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SEMS

Sustainable Energy Management Systems

Instrument: **Integrated Project**

Thematic Priority: **No. 6: "Sustainable development, global change and ecosystems (including energy and transport research)"**

D 4.06.4 Brochure describing the design and economic as well as ecological benefits of solar thermal systems

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Dissemination Level		
PU	Public	**PU**
PP	Restricted to other programme participants (including services)	
RE	Restricted to a group specified by the Commission (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

Thermal solar plants – Use the energy of the sun!

Solar plants for water heating and supporting heating systems

De Réidener Kanton

2008

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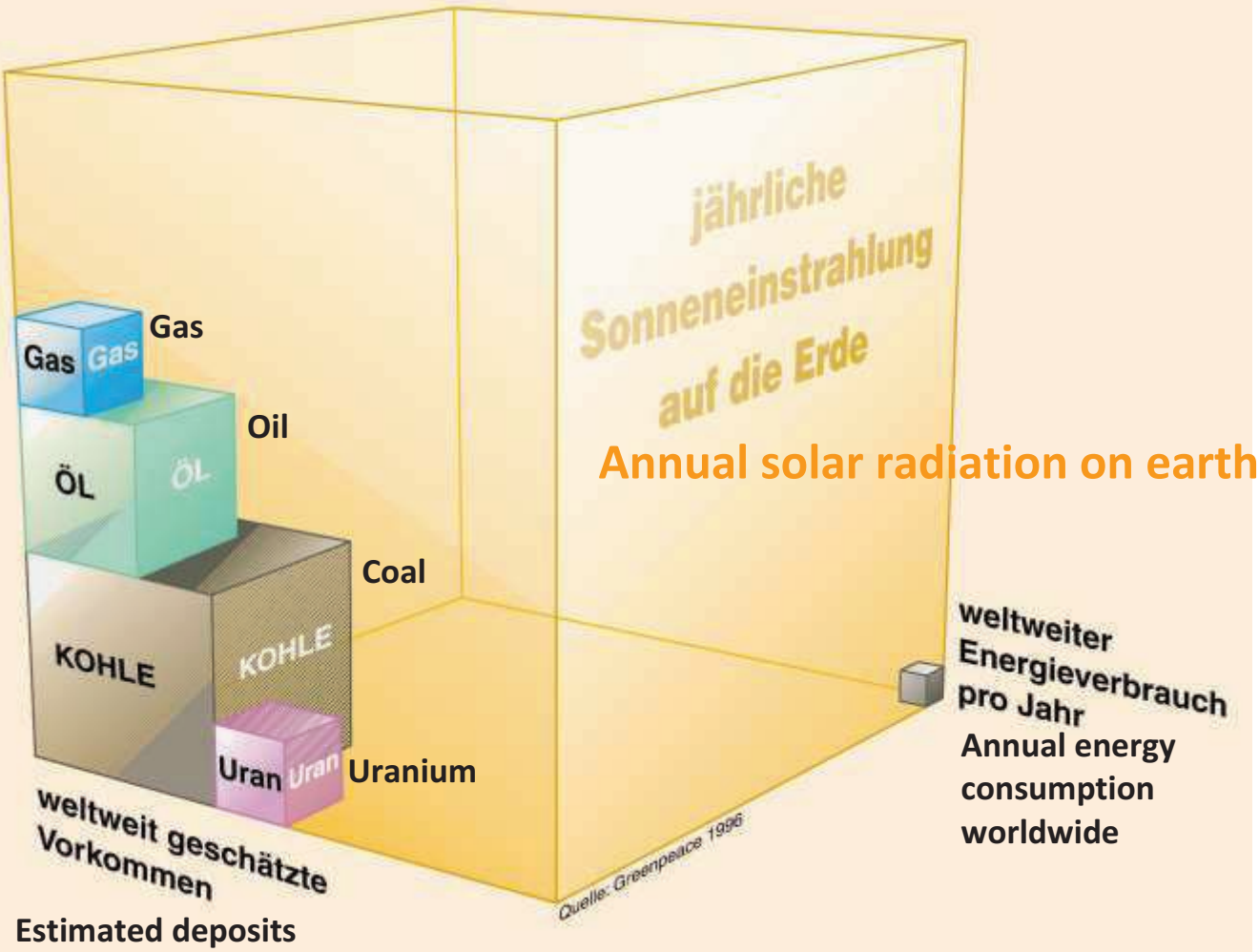
Potential of solar energy

The irradiation of the sun offers an enormous energy potential to earth. There is energy accumulated and just waiting to be used. Every half an hour the sun sends more energy down to earth than humankind consumes within one year. The technology which enables us to use a part of this energy is available and is continuously being improved.



