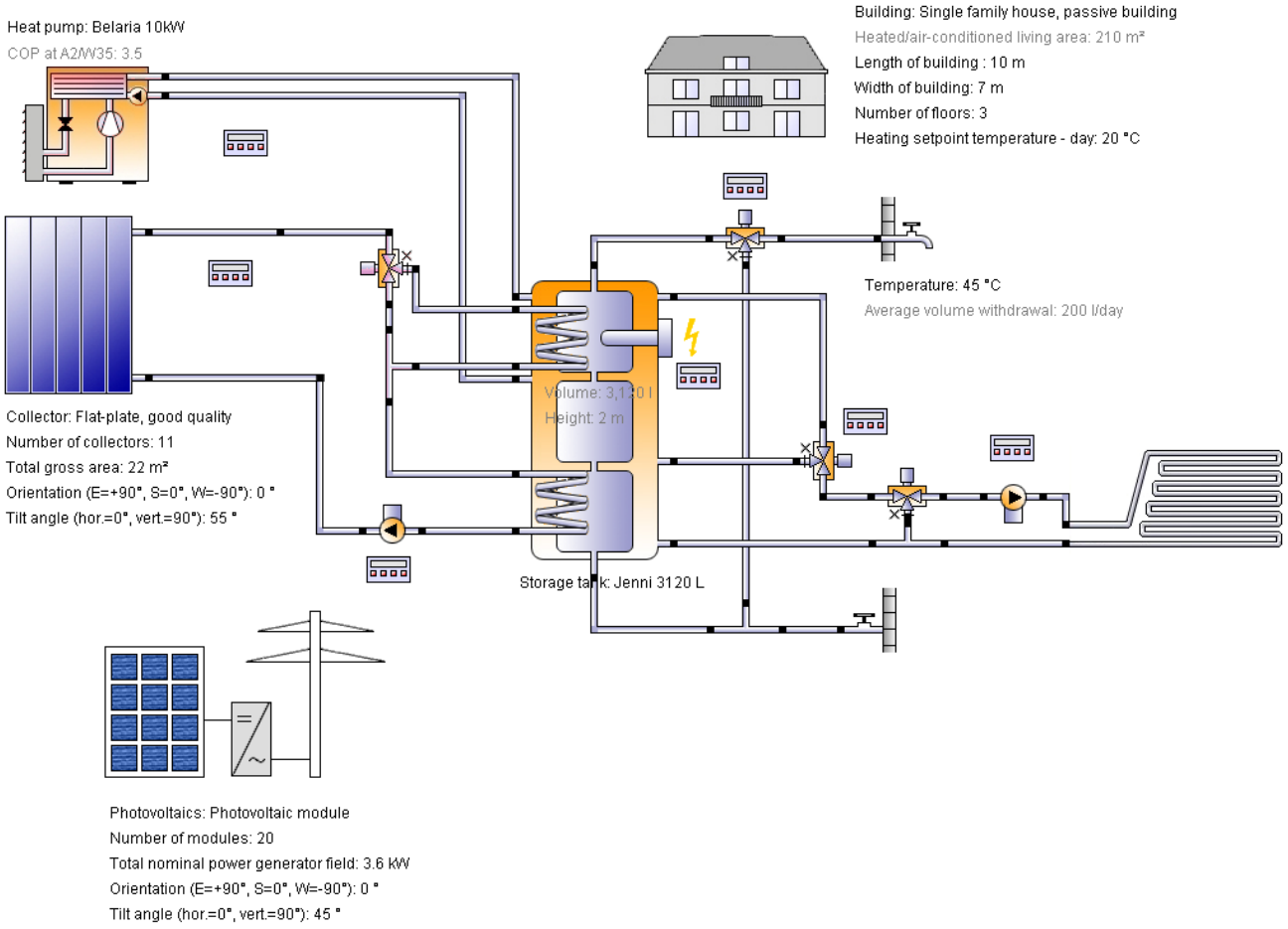
Professional Report

Project

Solar energy house with air-water heat pump and PV



Location of the system

Rapperswil SG
Longitude: 8.82°
Latitude: 47.23°
Elevation: 417 m

Map section

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This report has been created by:

Vela Solaris AG

System overview (annual values)

