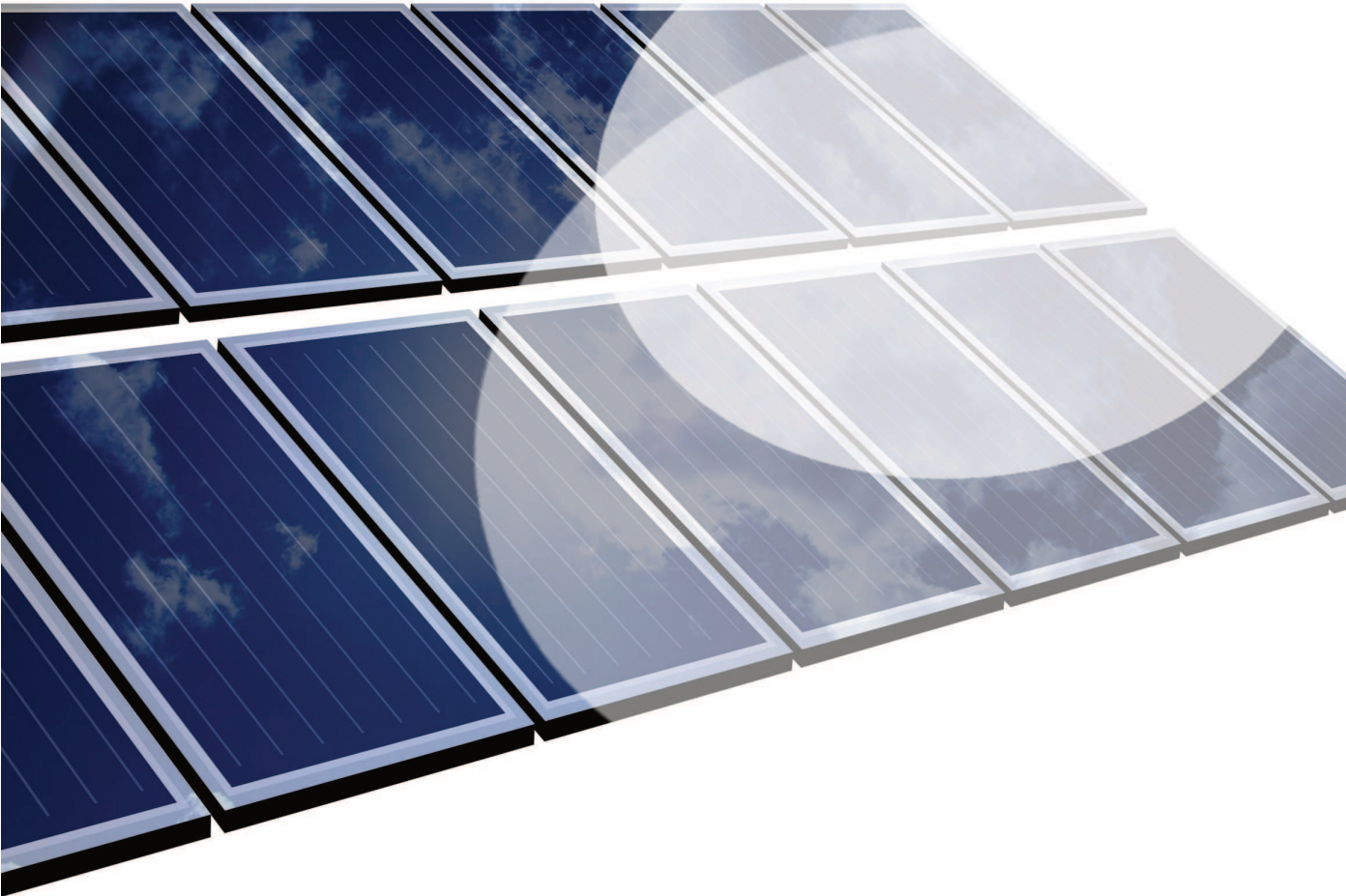
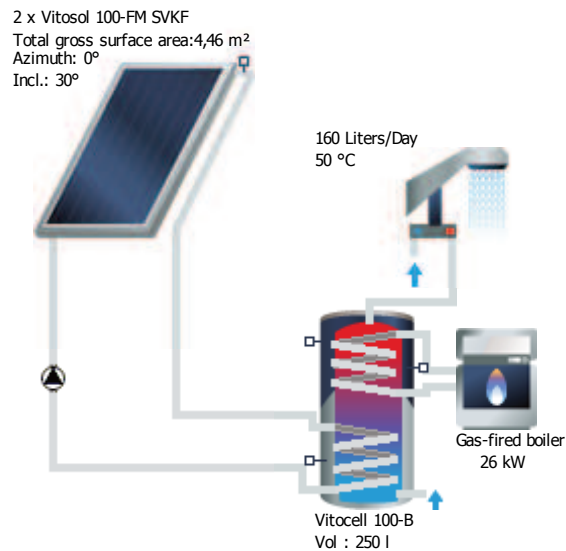


