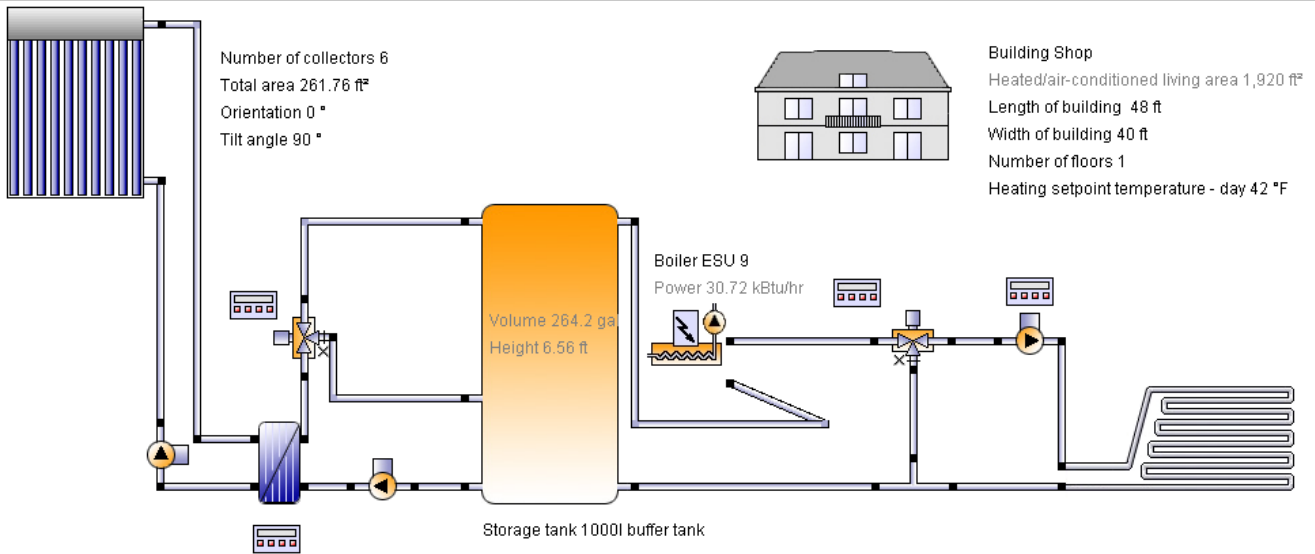


## Project

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



### Location of the system

### Map section

Gray Saskatchewan  
 Longitude: -104.568°  
 Latitude: 50.458°  
 Elevation: 1,893 ft

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### This report has been created by:

Elliott William  
 303 47 Str.E  
 S7K 5H2 Saskatoon

### Comments on the project

System is designed using verical panels. Maximize winter output

### Photograph of property



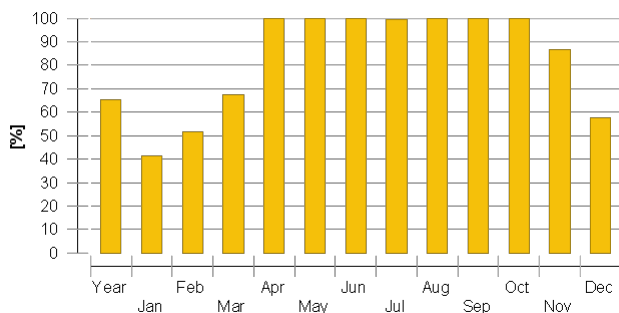
## System overview (annual values)

Total fuel and/or electrical energy consumption of the system [Etot]	10,704 kBtu
Total energy consumption [Quse]	17,224 kBtu
System performance (Quse / Etot)	1.61
Comfort demand	Energy demand covered

