SOLAR
SYSTEMS

Centrometal
HEATING TECHNIQUE

SOLAR SYSTEMS – SAVINGS AND ECOLOGY

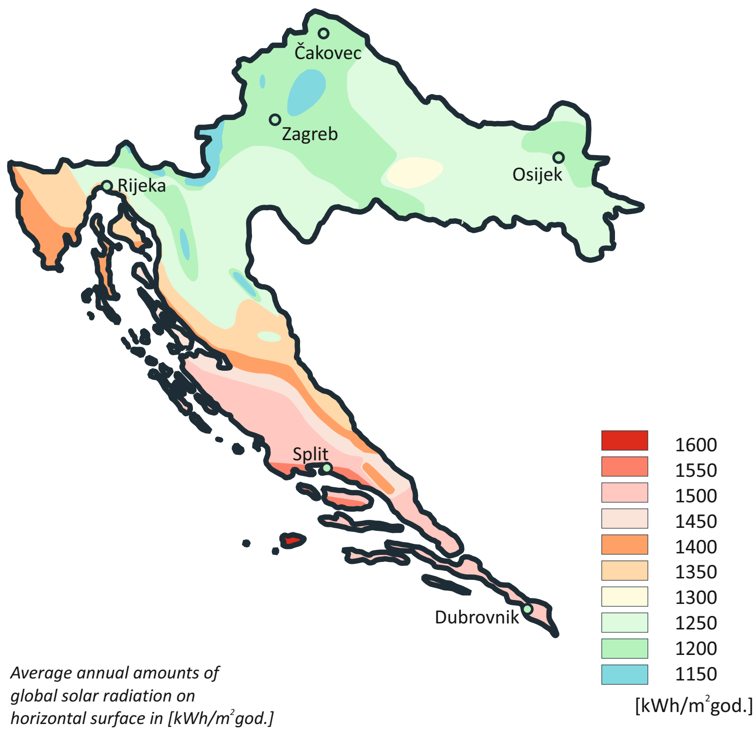
SOLAR ENERGY

Nowadays, a lot of energy is used for space heating and the preparation of domestic hot water. For this reason, intensive efforts are being made to obtain energy from alternative sources as **efficiently as possible.**

Using **solar energy** for domestic hot water (DHW) and space heating can reduce the consumption of conventional energy sources and decrease environmental pollution caused by harmful substances.

The intensity of solar radiation is variable and it depends on the season, meteorological conditions, and geographical location.

Therefore, when designing solar systems, it is necessary to know the amount of **incident solar energy.** The amount of solar energy reaching a horizontal surface over the course of a year varies across different parts of Croatia, ranging from 1.150 to 1.600 kWh/m² per year. In terms of energy, this is roughly equivalent to 115–160 liters of heating oil per year. Due to significant variations in solar irradiation across Croatia, the choice of collector type and quantity differs between the continental region and the coastal area.



Average annual amounts of global solar radiation on horizontal surface in [kWh/m²god.]

Solar energy is divided into two components: **direct radiation** and **diffuse radiation.** Direct radiation is the portion of radiation that reaches the Earth's surface directly from the Sun's apparent direction, whereas diffuse radiation results from the scattering of solar rays in the atmosphere by molecules and dust particles, reaching the Earth's surface from all directions of the sky. Global radiation is the sum of direct and diffuse radiation, and it is the value used to calculate the required collector surface area.

SOLAR SYSTEM COMPONENTS

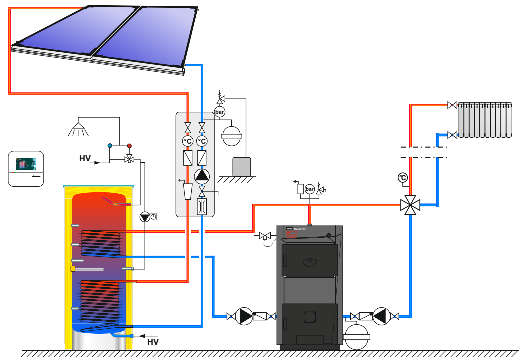
In our case, the solar system entails the **use of solar energy** for domestic hot water (DHW) heating and for supplementing the space heating system.

The solar system consists of several components: **solar collectors, solar and/or storage accumulation tank, controller, solar pump group, expansion vessel as well as fittings and insulated piping.**

In our region, solar energy alone is not sufficient to meet year-round DHW and space heating demands. Therefore, solar heating systems require an additional **conventional heat source**, such as an oil, gas, electric, or biomass boiler (wood, pellets, wood chips, etc.), or a heat pump. It is important to understand that solar systems collect and store solar energy only when sunlight is available. If cloudy weather persists for several days, the system may not be able to produce sufficient hot water. For this reason, the system must include a large thermal water heater capable of accumulating solar energy during sunny periods, allowing hot water to be used when solar radiation is unavailable, most commonly in the mornings and evenings. The components of the solar system must be carefully sized to ensure efficient domestic hot water production and effective support of the space heating system.

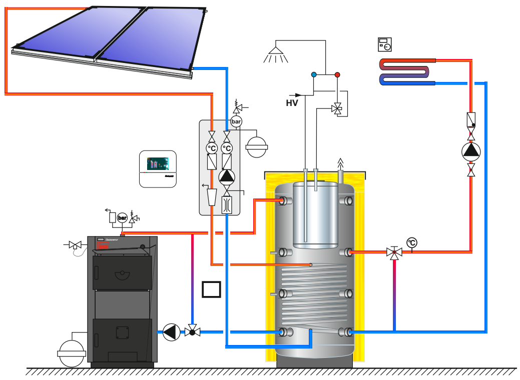
An optimally sized solar system can meet 45% to 75% of the annual demand for domestic hot water preparation and approximately 30% of the thermal energy required for space heating.

When **heating domestic hot water**, the central point of the solar system is a bivalent solar water heater (heater with 2 exchangers). Domestic water is heated by solar collectors, and when there is not enough energy from the collector (the Sun), it is reheated by a conventional source (e.g. boiler).



In the case of **solar reheating of the heating system and the heating of domestic hot water** the central point of the solar system is the accumulation tank with a solar heat exchanger and a hot water heater. Also, heating of larger amounts of DHW can be done with a bivalent water heater. Consumption water and water for heating is heated by solar collectors, and when there is not enough energy from the collector (the Sun), it is reheated by a conventional source (e.g. boiler).

Solar reheating of the heating system is recommended in low-temperature heating systems (floor, wall...) and in classic radiator systems (70°C/50°C) solar heating will not be so effective.



WATER HEATER SIZE

DOMESTIC HOT WATER HEATING (DHW)

We start the selection of **DHW heating** components by choosing a water heater. We choose the volume of the water heater according to the number of people who will use the DHW and their daily consumption (framework values for solar systems are given in the table). If there is no calculation for the volume of the boiler, the required volume can be roughly calculated as the product of the number of people and their individual daily consumption (usually 50 liters/person/day). The result of this multiplication, in the case of smaller systems, is increased by 50% in order to accumulate as much energy as possible when the Sun is available (in the case of larger solar systems, the accumulation does not need to be increased due to simultaneous consumption). If the volume value falls between two boilers, the larger boiler is always recommended.

