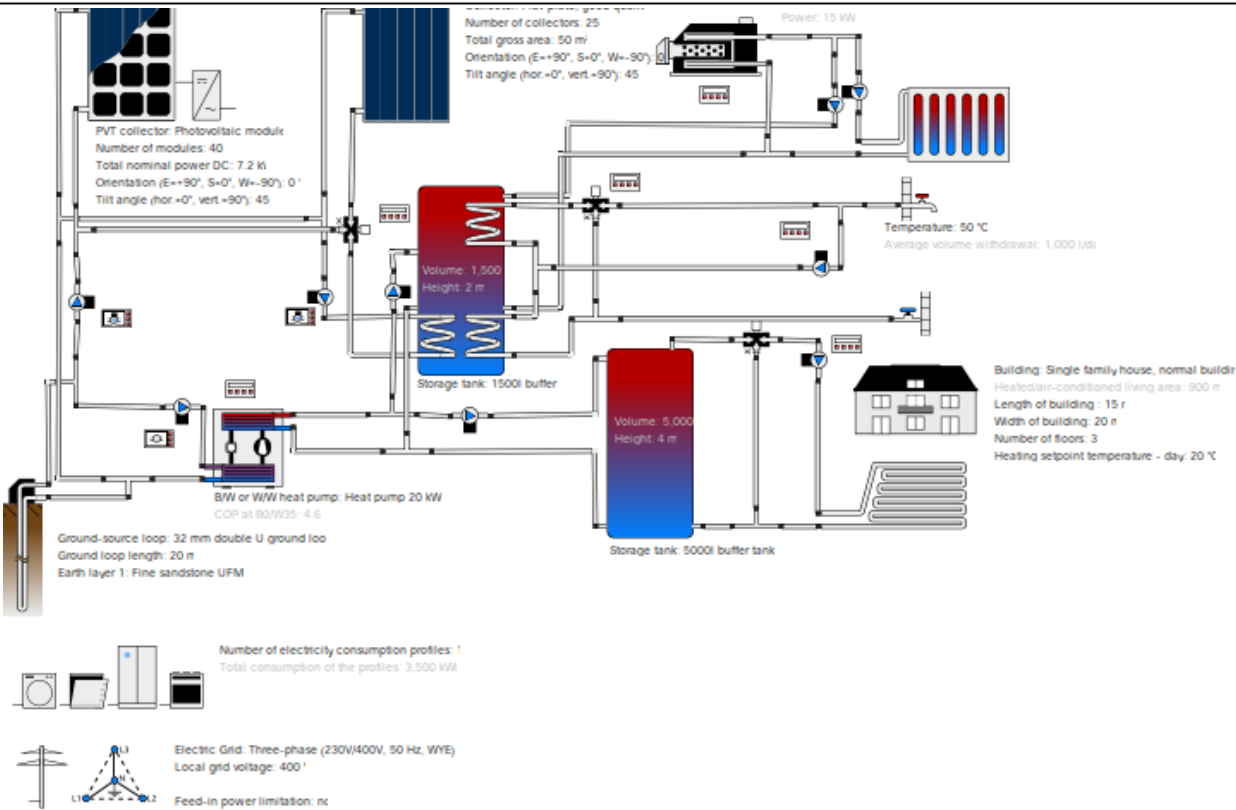


Professional Report

Etems Photovoltaic Thermal (PVT) System

59a: Space heating (seasonal storage, PVT collector)



Location of the system

Wandsworth Town
Longitude: -0.194°
Latitude: 51.449°
Elevation: 12 m

This report has been created by:

Etems K2354862

Kingston University
Kingston

Map section

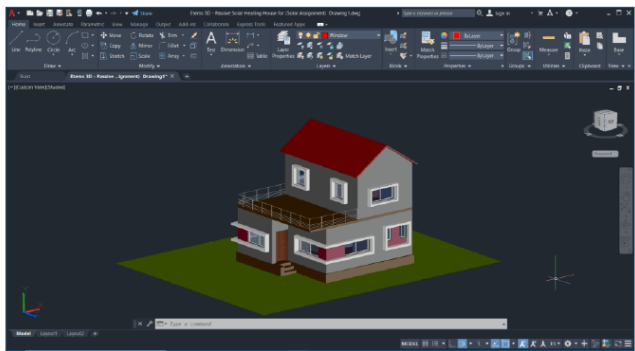


Professional Report

Comments on the project

Family house design on AutoCAD 3D for the Photovoltaic Thermal (PVT) Collector system

