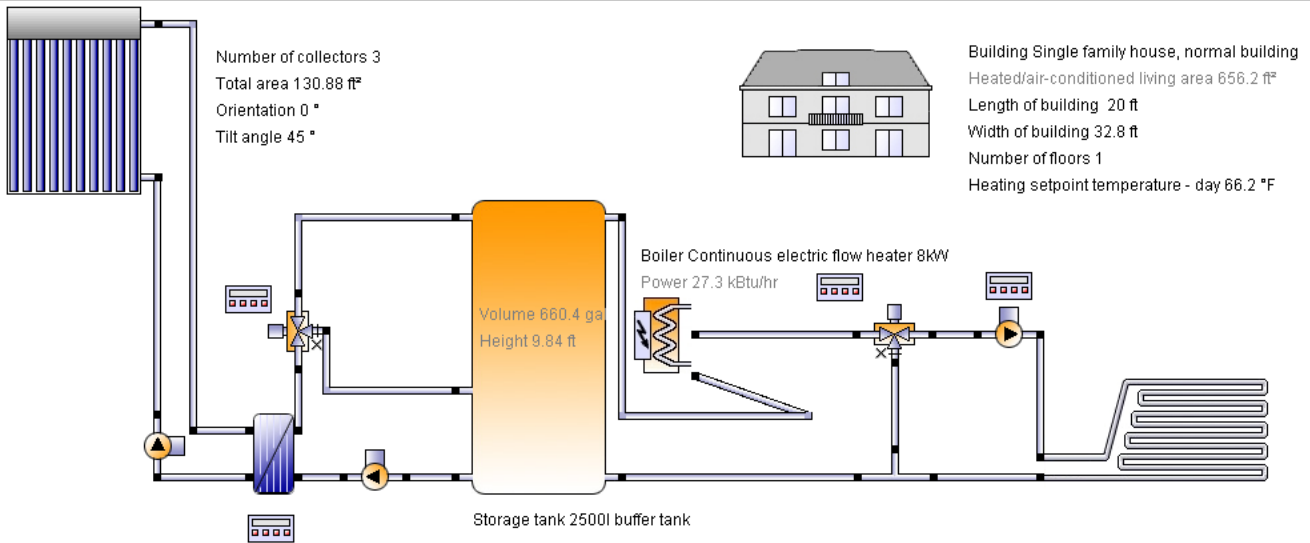


## Project

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



### Location of the system

Canada  
 Saskatoon  
 Longitude: -106.67°  
 Latitude: 52.17°  
 Elevation: 1,657 ft

### This report has been created by:

Elliott William  
 303 47 Str.E  
 S7K 5H2 Saskatoon

### Comments on the project

Based on 3 WSE58 Super Tubes Budgetary number \$3,600

### Photograph of property



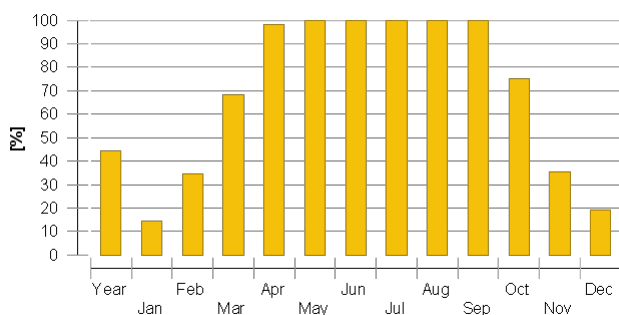
## System overview (annual values)

Total fuel and/or electrical energy consumption of the system [Etot]	29,641.8 kBtu
Total energy consumption [Quse]	37,204.5 kBtu
System performance (Quse / Etot)	1.26
Comfort demand	Energy demand covered

