User information

SOLPOOL



Solar swimming pool heating in Germany

DGS

Deutsche Gesellschaft für Sonnenenergie e.V.
International Solar Energy Society, German Section

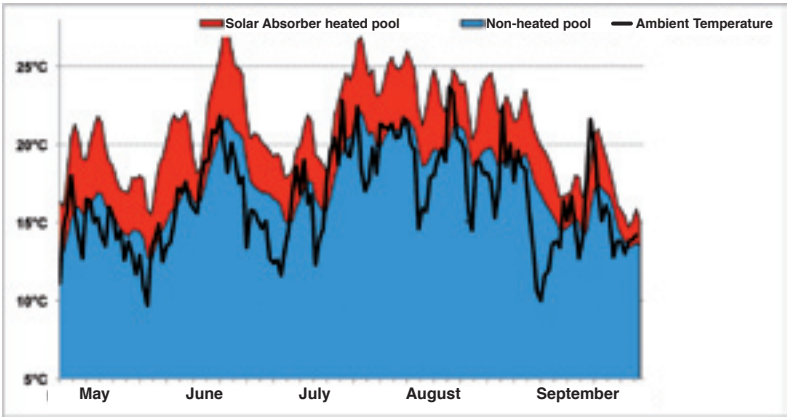
Solpool

Why should we use solar energy?

The Sun represents the single greatest source of renewable energy known to mankind. Directly or indirectly, all the energy that we use comes from the Sun. The Sun radiation amounts to 15.000 times more than the energy we use at present. The energy stored in fossil fuels like oil, natural gas, coal and uranium originally came from the Sun. The plants and animals stored the energy of sunlight in the organic material that composed them. When the ancient plants and animals died and decayed, this organic material was buried and gradually turned into the fossil fuels that we use today. The sun gives us energy in two forms: light and heat. Two main types of solar systems enable the use of Solar Energy:

- Solar modules for the generation of electricity (Photovoltaic)
- Collectors to store heat energy (Solar thermal systems)

The Heating of pool water is normally accomplished with a special type of unglazed collectors, also called swimming pool absorbers. Flow-through absorbers can completely substitute conventional heating systems, if changing water temperatures are acceptable for the owners and users. The adoption of absorber systems can raise the pool water temperature between 2 and 5°C, and after long periods of bad weather the water temperature raises clearly faster than in non-heated pools. In addition, water temperature rarely sinks below 20°C.

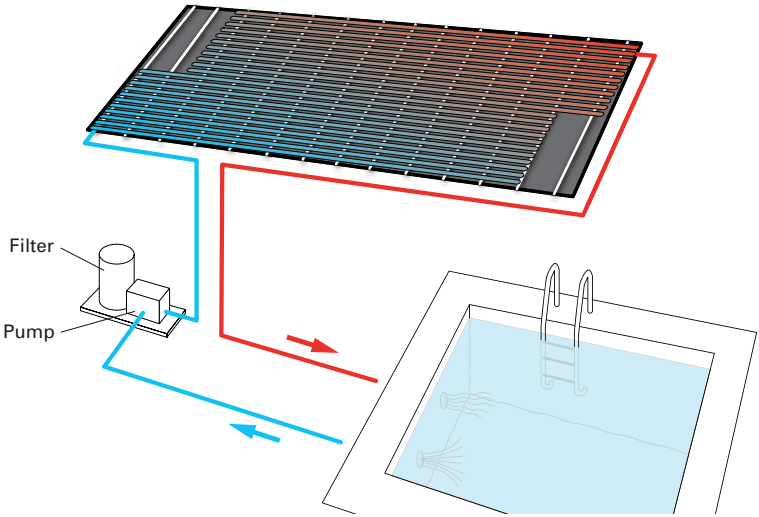


Temperature profile of heated and non-heated outdoor swimming pools
(T*SOL Simulation for an outdoor pool of 100 m² of pool surface area)

Solar Energy use in outdoor swimming pools

The solar energy use applied to outdoor pool heating has three main advantages compared to other solar thermal applications:
• Low temperature differences
The desired temperature level ranges between 18 and 25°C and thus enables the use of economic plastic absorbers.
• Solar radiation and seasonal operation
The time of the highest solar radiation matches the outdoor swimming pool operating period. In central Europe, outdoor swimming pools are operated from the beginning/middle of May until the middle of September. During this period, 65% to 75% of the annual solar radiation occurs.
• Simple system design
The pool water flows directly through the absorber. Hot water storage tanks which are necessary for other solar thermal systems are thus not required, since the pool itself takes over their function.

In the case of Germany, solar outdoor pool heating systems are based on a well-established technology. The first systems were already implemented in the 80s. Nowadays, about 20% of german outdoor pools are heated with solar thermal systems. In order to increase this share, both DGS and TTZ are currently implementing information campaigns through the SOLPOOL project.



