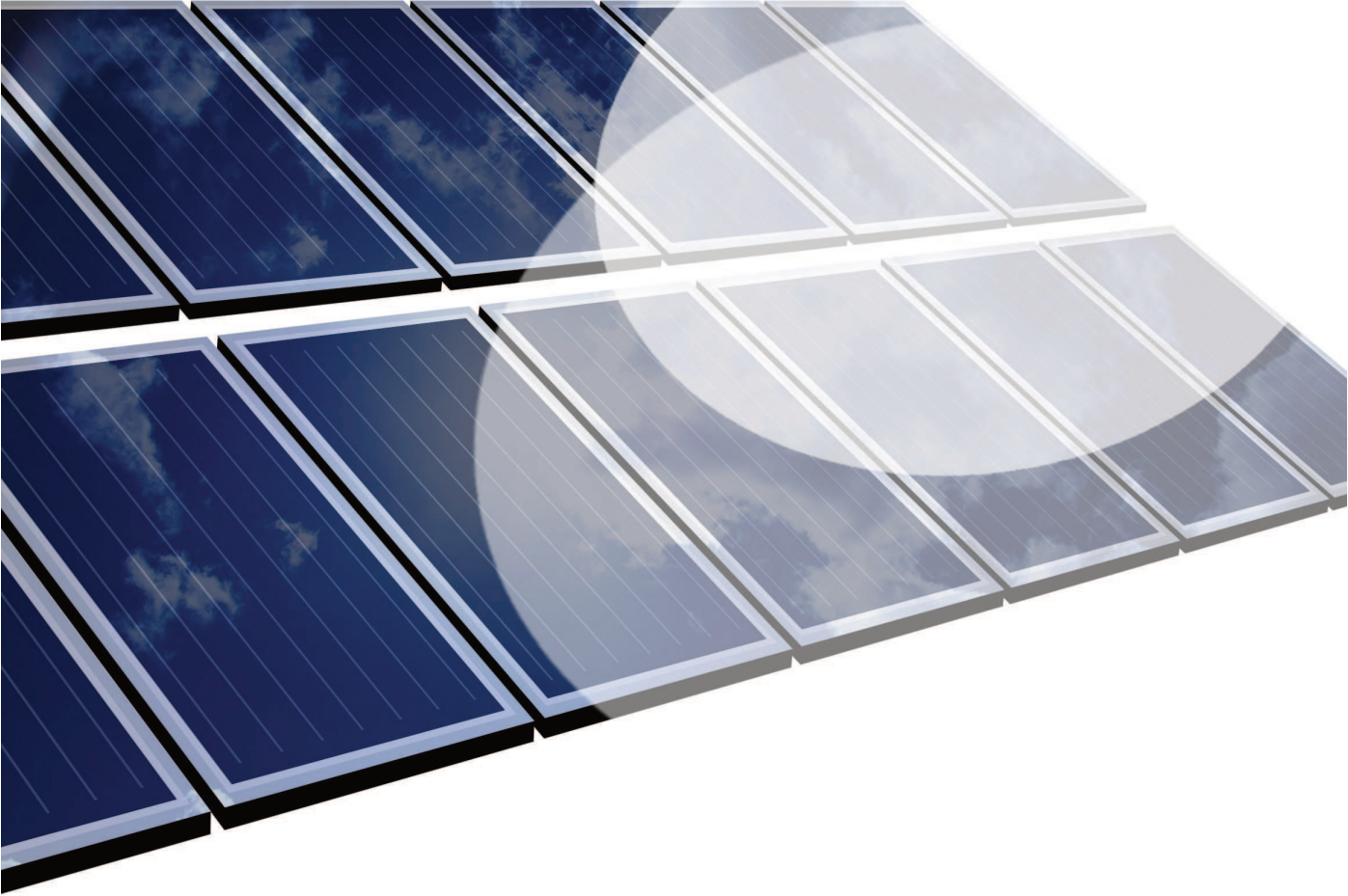
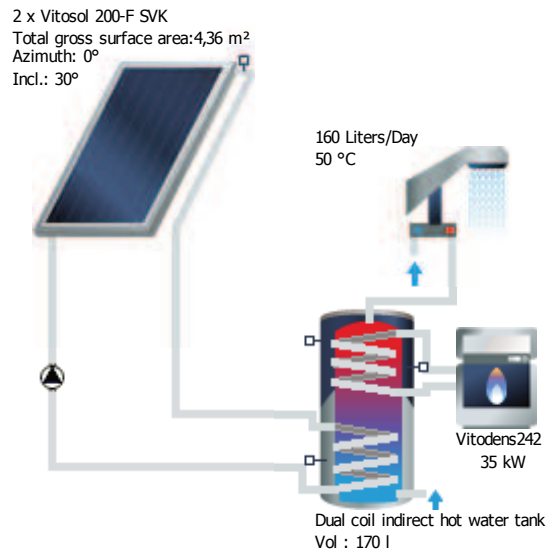