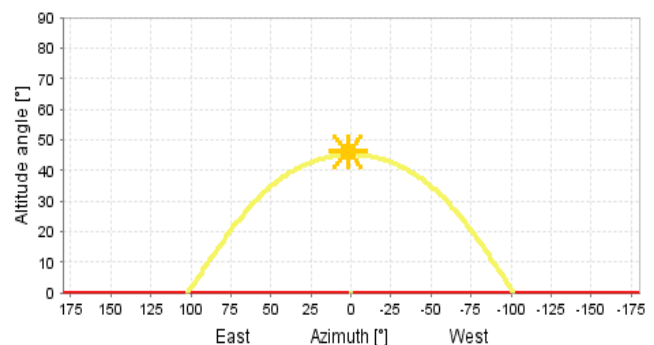
## Overview solar thermal energy (annual values)

Collector area	131 ft <sup>2</sup>
Solar fraction total	44.5%
Total annual field yield	20,077 kBtu
Collector field yield relating to gross area	153 kBtu/ft <sup>2</sup> /Year
Collector field yield relating to aperture area	164 kBtu/ft <sup>2</sup> /Year
Max. energy savings	21,133.7 kBtu
Max. reduction in CO2 emissions	7,324.4 pound

## Solar fraction: fraction of solar energy to system [SF<sub>n</sub>]



## Horizon line



## Meteorological data-Overview

Outdoor temperature 24h	37 °F
Annual global irradiance	430 kBtu/ft <sup>2</sup>
Annual diffuse irradiance	153 kBtu/ft <sup>2</sup>

## Financial analysis - Solar thermal

Purchase costs	3,600 CAD
Life span	50 years
Proportional incentives	0 %

## Financial analysis - Solar thermal

Incentives per area	0 CAD
Fixed incentives	0 CAD
Inflation	2 %
Interest	4 %
Increase of energy prices	5 %
Electricity	0.2 CAD/kWh
Effective purchase cost after grants	3,600 CAD
Annual fuel cost savings	1,238.743 CAD
Solar energy cost per kWh	0.02 CAD
Payback period	3 years
Present value of the system	135,849.312 CAD
Net present value	132,249.312 CAD

## Component overview (annual values)

Boiler	Continuous electric flow heater 8kW	
Power	kBtu/hr	27.3
Total efficiency	%	94.6
Energy from/to the system [Qaux]	kBtu	25,078.9
Fuel and electrical energy consumption [Eaux]	kBtu	26,522.6
Energy savings solar thermal	kBtu	21,133.7
CO savings solar thermal	pound	7,324.4
Fuel savings solar thermal	kBtu	21,139.1

Collector North America	WSE58ST	
Data Source		u138368
Number of collectors		3
Number of arrays		8
Total area	ft <sup>2</sup>	130.88
Total aperture area	ft <sup>2</sup>	122.547
Tilt angle	°	45
Orientation	°	0
Collector field yield [Qsol]	kBtu	20,077.1
Irradiance onto collector area [Esol]	kBtu	76,129.6
Collector efficiency [Qsol / Esol]	%	26.4
Direct irradiance after IAM	kBtu	58,419.5
Diffuse irradiance after IAM	kBtu	25,933.2

Building	Single family house, normal building	
Heated/air-conditioned living area	ft <sup>2</sup>	656.2
Heating setpoint temperature	°F	66.2
Heating energy demand excluding DHW [Qdem]	kBtu	37,204.5
Specific heating energy demand excluding DHW [Qdem]	kBtu/ft <sup>2</sup>	56.7
Solar gain through windows	kBtu	38,574.1
Total energy losses	kBtu	86,057.2

Convactor 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	36,666.4

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	0.057
Flow rate	gpm	0.8
Fuel and electrical energy consumption [Epar]	kBtu	851.7

<b>Pump Space heating loop pump</b>	<b>Pump, large</b>	
Circuit pressure drop	psi	11.31
Flow rate	gpm	13.9
Fuel and electrical energy consumption [Epar]	kBtu	1,415.9

<b>Pump Solar loop pump 2</b>	<b>Pump, medium</b>	
Circuit pressure drop	psi	0.021
Flow rate	gpm	0.8
Fuel and electrical energy consumption [Epar]	kBtu	851.7

