

Example printout



Building project

SDC Example

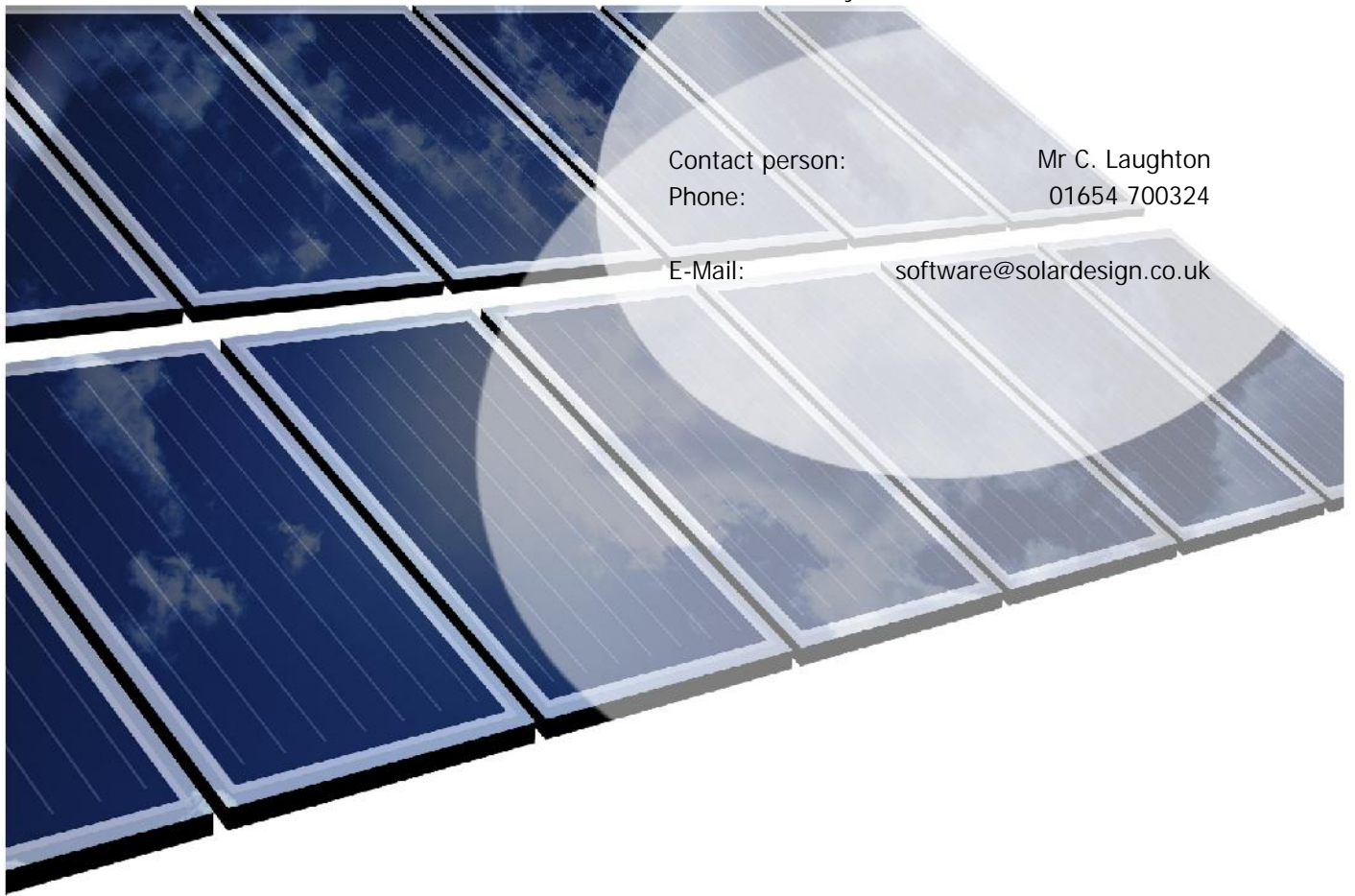
Dyfi Eco Park
SY20 8AX Machynlleth UK

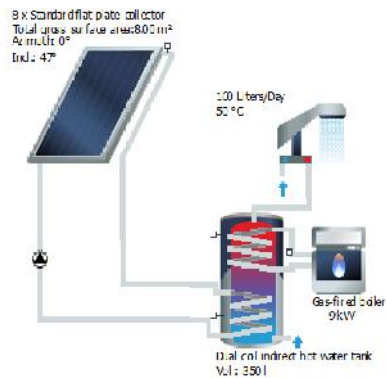
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Results of annual simulation