	Daily consumption DHW per person
low request	**10-40** lit./person and day
medium request	**40-70** lit./person and day
high request	**70-100** lit./person and day

SPACE HEATING SUPPORT AND DHW HEATING

Selecting heating system components is somewhat more complex than selecting for DHW heating only, and an engineering calculation is always recommended. It also starts with selecting the size and type of the accumulation tank, after which a DHW heater is chosen, either submerged in the boiler water of the accumulation tank (for lower consumption, up to approx. 5 people) or a separate water heater, for more demanding or higher DHW consumption (the size of the DHW water heater is selected as in the text above). If we have a solid fuel boiler connected to the heating installation, the size of the accumulation tank is selected according to the requirements of the solid fuel boiler.

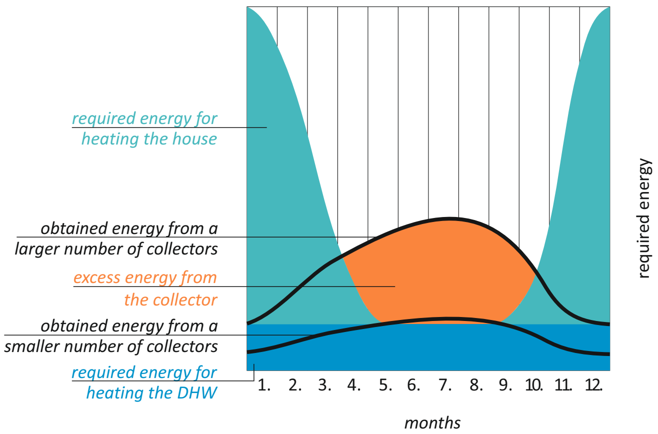
COLLECTOR NUMBER

The selection of the number of collectors depends on several parameters: the climate area (continental and coastal part), the angle of the collector towards the south and from the horizontal, the use of the collector (only for DHW or also for additional heating), the season of use of the collector, the volume of the water heater/accumulation tank, the desired temperature in the water heater/tank...

DHW HEATING

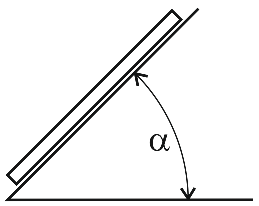
In principle, one collector is installed per 100 to 150 liters of **tank volume**, depending on the consumption and the place of installation... Along with the description of the collector, there are suggestions for the number of collectors and the size of the tank.

SPACE HEATING SUPPORT AND DHW HEATING

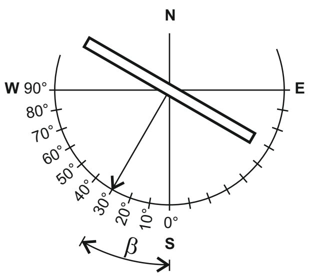


Choosing the **number of collectors** in heating systems is not as simple as in DHW heating, so it is recommended advice (calculation) from the engineer. The most common problem with the large number of collectors that we need for space heating in the winter is excess energy in the summer months. For this reason, the collectors that are used for space heating in winter are always mounted at a larger angle, which means that they receive more solar energy in winter, and in summer, when less energy is needed, they receive less solar energy due to the larger angle. The simplest way is to spend the summer surplus energy on heating the pool or absorption cooling of the space, while covering the excess collector in the summer should be avoided. For this reason, when collectors are used in heating systems, the calculation of the entire system and expert selection of equipment is definitely recommended.

COLLECTOR TILT ANGLE AND ORIENTATION



Angle of inclination of the collector α



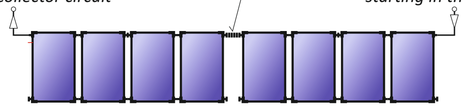
The collector is placed at an azimuth β of 30°

The angle of inclination and orientation of the collectors are important for the optimal operation of the solar system.
The angle of inclination of the collector α is the angle between the collector and the horizontal. The optimal tilt angle of the collector for Croatia is 30°-45°, for year-round operation. Collectors can be installed from min. 15° to max. 75°. A larger collector angle a is more suitable for the winter months (the Sun is low), while a smaller angle α is more suitable for the summer months (the Sun is high). Adjusting the collector tilt angle on a monthly basis, instead of maintaining a single tilt angle throughout the year, would increase solar irradiation by only 6%. Therefore, it can be concluded that a single year-round collector tilt angle is acceptable for our region.

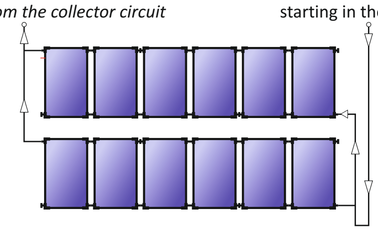
Azimuth β is the angle that describes the deviation of the collector plane from the south. The ideal position of the collector in relation to the side of the world is when the collector is facing south, i.e. when the azimuth is 0°. If the azimuth is different from zero, the received radiation is less. With the collector turned from the south by 10°, the irradiance is lower by approx. 1%, while when turning by 20°, the irradiance is less by approx. 4%. Acceptable deviations from the south are up to 45° to the west and east. In case of larger azimuth deviations from south, it is necessary to correct (increase) the collector area.

COLLECTOR CONNECTION

Pipelines in the **solar system** must be made of metal (usually copper or corrugated stainless steel pipes), very well thermally insulated. Pipes that are exposed to external influences (sun, rain, wind) must be additionally protected (e.g. insulation and pipe covered in aluminum sheet).
The output of the solar fluid from the collector to the tank must always be on the side where the sleeve for the solar controller temperature sensor is located.
If more than 6 collectors are connected to the field, it is necessary to install thermal compensation (flexible hose...).
Always view/adjust the connection proposal with the technical instructions. If we need a larger number of collectors, for easier balancing of the solar system, choose an even number of collectors and connect them in parallel, according to Tichelmann connection.



It is possible to connect 8 plate collectors with a compensator



Possible connection of 12 plate collectors according to Tiechelmann

SOLAR PUMP GROUP

The solar pump group combines several essential elements of the solar system: circulation pump, flow regulator, safety group - safety valve at 6 bar and pressure gauge, gravity brake with thermometer, manual vent valve and fittings for filling/draining the solar system. You can find a detailed description of the group below.

An important parameter when commissioning a solar system is the flow in the solar system. The flow is regulated by the pump speed and the flow regulator, components found in the solar pump group. The flow is always set at the maximum pump output (recommended flow through plate collectors: 30 lit./h*m^2 of light incident surface (0.5 lit./min. and m^2 average light incident).

In systems with a larger number of collectors (from 10 or more), a smaller flow of solar fluid through the collectors is recommended, approx. 15 lit./h*m^2.

Depending on the number of collectors and the length, diameter and position of the pipeline, it is necessary to check whether the pump in the solar pump group meets the pressure drops. Typically, solar pump groups can be mounted on systems up to approx. 10 collectors, for a larger number of collectors and a longer or pipeline with more arcs, it is necessary to check the power of the existing pump in the pump group and the scale on the flow regulator.

EXPANSION VESSEL IN THE SOLAR SYSTEM

Expansion vessel (closed) must be large enough to take over the expansion of the solar fluid due to high temperatures in the collector and in the extreme case of its evaporation. The expansion vessel must be at a pressure of 0.5 bar higher than the static pressure of the solar installation. Most often, the expansion vessel must be pre-pumped to a pressure of 3 bar. The solar installation must work at a pressure of 2.5 to 3 bar due to the movement of the boiling point of the solar fluid to approx. 140°C (depends on the type of solar fluid). With this, we raised the boiling point and enabled the solar system to deliver more energy to the wather heater.

