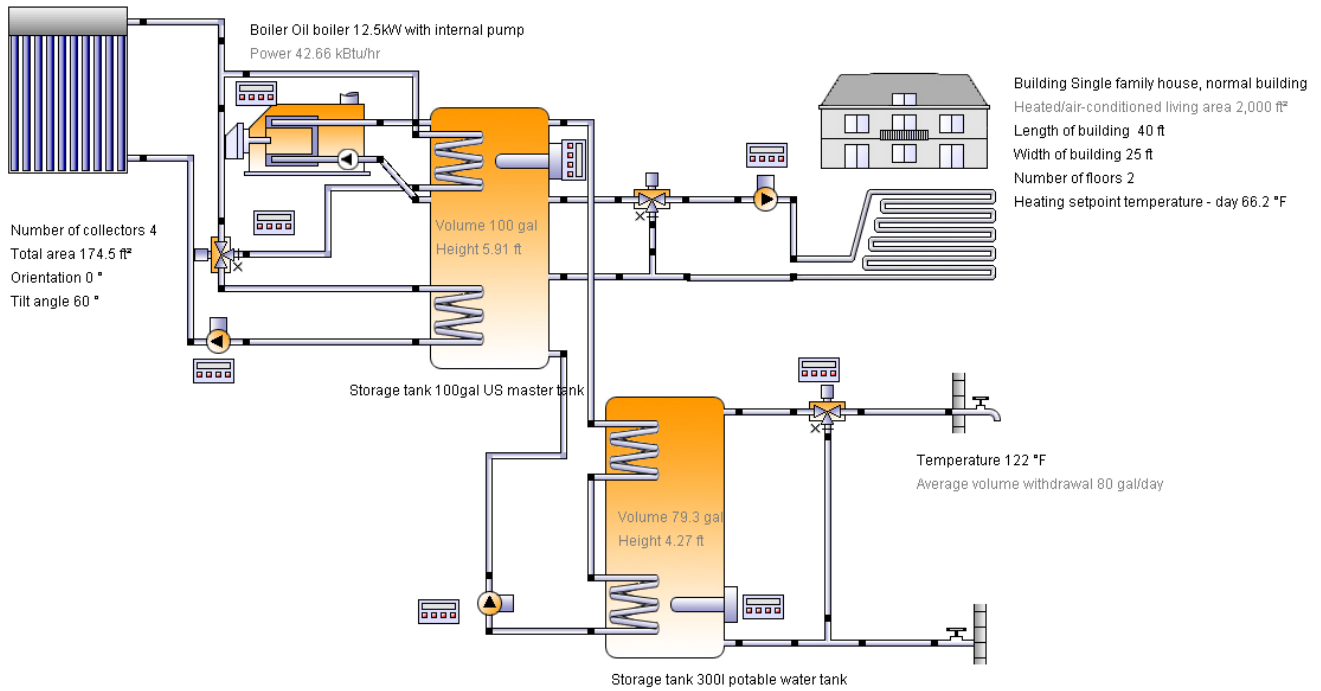


## Project

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



### Location of the system

### Map section

"Current report item is not supported in this report format."

Philadelphia  
Longitude: -75.174°  
Latitude: 39.951°  
Elevation: 36 ft

### This report has been created by:

Elliott William  
303 47 Str.E  
S7K 5H2 Saskatoon

## Comments on the project

Using 4 WSE58ST cost \$3,200 plus another \$1,800 for Controller and misc.

## Photograph of property



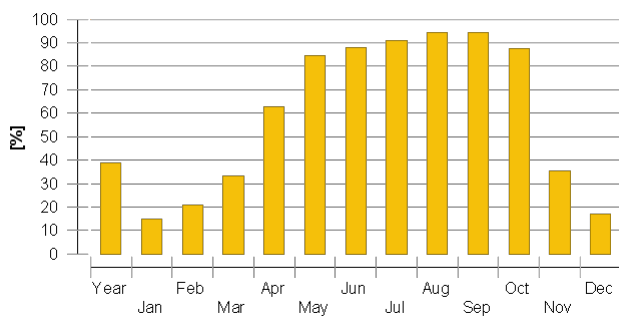
## System overview (annual values)

|  |                       |
|--|-----------------------|
| Total fuel and/or electrical energy consumption of the system [Etot] | 49,801.5 kBtu         |
| Total energy consumption [Quse]                                      | 52,728.4 kBtu         |
| System performance (Quse / Etot)                                     | 1.06                  |
| Comfort demand   | Energy demand covered |