Total fuel and/or electrical energy consumption of the system [Etot]	-1,729.6 kWh
Total energy consumption [Quse]	7,921.6 kWh
System performance (Quse / Etot)	4.38
Comfort demand	Energy demand covered

Overview solar thermal energy (annual values)

Collector area	22 m²
Solar fraction total	55.3%
Solar fraction hot water [SFnHw]	78.1 %
Solar fraction building [SFnBd]	23 %
Total annual field yield	5,899.3 kWh
Collector field yield relating to gross area	268.2 kWh/m²/Year
Collector field yield relating to aperture area	297.9 kWh/m²/Year
Max. energy savings	9,436.7 kWh
Max. reduction in CO2 emissions	3,164.4 kg

Overview photovoltaics (annual values)

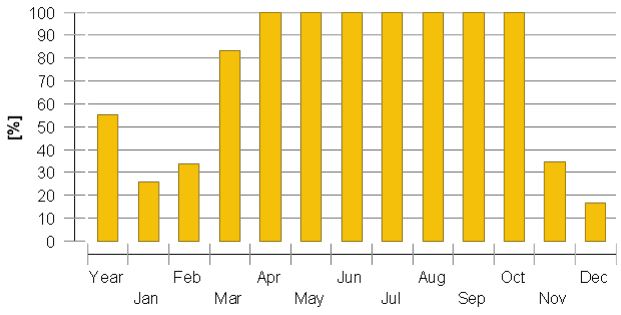
Total gross area	28 m²
Energy production DC [Qpvf]	3,744.4 kWh
Energy production AC [Qinv]	3,537.4 kWh
Total nominal power generator field	3.6 kW
Performance ratio	79.5 %
Specific annual yield	982.6 kWh/kWp/a
Phase imbalance	0.001 kVAh
Reactive energy [Qinvr]	0 kvarh
Apparent energy [Qinva]	3,537.4 kVAh
CO2 savings	1,897.5 kg

Overview heat pump (annual values)

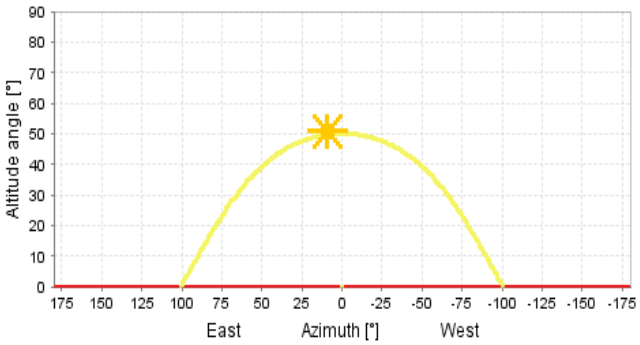
Seasonal performance factor for air-to-water heat pump	2.7
Total electrical energy consumption when heating [Eaux]	1,772.4 kWh
Total energy savings	2,997.5 kWh
Total reduction in CO2 emissions	1,607.9 kg

Professional Report

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



Horizon line



Meteorological data-Overview

Average outdoor temperature	10.1 °C
Global irradiation, annual sum	1,103.5 kWh/m²
Diffuse irradiation, annual sum	578 kWh/m²

Component overview (annual values)

Collector	**Flat-plate, good quality**	
Data Source		SPF
Number of collectors		11
Number of arrays		3
Total gross area	m²	22
Total aperture area	m²	19.8
Total absorber area	m²	19.8
Tilt angle (hor.=0°, vert.=90°)	°	55
Orientation (E=+90°, S=0°, W=-90°)	°	0
Collector field yield [Qsol]	kWh	5,899.3
Irradiation onto collector area [Esol]	kWh	23,629.7
Collector efficiency [Qsol / Esol]	%	25
Direct irradiation after IAM	kWh	11,889
Heat pump	**Belaria 10kW**	
Heating power at A2/W35	kW	10.4
Electrical power at A2/W35	kW	2.97
COP at A2/W35		3.5
DeltaT at A7/W35	K	5
Performance factor		2.69
Energy from/to the system [Qaux]	kWh	4,769.9
Fuel and electrical energy consumption [Eaux]	kWh	1,772.4
Energy savings solar thermal	kWh	5,899.3
CO2 savings solar thermal	kg	3,164.4
Energy savings heat pump	kWh	2,997.5
CO2 savings heat pump	kg	1,607.9