Volume exp. vessel	Number of plates collector
18	1
24	2-3
35	4-5
50	6-8
80	9-11
100	12-15

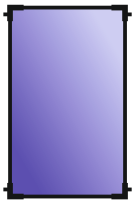
SOLAR FLUID

Solar systems are intended for year-round operation and all system components must be suitable for such use. To protect the solar system against freezing during winter, it is mandatory to fill the system with a mixture of water and propylene glycol (a non-toxic antifreeze) instead of water alone. This mixture is also referred to as **solar fluid**. Ethylene glycol was used in the past, but propylene glycol mixtures are now increasingly used due to their environmental advantages. The glycol-to-water mixing ratio should be determined according to the instructions on the glycol packaging in order to provide freeze protection down to the required temperature. Warranty claims for system components will not be accepted if the solar system does not contain solar fluid.

PLATE SOLAR COLLECTOR CPK-8203N 4H

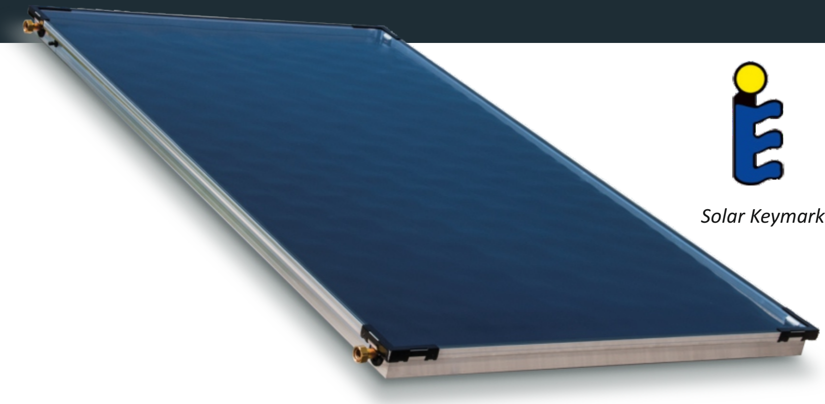
CPK-8203N 4H series flat-plate collectors represent a high-quality product with a modern design. They are intended primarily for domestic hot water heating systems and also for swimming pools and central heating systems with heat accumulation.

Flat plate collectors **CPK-8203N 4H** are made of quality materials which allows them a long service life in all weather conditions. By using high-performance selective coatings and one absorber plate over the entire collector surface, the best possible heat transfer is achieved based on the maximum use of the collector surface.



vertically

horizontally



Solar Keymark

CHARACTERISTICS OF THE COLLECTOR CPK-8203N 4H

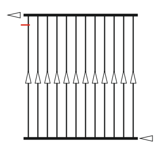
- Using modern laser welding technology, the copper tube absorber grid is bonded to an aluminum sheet coated with a high-performance selective coating, creating an efficient thermal absorber plate.
- The aluminum plate is set over the entire surface of the collector, which prevents the occurrence of air turbulence, and thus unnecessary energy losses.
- The pipes inside the collector are in the shape of a harp, which achieves optimal flow through the collector.
- The collector is designed for mounting in a **vertical** or **horizontal** position.
- A maximum of 6 plate collectors are connected in one series, a larger number are connected in parallel.
- The collector has a Solar Keymark certificate and label.

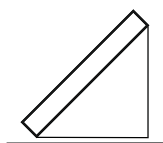
Tank	Number of collector	No. of persons
STB 200	1-2	1-3
STB 300	2-3	3-6
STB 600	4-6	6-12
STB 850	5-8	12-20

*This table is **informative**. The exact number of collectors is determined according to the place of installation (continental or coastal part), the size of the water heater and the number of persons.*

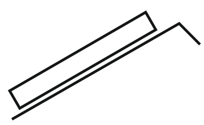
CPK-8203N 4H		
Gross area (A_G)	(m²)	2,02
Area of incidence of light (A_{ap})	(m²)	1,84
Absorber surface	(m²)	1,84
Absorber material		Al sheet metal with a selective layer
Absorption coefficient	(%)	95
Emission coefficient	(%)	5
Pipe registers	(mm)	ϕ8
Collector pipes	(mm)	ϕ22
Absorber volume	(l)	1,56
Transparent cover		3,2 mm tempered solar glass
Transmission	(%)	90
Number of connections		4x s with hermetic couplings
Connections	(R)	1"
Max. working overpressure	(bar)	10
Resting temperature		192°C according to the conditions in the norm
Isolation		40mm mineral wool
Collector height	(mm)	1.730
Collector width	(mm)	1.170
Collector thickness	(mm)	83
Collector mass	(kg)	31
Media in the system		mixture of propylene glycol and water
Permissible mounting angle		min. 15°, max. 75°

The collector has 4 connections with 'hermeto' connectors for easier connection. The outlet from the collector to the heaters is always on the side of the sleave for the temperature sensor.



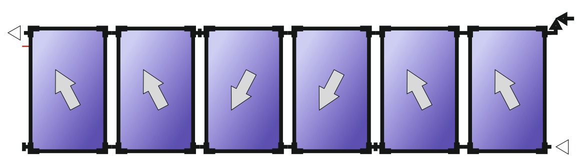


flat roof



pitched roof

A maximum of six collectors can be connected in series. Larger collector fields are connected in parallel or by using compensators.



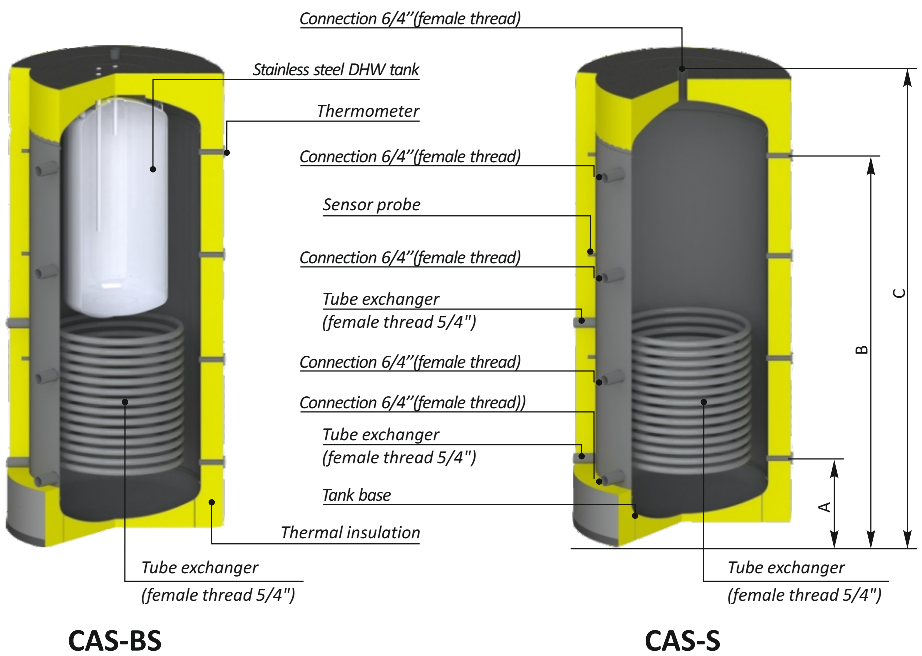
The collectors can be mounted on **pitched roof** (mounting set for a pitched roof for 1 and 2 collectors) or on **flat roof** at an angle of 45° (mounting set for a flat roof for 1 and 2 collectors) for **vertical** or **horizontal** installation. Collector inclinations between 0° and 45° are solved by adapting the mounting set for a flat roof.