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Planning a Solar Thermal Plant

Solar systems use the heat of the sun to provide eco-friendly warmth. A solar thermal plant can be used to support a conventional heating system as well as for heating water for daily usage.

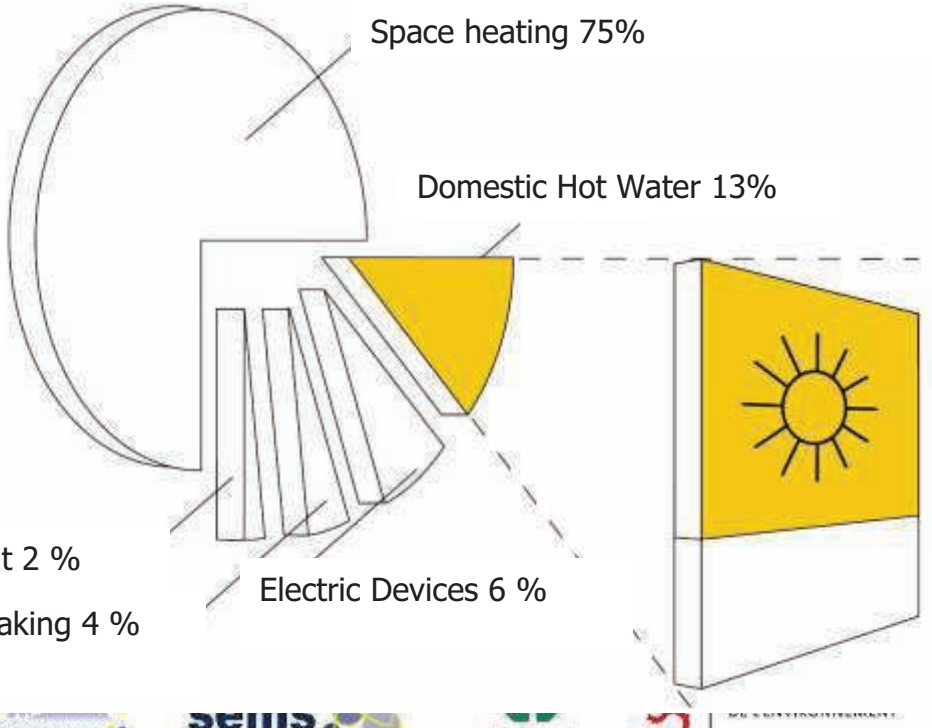
Water heating: An average family can supply 65% of their warm water needs by a solar plant. They can also reduce their consumption of primary energy by 30%. Between May and September a solar plant can often completely replace the water heating system.

Supporting the heating system: During winter a solar plant can be used to support your conventional heating system. For generating the support of the solar plants it is necessary to combine it with the boiler and a buffer. To ensure the efficiency of the solar plant and the space heating system it is necessary to have good isolation of the building.

Important Criteria:

- Direction of the collectors southwards
- Roof pitch: 45° for water heating plants
  60° for supporting the heating system
- Short distance between collector and buffer
- No shade, if possible