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**VIESSMANN**



## Variant 1



## Results of annual simulation

Installed collector power:		3,05 kW
Installed solar surface area (gross):		4,36 m <sup>2</sup>
Irradiation on collector surface (active):	4.895,41 kWh	1.217,76 kWh/m <sup>2</sup>
Energy delivered by collectors:	1.814,57 kWh	451,39 kWh/m <sup>2</sup>
Energy delivered by collector loop:	1.533,18 kWh	381,39 kWh/m <sup>2</sup>
DHW heating energy supply:		2.734,87 kWh
Solar energy contribution to DHW:		1.418,65 kWh
Energy from auxiliary heating:		1.525,9 kWh
<b>Natural gas (H) savings:</b>		<b>204,7 m<sup>3</sup></b>
<b>CO2 emissions avoided:</b>		<b>432,76 kg</b>
<b>DHW solar fraction:</b>		<b>48,2 %</b>
<b>Relative savings of supplementary energy (DIN EN 12977):</b>		<b>52,2 %</b>
<b>System efficiency:</b>		<b>29,0 %</b>

Variant 1

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## Site Data

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### Climate data

Location:	Würzburg
Climate data record:	"Würzburg"
Total annual global irradiation:	1091,309 kWh/m <sup>2</sup>
Latitude:	49,77 °
Longitude:	-9,97 °

### 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: 7 °C August: 12 °C
Circulation:	no

Variant 1

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## System

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### Collector loop

Manufacturer:	Viessmann Werke GmbH & Co
Type:	Vitosol 200-F SVK
Number:	2,00
Total gross surface area:	4,36 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:	interne boiler
Type:	Dual coil indirect hot water tank
Volume:	0,17 m <sup>3</sup>