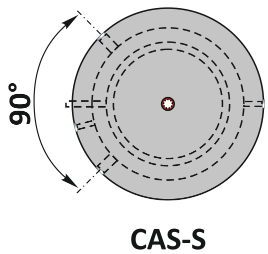
ACCUMULATION TANK CAS-S/-BS

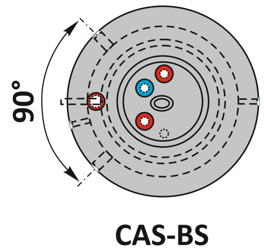
CAS-S and **CAS-BS** accumulation tanks are designed for integration into central heating systems along side boilers fueled by biomass (Bio-Tec II/Bio-Tec-C/-Plus, EKO-CK P, EKO-CKB P...), pellets, heating oil, gas, or electricity; they serve to store thermal energy, ensure more economical and efficient boiler operation, and allow for connection to solar collectors. They are manufactured in 5 sizes (volumes of 465, 727, 920, 1.426, and 2.122 liters) and two versions: as an accumulation tank with a built-in coil heat exchanger for solar collector connection (CAS-S), and as an accumulation tank with a built-in stainless steel domestic hot water tank and a coil heat exchanger (CAS-BS). These configurations enable the simultaneous use of multiple renewable energy sources, making them highly environmentally friendly and energy-efficient. With CAS tanks installed, boiler firing can be scheduled for convenient times; furthermore, during milder outdoor temperatures, space heating and domestic hot water supply can be maintained for several days without firing the boiler. The tanks are manufactured from certified materials in accordance with the ISO 9001 standard.

CAS-S/CAS-BS

		CAS-S					CAS-BS				
Type		503	803	1003	1503	2003	503	803	1003	1503	2003
Volume	(lit.)	465	727	920	1426	2122	465	727	920	1426	2122
Tank body diameter	(mm)	650	790	790	1000	1200	650	790	790	1000	1200
Outer diameter	(mm)	850	990	990	1200	1400	850	990	990	1200	1400
Total height C	(mm)	1600	1690	2100	2050	2140	1585	1675	2080	2040	2130
Connections	(R)	6/4''	6/4''	6/4''	6/4''	6/4''	6/4''	6/4''	6/4''	6/4''	6/4''
Max. operating pressure	(bar)	3	3	3	3	3	3	3	3	3	3
Max. operating temp.	(°C)	100	100	100	100	100	100	100	100	100	100
Min. room height	(mm)	1800	1890	2300	2250	2435	1785	1875	2280	2240	2420
Tank body weight	(kg)	75	100	115	185	265	130	185	195	265	345
Total tank weight	(kg)	85	110	130	200	285	140	195	210	280	365
DHW tank volume	(lit.)	-	-	-	-	-	125	170	170	170	170
Max. op. press. DHW tank	(bar)	-	-	-	-	-	7	7	7	7	7
DHW connections	(R)	-	-	-	-	-	3/4"	3/4"	3/4"	3/4"	3/4"
Heating exchanger surface	(m^2)	-	-	-	-	-	1,33	2,29	2,57	3,65	4,47
Heating exchanger volume	(lit.)	-	-	-	-	-	8,07	13,95	15,7	22,32	27,43
Thermal insulation	(mm)	100	100	100	100	100	100	100	100	100	100
Height A	(mm)	230	320	320	320	365	230	320	320	320	365
Height B	(mm)	1375	1365	1770	1720	1765	1375	1365	1770	1720	1765





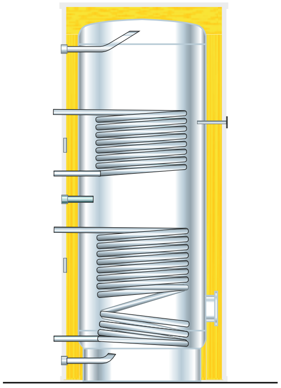


Tank cross-section CAS-BS i CAS-S

STAINLESS STEEL SOLAR HOT WATER TANK STB

STB

STB solar water heaters type **200, 300, 600, and 850** are designed for heating and storing domestic hot water using solar energy and other energy sources. Constructed from stainless steel and they ensure high standards of hygiene. The use of modern technologies and proven technical solutions enables the economical use of available energy sources. They can be upgraded with the Cm-SOL digital solar controller and are manufactured in accordance with ISO 9001 and ISO 14001 standards.



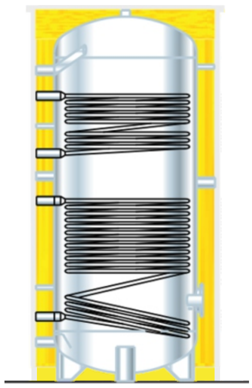
STB		200		300		600		850	
Volume	(l)	198		283		537		850	
Heating coil		upper	lower	upper	lower	upper	lower	upper	lower
Rated output[1] 80°C	(kW)	16,1	33,1	19,5	37,4	37,6	63,7	53,1	83,8
	(l/h)	395	814	479	916	922	1561	1299	2053
Tube heat exchanger	(m^2)	0,42	0,83	0,53	1,06	1,06	2,12	1,06	2,12
Tube heat exchanger water content	(l)	1,9	3,8	3,0	5,9	5,9	11,8	8,8	17,7
Boiler water flow rate	(m^3/h)	1,5	1,5	3	1,5	3	1,5	1,59	3,17
Water heater dimensions Ø / height	(mm)	640 x 1420		640 x 1900		810/1995		960/1940	
Heat exchanger flow/return[2]	(R)	3/4"		1"		1"		1"	
Solar heat exchanger flow/return[3]	(R)	3/4"		1"		1"		1"	
Max. operating pressure	(bar)	6		6		6		6	
Water heater weight	(kg)	49		66		125		162	
Energy efficiency class	L	C		C		C		C	

(1) Heating medium inlet temperature 80 °C; DHW 10/45 °C (2) Internal thread
(3) Male thread Ermeto fitting Ø 22-3/4" for STB-200, Ø 28-1" for STB-300, STB-600 and STB-850

SOLAR ENAMELLED WATER HEATER BE AND EP

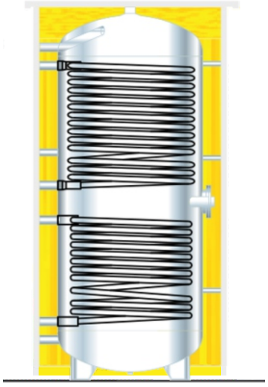
BE/EP

Bivalent solar enamel water heaters **BE** type **200, 300, 400, 500, 800 and 1.000 liters** and **EP** type **1.500 and 2.000** are designed for heating and storing domestic hot water using solar energy, with the option of supplementary heating via boiler water or an electric heater. Manufactured using state-of-the-art robotic welding technology and high-quality materials, they ensure long service life, high efficiency, and minimal heat loss. Thanks to excellent thermal insulation and optimized heat transfer, these water heaters are ideal for households, boiler rooms, and solar systems.