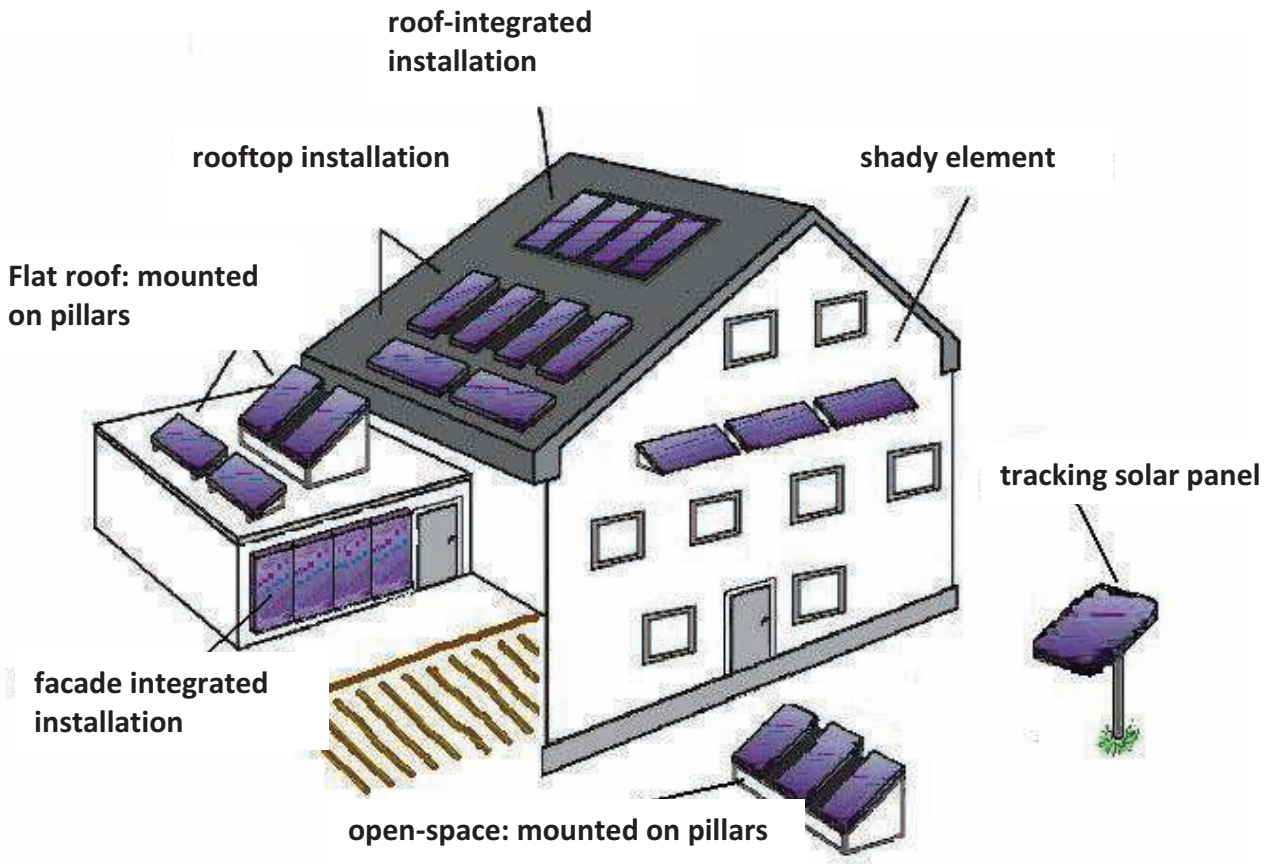
Average Energy Consumption in Private Households



Amount of hot water achievable through solar energy: 65%



Possibilities for Installing a Solar Thermal Plant



Collectors can be installed in numerous positions. While fastening the collector, the influence of wind, the collectors' own weight as well as the weight of snow must be considered.

Roof-integrated installation

For new constructions the collectors are mostly integrated into the roof. In such cases the collectors are directly screwed to the rafters, becoming a part of the roof cladding. There are no more roof tiles needed for this area. The piping of the collector is located beneath the tiles and leads into the building. The sealing, which is done similar to roof lights, can be installed by a covering frame. Considering the additional weight of new collectors the replaced tiles can be subduct off of the total roof load.

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Rooftop installation

Special fastening systems make it possible to install the collector parallel on the roof surface, without splitting the roof itself. The piping is not located under the tiles but is, in most cases, fixed on top of them instead and leads into the building at the most appropriate entrance point. In this way, the roof has to bear all the weight of the collectors and fastening systems.