### Auxiliary heating

Manufacturer:	Viessmann
Type:	Vitodens242
Nominal output:	35 kW

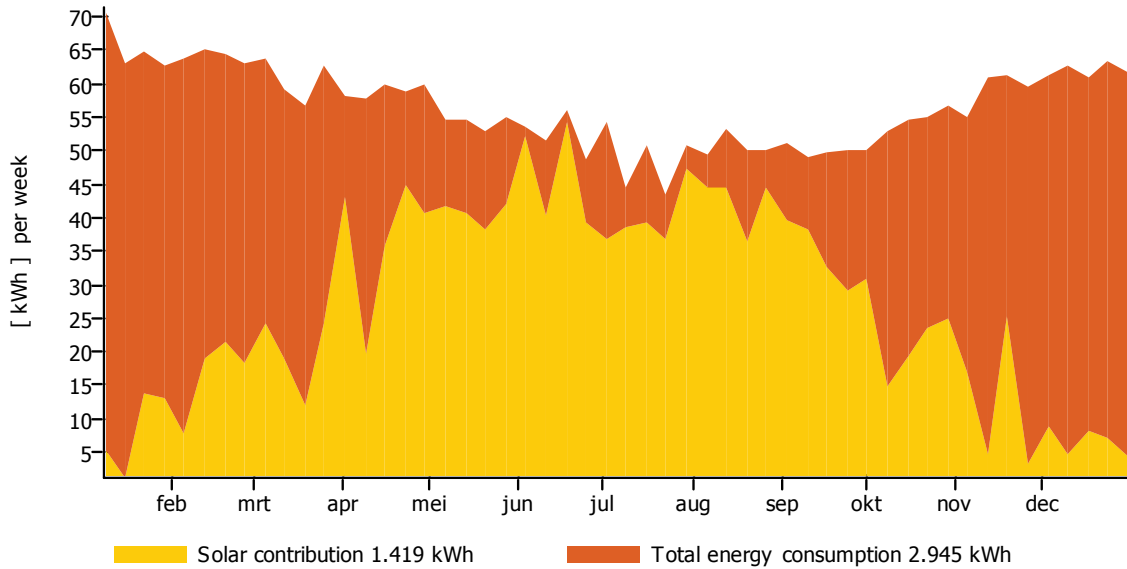
### Legend

With test report  
Solar Keymark

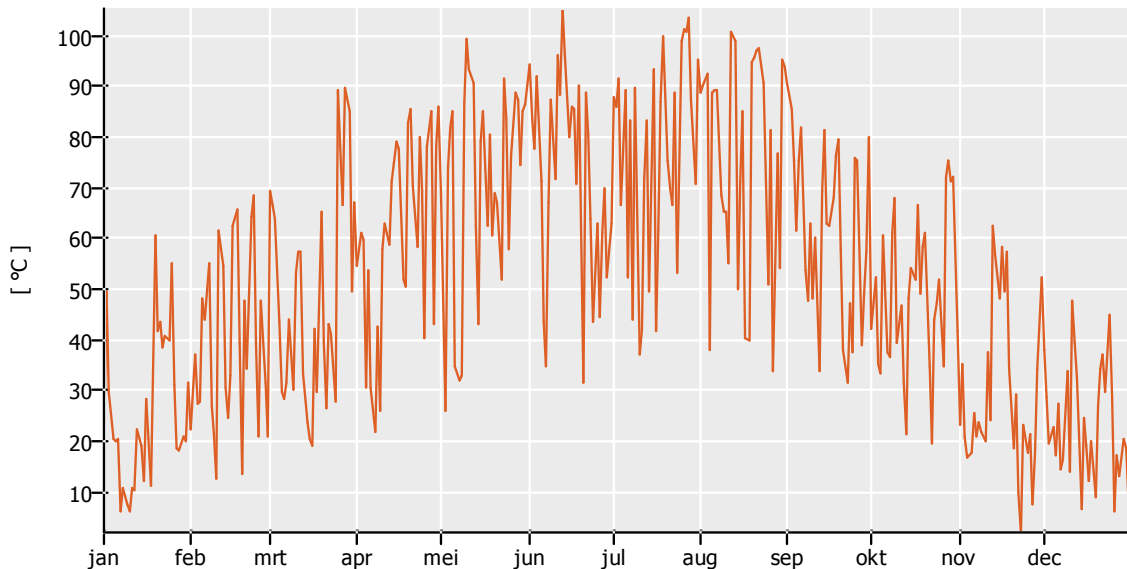


Variant 1

### Solar energy consumption as percentage of total consumption

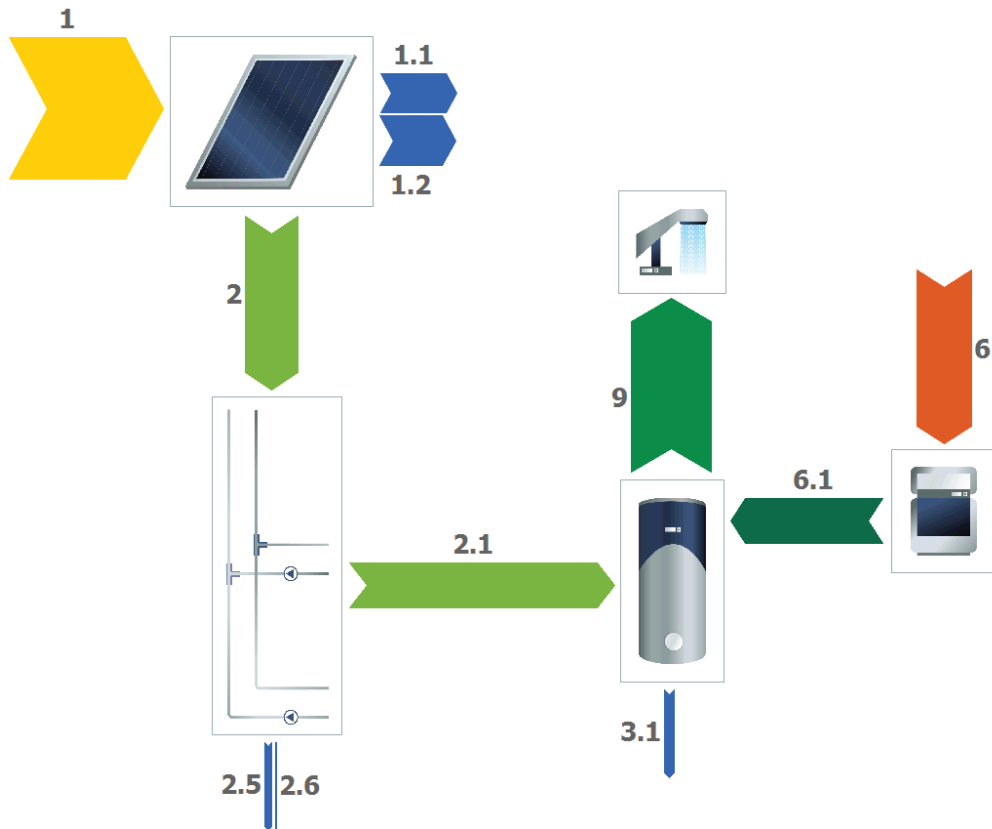


### Daily maximum collector temperature



These calculations were carried out by T\*SOL 2016 (R3) - 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)	4.895 kWh
1.1	Optical collector losses	1.352 kWh
1.2	Thermal collector losses	1.729 kWh
2	Energy from collector array	1.815 kWh
2.1	Solar energy to storage tank	1.533 kWh
2.5	Internal piping losses	234 kWh
2.6	External piping losses	47 kWh
3.1	Tank losses	325 kWh
6	Final energy	1.898 kWh
6.1	Supplementary energy to tank	1.526 kWh
9	DHW energy from tank	2.735 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

