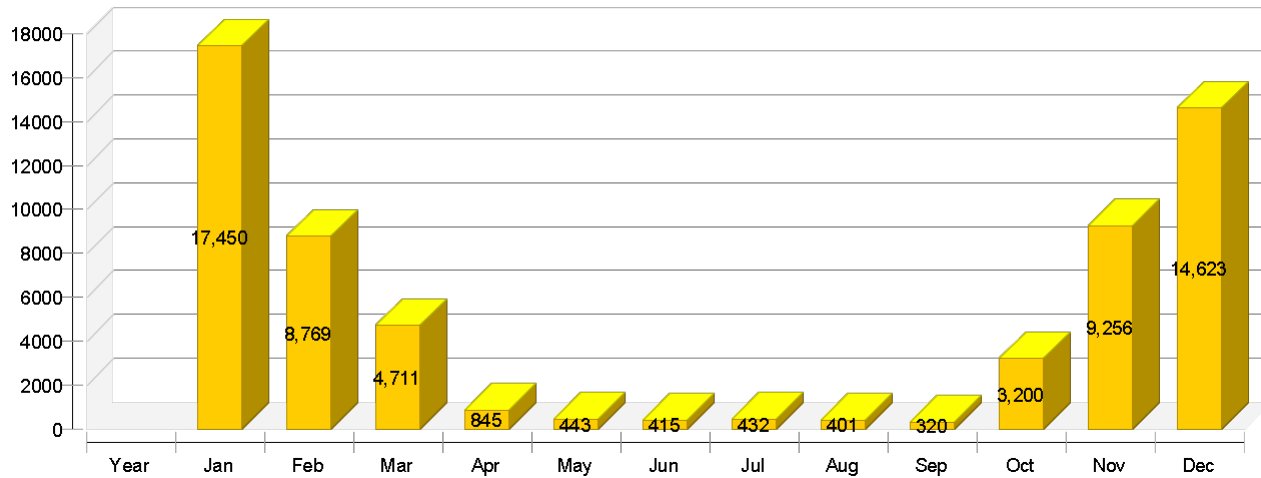
Solar fraction: fraction of solar energy to system [SFn]

%



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	29463	2548	3876	4895	3232	1841	1115	1186	1096	1841	2960	2685	2188
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Heat generator energy to the system (solar thermal energy not included) [Qaux]

kBtu	48626	15069	7335	3610	203	-55	4	2	-6	-204	2324	7788	12557
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Heat generator fuel and electrical energy consumption [Eaux]

kBtu	58571	17159	8504	4420	635	300	323	333	323	198	2990	9028	14356
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Solar fraction: fraction of solar energy to system [SFn]

%	37.7	14.5	34.6	57.6	94.1	100	99.6	99.8	100	100	56	25.6	14.8
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Total fuel and/or electrical energy consumption of the system [Etot]

kBtu	60864	17450	8769	4711	845	443	415	432	401	320	3200	9256	14623
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Irradiance onto collector area [Esol]

kBtu	116681	7880	11559	15703	12381	9691	8324	8779	9493	8969	9308	7876	6717
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Electrical energy consumption of pumps [Epar]

kBtu	2293	290	265	291	210	143	91	99	78	122	210	228	266
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Heat loss to indoor room (including heat generator losses) [Qint]

kBtu	18122	2501	1590	1415	1160	1209	1239	1355	1352	1343	1183	1603	2170
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Heat loss to surroundings (without collector losses) [Qext]

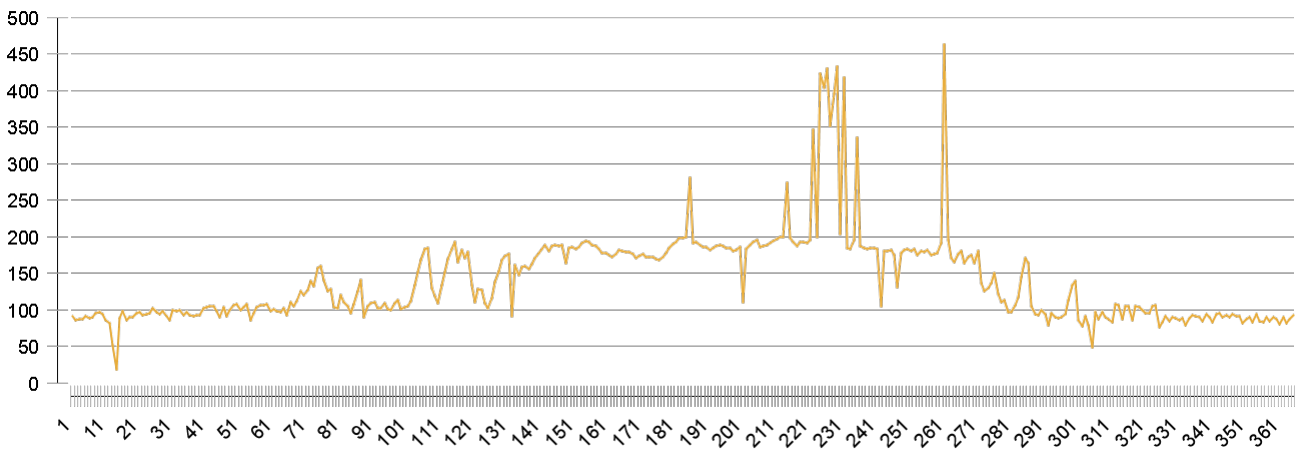
kBtu	2469	160	185	263	252	230	231	247	226	243	163	127	142
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Total energy consumption [Quse]

kBtu	70108	17337	10861	7864	2544	702	48	55	60	806	5130	10229	14473
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Collector North America

Daily maximum temperature [°F]



Energy flow diagram