Installed collector power:		5.60 kW
Installed solar surface area (gross):		8 m ²
Irradiation on collector surface (active):	8,735.97 kWh	1,092.00 kWh/m ²
Energy delivered by collectors:	2,536.27 kWh	317.03 kWh/m ²
Energy delivered by collector loop:	2,225.05 kWh	278.13 kWh/m ²
DHW heating energy supply:		2,566.43 kWh
Solar energy contribution to DHW:		2,006.69 kWh
Energy from auxiliary heating:		975.0 kWh
Natural gas (H) savings:		290.5 m ³
CO2 emissions avoided:		614.22 kg
DHW solar fraction:		67.3 %
Relative savings of supplementary energy (DIN EN 12977):		67.8 %
System efficiency:		23.0 %

Site Data

Climate data

Location:	LONDON CITY AIRPORT
Climate data record:	LONDON CITY AIRPORT
Total annual global irradiation:	991.562 kWh/m ²
Latitude:	51.5 °
Longitude:	0.5 °
Domestic hot water	
Average daily consumption:	0.16 m ³
Desired temperature:	50 °C
Consumption profile:	Detached house (evening max)
Cold water temperature:	February: 10.5 °C August: 14 °C
Circulation:	no

System

Collector loop

Manufacturer:	Standard
Type:	Standard flat-plate collector
Number:	8.00
Total gross surface area:	8 m ²
Total active solar surface area:	8 m ²
Inclination (Tilt Angle):	47 °
Orientation:	180 °
Azimuth:	0 °
Dual coil indirect hot water tank	

Manufacturer:	Standard
Type:	Dual coil indirect hot water tank
Volume:	0.35 m ³
Auxiliary heating	

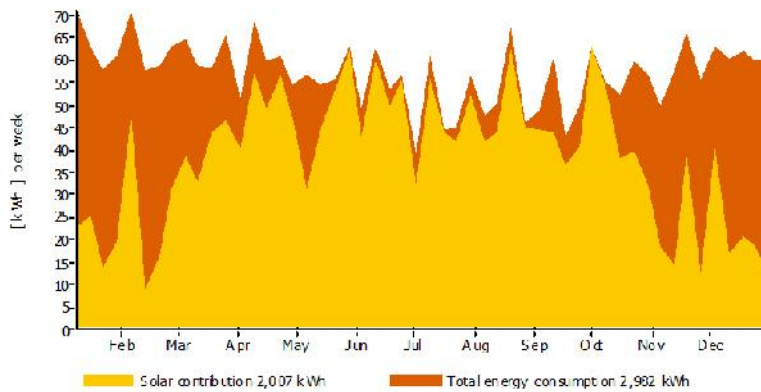
Manufacturer:	Standard
Type:	Gas-fired boiler
Nominal output:	9 kW