Photograph of property



System overview (annual values)

Total fuel and/or electricity consumption of the system [Etot]	16,660 kWh
Total electricity consumption [Ecs]	17,633 kWh
Total gas consumption [Egas]	6,548 kWh
Total energy consumption [Quse]	65,969 kWh
Seasonal performance factor (SPF-SHP)	3.2
Primary energy factor	0.49
Comfort demand	Energy demand of the building not met

Overview solar thermal energy (annual values)

Collector area	101.2 m²
Solar fraction total	39.7%
Solar fraction hot water [SFnHw]	52.8 %
Solar fraction building [SFnBd]	23.9 %
Total annual field yield	39,161.5 kWh
Collector field yield relating to gross area	387 kWh/m²/Year
Collector field yield relating to aperture area	407.1 kWh/m²/Year
Max. fuel savings	1,016.3 m³(gas): [Natural gas H] , 7,479.5 kWh: [Electricity]
Max. energy savings	25,671 kWh
Max. reduction in CO2 emissions	6,483 kg

Overview electricity (annual values)

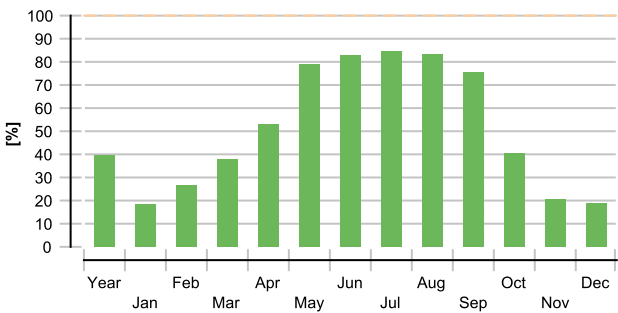
Annual consumption	17,633 kWh
Self-consumption	3,159 kWh
Self-consumption fraction	42 %
Degree of self-sufficiency	17.9 %

Professional Report

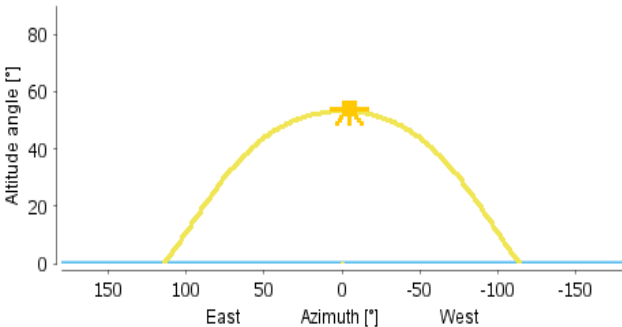
Overview heat pump (annual values)

Seasonal performance factor (without pump energy)	4
Total electricity consumption when heating [Eaux]	13,761 kWh
Ground loop length (Total)	300 m
Energy withdrawal of the ground-source loop	10,488 kWh
Total energy savings	40,620 kWh
Total reduction in CO2 emissions	21,788 kg

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



Horizon line



Meteorological data-Overview

Average outdoor temperature	11.9 °C
Global irradiation, annual sum	998 kWh/m²
Diffuse irradiation, annual sum	548 kWh/m²

Component overview (annual values)

B/W or W/W heat pump	Heat pump 20 kW	
Seasonal performance factor (without pump energy)		3.95
Energy from/to the system [Qaux]	kWh	54,381
Fuel and electricity consumption [Eaux]	kWh	13,761
Energy savings solar thermal	kWh	7,480
CO2 savings solar thermal	kg	4,012
Energy savings heat pump	kWh	40,620
CO2 savings heat pump	kg	21,788