Photovoltaics Roof plan 1	Photovoltaic module	
Manufacturer		Anonymous
Data Source		Enecolo
Number of modules		20
Number of modules (layout)		20
Total nominal power generator field	kW	3.6
Total gross area	m²	28
Tilt angle (hor.=0°, vert.=90°)	°	45
Orientation (E=+90°, S=0°, W=-90°)	°	0
Inverter 1: Name		Sunny Boy SB 3300TL HC
Inverter 1: Manufacturer		SMA Solar Technology AG
Inverter 1: Number of phases		1
Layout 1: Number of inverters		1
Layout 1: cos phi		1
Layout 1: A number of strings		1
Layout 1: A modules per string		20
Total nominal power of all inverters	kVA	3
Energy production DC [Qpvf]	kWh	3,744
Energy production AC [Qinv]	kWh	3,537
Specific annual yield	kWh/kWp/a	982.6
Reactive energy [Qinvr]	kvarh	0
Apparent energy [Qinva]	kVAh	3,537

Building	Single family house, passive building	
Heated/air-conditioned living area	m²	210
Heating setpoint temperature	°C	19.5
Heating energy demand excluding DHW [Qdem]	kWh	4,920.1
Specific heating energy demand excluding DHW [Qdem]	kWh/m²	23.4
Solar gain through windows	kWh	18,802.8
Total energy losses	kWh	33,696.7

Heating element	Floor heating	
Number of heating/cooling modules	-	11
Power per heating element under standard conditions	W	1,000
Nominal inlet temperature	°C	35
Nominal return temperature	°C	25
Net energy from/to heating/cooling modules	kWh	4,906.4

Hot water demand	Constant	
Volume withdrawal/daily consumption	l/d	200.1
Temperature setting	°C	45
Energy demand [Qdem]	kWh	2,965.2

Professional Report

Pump Solar loop	Eco, medium	
Circuit pressure drop	bar	0.329
Flow rate	l/h	693
Fuel and electrical energy consumption [Epar]	kWh	19.9

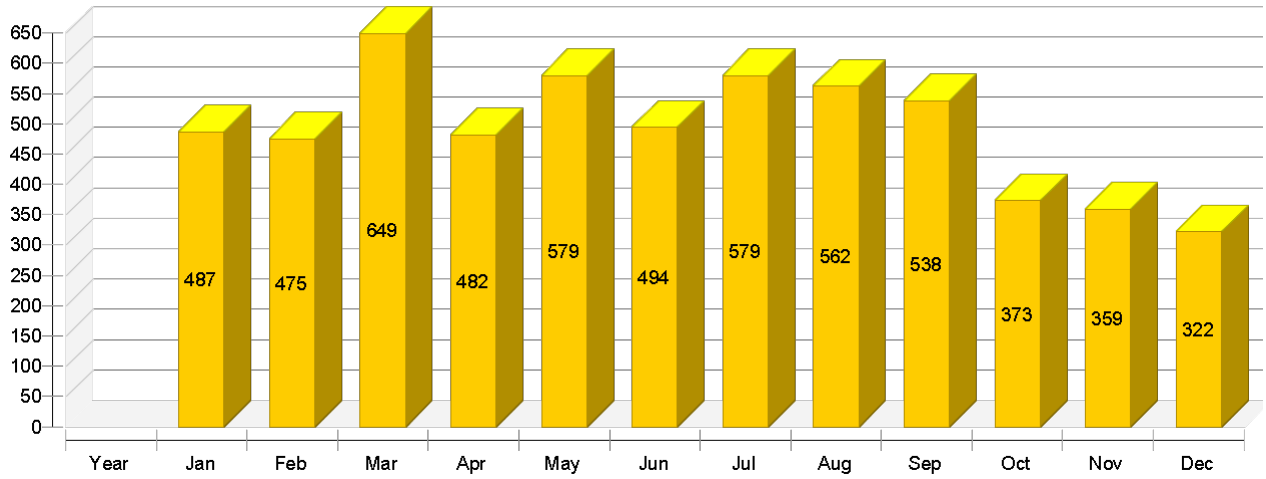
Pump Heating loop	Eco, medium	
Circuit pressure drop	bar	0.003
Flow rate	l/h	507.9
Fuel and electrical energy consumption [Epar]	kWh	15.5