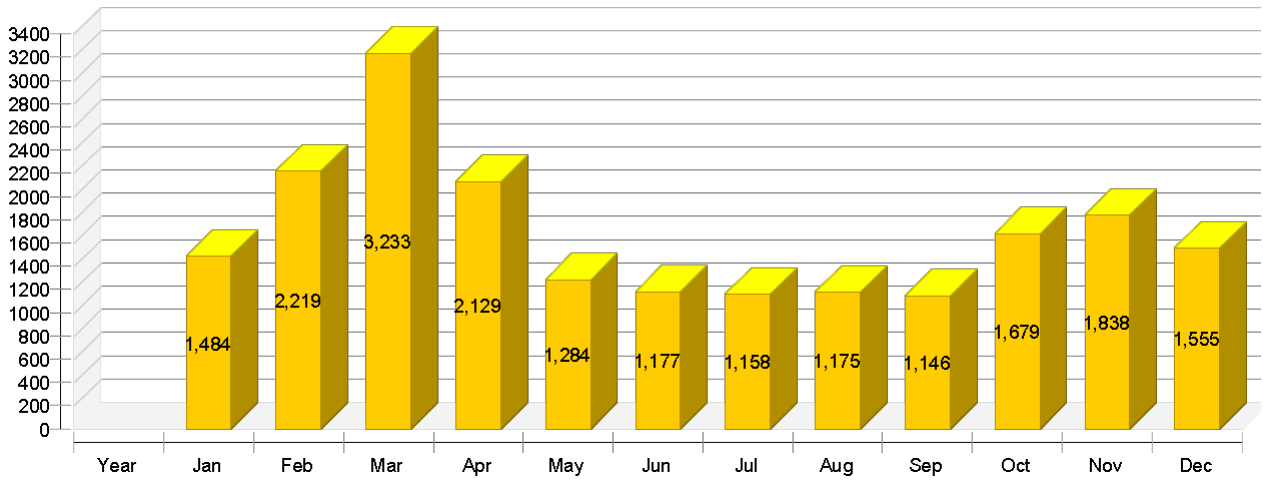
<b>Storage tank Solar buffer tank</b>	<b>2500l buffer tank</b>	
Volume	gal	660.4
Height	ft	9.84
Material		Steel
Insulation		Rigid PU foam
Thickness of insulation	in	4.7
Heat loss	kBtu	3,558.2
Connection losses	kBtu	1,141.2

## Loop

<b>Solar loop</b>		
Fluid mixture		Ethylene mixture
Fluid concentration	%	33.3
Fluid domains volume	gal	7.8
Pressure on top of the circuit	psi	58.016

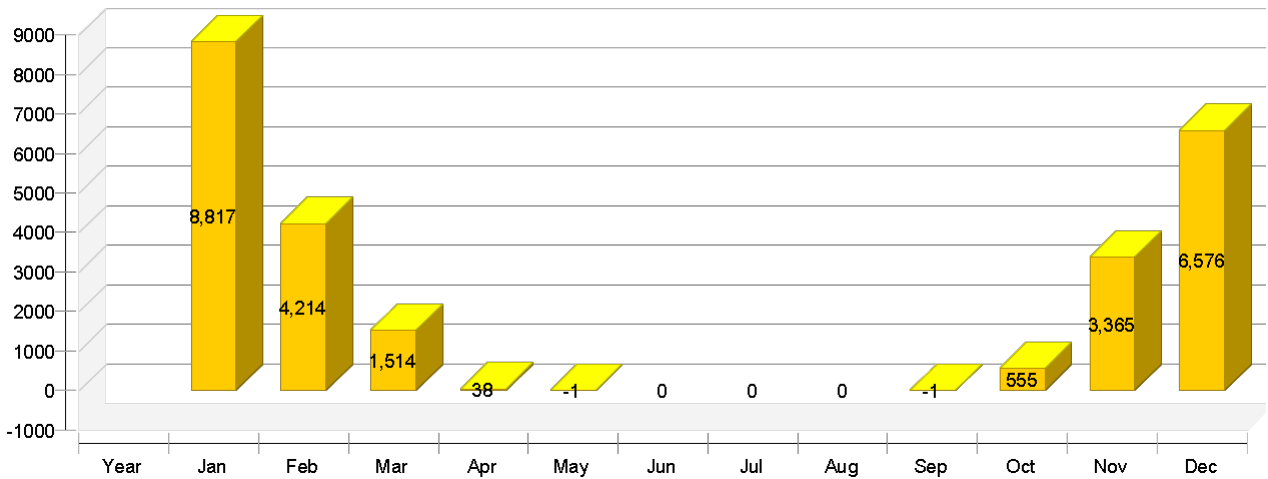
Solar thermal energy to the system [Qsol]