Professional Report

Boiler 3		Gas 15kW
Power	kW	15
Total efficiency	%	79.2
Energy from/to the system [Qaux]	kWh	5,186
Fuel and electricity consumption [Eaux]	kWh	6,548
Fuel consumption of the back-up boiler [Baux]	m³(gas)	624
Energy savings solar thermal	kWh	10,671
CO2 savings solar thermal	kg	2,471
Fuel savings solar thermal	m³(gas)	1,016
Exhaust fumes losses [Qex]	kWh	655
Collector 1		Flat-plate, good quality
Data Source		SPF
Number of collectors		25
Number of arrays		1
Total gross area	m²	50
Total aperture area	m²	45
Total absorber area	m²	45
Tilt angle (hor.=0°, vert.=90°)	°	45
Orientation (E=+90°, S=0°, W=-90°)	°	0
Collector field yield [Qsol]	kWh	9,136
Irradiation onto collector area [Esol]	kWh	52,061
Collector efficiency [Qsol / Esol]	%	17.5
Direct irradiation after IAM	kWh	25,645
Diffuse irradiation after IAM	kWh	23,561
Electric consumers 1		Standard
Electricity consumption [Ecs]	kWh	17,633
Electricity consumption of the profiles [Epcs]	kWh	3,500
Electricity consumption of the thermal components [Ethcs]	kWh	14,133
Self-consumption [Eocs]	kWh	3,159
Self-consumption fraction [Rocs]	%	42
Degree of self-sufficiency [Raut]	%	17.9
Ground-source loop		32 mm double U ground loop
Ground loop length	m	20
Number of ground-source loops		15
Distance between ground loops	m	2
Earth layer 1	m	20 / Fine sandstone UFM
Inflow temperature during operation	°C	6.6
Outflow temperature during operation	°C	6.7
Energy withdrawal of the ground-source loop	kWh	10,488

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PVT collector 2		Photovoltaic module	
Data Source		Enecolo	
Number of modules		40	
Collector aperture area	m ²	51.2	
Tilt angle (hor.=0°, vert.=90°)	°	45	
Orientation (E=+90°, S=0°, W=-90°)	°	0	
Global irradiation after IAM	kWh	56,748	
Diffuse irradiation after IAM	kWh	27,235	
Collector field yield [Qsol]	kWh	30,026	
Total nominal power DC	kW	7.2	
Performance ratio [PerfR]	%	90.3	
Inverter 1: Name		Sunny Boy SB 3300TL HC	
Inverter 1: Manufacturer		SMA Solar Technology AG	
Layout 1: Number of inverters		2	
Layout 1: A number of strings		1	
Layout 1: A modules per string		20	
Energy production DC [Qpvf]	kWh	7,951	
Energy production AC [Qinv]	kWh	7,521	
Specific annual yield	kWh/kWp	1,045	
Building		Single family house, normal building	
Heated/air-conditioned living area	m ²	900	
Setpoint room temperature	°C	19.5	
Heating energy demand excluding DHW [Qdem]	kWh	46,727	
Specific heating energy demand excluding DHW [Qdem]	kWh/m ²	51.9	
Solar gain through windows	kWh	56,182	
Total energy losses	kWh	126,227	
Heating/Cooling element		Floor heating	
Power per heating/cooling element under standard conditions	W	1,000	
Nominal inlet temperature	°C	40	
Nominal return temperature	°C	35	
Net energy from/to heating/cooling modules	kWh	47,299	
Heating/Cooling element		Radiator	
Power per heating/cooling element under standard conditions	W	1,000	
Nominal inlet temperature	°C	65	
Nominal return temperature	°C	55	
Net energy from/to heating/cooling modules	kWh	188	
Hot water demand		Daily peaks	
Volume withdrawal/daily consumption	l/d	1,000	
Temperature setting	°C	50	
Energy demand [Qdem]	kWh	16,161	

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Pump Solar loop pump 1	Eco, medium	
Circuit pressure drop	bar	13.67
Flow rate	l/h	2,560
Fuel and electricity consumption [Epar]	kWh	47.6
Pump Ground-source loop pump	Eco, large	
Circuit pressure drop	bar	0.404
Flow rate	l/h	4,771
Fuel and electricity consumption [Epar]	kWh	148
Pump Solar loop pump 2	Eco, medium	
Circuit pressure drop	bar	65.674
Flow rate	l/h	1,350
Fuel and electricity consumption [Epar]	kWh	18.3
Pump Loading tank pump 2	Eco, medium	
Circuit pressure drop	bar	0.025
Flow rate	l/h	1,500
Fuel and electricity consumption [Epar]	kWh	8.3
Pump Loading tank pump 1	Eco, medium	
Circuit pressure drop	bar	0.029
Flow rate	l/h	1,600
Fuel and electricity consumption [Epar]	kWh	51.1
Pump Heating loop	Eco, large	
Circuit pressure drop	bar	0.712
Flow rate	l/h	6,738
Fuel and electricity consumption [Epar]	kWh	88.2
Pump Loading tank pump 3	Eco, medium	
Circuit pressure drop	bar	0.149
Flow rate	l/h	1,300
Fuel and electricity consumption [Epar]	kWh	8.9
Pump Heating loop	Eco, large	
Circuit pressure drop	bar	0.016
Flow rate	l/h	1,000
Fuel and electricity consumption [Epar]	kWh	0.7
Pump Circulation	Eco, small	
Circuit pressure drop	bar	0.005
Flow rate	l/h	500
Fuel and electricity consumption [Epar]	kWh	0.4