		BE						EP	
Type		200	300	400	500	800	1000	1500	2000
Volume	(l)	196	273	400	475	738	930	1390	1950
Heat loss	(W)	67	85	105	112	130	142	162	186
Insulation thickness	(mm)	50	50	50	50	100	100	100	100
Total height with insulation	(mm)	1215	1615	1475	1705	1875	2205	2185	2470
Minimum room height	(mm)	1375	1735	1700	1900	1900	2200	2280	2580
Tank diameter with insulation	(ø mm)	600	600	750	750	990	990	1200	1300
Water volume of upper heat exchanger	(l)	2,6	4,1	7,0	5,6	7,0	7,0	10,4	16,9
Water volume of lower heat exchanger	(l)	5,6	7,9	9,2	11,4	12,6	15,1	19,5	28,1
Rated output–Flow 80/60°C – 10°/45°C (DIN 4708) (upper heat exch.)	(m^3/h)	0,3	0,5	0,5	0,6	0,7	0,7	1,2	1,8
Rated output–Flow 80/60°C – 0°/45°C (DIN 4708) (lower heat exch.)	(m^3/h)	0,5	0,7	0,8	1,1	1,2	1,5	2,2	2,9
Pressure drop (upper heat exchanger)	(mbar)	6	10	12	14	60	60	80	233
Pressure drop (lower heat exchanger)	(mbar)	14	32	70	105	190	480	499	1019
Weight	(kg)	83	112	127	151	210	235	350	542
Maximum tank operating pressure	(bar)	10	10	10	10	10	10	8	8
Maximum heat exchanger operating pressure	(bar)	10	10	10	10	10	10	10	10
Maximum operating temperature	(°C)	95	95	95	95	95	95	95	95
Energy efficiency class	L	C	C	C	C	C	C	C	C

SOLAR ENAMELLED HEATER WATER EPM



Bivalent solar enamel water heaters **EPM** type **300, 500, 800, 1.000, 1.500, and 2.000** are designed for heating and storing domestic hot water using solar energy, with the option of auxiliary heating via a **heat pump** or electric heater. Thanks to two coil heat exchangers, they allow for the simultaneous use of multiple energy sources—solar energy, heat pumps, electricity, gas, or biomass. They are manufactured using advanced robotic welding technology and feature a double-layer enamel coating in accordance with the DIN 4753 standard, ensuring high hygienic standards and long service life. The use of modern technologies and proven technical solutions enables the economical utilization of available energy sources. The Cm-SOL digital solar controller is recommended for use with the solar system.

EPM		300	500	800	1.000	1.500	2.000
Volume	(l)	260	455	702	900	1390	1900
Heat loss	(W)	85	112	130	142	162	186
Tank diameter	(mm)	500	650	790	790	1000	1100
Tank diameter with insulation	(mm)	600	750	990	990	1200	1300
Total height with insulation	(mm)	1615	1705	1875	2205	2185	2470
Weight	(kg)	131	182	265	294	395	601
Heating coil	(-)	upper/lower	upper/lower	upper/lower	upper/lower	upper/lower	upper/lower
Surface area of upper/lower heat exchanger	(m²)	3,7/1,2	5,2/1,8	5,2/2,4	6,0/3,7	6,0/3,7	12,0/4,3
Water volume of upper/lower heat exchanger	(l)	18/8	31/10	31/14	35/23	35/23	68/26
Heating water flow rate (upper/lower heat exchanger)	(m³/h)	1,6/0,7	2,37/1,1	2,58/1,5	3/2,2	3/2,2	6/2,5
Continuous output (upper/lower heat exchanger)	(kW)	19/29	28/44	30/30	35/88	35/88	70/103
Continuous output – flow rate (upper/lower heat exchanger)	(m³/h)	0,5/1,3	0,7/1,9	0,7/2,6	0,9/3,8	0,9/3,8	1,7/4,4
Energy efficiency class	L	C	C	C	C	C	C

EPM

STAINLESS STEEL HOT WATER HEATERS TB AND ENAMELLED HOT WATER HEATERS BW, WW AND WWM

Hot water stainless steel boilers **TB** type **120 to 850**, enameled boilers **BW** and **WW** and enameled boilers **WWM** for **heat pumps** are intended for heating and accumulating hot water by connecting to the boiler circuit in the boiler room or to another heat source within a technological process. They are often installed next to solar systems as additional storage with solar stainless steel boilers STB, BE or EPM. Boilers TB are made of high-quality stainless steel, while BW, WW and WWM are made of black steel, double enameled according to DIN 4753. Using modern technologies and proven technical solutions, a high coefficient of heat transfer and negligible losses to the environment are possible. They are made in accordance with the ISO 9001 and ISO 14001 standards.

		TB						BW					
Type		120	150	200	300	600	850	200	300	400	500	800	1000
Volume	(l)	121	150	200	294	545	860	196	273	400	475	738	930
Rated output (1) 80°C	(kW)	17	21	33	53	83	124	19	29	34	43	50	60
Boiler water flow rate	(m³/h)	1,5	1,5	1,5	5,0	5,0	5,0	0,8	1,2	1,5	1,8	2,2	2,6
Heating surface area	(m²)	0,42	0,53	0,84	1,3	2,1	3,15	0,7	1,2	1,4	1,8	2,0	2,4
Heating water volume	(l)	1,9	2,4	2,8	7,2	11,6	17,5	5,6	7,9	9,2	11,4	12,6	15,1
Water heater weight	(kg)	30	41	46	63	129	157	77	93	113	128	190	220
Water heater diameter ØA	(mm)	640	640	640	640	810	960	600	600	750	750	990	990
Water heater height	(mm)	970	1125	1450	1900	1995	1940	1215	1615	1475	1705	1875	2205
Heat exch. flow/return connections	(R")	3/4"	3/4"	3/4"	1"	1"	1"	1"	1"	1"	1"	5/4"	5/4"
Cold/hot water connections	(R")	3/4"	3/4"	3/4"	3/4"	5/4"	5/4"	1"	1"	1"	1"	5/4"	5/4"
Energy efficiency class	L	C	C	C	C	C	C	C	C	C	C	C	C

(1) Inlet temperature of the heating medium 80, 60 °C; PTV 10/45 °C

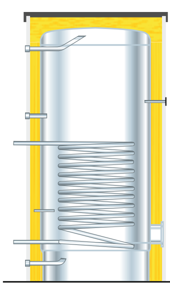
TB

BW and WW

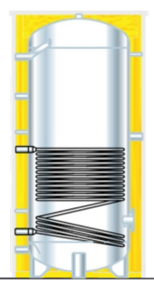
WWM

		WW		WWM						
Type		1500	2000	200	300	500	800	1000	1500	2000
Volume	(l)	1500	1950	190	263	470	702	900	1300	1900
Rated output(1) 80°C	(kW)	94	112	72	96	156	189	216	225	340
Boiler water flow rate	(m³/h)	4	5	1,8	2,4	3,8	4,6	5,3	5,5	8,4
Heating surface area	(m²)	3,6	4,3	3,0	4,0	6,0	7,0	8,0	8,0	13,0
Heating water volume	(l)	21,0	26,0	17,2	23,0	51,5	60,0	68,5	68,5	102,0
Water heater weight	(kg)	335	503	90	124	175	235	265	370	573
Water heater diameter ØA	(mm)	1200	1300	600	600	750	990	990	1200	1300
Water heater height	(mm)	2185	2470	1215	1615	1705	1875	2205	2085	2470
Heat exch. flow/return connections	(R")	5/4"	5/4"	1"	1"	5/4"	5/4"	5/4"	5/4"	5/4"
Cold/hot water connections	(R")	1" 1/2	1" 1/2	1"	1"	1"	5/4"	5/4"	1" 1/2	1" 1/2
Energy efficiency class	L	C	C	C	C	C	C	C	C	C

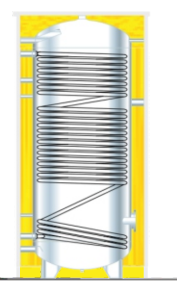
(1) Inlet temperature of the heating medium 80, 60 °C; PTV 10/45 °C



TB



BW and WW



WWM

SOLAR PUMP GROUP CSPG TL-6600

*Solar pump group **CSPG TL-6600***

An important element of solar systems is **CSPG TL-6600** solar pump group. **CSPG TL-6600** solar pump group contains all the components required for the proper operation of a solar system (in addition to the collectors, tank, controller and expansion vessel). In addition to having all the necessary functional and safety components in one place, the solar pump groups are thermally and acoustically insulated, require little installation space and are easy to install.