kBtu



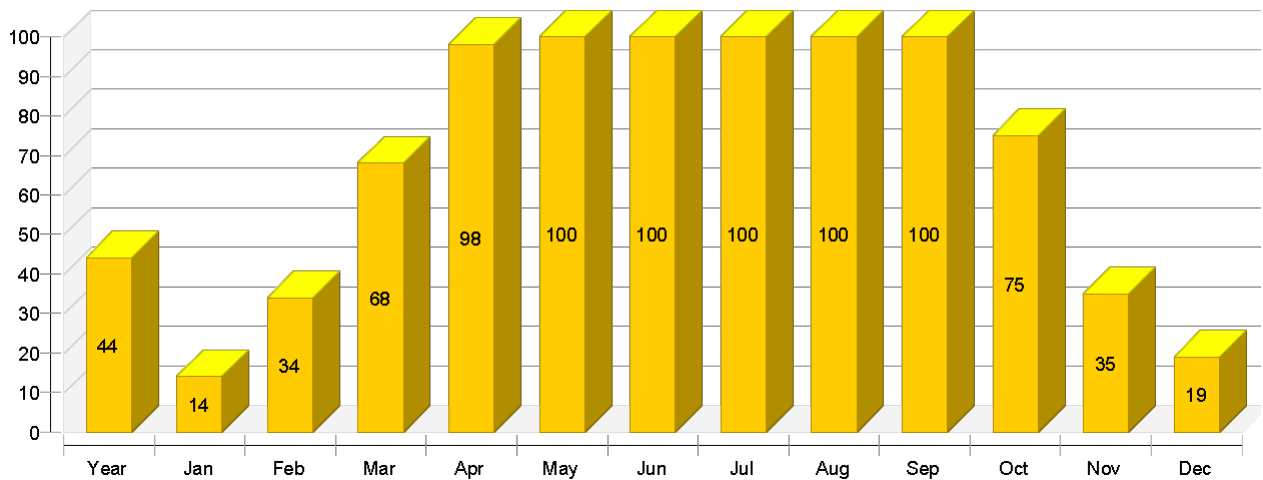
Heat generator energy to the system (solar thermal energy not included) [Qaux]

kBtu



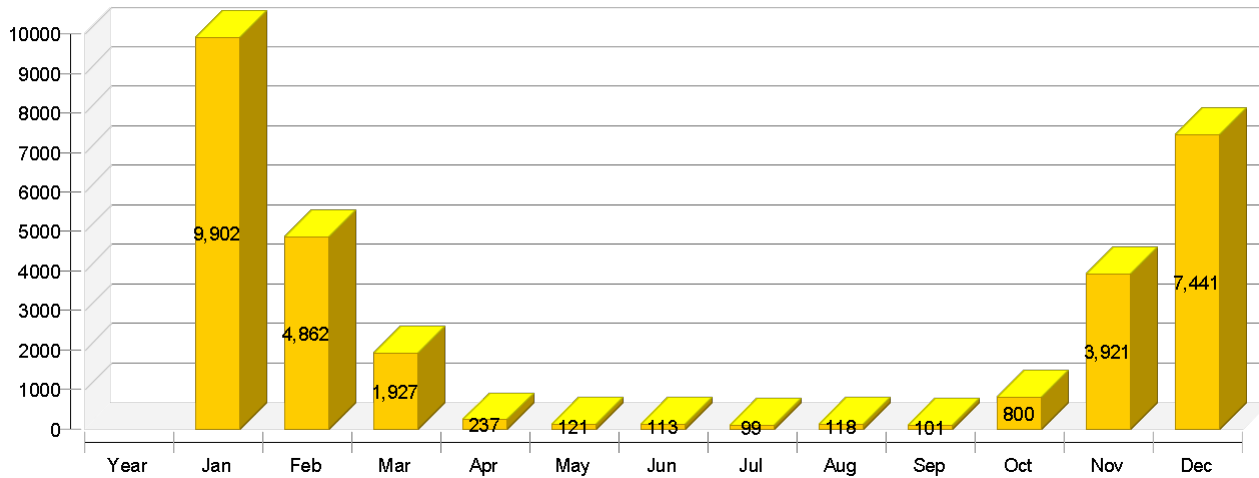
Solar fraction: fraction of solar energy to system [SFn]