Free setup/flat roof installation

On free areas or on flat roofs there are usually racks mounted on pillars to which the solar collectors are attached. For installation on a flat roof the collectors are mounted sloping onto a metal rack. Due to the risk of possible damage by wind, the construction needs to be anchored. Usually this is ensured by a loading of concrete. In general roofs must be checked before heavy weight is allowed to be put up on top of them.

Façade integrated installation

In the case of installations on the front of a building, the collectors are mounted vertically or tilted to the southern wall of the house. The loading capacity of the wall should be checked beforehand. Collectors which are vertically attached have a lower energy output. Solar facades are getting more and more popular as a visual and architectural upgrade for buildings.

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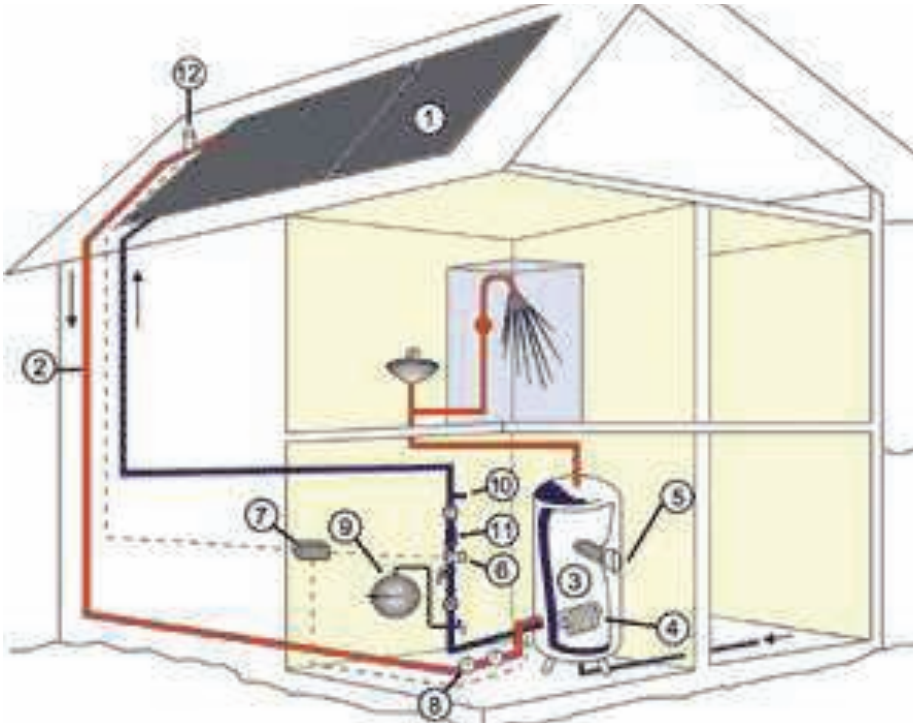
Functional Principle of a Solar Thermal System



1. Solar collector
2. Piping
3. Water tank
4. Solar Connector
5. Electrical heating element
6. Pump
7. Electronic control
8. Temperature indicator
9. Expansion vessel
10. Pressure relief valve
11. Gravitational brake
12. Venting valve

The heat gained through the solar collectors 1 is transported by a heat transfer medium (water-antifreeze mixture) through dammed piping 2 to a special water tank 3 with a solar connector 4. The heat transfer medium is stirred with the aid of a pump 6. It is important to ensure that for this purpose the most efficient types of pumps are used. An electronic control 7 ensures that circulation only takes place if the temperature of the collector is higher than the hot water in the tank. In the case of cool weather and in cases where the required temperature is not attained in the reservoir, the existing heating or an electrical heating element 5 can be used to raise the temperature to the desired level. In so doing, regardless of the weather, one can ensure that there is always enough hot water available. Furthermore the basic equipment of a solar plant contains temperature indicators 8. One is located in the supply pipe and the other one is integrated into the return pipe. A gravitational brake is also included, which prevents a loss of heat in the circulation back to the collector, as well as safety installations, which works like a pressure relief valve 10 and expansion vessel 9. A special venting valve 12 is mounted at the highest point to guarantee the escape of air from the pipes.