Professional Report

Storage tank Solar tank		1500l buffer
Volume	l	1,500
Height	m	2
Material		Steel
Insulation		Rigid PU foam
Thickness of insulation	mm	80
Heat loss [Q _{hl}]	kWh	691
Connection losses	kWh	720

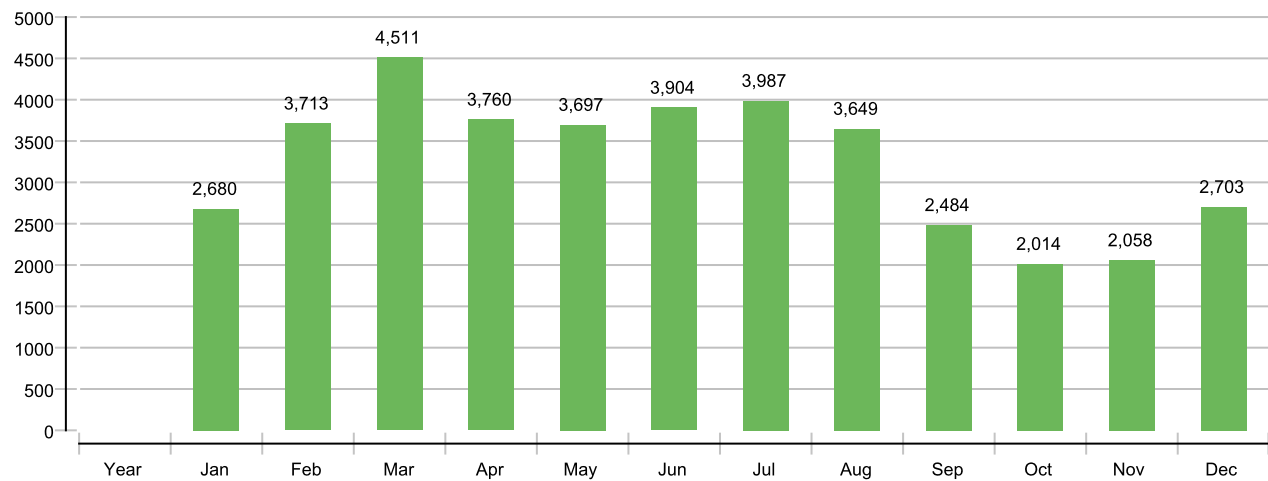
Storage tank Buffer tank		5000l buffer tank
Volume	l	5,000
Height	m	4
Material		Steel
Insulation		Rigid PU foam
Thickness of insulation	mm	140
Heat loss [Q _{hl}]	kWh	807
Connection losses	kWh	139

Loop

Solar loop		
Fluid mixture		Ethylene mixture
Fluid concentration	%	40
Fluid domains volume	l	901.4
Pressure on top of the circuit	bar	4

Solar thermal energy to the system [Q_{sol}]