%



## 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	20077	1484	2219	3233	2129	1284	1177	1158	1175	1146	1679	1838	1555
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### Heat generator energy to the system (solar thermal energy not included) [Qaux]

kBtu	25079	8817	4214	1514	38	-1	0	0	0	-1	555	3365	6576
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### Heat generator fuel and electrical energy consumption [Eaux]

kBtu	26523	9291	4445	1604	52	9	9	10	10	9	598	3553	6933
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### Solar fraction: fraction of solar energy to system [SFn]

%	44.5	14.4	34.5	68.1	98.2	100	100	100	100	100	75.2	35.3	19.1
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### Total fuel and/or electrical energy consumption of the system [Etot]

kBtu	29642	9902	4862	1927	237	121	113	99	118	101	800	3921	7441
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### Irradiance onto collector area [Esol]

kBtu	76130	4014	5512	8011	7069	7481	7278	8358	7711	6883	5285	4463	4065
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### Electrical energy consumption of pumps [Epar]

kBtu	3119	610	417	323	186	112	103	89	108	92	202	368	508
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### Heat loss to indoor room (including heat generator losses) [Qint]

kBtu	10340	996	633	606	887	1051	1002	1024	1030	957	795	553	806
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### Heat loss to surroundings (without collector losses) [Qext]

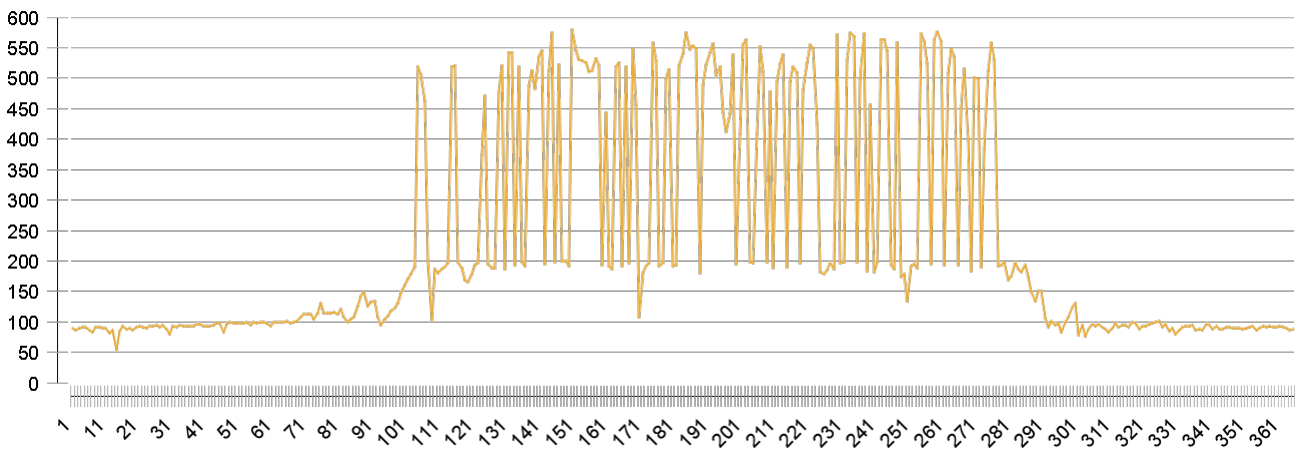
kBtu	2711	173	176	236	300	297	266	247	261	244	228	135	149
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### Total energy consumption [Quse]

kBtu	37204	10228	6282	4042	966	86	64	71	80	124	2148	5080	8035
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## Collector North America

Daily maximum temperature [ °F]



## Energy flow diagram