Elements of solar pump group CSPG TL-6600

- 2 ball valves (1 with gravity brake)
- 2 thermometers
- Pressure gauge
- Safety valve, 6 bar
- Grundfos Solar UPM3 15-75 circulating pump
- Filling/draining valves
- Flow regulator (2-12 lit./min.)
- Hermeto fittings, Ø22 mm
- Manual air vent valve
- Expansion vessel connection
- Two-part insulating foam

CSPG TL-6600		
Pump	(type)	Grundfos Solar UPM3 15/75-130
Max. operating pressure	(bar)	6
Flow operating temp.	(°C)	130-150°C max
Return operating temp.	(°C)	130-150°C max
Fluid		water with max. 50% glycol
Connections/fill-drain	(mm)	R 3/4'', for hose f15 mm
Width	(mm)	250
Height	(mm)	430
Depth	(mm)	170

3-WAY ZONE VALVE

3-way zone valve
for two water heaters

If we have an additional accumulation tank or an additional water heater, in addition to the CSPG TL-660 solar pump group, we need to install a **3-way zone valve** that serves to expand the solar system.

3-way zone valve:

- Directs the fluid to either of the two water heaters
- Returns to its default position in the event of a power failure
- 1'' connections

DIFFERENTIAL THERMOSTAT

Simple regulation
differential thermostat

If we want to simply run the solar system over 2 temperatures, we can install the simplest controller, a **differential thermostat**. Automatic or manual operation can be selected on it, and the thermostat on/off range can be set from 0 - 20°C. It is delivered with all the necessary sensors.

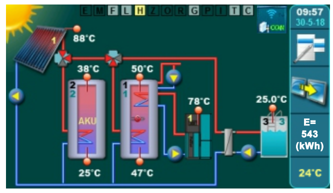
Solar regulator **Cm-SOL** is intended for controlling the heating of the DHW tank, accumulation tank (with or without a built-in DHW tanks) or swimming pool via solar collectors and/or boilers and/or an electric heater. The regulator can manage the heating of up to 4 different tanks/pools that can be heated via up to 2 separate solar collector fields for hot water and up to 2 types of conventional sources (boilers) or an electric heater.

Collector pumps can be controlled with PWM or analog signal. In addition to the temperature sensor, it is possible to connect a flow meter and a pressure switch to the regulator. In addition to the standard management of tank heating via the difference in temperature, controller has protective functions such as collector cooling (via the tank), options against regulator freezing, tank cooling (via the collector or recirculation), legionella protection (disinfection function) and outlet protection (pumps and valves) from blocking due to long-term rest.

All functions are controlled via a screen touch color screen, which simplifies the use of regulator. As an additional equipment, Cm WiFi-box can be connected, through which it is possible to connect the regulation to the local WiFi network and manage and monitor the system remotely.

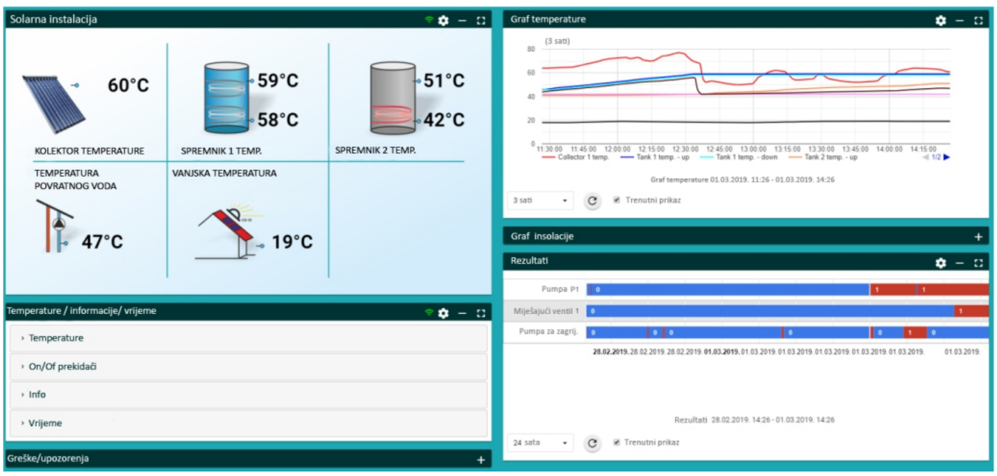
Solar regulator Cm-SOL

Wi Fi READY



Touchscreen featuring various solar systems

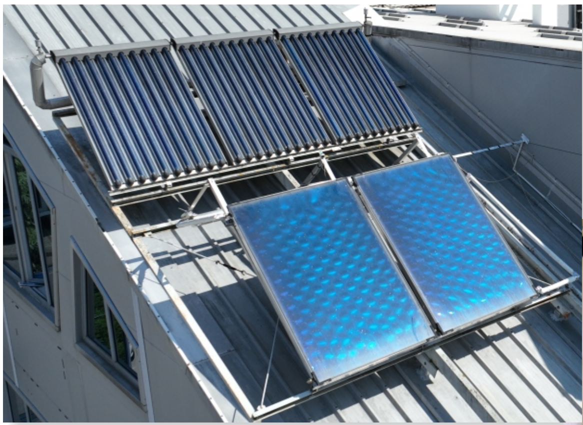
- The Cm-SOL regulator can control solar heating of up to 4 separate tanks with 1 or 2 collector fields and heating of the first tank by means of conventional sources - electric heater and up to two boilers.
- Regulator has 10 inputs, 8 outputs and 2 PWM and 2 analog outputs for collector pumps.
- Collector types can be chosen between flat plate and tube collectors.
- Tank types can be selected from DHW tank, accumulation tank, accumulation tank with built-in DHW water heater and pool.
- The hydraulic connection of several tanks can be selected via pumps, zone 3-way valve and zone 2-way valve.
- It is possible to run the heating pump of the first tank to the second (heating of the DHW tank with accumulation tank).
- Heating of the first tank can be done with an electric heater (via a contactor) and with up to 2 conventional heat sources.
- The regulator can run the recirculation pump to pulse operation at a given timer settings.
- By entering the precise flow rate through the collectors and installing a collector return flow sensor, the control system calculates the total energy gained from the collectors. Installing a flow meter allows for a more accurate energy calculation.
- To monitor the solar system's operation, a Cm WiFi-box can be installed, enabling the monitoring of specific temperatures as well as the operation of individual pumps and valves via a web portal. The web portal also allows for the adjustment of set temperatures for the storage tank and collectors.