Legend

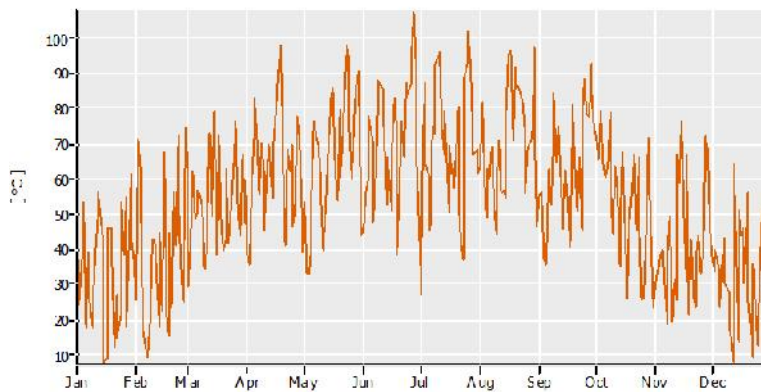
With test report
Solar Keymark



Solar energy consumption as percentage of total consumption



Daily maximum collector temperature



These calculations were carried out by T*SOL 2016 (R1) - the simulation program for solar thermal heating systems. The results are determined by a mathematical model calculation with variable time steps of up to 6 minutes. Actual yields can deviate from these values due to fluctuations in climate, consumption and other factors. The system schematic diagram above does not represent and cannot replace a full technical drawing of the solar system.

Photo Plan
Geometry 3D 1



Financial analysis

System

Active solar surface:	8 m ²
System yield:	2,006.69 kWh
Annual fuel savings:	290.5 m ³ Natural gas (H)

Financial analysis parameters

Life span:	20 Years
Interest on capital:	2.5 %
Reinvestment return:	2.5 %
Energy cost escalation rate:	3.0 %
Running cost escalation rate:	1.5 %

Allowances

Amount:	0.160 £/kWh
Payout Duration:	7 Years
Adjustment:	1.0 %/a

Financing

Total investments:	8,000 £
Subsidies:	0 £
Loan capital:	0 £
Remaining investment:	8,000 £

Running costs in first year:	0 £
Savings in first year:	145 £
Allowances in first year:	321 £

Financial analysis

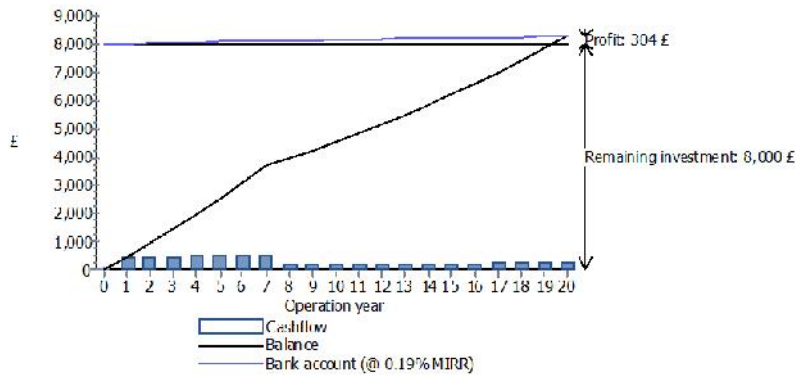
Cost of solar energy:	0.189 £/kWh
Capital return time:	---
Amortization period:	---

Profitability

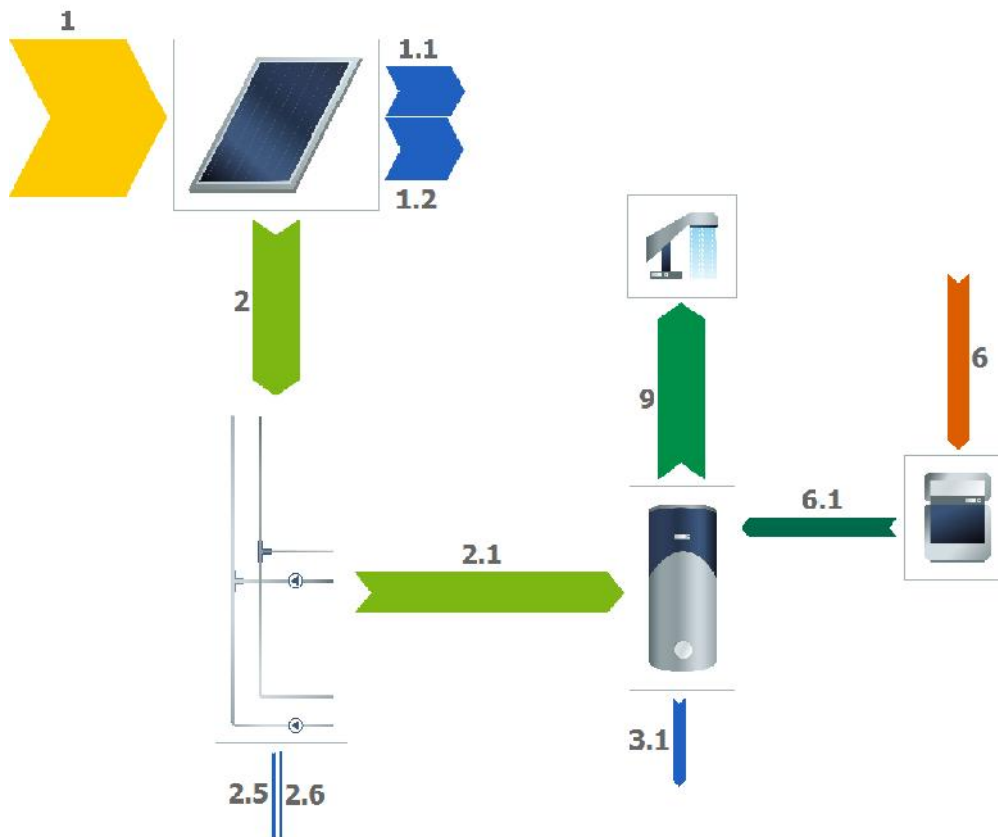
Return on assets:	77.7 %
Return on equity:	77.7 %
Internal rate of return rate, IRR:	---
Net present value:	-2,932 £