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**VIESSMANN**



## Variant 1



## Results of annual simulation

Installed collector power:		3,12 kW
Installed solar surface area (gross):		4,46 m <sup>2</sup>
Irradiation on collector surface (active):	4.636,04 kWh	1.153,24 kWh/m <sup>2</sup>
Energy delivered by collectors:	1.840,47 kWh	457,83 kWh/m <sup>2</sup>
Energy delivered by collector loop:	1.588,90 kWh	395,25 kWh/m <sup>2</sup>
DHW heating energy supply:		2.632,04 kWh
Solar energy contribution to DHW:		1.454,06 kWh
Energy from auxiliary heating:		1.452,4 kWh
<b>Natural gas (H) savings:</b>		<b>211,1 m<sup>3</sup></b>
<b>CO<sub>2</sub> emissions avoided:</b>		<b>446,33 kg</b>
<b>DHW solar fraction:</b>		<b>50,0 %</b>
<b>Relative savings of supplementary energy (DIN EN 12977):</b>		<b>53,0 %</b>
<b>System efficiency:</b>		<b>31,4 %</b>

Variant 1

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## Site Data

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### Climate data

Location:	BRUSSELS NATIONAL
Climate data record:	BRUSSELS NATIONAL
Total annual global irradiation:	1014,311 kWh/m <sup>2</sup>
Latitude:	50,9 °
Longitude:	-4,53 °

### Domestic hot water

Average daily consumption:	0,16 m <sup>3</sup>
Desired temperature:	50 °C
Consumption profile:	Detached house (evening max)
Cold water temperature:	February: 9 °C August: 13 °C
Circulation:	no

Variant 1

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## System

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### Collector loop

Manufacturer:	Viessmann Werke GmbH & Co
Type:	Vitosol 100-FM SVKF
Number:	2,00
Total gross surface area:	4,46 m <sup>2</sup>
Total active solar surface area:	4,02 m <sup>2</sup>
Inclination (Tilt Angle):	30 °
Orientation:	180 °
Azimuth:	0 °