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>204,7</b>	4,2	8,2	12,8	19,1	27,8	30,7	31,3	31,8	19,7	11,3	4,9	2,9
<b>CO2 emissions avoided in kg</b>												
<b>432,8</b>	8,9	17,4	27,0	40,4	58,7	64,9	66,2	67,3	41,6	23,9	10,3	6,1
<b>DHW solar fraction in %</b>												
<b>48,2</b>	13,5	28,2	42,9	61,3	77,9	82,3	86,8	80,6	65,6	39,9	16,3	9,3
<b>System efficiency in %</b>												
<b>29,0</b>	25,8	29,3	29,7	30,1	29,1	29,1	27,5	29,0	30,9	30,6	27,1	23,1
<b>Solar energy contribution to DHW in kWh</b>												
<b>1.419</b>	37	73	113	156	186	185	183	182	138	96	43	26
<b>E - Solar loop to tank in kWh</b>												
<b>1.533</b>	39	76	120	166	201	201	204	202	149	103	45	27
<b>Energy: Aux. heating in kWh</b>												
<b>1.526</b>	240	186	150	99	53	40	28	44	73	145	219	250
<b>Climate</b>												
<b>Outside temperature in °C</b>												
<b>9,5</b>	0,4	1,0	5,3	9,1	14,0	16,6	18,9	18,6	14,4	9,5	4,1	1,6
<b>Global radiation - horizontal in kWh/m<sup>2</sup></b>												
<b>1.091</b>	24	43	78	119	158	161	167	145	96	57	26	18
<b>Position of sun - altitude in °</b>												
<b>13,0</b>	4,3	7,0	11,3	16,7	21,3	23,5	22,4	18,5	13,2	8,3	4,9	3,6
<b>Position of sun - azimuth in °</b>												
<b>-2,9</b>	-4,0	-4,8	-3,9	-2,9	-2,7	-2,9	-3,4	-3,4	-2,3	-1,2	-1,1	-2,4
<b>Wind speed in m/s</b>												
<b>4,0</b>	5,1	3,1	4,6	4,6	3,6	3,6	3,6	3,1	3,6	4,1	4,6	5,1



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>2.735</b>	271	248	249	235	210	199	179	198	195	227	253	269
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### DHW heating energy requirement in kWh

<b>2.735</b>	271	248	249	235	210	199	179	198	195	227	253	269
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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>9,5</b>	7,3	7,0	7,4	8,3	9,6	10,8	11,7	12,0	11,6	10,6	9,4	8,1
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### DHW temperature in °C

<b>49,8</b>	49,7	49,8	49,8	49,8	49,9	49,8	49,9	49,8	49,8	49,8	49,7	49,8
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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>53,1</b>	5,3	4,8	4,8	4,5	3,8	3,7	3,2	3,6	4,1	4,8	5,2	5,4
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## Solar loop

### Max collector temperature in °C

<b>35,5</b>	15,2	24,3	30,9	40,2	49,0	50,8	53,6	52,7	41,8	32,9	19,8	14,1
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## Collector loop

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

<b>1.533</b>	39	76	120	166	201	201	204	202	149	103	45	27
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### Collector loop efficiency (CL 1) in %

<b>31,3</b>	27,0	30,6	31,4	32,0	31,4	31,7	30,6	32,1	33,3	32,6	28,8	24,5
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### Collector loop reference temperature (CL 1) in °C

<b>21,5</b>	11,1	13,3	16,9	21,9	28,9	31,1	34,9	32,5	23,9	18,2	13,4	11,3
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### T Coll out (CL 1) in °C

<b>44,1</b>	27,9	32,0	36,8	42,2	50,0	51,3	54,2	52,1	41,4	36,0	30,1	26,9
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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>391,8</b>	13,1	21,2	32,8	40,5	47,2	47,8	48,6	45,7	40,1	29,1	15,4	10,5
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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>881,4</b>	25,9	44,9	68,3	93,1	115,7	114,1	120,4	114,2	80,3	56,7	28,3	19,6
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**Specific global radiation onto inclined surface area (CL 1) in kWh/m<sup>2</sup>**

<b>1.217,8</b>	36,0	61,8	94,8	128,8	159,4	157,8	166,1	156,4	111,5	78,4	39,3	27,4
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**Spec. global radiation onto inclined, shaded surface (CL 1) in kWh/m<sup>2</sup>**

<b>1.217,8</b>	36,0	61,8	94,8	128,8	159,4	157,8	166,1	156,4	111,5	78,4	39,3	27,4
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**Irradiation on gross surface area -unshaded- (CL 1) in kWh**

<b>5.309</b>	157	270	414	562	695	688	724	682	486	342	171	120
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**Irradiation on gross surface area (CL 1) in kWh**

<b>5.309</b>	157	270	414	562	695	688	724	682	486	342	171	120
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**Irradiation on active solar surface area -unshaded- (CL 1) in kWh**