Schematic diagram of solar pool heating

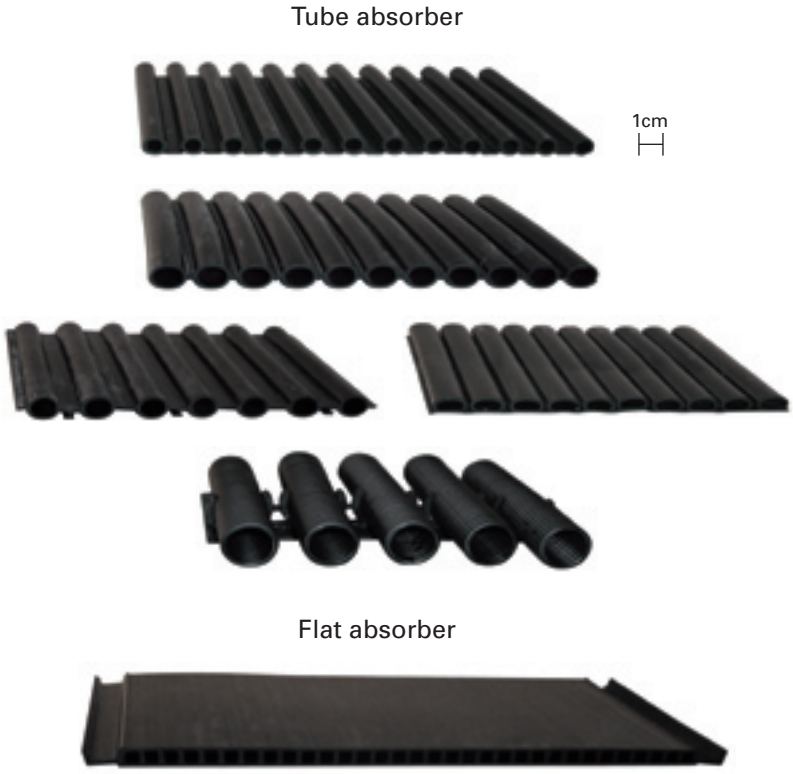
Absorber types

The absorbers used for swimming pool heating are far cheaper than the flat-plate collectors normally used for providing hot water to a family unit, because of abdication of transparent cover, casing and thermal insulation. The former system is suitable for pools, since the system operates at low temperature differences between the absorber and the surroundings and relative steady return temperatures (between 10 and 24°C). The swimming pool absorbers are predominantly made out of plastic in the form of tube or flat-absorbers.

In the installation of tube absorbers, a certain number of smooth or ribbed tubes are arranged in parallel and according to the specific design, they are connected together with intermediate webs or by retainers at a given spacing. Absorber lengths of up to 100 m can be achieved and obstructions like chimneys or roof lights can easily be circumvented.

In the case of flat absorbers the channels are linked together structurally. This produces plates of different dimensions with a smooth surface. This has the advantage that there are no grooves in which dirt or leaves can accumulate and solidify. The self-cleaning effect during rain is also better. All absorbers are very easy to handle. The low specific weight (approx. 2 kg/m^2) and the flexibility of the material make possible to install the system by only one person. The absorbers are not sensitive to mechanical stress and therefore it is possible to step and walk over them. The following figure show a summary of the absorbers available on the market (see right next page).

Apart from the classic absorbers which are normally installed on the roof, there are a couple of interesting alternatives:
• Selective coating unglazed absorber of high-grade steel.
This type of absorber is particularly of interest when a new construction is considered, or when a roof is being renovated, since the absorber is integrated in the roof
• Absorbers which can be integrated round the pool area. Those absorbers do not only heat the pool water but also serve as the material for the ground surrounding the pool.



Absorber types. Source: IST Energieplan GmbH

Mode of operation

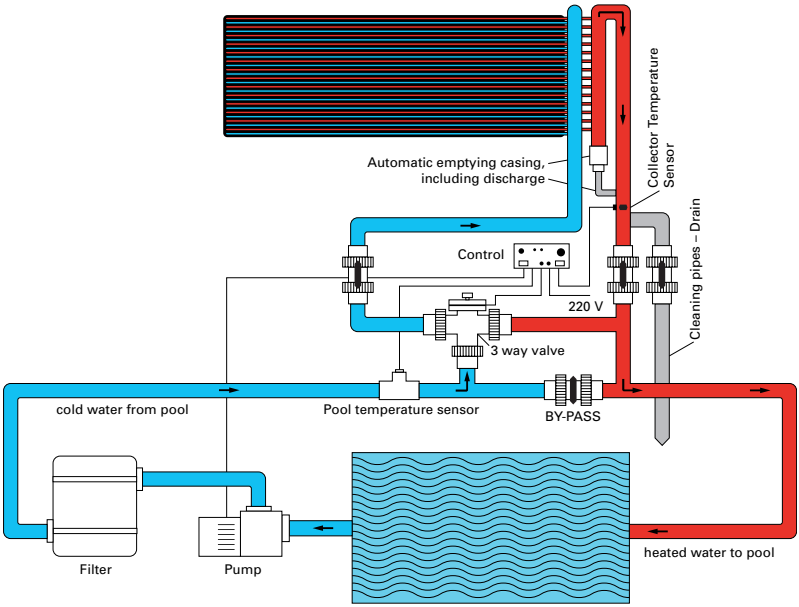
Absorbers for outdoor pool heating are generally installed over available roofs but it is also possible to install them at ground level. Like for other applications of solar energy, a location free of shadows of the absorber will have a positive effect on the yield of the system

If a solar absorber system is to be integrated in an existing infrastructure, it does not normally require significant modifications to it. Part of the filtered water is diverted to the absorber system before the necessary chemical treatment. After the water has been heated it is returned to the circuit. The volume of the diverted water depends on the size of the absorber area.