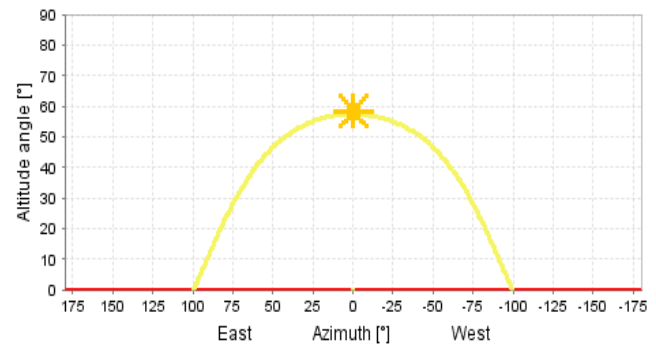
## Overview solar thermal energy (annual values)

|   |                                |
|---|--------------------------------|
| Collector area                                  | 175 ft <sup>2</sup>            |
| Solar fraction total                            | 38.8%                          |
| Solar fraction hot water [SFnHw]                | 64.3 %                         |
| Solar fraction building [SFnBd]                 | 18.5 %                         |
| Total annual field yield                        | 24,720 kBtu                    |
| Collector field yield relating to gross area    | 142 kBtu/ft <sup>2</sup> /Year |
| Collector field yield relating to aperture area | 151 kBtu/ft <sup>2</sup> /Year |
| Max. fuel savings                               | 219.3 gal: [Heating oil]       |
| Max. energy savings                             | 29,002.7 kBtu                  |
| Max. reduction in CO2 emissions                 | 5,737.8 pound                  |

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



## Horizon line



## Meteorological data-Overview

|                           |                            |
|---------------------------|----------------------------|
| Outdoor temperature 24h   | 55.7 °F                    |
| Annual global irradiance  | 460.2 kBtu/ft <sup>2</sup> |
| Annual diffuse irradiance | 209 kBtu/ft <sup>2</sup>   |

## Financial analysis - Solar thermal

|                                      |                               |
|--------------------------------------|-------------------------------|
| Purchase costs                       | 5,000 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                   |
| Heating oil                          | 3.785 CAD/gal; 0.029 CAD/kBtu |
| Effective purchase cost after grants | 5,000 CAD                     |
| Annual fuel cost savings             | 869.898 CAD                   |
| Solar energy cost per kWh            | 0.02 CAD                      |
| Payback period                       | 6 years                       |
| Present value of the system          | 95,115.078 CAD                |
| Net present value                    | 90,115.078 CAD                |

## Component overview (annual values)

| <b>Boiler 2</b>                               | <b>Oil boiler 12.5kW with internal pump</b> |          |
|---|---|----------|
| Power   | kBtu/hr                                     | 42.66    |
| Total efficiency                              | %   | 79.4     |
| Energy from/to the system [Qaux]              | kBtu  | 39,003.8 |
| Fuel and electrical energy consumption [Eaux] | kBtu  | 49,108.8 |
| Energy savings solar thermal                  | kBtu  | 28,323.5 |
| CO savings solar thermal                      | pound                                       | 5,502.3  |
| Fuel savings solar thermal                    | gal   | 219.3    |

| <b>Collector North America</b>        | <b>WSE58ST</b>  |          |
|---------------------------------------|-----------------|----------|
| Data Source                           |                 | u138368  |
| Number of collectors                  |                 | 4        |
| Number of arrays                      |                 | 3        |
| Total area                            | ft <sup>2</sup> | 174.5    |
| Total aperture area                   | ft <sup>2</sup> | 163.396  |
| Tilt angle                            | °               | 60       |
| Orientation                           | °               | 0        |
| Collector field yield [Qsol]          | kBtu            | 24,720.3 |
| Irradiance onto collector area [Esol] | kBtu            | 85,044.1 |
| Collector efficiency [Qsol / Esol]    | %               | 29.1     |
| Direct irradiance after IAM           | kBtu            | 55,424.7 |
| Diffuse irradiance after IAM          | kBtu            | 38,448.6 |