<b>4.895</b>	145	249	381	518	641	634	668	629	448	315	158	110
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**Irradiation on active surface area (CL 1) in kWh**

<b>4.895</b>	145	249	381	518	641	634	668	629	448	315	158	110
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**Optical losses (CL 1) in kWh**

<b>1.352</b>	41	68	107	144	176	175	184	170	126	87	44	32
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**Losses - external piping (CL 1) in kWh**

<b>47</b>	2	3	4	5	6	6	6	6	4	3	2	1
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**Losses - internal piping (CL 1) in kWh**

<b>234</b>	2	6	13	23	34	37	43	39	22	12	3	1
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**Thermal collector losses (CL 1) in kWh**

<b>1.729</b>	62	96	139	181	223	215	231	212	147	110	63	49
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Variant 1

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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**Collector outlet temperature (CL 1) in °C**

<b>21,0</b>	5,3	9,4	16,2	23,7	31,3	33,9	36,7	35,0	26,5	18,3	9,4	5,6
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**Collector temperature (CL 1) in °C**

<b>20,6</b>	5,2	9,1	15,8	23,1	30,6	33,2	36,0	34,3	25,9	18,0	9,2	5,5
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**Max collector temperature (CL 1) in °C**

<b>33,4</b>	14,1	21,9	28,5	37,9	46,4	48,0	51,1	50,0	39,5	30,4	18,7	13,4
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**Pump energy (CL 1) in kWh**

<b>98</b>	3	5	8	10	12	12	12	11	10	7	4	3
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**Dual coil indirect hot water tank****Tank losses in kWh**

<b>325</b>	9	12	20	28	41	43	52	49	31	21	11	9
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**Change in internal energy in kWh**

<b>-1</b>	-1	1	0	1	3	-1	2	-1	-5	0	1	-1
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**Average temperature in °C**

<b>35,3</b>	25,2	27,7	31,4	36,0	42,6	44,2	48,2	46,5	37,3	31,7	26,5	25,2
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**Sensor: collector loop reference temperature in °C**

<b>21,5</b>	11,1	13,3	16,8	21,9	28,9	31,1	34,8	32,5	23,8	18,2	13,4	11,3
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**Sensor: collector loop switch-off temperature in °C**

<b>54,2</b>	51,5	51,5	52,4	53,1	56,8	57,4	60,2	60,0	52,5	51,6	51,4	51,5
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**Auxiliary heating sensor on in °C**

<b>53,7</b>	50,5	50,7	51,8	52,7	56,6	57,3	60,0	59,7	52,3	51,1	50,5	50,5
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**Sensor: auxiliary heating off in °C**

<b>53,7</b>	50,5	50,7	51,8	52,7	56,6	57,3	60,0	59,7	52,3	51,1	50,5	50,5
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**E-Electric heater rod in kWh**

<b>0</b>	0	0	0	0	0	0	0	0	0	0	0	0
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**Consumption Natural gas (H) in m³**

<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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**Desired temperature auxiliary heating in °C**

<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
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Variant 1

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
<b>solar tank losses in kWh</b>												
<b>115</b>	2	3	7	10	15	16	21	19	11	7	3	2
<b>Gas-fired boiler</b>												
<b>Energy from boiler in kWh</b>												
<b>1.526</b>	240	186	150	99	53	40	28	44	73	145	219	250
<b>Primary energy equivalent in kWh</b>												
<b>1.898</b>	283	219	177	119	75	62	47	80	107	173	263	294
<b>Consumption Natural gas (H) in m<sup>3</sup></b>												
<b>182,1</b>	27,1	21,0	17,0	11,4	7,2	6,0	4,5	7,7	10,3	16,6	25,2	28,2
<b>Return temperature in °C</b>												
<b>57,3</b>	56,9	57,2	57,5	57,6	58,2	58,1	58,5	57,8	58,3	57,7	57,1	56,9
<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