Control the solar system via mobile phone, tablet, or computer using the Cm WiFi-box (optional accessory)

Operating principle of a solar domestic hot water system

Solar systems heat water using free energy from the Sun. Solar energy is captured by solar collectors and transferred to the solar fluid circulating through the collectors. The heat is then transferred to the DHW via the lower heat exchanger in the solar water heater. To maximize the utilization of solar energy, the solar system is equipped with a controller that manages the heat transfer process. Using temperature sensors, the controller compares the temperature of the water in the water heater with the temperature of the solar fluid in the collector and activates the pump when the temperature difference is sufficiently high (5°C). The pump is switched off when the temperature difference falls to a low value (3°C). In the event that the collectors cannot deliver enough heat to the water in the water heater, the controller activates the pump in the circuit of a conventional heat source (oil/gas boiler, electric heater or biomass (wood, pellets), or heat pump) and heats the water up to the desired temperature.



An example of a built-in educational/demonstration solar system with two separate collector circuits (flat CPK 8203N 4H and tube vacuum CVSKC-10), one solar boiler STEB and one storage boiler TB, solar pump groups and all necessary fittings.

EXAMPLE OF SOLAR SYSTEM FOR HEATING DHW FOR A FAMILY HOUSE

Below is a rough selection of solar system **components for the heating of DHW** for a family of four in the coastal area. For the correct selection of the solar system, the designer should calculate each component separately.

First, the daily water consumption per person is determined. In this example, a typical daily consumption of 50 liters per person per day is taken. So, according to 4 x 50 liters/person and day and increased by 50% for the sake of accumulation, it follows that 4 people need 300 liters of water. Water heater that meets this volume is the STB-300. Additional heating of the water heater is provided by a wood biomass boiler. If desired, an electric heater can be installed in the solar water heater, on the cleaning flange, to heat up the water heater without using a boiler.

Once the solar water heater has been selected, the number of collectors is determined. In addition to the water heater volume, the number of collectors depends on their placement, specifically the tilt angle and azimuth. In this example, the collectors are installed on a pitched roof at a 30° angle, oriented 5° towards the west. Based on these parameters, either two or three collectors could be chosen; in this instance, two collectors are selected. If the collector placement were less favorable (e.g., different angles or a greater deviation from the south) or if consumption fluctuated significantly from the projected levels, three collectors would need to be installed. This example also takes into account that the solar system is being installed in a coastal region, which experiences more sunny days and higher annual solar irradiance compared to the continent interior. After selecting the number of collectors, the mounting set must be selected. In this example, the selected mounting set is a pitched-roof mounting set for two vertically installed flat-plate collectors.

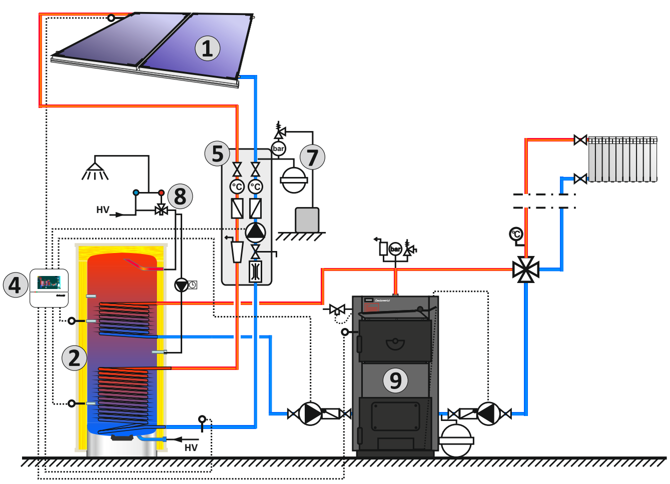
The next step in the selection process involves choosing the solar pump station and determining the flow rate for the solar system. The CSPG-TL6600 solar pump station is selected; this unit includes, among other components (see the "Solar Pump Stations" section), a flow regulator. Based on the recommended flow rate of 30 l/h*m² for flat-plate collectors and the use of two collectors, the flow rate is set to 120 l/h (or 2 l/min).

Based on the table on page 5 (section "Expansion vessel in the solar system"), a **24-liter expansion vessel** pre-charged to 3 bar is selected. The pressure in the solar system when it is not operating (i.e., when there is no sunlight) should be 3 bar.

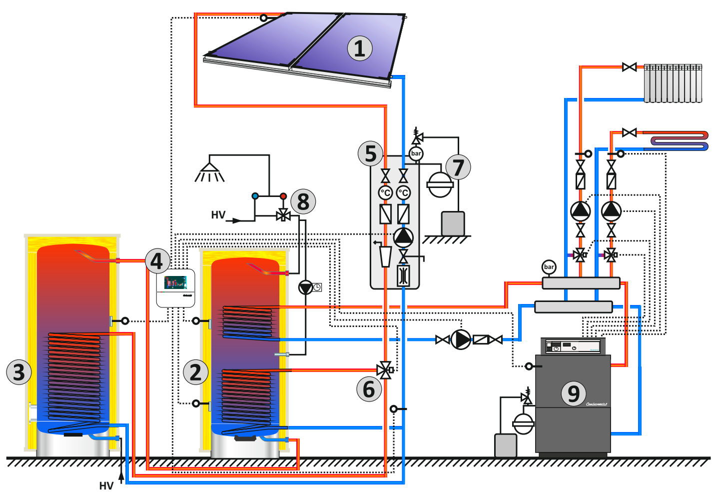
Regarding other system components in this example, a solar controller is required to manage the solar system. Here, we select the **Cm-SOL solar controller** (for details, see the section "Cm-SOL solar controller").

A **three-way thermostatic valve** for domestic hot water (DHW) is strongly recommended to prevent excessively high temperatures at the points of use (the DHW temperature in the solar water heater can be set up to 90°C).

Schematic diagram of a solar system for DHW heating for a family home



Schematic diagram of a solar system for heating large quantities of DHW



Legend:

1. solar collectors **CPK-8203N 4H**
2. solar water heater **STB**
3. water heater **TB**
4. solar controller **Cm-SOL**
5. solar pump group **CSPG-TL6600**
6. **3-way diverter valve**
7. solar circuit expansion vessel
8. thermostatic 3-way mixing valve for DHW
9. boiler (**EKO-CUP, EKO-CK P...**)

EXAMPLE OF A SOLAR SYSTEM FOR HEATING LARGE QUANTITIES OF DHW

For facilities requiring large quantities of domestic hot water, it is recommended that an authorized designer perform an accurate calculation of consumption and necessary equipment. The reference tables provided on previous pages of this brochure should be treated with caution in such demanding cases, serving only to provide a rough estimate of the investment scale.

This example illustrates the preliminary selection of solar system components for a house with four apartments, located in a continental region, intended for 16 persons with an estimated DHW consumption of 50 litres per person per day, a year-round requirement for solar DHW heating, and collectors planned for installation on a flat roof. A gas boiler serves as the conventional energy source.

For 16 people, approximately 800 liters of DHW are required; therefore, an **STB-300** solar water heater and **TB-600** storage water heater are selected and connected in series. **Cm-SOL** solar controller enables maximum utilization of the solar system and rapid DHW heating. Initially, all collectors heat the STB water heater to its maximum set temperature, after which excess energy is stored in the TB storage water heater. Water heater is connected to the upper heat exchanger of the solar water heater to provide supplementary DHW heating during winter days and periods of high consumption. Heating 900 liters of water requires 7 to 9 collectors; given the requirement for year-round solar DHW heating in this example, **8 collectors** are selected (though the exact number depends on a precise consumption calculation). To manage pressure drop within the collectors, two parallel rows of four collectors each are connected. A flat-roof **mounting set** (for 4 x 2 collectors) angled at 45° and facing due south is used. Since the system includes two water heaters, **CSPG-TL 6600** solar pump group and a **3-way diverter valve (zone)** must be installed to redirect the solar fluid to the second water heater. **Expansion vessel** must have a minimum capacity of **50 liters** and be pre-charged to 3 bar. Operating pressure of the solar system must be 3 bar. Other necessary components include a **3-way thermostatic mixing valve for DHW** to prevent scalding at the point of use (as the maximum safety temperature in the solar water heater is 90°C).