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Tip: Make sure that the reservoir is sufficiently dammed and the insulation of the piping which connects the collector with the reservoir is temperature-resistant. Use special insulating material for the damping of the piping, for example mineral rock, wool or special caoutchouc material. The thickness of the insulation should correspond to the diameter of the pipe.

Quelle: www.energie-tirol.at

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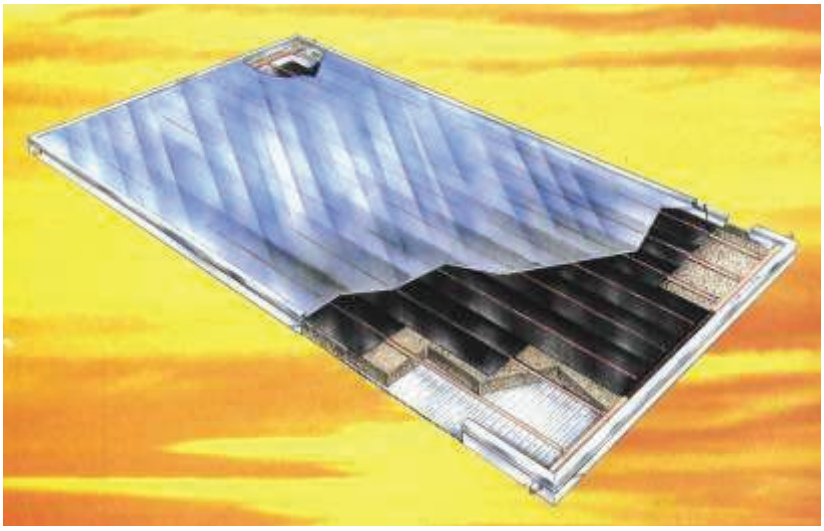
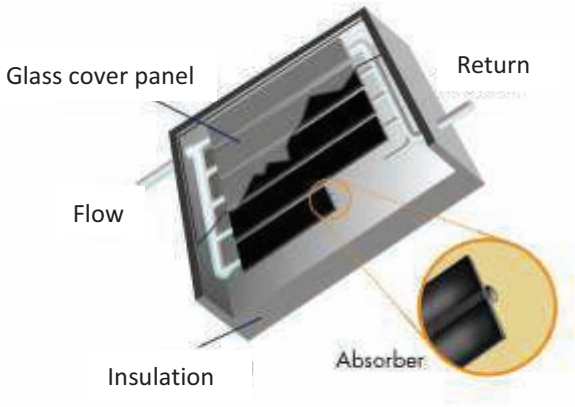
Collectors

There are various kinds of solar collectors. The choice of collector depends on the thermal use. The defining criteria are the temperature level and the period of primary use during the year. For private households, with or without the support of the heating system, it is common to use mainly flat plate and evacuated tube collectors for water heating.

Glazed Flat Plate Collectors





These collectors basically consist of the collector casing, an absorber, insulation and a transparent cover (glass). The incoming solar radiation penetrates the glass and hits the absorber (coated metal plate). The absorber converts the solar energy into heat by absorption. Beneath the absorber the heat transfer medium is located inside the piping (water-antifreeze mixture), which absorbs the heat and carries it further on.

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- Ideal for warm water from 30 °C to 60 °C
- Applicable for water heating and supporting conventional heating systems
- Vitrified flat plate collectors are widely used for private households and commercial buildings
- They can be integrated into sloping roofs and storefronts or be mounted on pillars on flat roofs or on the ground
- A life cycle of about 25 years is common