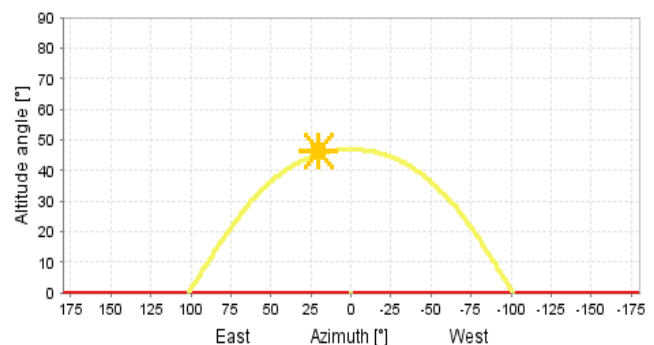
## Overview solar thermal energy (annual values)

Collector area	262 ft <sup>2</sup>
Solar fraction total	65.4%
Total annual field yield	17,763 kBtu
Collector field yield relating to gross area	68 kBtu/ft <sup>2</sup> /Year
Collector field yield relating to aperture area	72 kBtu/ft <sup>2</sup> /Year
Max. energy savings	17,762.9 kBtu
Max. reduction in CO2 emissions	6,156.2 pound

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



## Horizon line



## Meteorological data-Overview

Outdoor temperature 24h	37.2 °F
Annual global irradiance	433.4 kBtu/ft <sup>2</sup>
Annual diffuse irradiance	158.8 kBtu/ft <sup>2</sup>

## Financial analysis - Solar thermal

Purchase costs	6,000 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	6,000 CAD
Annual fuel cost savings	1,041.161 CAD
Solar energy cost per kWh	0.04 CAD
Payback period	6 years
Present value of the system	113,839.359 CAD
Net present value	107,839.359 CAD

## Component overview (annual values)

Boiler	ESU 9	
Power	kBtu/hr	30.72
Total efficiency	%	100.8
Energy from/to the system [Qaux]	kBtu	9,388.9
Fuel and electrical energy consumption [Eaux]	kBtu	9,313.5
Energy savings solar thermal	kBtu	17,762.9
CO savings solar thermal	pound	6,156.2
Fuel savings solar thermal	kBtu	17,767.4

Collector North America		WSE58ST
Data Source		u138368
Number of collectors		6
Number of arrays		8
Total area	ft <sup>2</sup>	261.76
Total aperture area	ft <sup>2</sup>	245.094
Tilt angle	°	90
Orientation	°	0
Collector field yield [Qsol]	kBtu	17,762.9
Irradiance onto collector area [Esol]	kBtu	122,925.8
Collector efficiency [Qsol / Esol]	%	14.5
Direct irradiance after IAM	kBtu	66,622.4
Diffuse irradiance after IAM	kBtu	43,349.7

Building	Shop	
Heated/air-conditioned living area	ft <sup>2</sup>	1,920
Heating setpoint temperature	°F	48
Heating energy demand excluding DHW [Qdem]	kBtu	13,863
Specific heating energy demand excluding DHW [Qdem]	kBtu/ft <sup>2</sup>	7.2
Solar gain through windows	kBtu	61,945.5
Total energy losses	kBtu	315,049.3

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	16,606.9

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	0.117
Flow rate	gpm	1.5
Fuel and electrical energy consumption [Epar]	kBtu	523.8

<b>Pump Space heating loop pump</b>	<b>Pump, large</b>	
Circuit pressure drop	psi	33.927
Flow rate	gpm	23.7
Fuel and electrical energy consumption [Epar]	kBtu	343

<b>Pump Solar loop pump 2</b>	<b>Pump, medium</b>	
Circuit pressure drop	psi	0.073
Flow rate	gpm	1.5
Fuel and electrical energy consumption [Epar]	kBtu	523.8