SOLAR SYSTEMS FOR HEATING SYSTEM SUPPORTS AND DHW PREPARATION

Operating principle of a solar system for heating support and DHW preparation

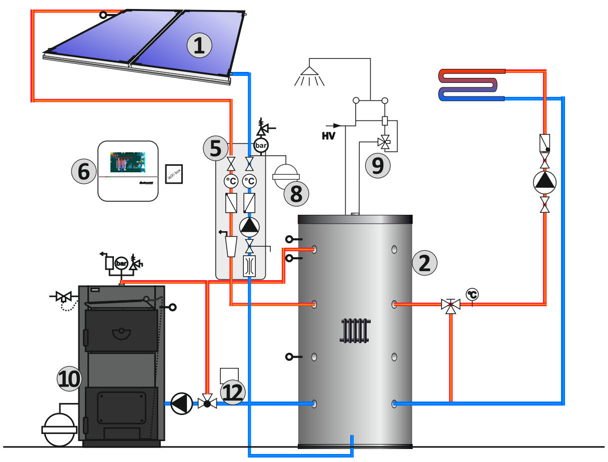
In winter, when it is cold outside and heating is required, we receive far less solar energy than in summer, when heating is not needed. Consequently, solar systems designed to support space heating require a larger number of collectors (to capture more "free" energy) and larger accumulator tanks compared to systems used solely for DHW production. However, because solar energy availability is significantly higher in summer than in winter, and because such systems incorporate more collectors than are required for DHW production alone, a method of utilizing this surplus solar energy during the summer months is required. This excess summer energy is most commonly used to heat swimming pool water, DHW for apartments (where the system heats the living space in winter when there are no guests, but heats water for multiple occupants in summer), and similar applications. As solar systems operate at low temperatures, they are best utilized in combination with low-temperature heating systems (such as underfloor or wall heating), whereas their benefits are less apparent in conventional radiator systems (70°C/50°C).

The solar system for heating support and DHW preparation uses the full array of collectors to first heat the DHW water heater, which heats up very quickly due to the large number of roof-mounted collectors. Any excess energy is then diverted to the heating system's accumulation tanks. As soon as there is a demand for DHW, the entire collector array switches back to heating the DHW water heater. If the collectors cannot transfer sufficient energy to the water in the water heater or accumulation tank, the control system activates the pump in the conventional heat source (boiler) circuit or an electric heater to bring the water up to the desired temperature.

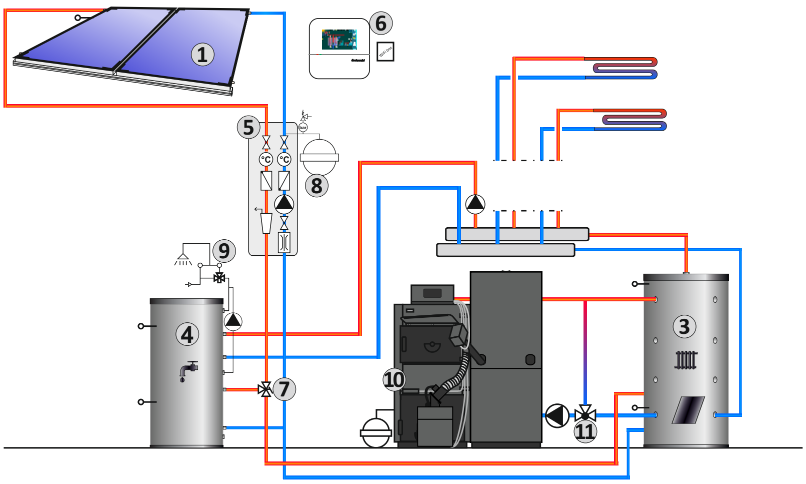
Since the investment in such systems is higher than in DHW heating systems, it is definitely recommended to make a design budget and analyze the cost-effectiveness of such a system before starting construction.

An example of an integrated solar system for support heating of the space heating system, DHW, and pool water. The solar system consists of multiple CVSKC-10 tube collectors, two CAS-S storage tanks with heat exchangers, one STEB-600 solar water heater, CSPG-260 solar pump station, Bio-Tec wood and EKO-CUP M3 gas boilers, and all necessary fittings.

Schematic diagram of a solar system for space heating backup and DHW with a single CAS-BS storage tank



Schematic diagram of a solar system for space heating backup and DHW preparation, featuring a single CAS-S storage tank and an STB solar water heater.

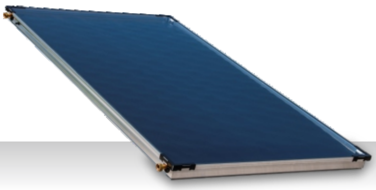


Legend:

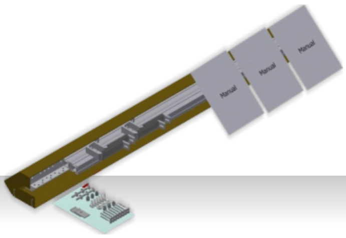
1. solar collectors **CPK 8203N 4H**
2. accumulation tank **CAS-BS**
3. accumulation tank **CAS-S**
4. solar water heater **STB**
5. solar pump group **CSPG-TL6600**
6. solar controller **Cm-SOL**
7. **3-way diverter valve**
8. solar circuit expansion vessel
9. thermostatic 3-way mixing valve for DHW
10. boiler (**EKO-CUP, EKO-CK P...**)
11. 3-way thermal valve (**ESBE VTC, LTC.**.)
12. differential thermostat

The solar collector system is connected to the lower heat exchanger, while an auxiliary heat source, such as a biomass, pellet, oil, gas, or electric boiler, is connected to the upper heat exchanger. In EPM water heaters, the solar collector system is connected to the lower heat exchanger, whereas the upper heat exchanger is specifically designed for connection to a heat pump or some low temperature heat source..

Flat-plate solar collector
CPK-8203N 4H



Mounting set
for a pitched roof, for 1 or 2 flat-plate collectors
for a flat roof, for 1 or 2 flat-plate collectors
for vertical installation
for horizontal installation



Solar controller
Cm-SOL

Solar pump group
CSPG-TL6600

3-way diverter valve
(zone)

Expansion vessel
for solar systems
18 – 500 liters

Three-way thermostatic mixing
valve for DHW

Solar stainless steel and
enamel water heaters
stainless steel type STB 200 - 850
enamelled type BE 200 - 1.000
enamelled type EP 1.500 - 2.000
enamelled type EPM 300 - 2.000

Accumulation stainless steel and
enameled water heaters
stainless steel type TB 120 - 850
enamelled type BW 200 - 1.000
enamelled type WW 1.500 - 2.000
enamelled type WWM 200 - 2.000

Accumulation tanks
type CAS-S 503 - 2.003
type CAS-BS 503 - 2.003

Conventional heat sources
oil/gas boilers: 18 - 2.100 kW
wood biomass boilers: 14 - 500 kW
pellet boilers: 4 - 96 kW
electric boilers: 6 - 45 kW
heat pumps: 5 - 40 kW

HEATING TECHNIQUE

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