Storage tank Combined tank	Jenni 3120 L	
Volume	l	3,120
Height	m	2
Material		Steel
Insulation		Fibreglass and mineral wool matting
Thickness of insulation	mm	160
Heat loss	kWh	1,279
Connection losses	kWh	575.1

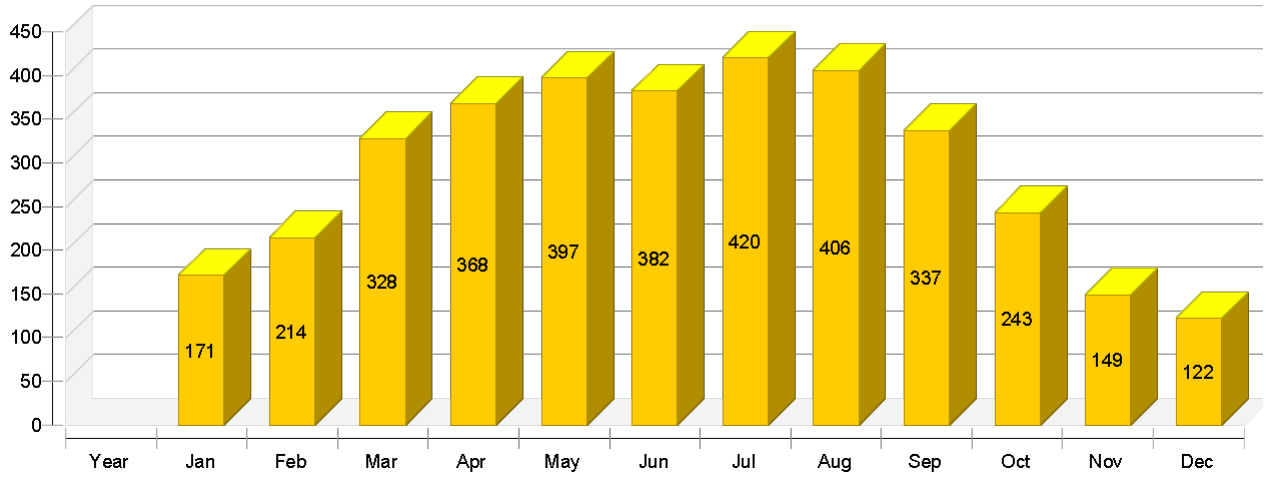
Loop

Solar loop		
Fluid mixture		Propylene mixture
Fluid concentration	%	33.3
Fluid domains volume	l	90.3
Pressure on top of the circuit	bar	4

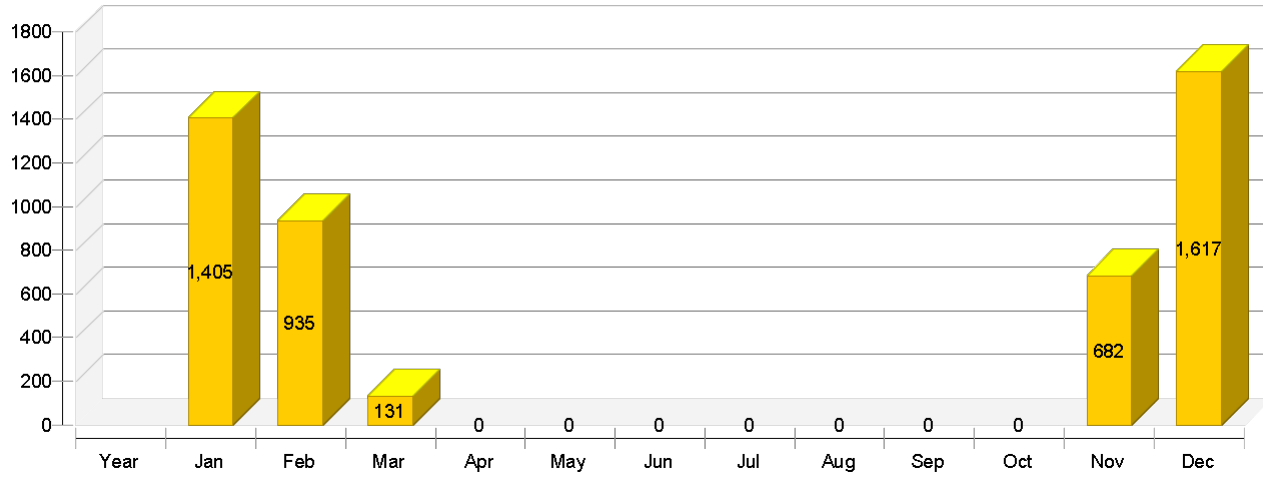
Solar thermal energy to the system [Qsol] kWh