### Dual coil indirect hot water tank

Manufacturer:	Viessmann(141 FM)
Type:	Vitocell 100-B
Volume:	0,25 m <sup>3</sup>

### Auxiliary heating

Manufacturer:	Standard
Type:	Gas-fired boiler
Nominal output:	26 kW

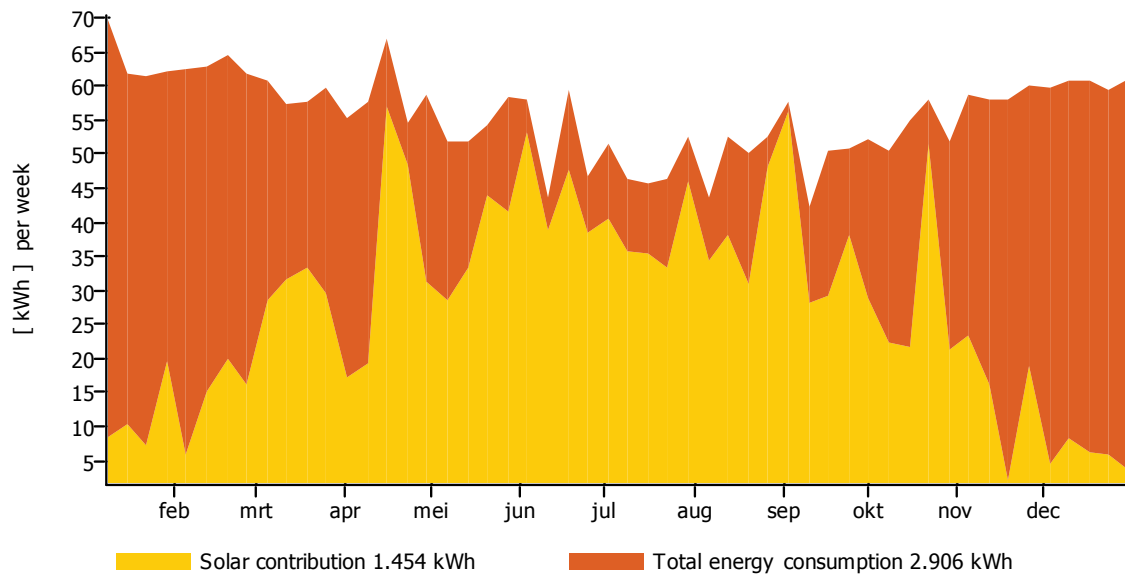
### Legend

With test report  
Solar Keymark

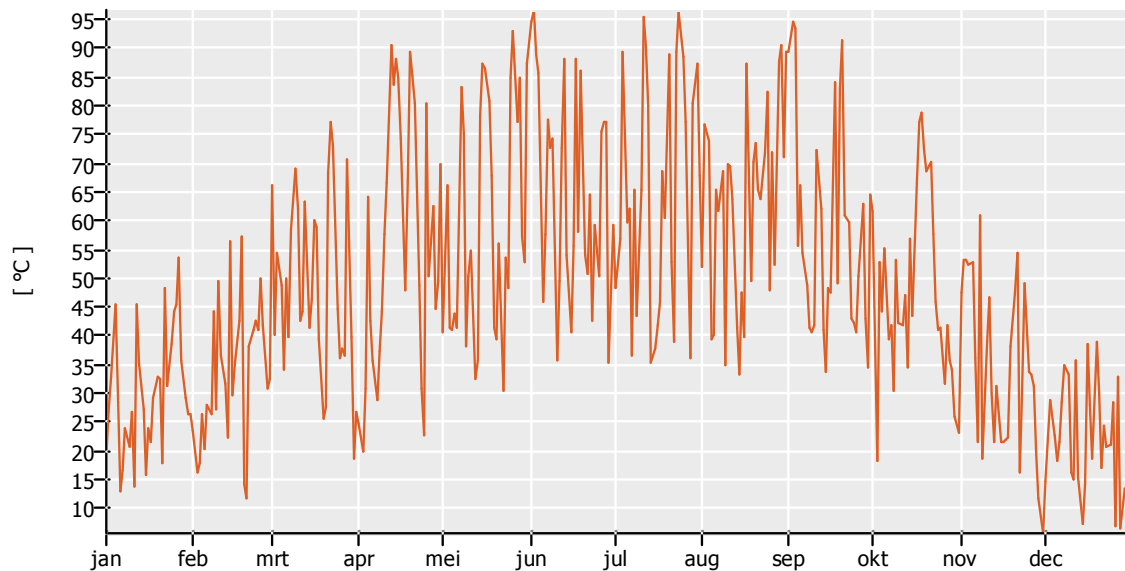


Variant 1

### Solar energy consumption as percentage of total consumption

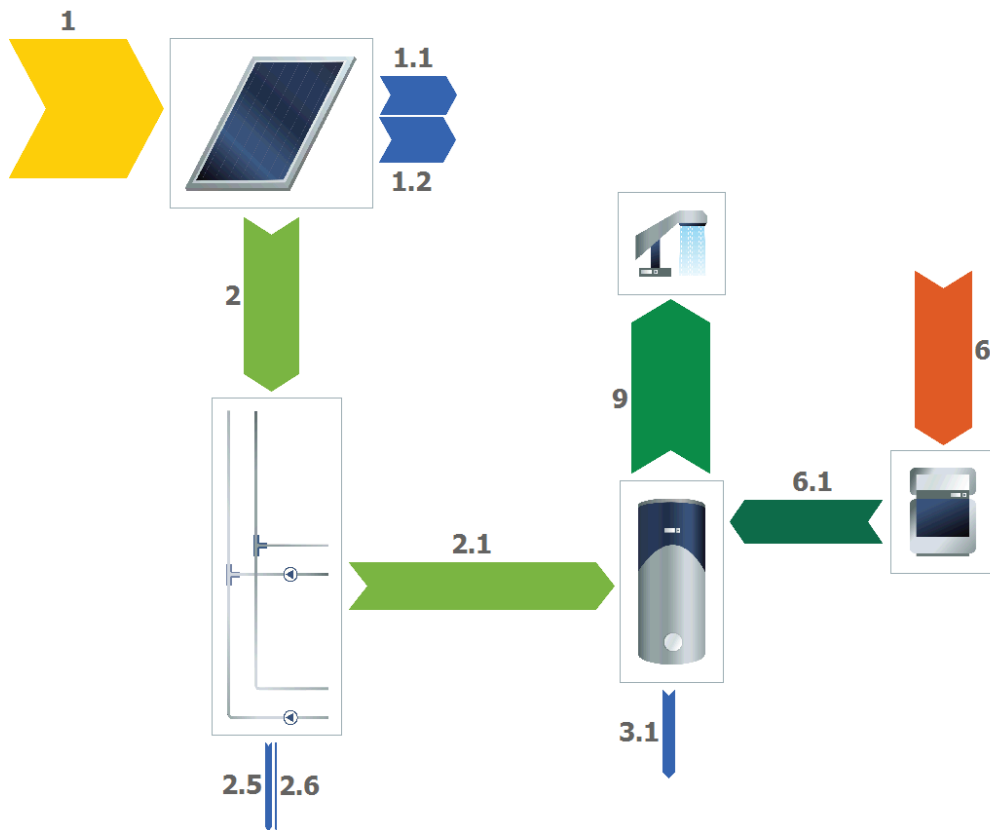


### Daily maximum collector temperature



These calculations were carried out by T\*SOL 2016 (R4) - 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.

## Energy balance schematic



### Legend

1	Irradiation on collector surface (active)	4.636 kWh
1.1	Optical collector losses	1.289 kWh
1.2	Thermal collector losses	1.507 kWh
2	Energy from collector array	1.840 kWh
2.1	Solar energy to storage tank	1.589 kWh
2.5	Internal piping losses	210 kWh
2.6	External piping losses	41 kWh
3.1	Tank losses	409 kWh
6	Final energy	1.862 kWh
6.1	Supplementary energy to tank	1.452 kWh
9	DHW energy from tank	2.632 kWh

Variant 1

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**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

Variant 1

## Results of annual simulation

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
<b>DHW system</b>												
<b>Savings Natural gas (H) in m<sup>3</sup></b>												