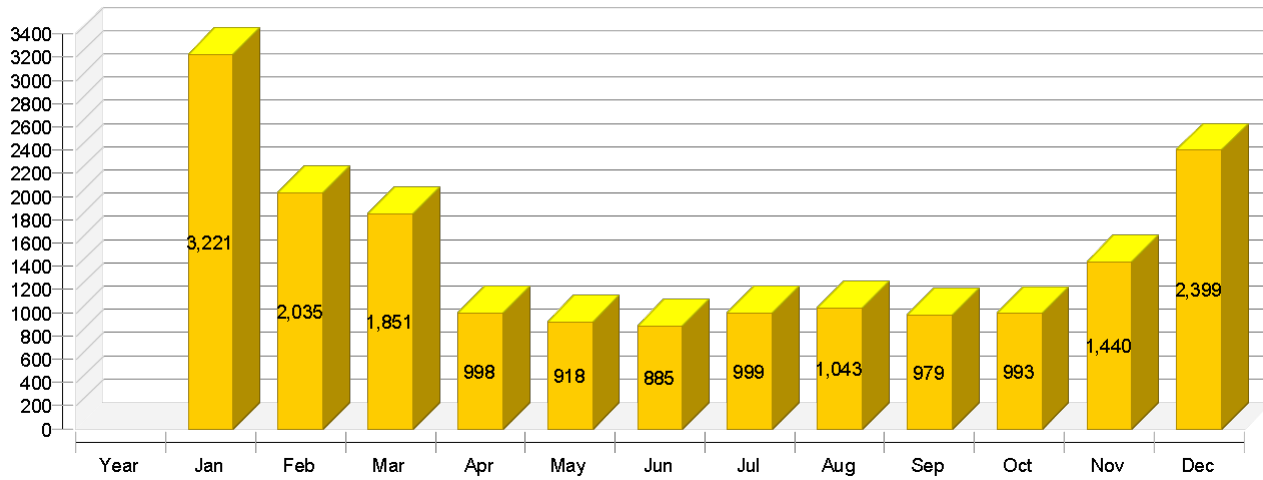
<b>Storage tank Solar buffer tank</b>	<b>1000l buffer tank</b>	
Volume	gal	264.2
Height	ft	6.56
Material		Steel
Insulation		Rigid PU foam
Thickness of insulation	in	3.1
Heat loss	kBtu	3,880.2
Connection losses	kBtu	1,873.7

## Loop

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

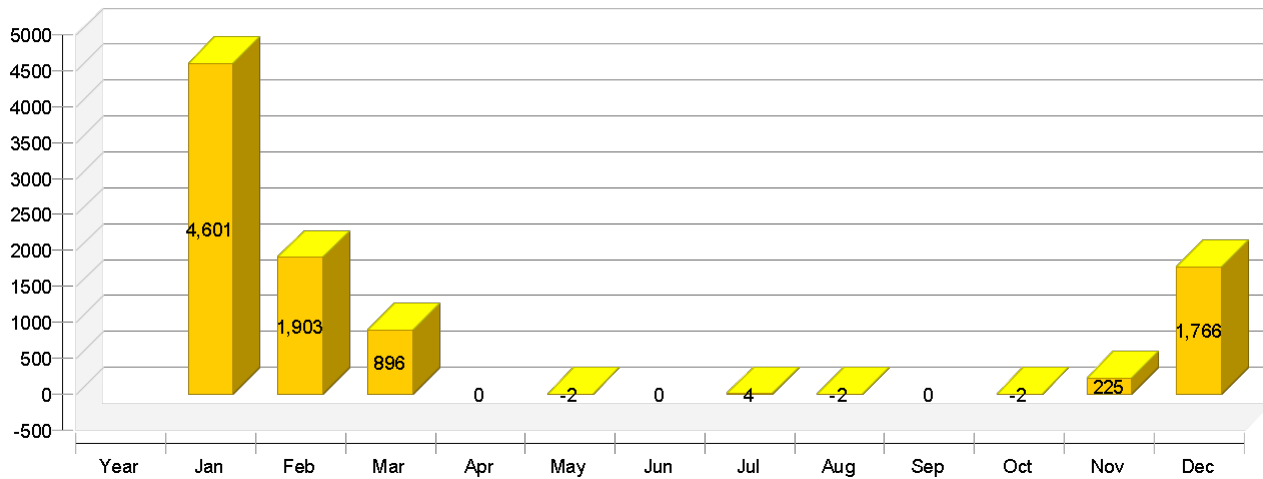
Solar thermal energy to the system [Qsol]