| <b>Building</b>                                     | <b>Single family house, normal building</b> |           |
|---|---|-----------|
| Heated/air-conditioned living area                  | ft <sup>2</sup>                             | 2,000     |
| Heating setpoint temperature                        | °F  | 66.2      |
| Heating energy demand excluding DHW [Qdem]          | kBtu  | 36,076.1  |
| Specific heating energy demand excluding DHW [Qdem] | kBtu/ft <sup>2</sup>                        | 18        |
| Solar gain through windows                          | kBtu  | 73,770.8  |
| Total energy losses                                 | kBtu  | 135,108.9 |

| <b>Convactor Floor heating</b>                     | <b>Floor heating 1000W</b> |          |
|--|----------------------------|----------|
| 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                       | 35,883.8 |

| <b>Hot water demand</b>          | <b>Constant</b> |          |
|----------------------------------|-----------------|----------|
| Withdraw volume                  | gal/d           | 80.3     |
| Temperature setting              | °F              | 122      |
| Energy from/to the system [Quse] | kBtu            | 16,652.3 |

| <b>Pump Space heating loop pump</b>           | <b>Pump, medium</b> |       |
|---|---------------------|-------|
| Circuit pressure drop                         | psi                 | 0.732 |
| Flow rate                                     | gpm                 | 5     |
| Fuel and electrical energy consumption [Epar] | kBtu                | 219.3 |

| <b>Pump Solar loop pump</b>                   | <b>Pump, small</b> |       |
|---|--------------------|-------|
| Circuit pressure drop                         | psi                | 0.072 |
| Flow rate                                     | gpm                | 1     |
| Fuel and electrical energy consumption [Epar] | kBtu               | 328.7 |

| <b>Pump Potable water tank loading pump</b>   | <b>Pump, small</b> |       |
|---|--------------------|-------|
| Circuit pressure drop                         | psi                | 0.125 |
| Flow rate                                     | gpm                | 2.6   |
| Fuel and electrical energy consumption [Epar] | kBtu               | 90.4  |

| <b>Storage tank Buffer tank</b> | <b>100gal US master tank</b> |                            |
|---------------------------------|------------------------------|----------------------------|
| Volume                          | gal                          | 100                        |
| Height                          | ft                           | 5.91                       |
| Material                        |                              | Enameled steel             |
| Insulation                      |                              | Flexible polyurethane foam |
| Thickness of insulation         | in                           | 4                          |
| Heat loss                       | kBtu                         | 1,588                      |
| Connection losses               | kBtu                         | 2,481.5                    |

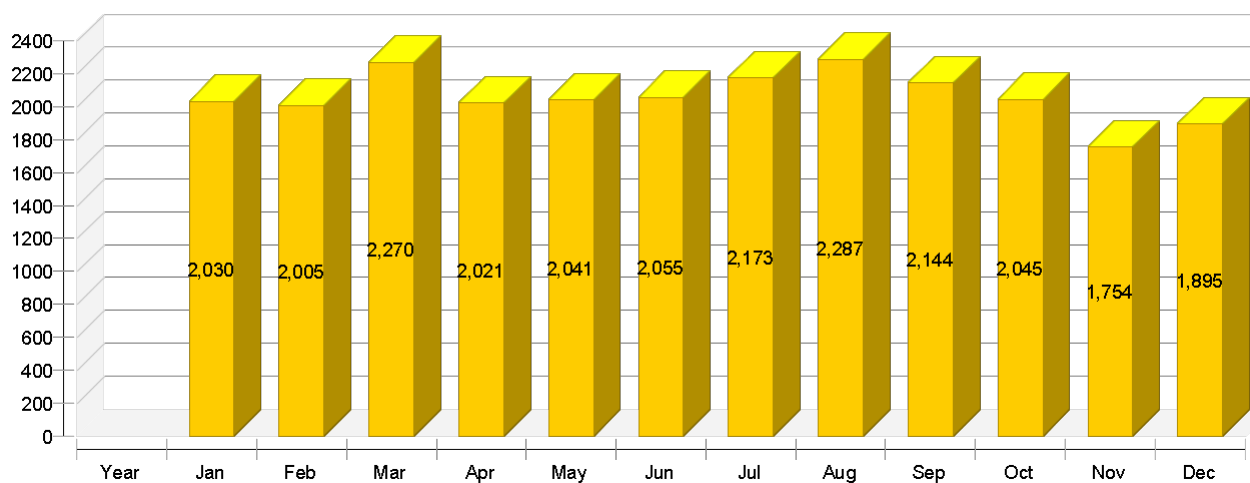
| Storage tank Potable water tank | 300l potable water tank |                 |
|---------------------------------|-------------------------|-----------------|
| Volume                          | gal                     | 79.3            |
| Height                          | ft                      | 4.27            |
| Material                        |                         | Stainless steel |
| Insulation                      |                         | Rigid PU foam   |
| Thickness of insulation         | in                      | 3.1             |
| Heat loss                       | kBtu                    | 1,418.4         |
| Connection losses               | kBtu                    | 1,417           |