<b>211,1</b>	5,6	7,6	14,1	20,2	26,1	29,9	29,1	31,8	21,8	15,7	6,4	2,8
<b>CO2 emissions avoided in kg</b>												
<b>446,3</b>	11,8	16,2	29,9	42,7	55,1	63,2	61,4	67,3	46,2	33,2	13,5	5,9
<b>DHW solar fraction in %</b>												
<b>50,0</b>	18,2	26,8	49,1	65,2	72,5	83,6	80,1	79,2	66,2	49,5	22,2	9,2
<b>System efficiency in %</b>												
<b>31,4</b>	31,5	32,4	32,7	32,1	30,1	30,3	28,4	32,6	32,1	35,6	32,5	25,5
<b>Solar energy contribution to DHW in kWh</b>												
<b>1.454</b>	50	68	125	165	176	182	167	182	140	119	57	25
<b>E - Solar loop to tank in kWh</b>												
<b>1.589</b>	54	72	134	178	192	200	188	199	154	128	61	28
<b>Energy: Aux. heating in kWh</b>												
<b>1.452</b>	222	185	130	88	67	36	42	48	71	121	199	245
<b>Climate</b>												
<b>Outside temperature in °C</b>												
<b>11,0</b>	4,0	4,7	7,0	10,2	14,1	16,7	18,4	18,2	15,2	11,7	7,8	4,0
<b>Global radiation - horizontal in kWh/m<sup>2</sup></b>												
<b>1.014</b>	24	37	74	114	144	153	148	129	91	58	26	16
<b>Position of sun - altitude in °</b>												
<b>12,7</b>	4,0	6,6	11,0	16,4	21,1	23,3	22,3	18,3	12,9	8,0	4,6	3,3
<b>Position of sun - azimuth in °</b>												
<b>-5,6</b>	-6,7	-7,2	-6,8	-5,6	-5,2	-5,7	-6,3	-6,2	-5,1	-3,8	-3,7	-5,1
<b>Wind speed in m/s</b>												
<b>3,9</b>	5,0	4,6	4,3	3,5	3,6	3,2	3,4	3,1	3,2	3,8	4,4	4,3