Quellen: www.swissolar.ch; www.esv.or.at

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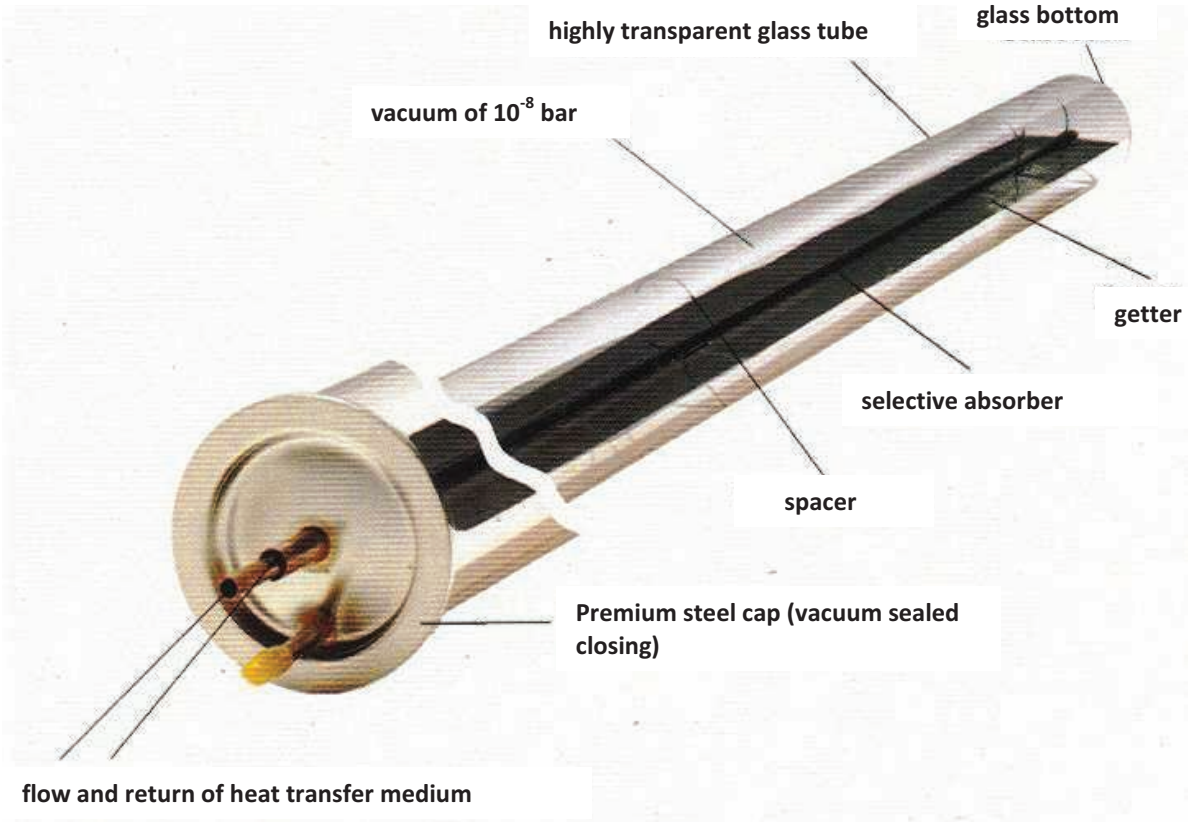
Evacuated Tube Collectors



- Ideal for warming water up to a temperature of 100 °C
- Adapted for technical processes like water heating and supporting a conventional heating system
- In the evacuated tube collectors the absorber is situated in a tube made out of glass which contains a vacuum. As a result of the excellent insulation of this vacuum, the loss of heat is very low even if high temperatures are transferred
- Evacuated tube collectors show the highest level of efficiency throughout the year
- Ideal in case of suboptimal orientation of the collector surface (storefronts), because the absorber inside the tubes can be oriented towards the sun. In areas with a high risk of hail the thickness of the glass needs to be considered
- Life cycle: 20 years
- Plants for water heating and supporting heating systems provide, compared to glazed flat plate collectors, 1.2 to 1.4 times the yield if evacuated tube collectors are used.