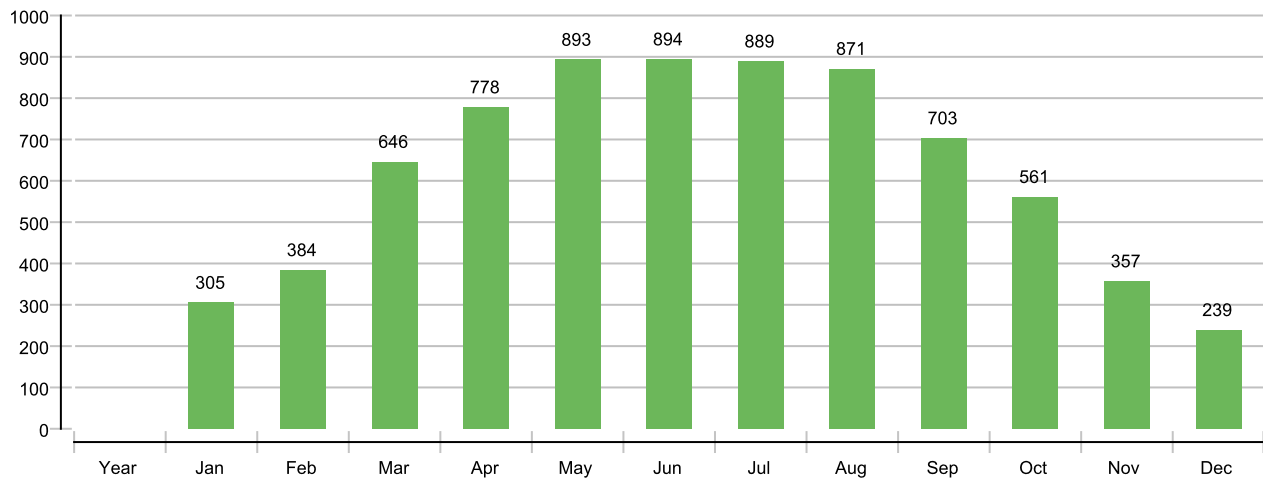
kWh



Professional Report

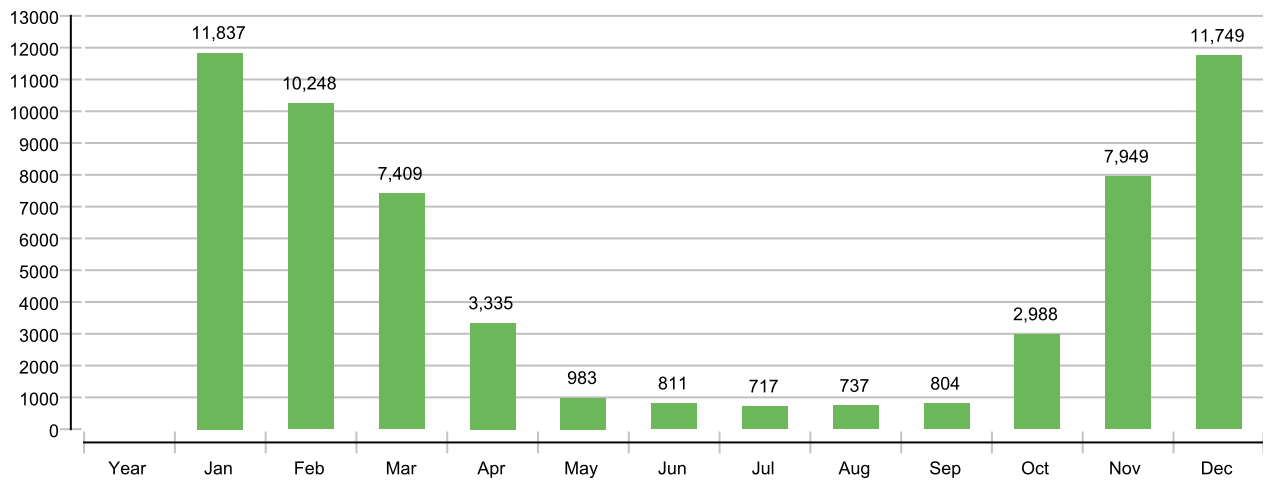
Yield Photovoltaics AC [Q_{inv}]

kWh



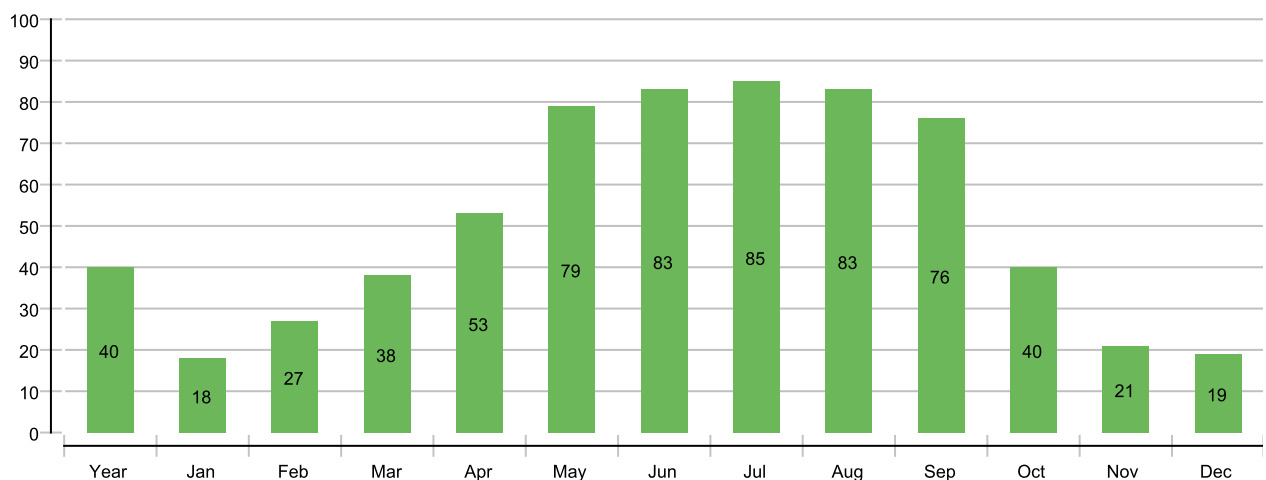
Heat generator energy to the system (solar thermal energy not included) [Q_{aux}]