## Loop

| Solar loop                     |     |                  |
|--------------------------------|-----|------------------|
| Fluid mixture                  |     | Ethylene mixture |
| Fluid concentration            | %   | 33.3             |
| Fluid domains volume           | gal | 8.5              |
| Pressure on top of the circuit | psi | 58.016           |

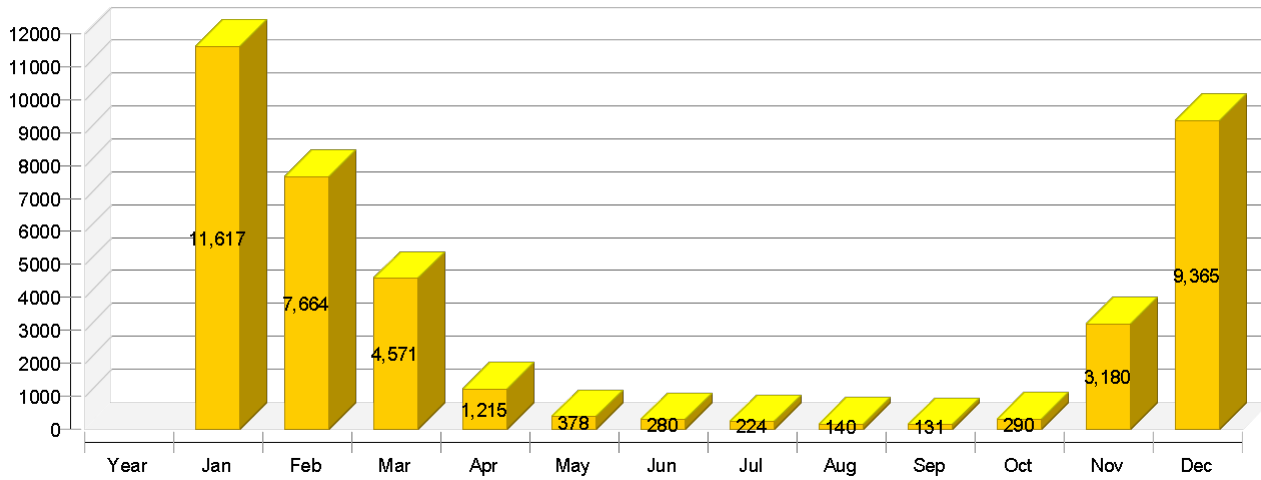
## Solar thermal energy to the system [Qsol]

kBtu



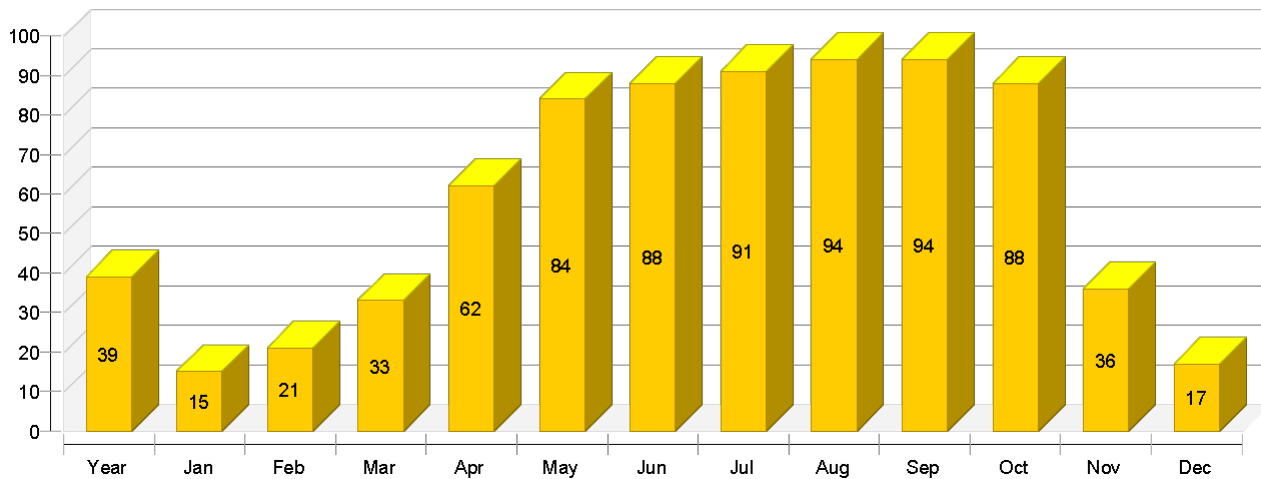
Heat generator energy to the system (solar thermal energy not included) [Qaux]