Reinvestment premise

Profit: 304 £
Modified internal rate of return, MIRR: 0.19 %



Energy balance schematic



Legend

1	Irradiation on collector surface (active)	8,736 kWh
1.1	Optical collector losses	2,745 kWh
1.2	Thermal collector losses	3,455 kWh
2	Energy from collector array	2,536 kWh
2.1	Solar energy to storage tank	2,225 kWh
2.5	Internal piping losses	248 kWh
2.6	External piping losses	63 kWh
3.1	Tank losses	635 kWh
6	Final energy	1,224 kWh
6.1	Supplementary energy to tank	975 kWh
9	DHW energy from tank	2,566 kWh

Glossary

- 1 **Irradiation on collector surface (active)**
Solar energy irradiated onto tilted collector area (active surface area)
- 1.1 **Optical collector losses**
Reflection and other losses
- 1.2 **Thermal collector losses**
Heat conduction and other losses
- 2 **Energy from collector array**
Energy output at collector array outlet (i.e. before piping)
- 2.1 **Solar energy to storage tank**
Energy from collector loop to storage tank (minus piping losses)
- 2.5 **Internal piping losses**
Internal piping losses
- 2.6 **External piping losses**
External piping losses
- 3.1 **Tank losses**
Heat losses via surface area
- 6 **Final energy**
Final energy supply to system. This can be supplied from natural gas, oil or electricity (not including solar energy) and takes efficiency into account.
- 6.1 **Supplementary energy to tank**
Supplementary energy (e.g. boiler) to tank
- 9 **DHW energy from tank**
Heat from tank (excluding circulation) for DHW consumption

Climate

Data record:	LONDON CITY AIRPORT
Location:	LONDON CITY AIRPORT
Latitude:	51.5 °
Longitude:	0.5 °
Total annual global irradiation:	992 kWh/m ²
Diffuse radiation percentage:	59.1 %
Mean outside temperature:	12.36 °C



Hot water consumption

DHW consumption

Average daily consumption:	0.160 m ³
Annual consumption:	58.4 m ³
Max daily consumption:	0.190 m ³
Desired temperature:	50.0 °C
Cold water temperature:	10.5 °C / 14.0 °C
Annual energy requirement:	2,560 kWh
Days in operation:	365 Days
Not operating:	-No limitation-
Circulation	

- No circulation present -

Consumption profile

Profile:	Detached house (evening max)
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Collector loop (CL 1)

Volume flow:	40 l/h
Heat transfer medium: water with	40 % Polypropylene glycol
Heat capacity:	3588 J/(kg·K)
Control:	

The collector loop pump control is dependent on the difference between the collector outlet temperature and the tank reference temperature.