kWh



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

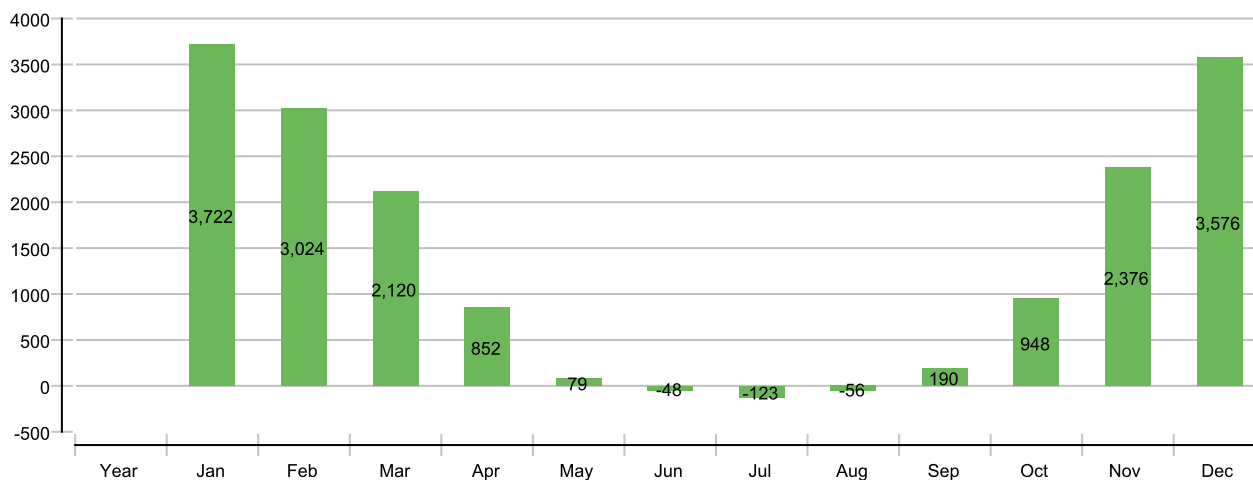
%



Professional Report

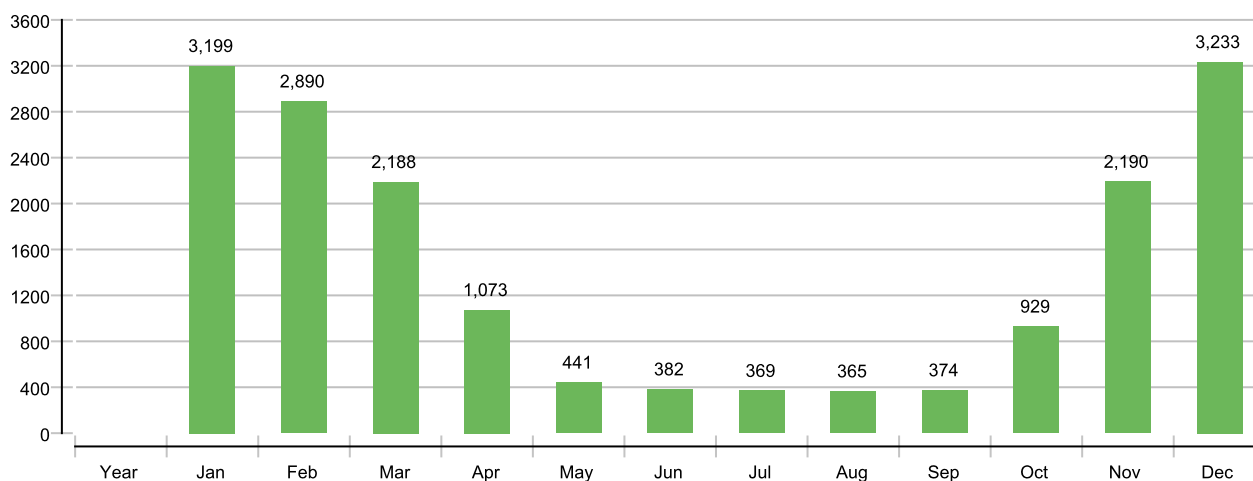
Total fuel and/or electricity consumption of the system [Etot]