Variant 1

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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## Hot water consumption

### DHW heating energy supply in kWh

<b>2.632</b>	259	237	238	226	202	193	174	193	190	220	243	258
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### DHW heating energy requirement in kWh

<b>2.632</b>	259	237	238	226	202	193	174	193	190	220	243	258
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### Circulation losses in kWh

<b>0</b>	0	0	0	0	0	0	0	0	0	0	0	0
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### Cold water temperature in °C

<b>11,0</b>	9,2	9,0	9,3	10,1	11,1	12,1	12,8	13,0	12,7	11,9	10,9	9,9
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### DHW temperature in °C

<b>49,9</b>	49,9	49,9	49,7	49,9	49,9	50,0	49,9	49,8	49,9	49,8	49,9	49,9
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### Preset DHW consumption in m<sup>3</sup>

<b>58,0</b>	5,5	5,0	5,0	4,9	4,5	4,4	4,0	4,5	4,4	5,0	5,4	5,5
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### DHW - consumption in m<sup>3</sup>

<b>53,4</b>	5,3	4,8	4,8	4,4	3,9	3,8	3,4	4,0	3,9	4,7	5,1	5,3
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## Solar loop

### Max collector temperature in °C

<b>33,2</b>	18,2	21,6	30,3	38,5	42,7	45,5	46,8	45,1	40,2	32,1	22,0	14,4
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## Collector loop

### Energy from collector loop (CL 1) in kWh

<b>1.589</b>	54	72	134	178	192	200	188	199	154	128	61	28
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### Collector loop efficiency (CL 1) in %

<b>34,3</b>	34,0	34,6	35,2	34,7	32,9	33,3	31,9	35,6	35,4	38,4	35,3	28,4
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### Collector loop reference temperature (CL 1) in °C

<b>23,2</b>	13,0	14,0	18,0	24,3	30,2	33,9	37,7	30,7	27,7	19,7	15,3	12,7
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### T Coll out (CL 1) in °C

<b>43,0</b>	28,3	31,5	36,1	45,0	48,6	49,7	49,9	47,6	44,1	35,7	33,8	24,7
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Variant 1

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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**Volume flow (CL 1) in m<sup>3</sup>**

<b>363,9</b>	14,9	18,1	31,1	37,9	42,6	44,8	43,7	42,0	35,2	30,3	13,9	9,4
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**Control factor (CL 1) in %**

<b>0,0</b>	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
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**Collector array****spec. DNI (CL 1) in kWh/m<sup>2</sup>**

<b>0,0</b>	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
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**G opt. loss deduct. (CL 1) in kWh/m<sup>2</sup>**

<b>832,7</b>	28,2	37,4	68,9	92,9	105,1	107,8	105,2	100,7	78,2	59,9	31,3	17,2
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**Specific global radiation onto inclined surface area (CL 1) in kWh/m<sup>2</sup>**

<b>1.153,2</b>	39,1	52,0	95,0	127,7	145,4	149,7	146,5	139,1	108,2	83,0	43,3	24,1
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**Spec. global radiation onto inclined, shaded surface (CL 1) in kWh/m<sup>2</sup>**

<b>1.153,2</b>	39,1	52,0	95,0	127,7	145,4	149,7	146,5	139,1	108,2	83,0	43,3	24,1
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**Irradiation on gross surface area -unshaded- (CL 1) in kWh**

<b>5.143</b>	175	232	424	570	649	668	653	620	483	370	193	107
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**Irradiation on gross surface area (CL 1) in kWh**

<b>5.143</b>	175	232	424	570	649	668	653	620	483	370	193	107
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**Irradiation on active solar surface area -unshaded- (CL 1) in kWh**

<b>4.636</b>	157	209	382	513	585	602	589	559	435	334	174	97
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**Irradiation on active surface area (CL 1) in kWh**