kBtu



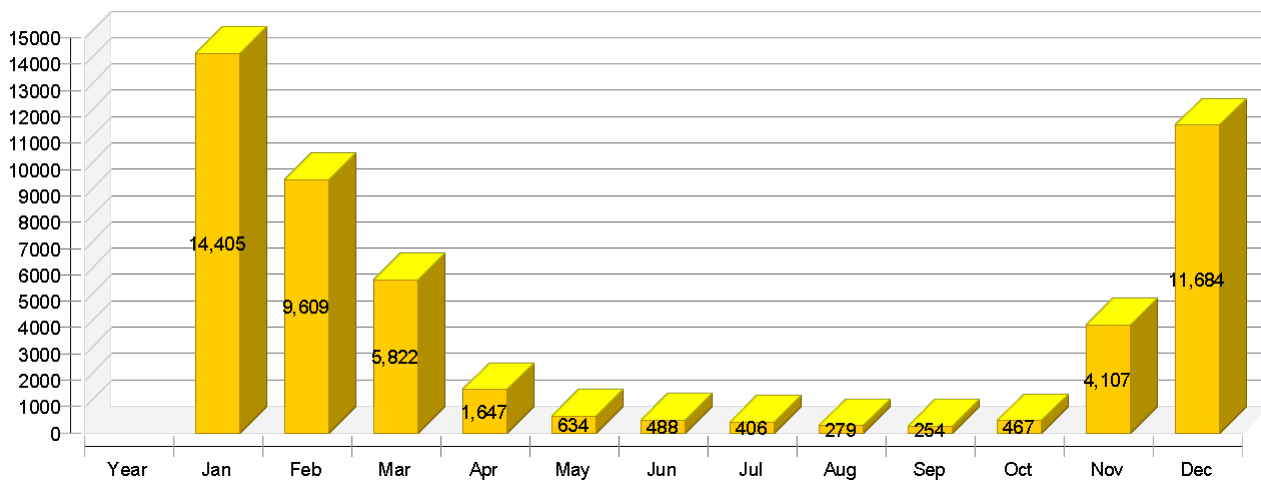
Solar fraction: fraction of solar energy to system [SF<sub>n</sub>]

%



Total fuel and/or electrical energy consumption of the system [E<sub>tot</sub>]