kWh



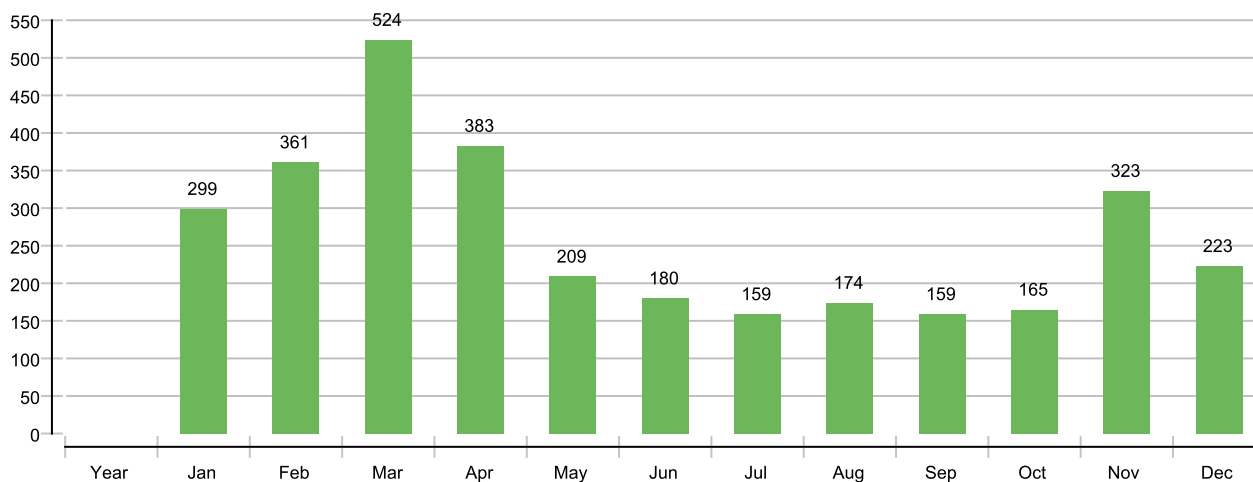
Total electricity consumption [Ecs]

kWh



Self-consumption [Eocs]