kBtu



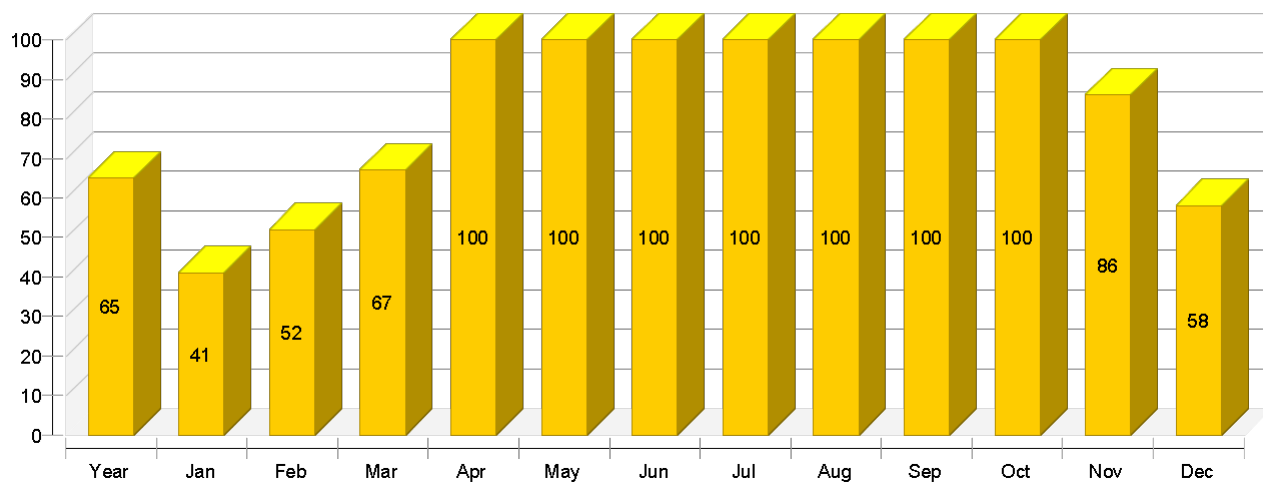
Heat generator energy to the system (solar thermal energy not included) [Qaux]

kBtu



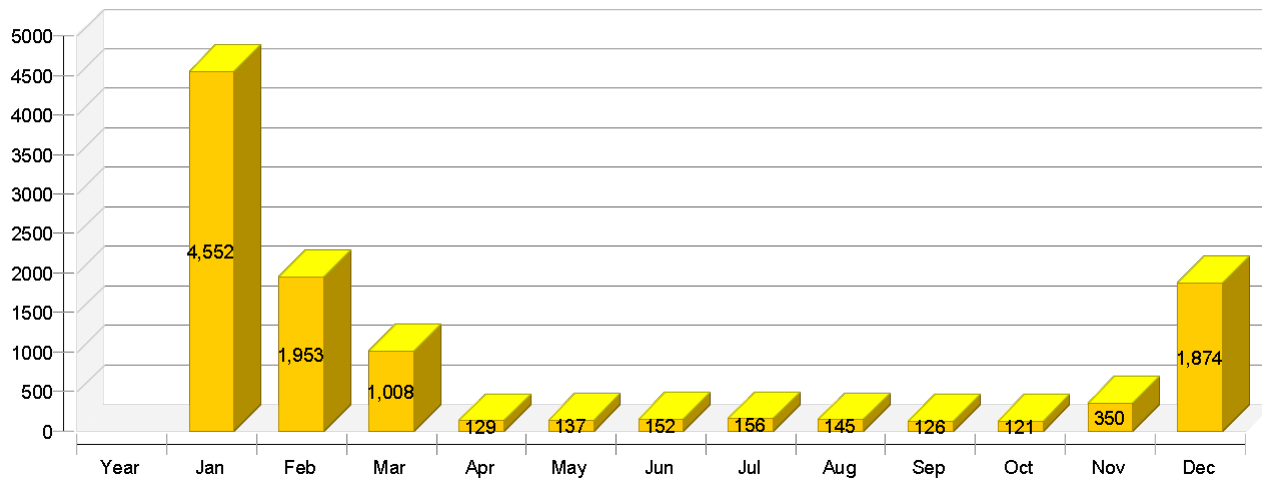
Solar fraction: fraction of solar energy to system [SFn]