Quelle: www.swissolar.ch

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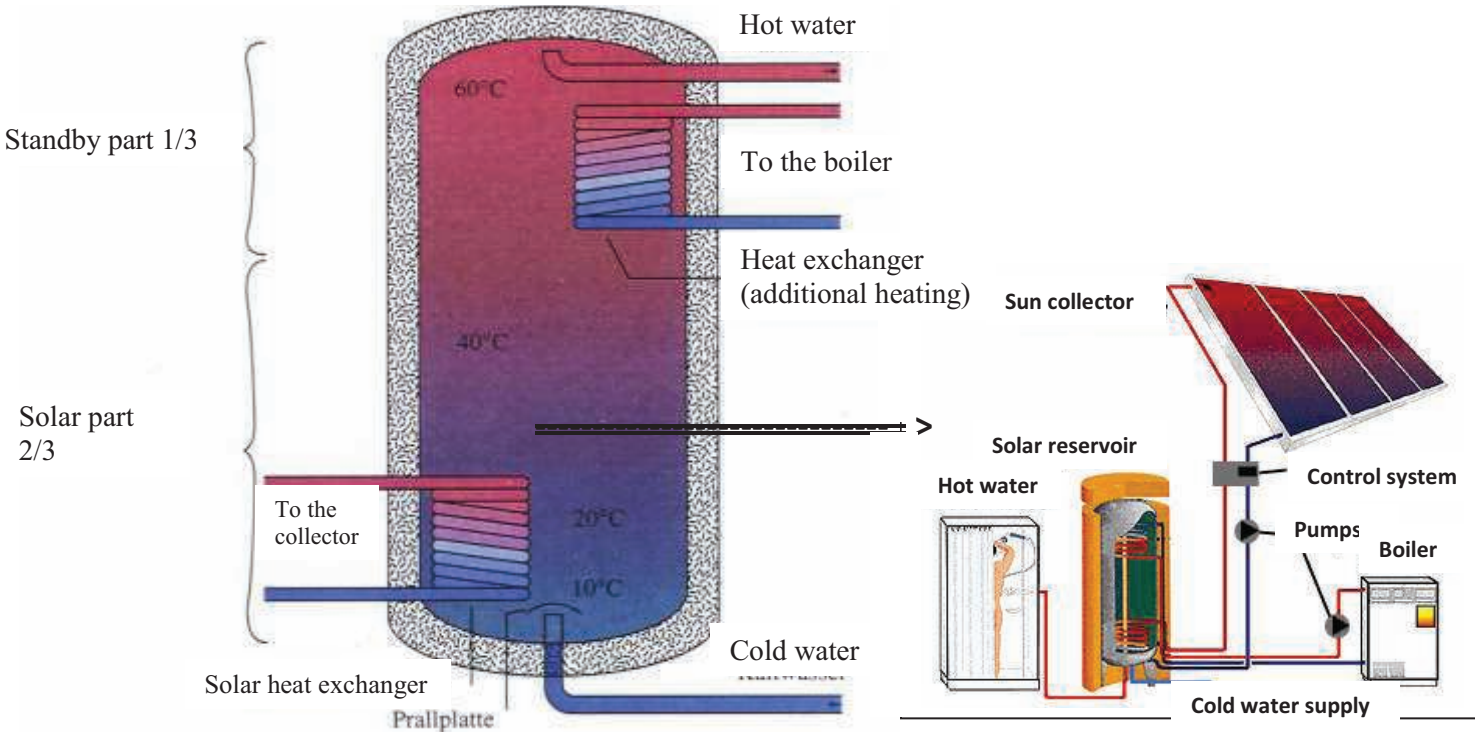
Size of Solar Collectors and Reservoir

The collectors and the reservoir should be neither too big, nor too small. For water heating in a household of four people a flat plate collector surface of about 6 m² is needed, as well as a heat reservoir of 300 to 400 l. In case of a low heat demand the heating system can be effectively supported by using a bigger collector surface, a bigger buffer capacity and low heat circuit temperature as well as an optimal adjustment of the solar collector. For low-energy buildings a solar energy plant can bring a contribution of about 20% of the space heat consumption and cover 60 to 70% of the needed hot water.

Storage Unit for Solar Energy

To be able to use the captured heat independent of the incoming solar radiation, a storage unit is necessary. The storage unit of a solar plant usually contains two heat exchangers. The lower heat exchanger transfers the heat from the upper exchanger to the water. The upper heat exchanger is connected to the heating boiler in order to reheat the water if necessary. For a plant in a one-family house this reservoir contains 300 to 500 l. For solar plants to support the heating a bigger reservoir is needed.