kWh

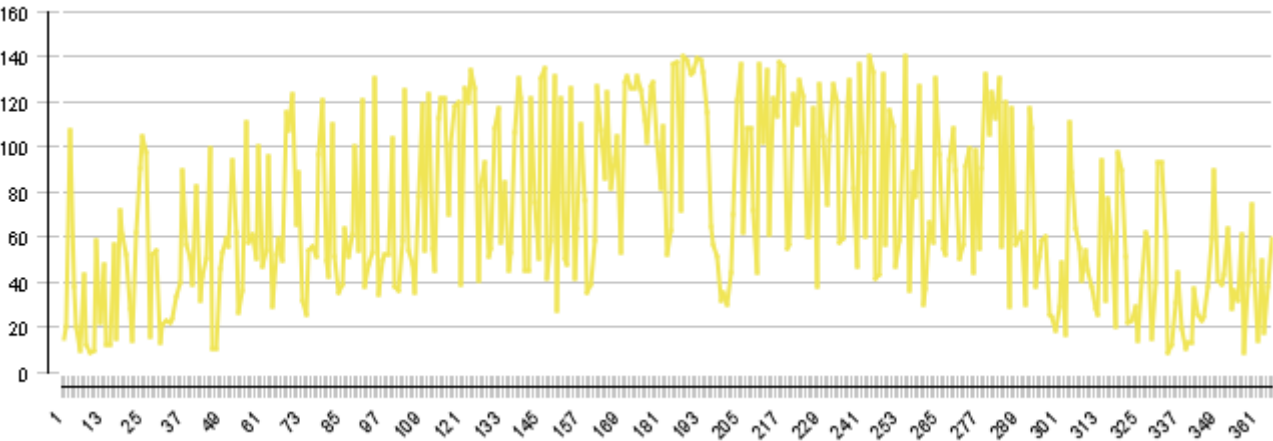


Professional Report

	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Solar thermal energy to the system [Qsol]													
kWh	39162	2680	3713	4511	3760	3697	3904	3987	3649	2484	2014	2058	2703
Heat generator energy to the system (solar thermal energy not included) [Qaux]													
kWh	59566	11837	10248	7409	3335	983	811	717	737	804	2988	7949	11749
Heat generator fuel and electricity consumption [Eaux]													
kWh	20309	3600	3030	2396	1317	688	591	512	558	631	1200	2388	3399
Solar fraction: fraction of solar energy to system [SF_n]													
%	39.7	18.5	26.6	37.8	53	79	82.8	84.8	83.2	75.6	40.3	20.6	18.7
Total fuel and/or electricity consumption of the system [E_{tot}]													
kWh	16660	3722	3024	2120	852	79	-48	-123	-56	190	948	2376	3576
Irradiation onto collector area [E_{sol}]													
kWh	111295	4346	5393	9131	11291	13261	13431	13614	13223	10657	8399	5125	3424
Yield Photovoltaics DC [Q_{pvt}]													
kWh	7951	325	407	683	822	943	944	939	919	742	592	379	255
Radiation onto module area [E_{sol} PV]													
kWh	59234	2313	2871	4860	6009	7058	7148	7245	7038	5672	4470	2727	1822
Yield Photovoltaics AC [Q_{inv}]													
kWh	7521	305	384	646	778	893	894	889	871	703	561	357	239
Electricity consumption of pumps [E_{par}]													
kWh	371.6	68.8	64.2	45	21.3	9.2	8.7	8.6	8.1	6.6	16.8	42.6	71.7
Total energy consumption [Q_{use}]													
kWh	65969	12146	10582	8026	3828	1701	1505	1504	1477	1418	3499	8306	11976
Heat loss to indoor room (including heat generator losses) [Q_{int}]													
kWh	4100	325	293	349	341	363	353	357	366	349	350	339	315
Total electricity consumption [E_{cs}]													
kWh	17633	3199	2890	2188	1073	441	382	369	365	374	929	2190	3233
Self-consumption [E_{ocs}]													
kWh	3159	299	361	524	383	209	180	159	174	159	165	323	223

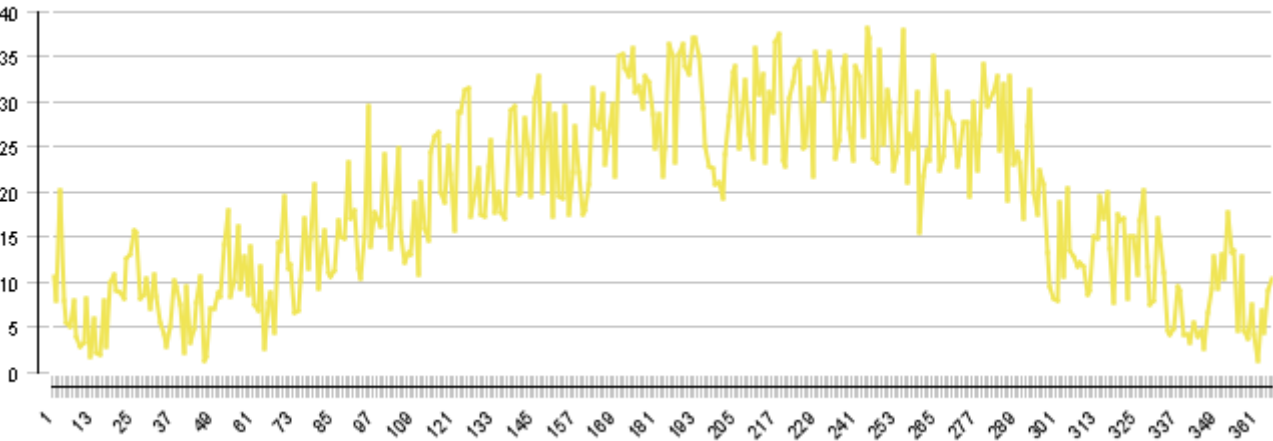
Collector 1

Daily maximum temperature [°C]



PVT collector 2

Daily maximum temperature [°C]



Professional Report

Energy flow diagram (annual balance)