Switch on above a difference of:	8 K
Switch off below a difference of:	3 K

Collector array

Total gross surface area	8 m ²
Total active solar surface area	8 m ²
Number of collectors:	8
Installation:	

Inclination (Tilt Angle):	47 °
Azimuth angle:	0 °
Annual irradiation onto the collector active solar surface	
Without shade:	8,945 kWh
With shade:	8,736 kWh
Piping:	

One-way length of piping system	
inside:	8 m
outside:	1 m
between collectors:	200 mm/Collector
Thermal conductivity of insulation	
inside:	0.045 W/(m·K)
outside:	0.045 W/(m·K)
between collectors:	0.045 W/(m·K)
Nominal diameter of piping	
inside and outside:	15 mm
between collectors:	10 mm
(Corresponds to a flow velocity of approx 0.5 m/s)	
Insulation thickness	
inside:	20 mm
outside:	20 mm
between collectors:	20 mm

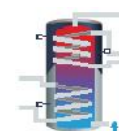


Flat-plate collector

Manufacturer:	Standard
Type:	Standard flat-plate collector
Heat capacity:	
Specific heat capacity:	6000 J/(m ² *K)
Heat losses:	
Simple heat transfer coefficient:	3.8 W/(m ² K)
Quadratic heat transfer coefficient:	0.03 W/(m ² K ²)
Heat transfer coefficients based on collector flow temperature:	No
Optical losses:	
Conversion factor:	78 %
Incident angle modifier (IAM) for diffuse radiation:	83 %
Incident angle modifier for direct irradiation with an incident angle of 50°:	88 %
Size:	
Gross surface:	1 m ²
Active solar surface:	1 m ² (Absorber area)

Shade: A tree

Shade from above	none
Reduction of diffuse radiation:	1.2 %



Dual coil indirect hot water tank

Manufacturer:	Standard
Type:	Dual coil indirect hot water tank
Volume:	350 l
Height/Diameter:	1.80

Number of tanks:		1
Insulation:		
Insulation thickness		100 mm
Thermal conductivity:		0.065 W/(m·K)
Connections:		
	Height:	Losses:
Upper tank outlet:	100 %	0.25 W/K
Lower tank inlet:	0 %	0.25 W/K
Circulation return:	-without-	
Heat exchanger Collector loop connection		
	Height:	Losses:
Return:	2 %	0.25 W/K
Supply:	40 %	0.25 W/K
Heat exchanger Auxiliary heating:		
	Height:	Losses:
Return:	60 %	0.25 W/K
Supply:	95 %	0.25 W/K
Heat exchanger:		
kA value Collector loop connection:		1 W/K per tank volume
kA value Auxiliary heating:		1 W/K per tank volume
Control:		
Desired tank temperature:		Desired DHW temp + 0 K
Limited load times:		none
	Height:	Switching temp.:
Collector loop - switch on/off:	19 %	
Switch off collector loop:	90 %	90 °C
Switch on auxiliary heating:	75 %	-3 K
Switch off auxiliary heating:	75 %	3 K

Gas-fired boiler



Manufacturer:	Standard
Type:	Gas-fired boiler
Nominal output:	9.0 kW
Boiler type:	modulating boiler
Temperature range:	5 K / 20 K / 40 K

Return mixing valve:	none
Energy source:	Natural gas (H)
Efficiency:	85 %
with a return temperature of:	60 °C
Efficiency:	85 %
with a return temperature of:	30 °C
Efficiency of domestic hot water supply:	55 %
Efficiency based on the higher heating value (HHV), Hs:	80 %
with a return temperature of:	60 °C
Efficiency based on the higher heating value (HHV), Hs:	100 %
with a return temperature of:	30 °C
Efficiency of DHW supply, Hs:	50 %
Hi (LHV):	37512 kJ/m ³
Not operating:	-No limitation-

Results of annual simulation

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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DHW system

Savings Natural gas (H) in m³

290.5	11.2	12.2	20.6	27.2	31.1	36.5	36.5	38.0	32.7	23.7	12.7	8.1
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CO2 emissions avoided in kg