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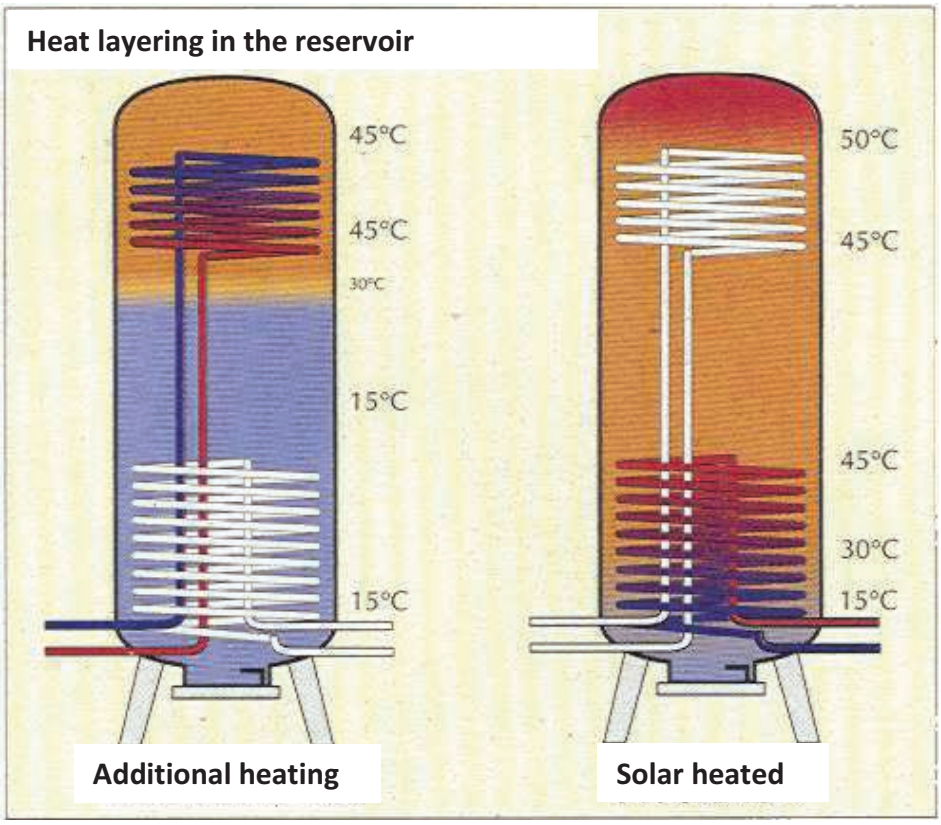
Important selection criteria

- Tall shape for a good temperature layering
- Good insulation should also include the bottom
- Water storage space should not be oversized
- Enough space is needed for setting up the reservoir
- 2 years of warranty in Luxembourg, some producers offer longer warranties



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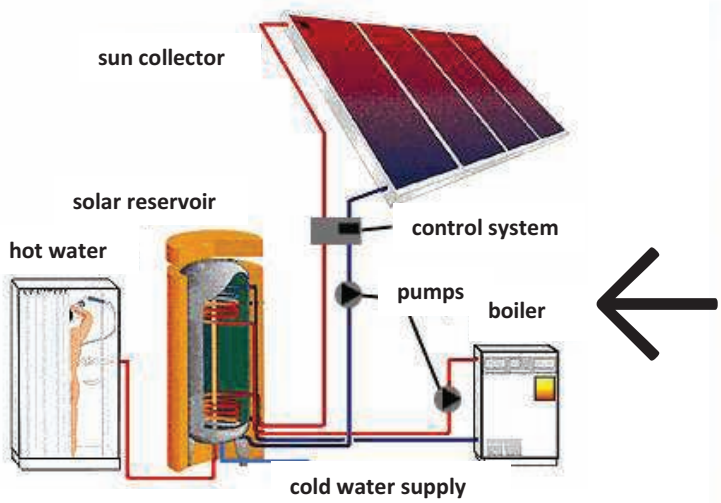
Regulation

A solar thermal plant is basically regulated by pumps towards an optimum “yield” of solar energy. In most cases this involves a simple electronic control of the pumps according to the temperature: as long as the temperature in the collector is a few degrees higher than the water in the lower area of the reservoir the pumps keep on running. Increasingly controllers are developed which can control different regulation systems and which include additional functions such as those of a heat meter, a data logger and error diagnosis.



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