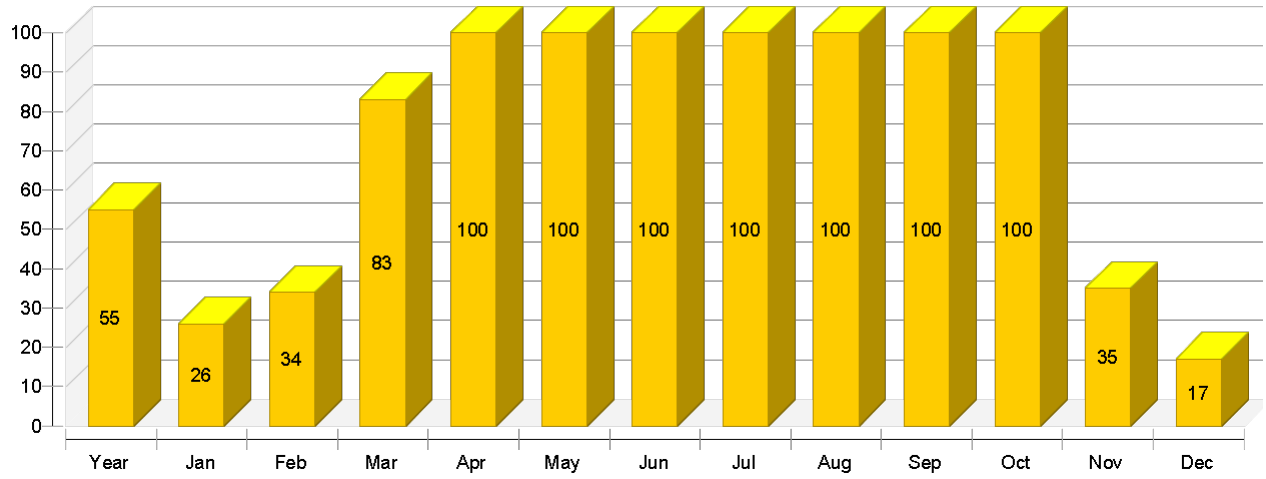
Yield Photovoltaics AC [Qinv] kWh



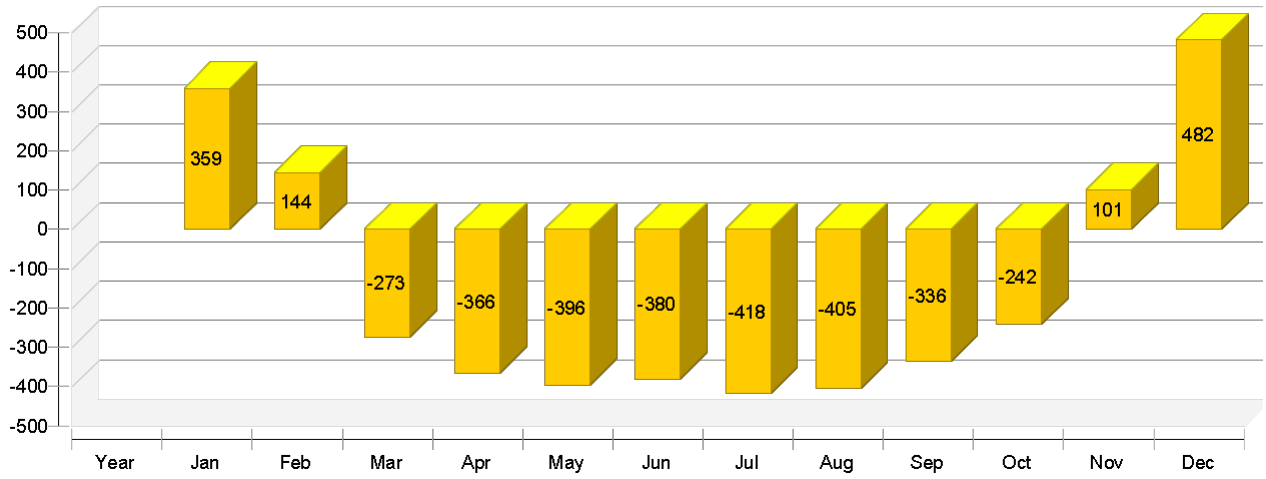
Heat generator energy to the system (solar thermal energy not included) [Qaux] kWh