614.2	23.6	25.7	43.5	57.5	65.8	77.2	77.2	80.3	69.2	50.2	26.9	17.2
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DHW solar fraction in %

67.3	36.5	42.7	69.3	84.2	86.2	92.6	93.1	92.3	84.7	70.2	42.9	26.9
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System efficiency in %

23.0	31.7	26.0	25.8	22.8	19.4	19.9	19.3	21.2	23.4	27.3	29.1	29.6
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Solar energy contribution to DHW in kWh

2,007	99	108	182	220	209	214	209	218	194	170	112	72
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E - Solar loop to tank in kWh

2,225	106	116	196	241	238	243	241	246	216	184	121	78
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Energy: Aux. heating in kWh

975	172	145	81	41	33	17	15	18	35	72	149	196
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Climate

Outside temperature in °C

12.4	6.5	6.4	8.3	10.8	14.4	17.6	19.3	19.2	16.5	13.0	9.3	6.6
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Global radiation - horizontal in kWh/m²

992	21	34	72	112	143	150	148	127	86	56	27	17
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Position of sun - altitude in °

12.5	3.8	6.4	10.8	16.3	20.9	23.3	22.1	18.1	12.8	7.8	4.4	3.0
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Position of sun - azimuth in °

0.1	0.4	0.1	-0.2	-0.3	0.2	0.4	1.4	-0.1	-0.3	0.0	-0.2	0.1
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Wind speed in m/s

4.0	4.7	4.2	4.4	3.9	4.1	3.8	4.0	3.6	3.6	3.8	3.8	4.0
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Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
CLEARNESS INDEX in %												
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Hot water consumption

DHW heating energy supply in kWh

2,566	252	230	231	220	197	189	170	189	186	215	237	251
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DHW heating energy requirement in kWh

2,566	252	230	231	220	197	189	170	189	186	215	237	251
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Circulation losses in kWh

0	0	0	0	0	0	0	0	0	0	0	0	0
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Cold water temperature in °C

12.3	10.7	10.5	10.8	11.4	12.3	13.2	13.8	14.0	13.7	13.0	12.2	11.3
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DHW temperature in °C

49.9	49.9	49.9	49.9	49.9	50.0	49.9	49.9	49.9	49.8	49.9	49.9	49.9
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Preset DHW consumption in m³

58.4	5.5	5.0	5.1	4.9	4.5	4.4	4.1	4.5	4.4	5.0	5.4	5.6
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DHW - consumption in m³

51.0	5.3	4.7	4.7	4.2	3.5	3.4	3.1	3.5	3.7	4.5	5.1	5.4
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Solar loop

Max collector temperature in °C

38.4	21.3	25.7	35.1	43.8	47.9	51.4	52.3	50.9	46.1	37.2	28.6	20.0
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Collector loop

Energy from collector loop (CL 1) in kWh

2,225	106	116	196	241	238	243	241	246	216	184	121	78
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Collector loop efficiency (CL 1) in %

25.5	34.0	27.9	27.7	24.9	22.1	22.6	22.3	24.0	26.1	29.6	31.4	32.1
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Collector loop reference temperature (CL 1) in °C

31.9	16.0	18.3	24.0	34.8	44.4	47.2	50.1	46.6	39.2	25.9	19.5	15.6
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Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
T Coll out (CL 1) in °C												
45.8	33.1	40.4	41.0	45.9	50.2	54.1	54.6	52.8	51.3	43.7	36.2	30.6
Volume flow (CL 1) in m ³												
502.1	24.7	26.7	46.0	52.8	51.3	51.4	51.0	56.7	47.9	42.0	31.1	20.4
Control factor (CL 1) in %												
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Collector array