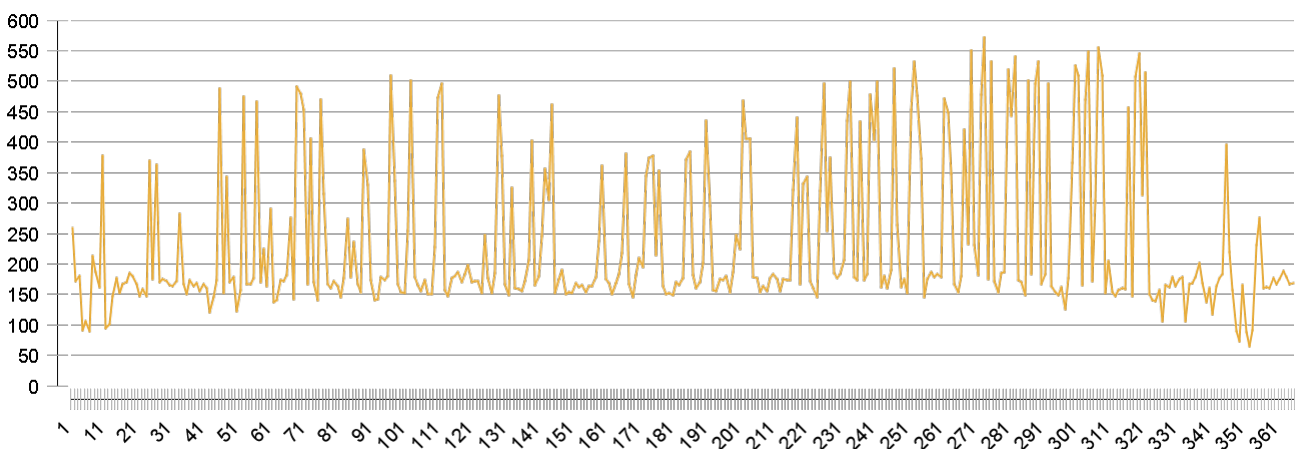
kBtu



| Year  | Jan   | Feb   | Mar  | Apr  | May  | Jun  | Jul  | Aug  | Sep  | Oct  | Nov  | Dec  |       |
|---|-------|-------|------|------|------|------|------|------|------|------|------|------|-------|
| <b>Solar thermal energy to the system [Qsol]</b>                                      |       |       |      |      |      |      |      |      |      |      |      |      |       |
| kBtu  | 24720 | 2030  | 2005 | 2270 | 2021 | 2041 | 2055 | 2173 | 2287 | 2144 | 2045 | 1754 | 1895  |
| <b>Heat generator energy to the system (solar thermal energy not included) [Qaux]</b> |       |       |      |      |      |      |      |      |      |      |      |      |       |
| kBtu  | 39055 | 11617 | 7664 | 4571 | 1215 | 378  | 280  | 224  | 140  | 131  | 290  | 3180 | 9365  |
| <b>Heat generator fuel and electrical energy consumption [Eaux]</b>                   |       |       |      |      |      |      |      |      |      |      |      |      |       |
| kBtu  | 49163 | 14294 | 9532 | 5760 | 1607 | 596  | 449  | 366  | 241  | 220  | 434  | 4061 | 11602 |
| <b>Solar fraction: fraction of solar energy to system [SFn]</b>                       |       |       |      |      |      |      |      |      |      |      |      |      |       |
| %   | 38.8  | 14.9  | 20.7 | 33.2 | 62.5 | 84.4 | 88   | 90.6 | 94.2 | 94.2 | 87.6 | 35.6 | 16.8  |
| <b>Total fuel and/or electrical energy consumption of the system [Etot]</b>           |       |       |      |      |      |      |      |      |      |      |      |      |       |
| kBtu  | 49802 | 14405 | 9609 | 5822 | 1647 | 634  | 488  | 406  | 279  | 254  | 467  | 4107 | 11684 |
| <b>Irradiance onto collector area [Esol]</b>  |       |       |      |      |      |      |      |      |      |      |      |      |       |
| kBtu  | 85044 | 6325  | 6380 | 7679 | 7188 | 7209 | 7029 | 7402 | 8002 | 7924 | 7966 | 6201 | 5740  |
| <b>Electrical energy consumption of pumps [Epar]</b>                                  |       |       |      |      |      |      |      |      |      |      |      |      |       |
| kBtu  | 638   | 111   | 77   | 62   | 40   | 38   | 39   | 40   | 38   | 34   | 33   | 45   | 82    |
| <b>Heat loss to indoor room (including heat generator losses) [Qint]</b>              |       |       |      |      |      |      |      |      |      |      |      |      |       |
| kBtu  | 20593 | 3580  | 2673 | 2082 | 1223 | 1081 | 1028 | 1054 | 1044 | 981  | 1030 | 1703 | 3113  |
| <b>Heat loss to surroundings (without collector losses) [Qext]</b>                    |       |       |      |      |      |      |      |      |      |      |      |      |       |
| kBtu  | 1394  | 120   | 116  | 131  | 123  | 121  | 113  | 115  | 117  | 112  | 117  | 104  | 106   |
| <b>Total energy consumption [Quse]</b>  |       |       |      |      |      |      |      |      |      |      |      |      |       |
| kBtu  | 52728 | 12740 | 8830 | 5900 | 2307 | 1499 | 1425 | 1433 | 1396 | 1327 | 1390 | 4113 | 10368 |

## Collector North America

### Daily maximum temperature [ °F]



## Energy flow diagram