<b>4.636</b>	157	209	382	513	585	602	589	559	435	334	174	97
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**Optical losses (CL 1) in kWh**

<b>1.289</b>	44	59	105	140	162	168	166	154	121	93	48	28
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**Losses - external piping (CL 1) in kWh**

<b>41</b>	2	2	4	5	5	5	5	5	4	3	2	1
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**Losses - internal piping (CL 1) in kWh**

<b>210</b>	2	4	12	22	30	33	36	32	22	12	5	1
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**Thermal collector losses (CL 1) in kWh**

<b>1.507</b>	56	72	127	169	195	195	194	170	135	98	58	39
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## Variant 1

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
<b>Collector outlet temperature (CL 1) in °C</b>												
<b>21,3</b>	8,6	11,2	17,1	24,0	29,5	32,6	33,7	31,9	26,4	19,7	12,7	7,3
<b>Collector temperature (CL 1) in °C</b>												
<b>20,7</b>	8,4	10,9	16,6	23,2	28,7	31,8	32,9	31,1	25,8	19,2	12,4	7,2
<b>Max collector temperature (CL 1) in °C</b>												
<b>31,1</b>	16,9	20,0	27,6	35,7	40,5	43,2	44,3	42,5	37,5	29,9	20,7	13,9
<b>Pump energy (CL 1) in kWh</b>												
<b>91</b>	4	5	8	9	11	11	11	11	9	8	3	2
<b>Dual coil indirect hot water tank</b>												
<b>Tank losses in kWh</b>												
<b>409</b>	17	17	29	40	47	50	55	48	42	31	19	14
<b>Change in internal energy in kWh</b>												
<b>0</b>	0	3	-3	1	9	-7	1	6	-7	-2	-2	0
<b>Average temperature in °C</b>												
<b>36,8</b>	28,2	29,0	34,1	39,9	42,9	45,0	46,7	43,1	41,0	34,7	29,3	27,1
<b>Sensor: collector loop reference temperature in °C</b>												
<b>23,1</b>	13,0	14,0	18,0	24,3	30,1	33,8	37,7	30,7	27,7	19,7	15,3	12,7
<b>Sensor: collector loop switch-off temperature in °C</b>												
<b>53,8</b>	51,9	51,8	51,8	55,1	56,2	56,6	57,5	54,6	54,8	51,8	51,8	51,8
<b>Auxiliary heating sensor on in °C</b>												
<b>53,3</b>	51,0	51,0	51,4	54,8	56,0	56,3	57,3	54,5	54,3	51,4	51,0	50,8
<b>Sensor: auxiliary heating off in °C</b>												
<b>53,3</b>	51,0	51,0	51,4	54,8	56,0	56,3	57,3	54,5	54,3	51,4	51,0	50,8
<b>E-Electric heater rod in kWh</b>												
<b>0</b>	0	0	0	0	0	0	0	0	0	0	0	0
<b>Consumption Natural gas (H) in m<sup>3</sup></b>												
<b>0,0</b>	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
<b>Desired temperature auxiliary heating in °C</b>												
<b>50,0</b>	50,0	50,0	50,0	50,0	50,0	50,0	50,0	50,0	50,0	50,0	50,0	50,0

## Variant 1

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
<b>solar tank losses in kWh</b>												
<b>135</b>	4	4	9	13	16	18	21	17	15	10	5	3
<b>Gas-fired boiler</b>												
<b>Energy from boiler in kWh</b>												
<b>1.452</b>	222	185	130	88	67	36	42	48	71	121	199	245
<b>Primary energy equivalent in kWh</b>												
<b>1.862</b>	262	218	152	112	96	61	75	87	118	160	233	288
<b>Consumption Natural gas (H) in m<sup>3</sup></b>												
<b>178,7</b>	25,1	20,9	14,6	10,8	9,2	5,8	7,2	8,3	11,4	15,4	22,4	27,6
<b>Return temperature in °C</b>												
<b>56,2</b>	55,6	55,9	56,5	56,7	57,2	57,8	57,3	57,6	57,2	56,7	55,8	55,3
<b>Supply temperature in °C</b>												
<b>63,0</b>	63,0	63,0	63,0	63,0	63,0	63,0	63,0	63,0	63,0	63,0	63,0	63,0