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



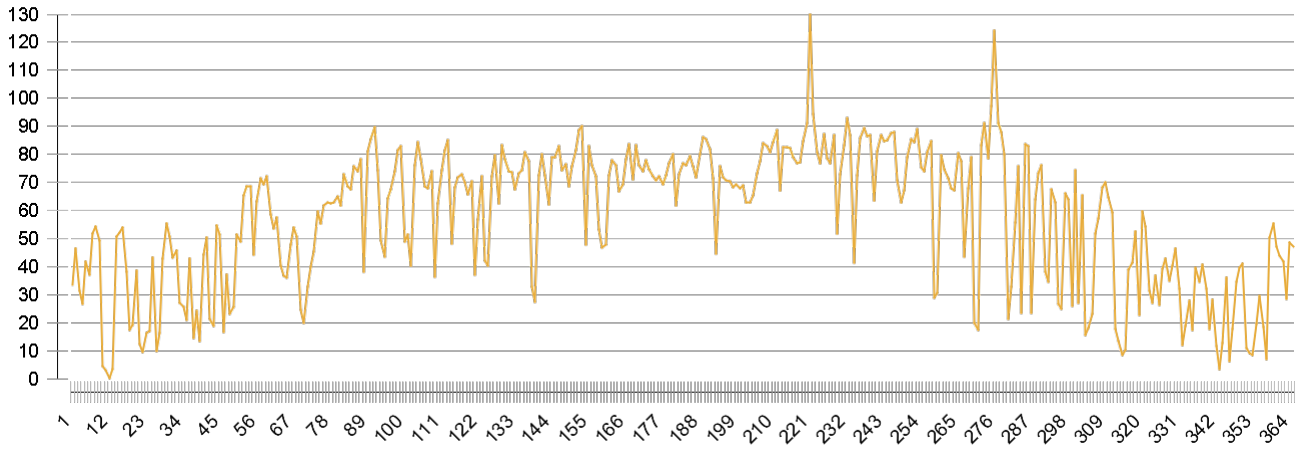
Total fuel and/or electrical energy consumption of the system [Etot] kWh



	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Solar thermal energy to the system [Qsol]													
kWh	5899	487	475	649	482	579	494	579	562	538	373	359	322
Heat generator energy to the system (solar thermal energy not included) [Qaux]													
kWh	4770	1405	935	131	0	0	0	0	0	0	0	682	1617
Heat generator fuel and electrical energy consumption [Eaux]													
kWh	1772	523	353	51	0	0	0	0	0	0	0	247	598
Solar fraction: fraction of solar energy to system [SFn]													
%	55.3	25.7	33.7	83.2	100	100	100	100	100	100	100	34.5	16.6
Total fuel and/or electrical energy consumption of the system [Etot]													
kWh	-1730	359	144	-273	-366	-396	-380	-418	-405	-336	-242	101	482
Irradiation onto collector area [Esol]													
kWh	23630	1185	1455	2170	2386	2570	2474	2735	2729	2310	1704	1051	861
Yield Photovoltaics DC [Qpvf]													
kWh	3744	182	227	346	389	420	404	444	429	356	258	159	131
Radiation onto module area [Esol PV]													
kWh	34613	1595	2019	3108	3540	3922	3821	4196	4085	3336	2388	1441	1163
Yield Photovoltaics AC [Qinv]													
kWh	3537	171	214	328	368	397	382	420	406	337	243	149	122
Electrical energy consumption of pumps [Epar]													
kWh	35	6	4	3	2	2	2	2	2	2	1	4	6
Total energy consumption [Quse]													
kWh	7922	1741	1178	516	265	261	241	238	233	225	239	996	1789
Heat loss to indoor room (including heat generator losses) [Qint]													
kWh	2744	131	149	221	262	274	276	297	330	287	250	146	121
Heat loss to surroundings (without collector losses) [Qext]													
kWh	62	4	4	7	6	6	6	7	7	6	4	3	3

Collector

Daily maximum temperature [°C]



Energy flow diagram (annual balance)