%



## 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	17763	3221	2035	1851	998	918	885	999	1043	979	993	1440	2399
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### Heat generator energy to the system (solar thermal energy not included) [Qaux]

kBtu	9389	4601	1903	896	0	-2	0	4	-2	0	-2	225	1766
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### Heat generator fuel and electrical energy consumption [Eaux]

kBtu	9314	4246	1788	880	63	63	63	69	63	63	63	270	1684
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### Solar fraction: fraction of solar energy to system [SFn]

%	65.4	41.2	51.7	67.4	100	100	100	99.6	100	100	100	86.5	57.6
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### Total fuel and/or electrical energy consumption of the system [Etot]

kBtu	10704	4552	1953	1008	129	137	152	156	145	126	121	350	1874
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### Irradiance onto collector area [Esol]

kBtu	122926	11433	11379	14108	10680	9205	7347	8472	9768	10686	11349	9583	8918
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### Electrical energy consumption of pumps [Epar]

kBtu	1390	306	165	129	67	74	90	87	83	63	58	80	190
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### Heat loss to indoor room (including heat generator losses) [Qint]

kBtu	8911	181	513	705	887	891	777	928	939	900	886	796	507
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### Heat loss to surroundings (without collector losses) [Qext]

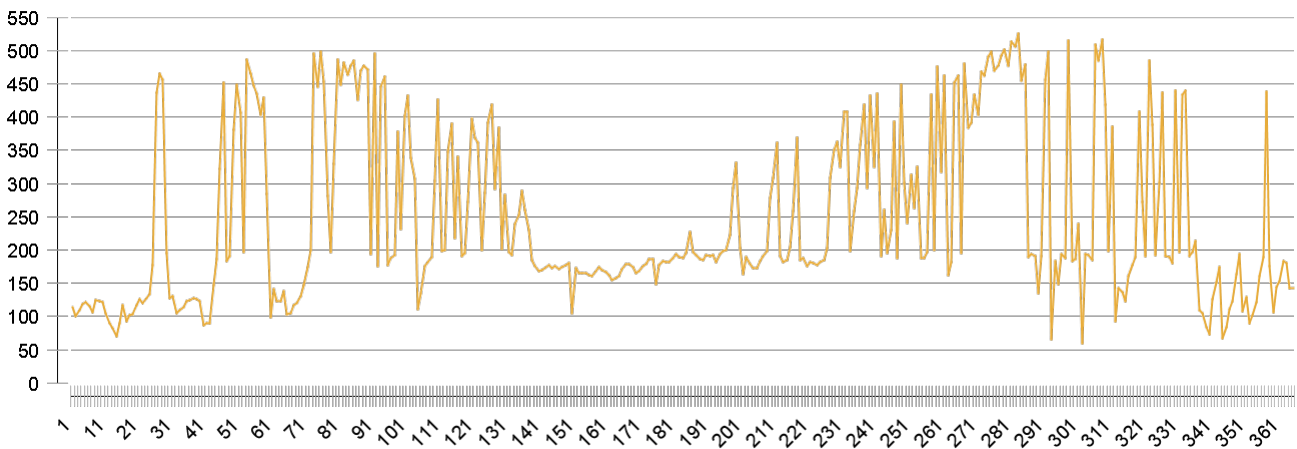
kBtu	2860	260	255	273	237	233	200	224	231	228	228	242	249
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### Total energy consumption [Quse]

kBtu	17224	7306	3110	1929	41	52	59	77	84	74	47	789	3656
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## Collector North America

Daily maximum temperature [ °F]



## Energy flow diagram