spec. DNI (CL 1) in kWh/m ²												
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
G opt. loss deduct. (CL 1) in kWh/m ²												
748.9	27.9	36.7	61.2	82.6	91.0	90.3	91.3	86.6	71.4	54.1	34.2	21.7
Specific global radiation onto inclined surface area (CL 1) in kWh/m ²												
1,118.1	41.4	54.2	90.1	121.3	135.5	135.3	136.6	129.3	106.0	86.0	50.3	32.2
Spec. global radiation onto inclined, shaded surface (CL 1) in kWh/m ²												
1,092.0	39.0	51.9	88.2	120.6	134.6	134.3	135.5	128.2	103.4	77.7	48.1	30.4
Irradiation on gross surface area -unshaded- (CL 1) in kWh												
8,945	331	434	720	971	1,084	1,083	1,093	1,034	848	688	402	258
Irradiation on gross surface area (CL 1) in kWh												
8,736	312	415	706	965	1,077	1,074	1,084	1,026	827	622	385	244
Irradiation on active solar surface area -unshaded- (CL 1) in kWh												
8,945	331	434	720	971	1,084	1,083	1,093	1,034	848	688	402	258
Irradiation on active surface area (CL 1) in kWh												
8,736	312	415	706	965	1,077	1,074	1,084	1,026	827	622	385	244
Optical losses (CL 1) in kWh												
2,745	89	121	216	304	349	352	354	333	256	189	111	70
Losses - external piping (CL 1) in kWh												
63	2	3	5	7	8	8	8	7	6	4	3	2
Losses - internal piping (CL 1) in kWh												
248	4	8	15	25	33	36	39	36	27	16	7	3

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Thermal collector losses (CL 1) in kWh												
3,455	111	167	274	388	449	435	442	403	323	229	143	90
Collector outlet temperature (CL 1) in °C												
23.1	10.9	13.4	18.5	25.1	30.3	33.5	35.0	33.8	28.6	21.6	15.0	10.2
Collector temperature (CL 1) in °C												
22.7	10.7	13.2	18.2	24.7	29.8	33.0	34.5	33.3	28.2	21.3	14.7	10.1
Max collector temperature (CL 1) in °C												
36.7	20.4	24.3	32.8	41.6	46.2	49.3	50.3	48.9	44.2	35.0	27.2	19.3
Pump energy (CL 1) in kWh												
126	6	7	11	13	13	13	13	14	12	11	8	5

Dual coil indirect hot water tank

Tank losses in kWh												
635	27	30	46	60	74	75	81	76	63	48	32	25
Change in internal energy in kWh												
-1	-1	1	0	3	0	-3	6	-1	2	-7	1	-2
Average temperature in °C												
43.2	31.5	34.0	39.5	46.6	51.9	53.5	55.0	53.0	47.9	40.6	34.1	30.4
Sensor: collector loop reference temperature in °C												
31.8	16.0	18.3	24.0	34.8	44.4	47.1	50.1	46.6	39.1	25.8	19.5	15.6
Sensor: collector loop switch-off temperature in °C												
56.9	51.8	52.7	53.3	57.9	62.5	62.8	63.6	61.8	57.6	54.0	52.6	51.8
Auxiliary heating sensor on in °C												
56.6	51.3	52.2	53.1	57.5	62.1	62.7	63.3	61.5	57.5	53.7	52.1	51.2
Sensor: auxiliary heating off in °C												
56.6	51.3	52.2	53.1	57.5	62.1	62.7	63.3	61.5	57.5	53.7	52.1	51.2
E-Electric heater rod in kWh												
0	0	0	0	0	0	0	0	0	0	0	0	0
Consumption Natural gas (H) in m ³												
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Desired temperature auxiliary heating in °C												
50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
solar tank losses in kWh												
218	7	8	13	21	29	29	32	28	22	14	9	6

Gas-fired boiler

Energy from boiler in kWh												
975	172	145	81	41	33	17	15	18	35	72	149	196
Primary energy equivalent in kWh												
1,224	203	170	95	51	43	31	28	33	60	98	181	230
Consumption Natural gas (H) in m ³												
117.5	19.4	16.3	9.1	4.9	4.1	3.0	2.7	3.2	5.8	9.4	17.3	22.1
Return temperature in °C												
55.4	55.1	54.5	56.3	56.8	56.9	56.8	56.5	57.6	56.6	55.9	54.8	54.7
Supply temperature in °C												
63.0	63.0	63.0	63.0	63.0	63.0	63.0	63.0	63.0	63.0	63.0	63.0	63.0