A simple automatic control system enables the operation and control of the solar system. The operation of the absorbers can be automatically activated when the water temperature goes below a specific temperature level. For that reason, a temperature sensor is connected to the control system. In the cases where the performance of the absorber system is reduced (e.g. a lack of solar radiation), the absorbers will be automatically disconnected from the system. Like in the planning of any other solar water heating system, in the case of pool heating, the solar radiation and the heat requirements are of major importance at the design stage.

The heat requirements of a swimming pool depend on the following factors:

- Pool surface area
- Water depth
- Colour of the pool
- Target water temperature
- Availability of a pool cover
- Meteorological conditions of the area where the pool is located (Ambient air temperature, wind speed, etc.)



Schematic diagram of an absorber system. Source: Austrian Standards Institute

The solar radiation between May and September fluctuates and therefore there are slight water temperature variations at the beginning and at the end of the swimming season, as well as during long periods of bad weather conditions. The pool water temperature fluctuations do not generally affect the number of visitors, since they mostly come in sunny weather conditions.

Location requirements

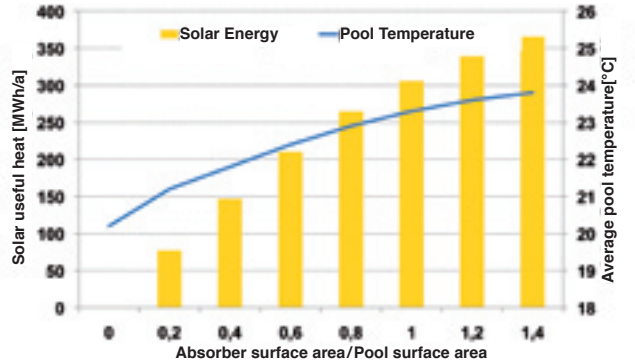
The ideal location for the installation of solar absorbers is on a roof that is free of shadows. If the absorbers are installed at ground level, care must be taken to avoid plants covering the system. In the cases where absorbers are installed on pitched roofs, an orientation to the South is beneficial; however any orientation from East to West can be wisely planned.

The installation of absorbers is mainly done by gluing or with belt webbings, depending on the type of roof. The absorbers are places along the roof in order to be able to reach lengths of up to 30 m. The absorber even when filled with water has a small area load, which depending on the construction can range between 8 and 12 kg/m^2.

Concrete slabs are used to secure the absorber field from wind. In these particular areas the load can be significantly higher and therefore the roof bearing capacity must be checked.

Assembly of solar absorbers. Source: DGS, CRES, Firma Dr. Joachim Bauch

Planning and Dimensioning



Pool Temperature and solar useful heat in relation to absorber-pool surface area (adapted from IST Energieplan GmbH)

In the presented diagram the average pool temperature and solar useful heat in relation to absorber-pool surface area is presented. By a ration from 0,5 to 1 pool temperatures between 22 and 23°C can be achieved. In order to achieve satisfactory pool water heating levels, the absorber area should represent from 50 to 100% of the pool surface area.

Rule of thumb : $\frac{\text{absorber area}}{\text{pool surface area}} = 0{,}5\ldots1$

SOLPOOL Impact Advisor

Through the European Commission co-financed information campaigns, DGS together with TTZ Bremerhaven and other partners from 6 different European countries, have developed a calculation tool called the Impact Advisor.

The Impact Advisor is a decision tool for the implementation of solar thermal heating for outdoor swimming pools. It offers owners/operators as well as installers an Excel based tool to have a cost and size estimation of a solar thermal system.

The user can select different locations across Europe and three different pool sizes (<100m², 100–500 m², >500 m²). In addition there is a possibility to select between an existing outdoor pool and a new planned pool.

The Impact Advisor needs the following input parameters: location, pool surface area, information on energy use, and target pool water temperature. The figures for energy requirement in new planned outdoor pools are automatically calculated by the software programme.

The Impact Advisor calculates the required size of absorber, a cost estimation, energy savings and payback time. The tool is simple, clearly structured and it can be used without any previous knowledge. The Impact Advisor can be used as a basis to decide to continue with further design and implementation plans.

The Impact Advisor can be downloaded for free at www.solpool.info/2104.0.html

Costs and yields

The average energy yield of a solar absorber system ranges from 250 until 350 kWh per m² of absorber surface area per swimming season (Middle of May until Middle of September). Systems work at a solar radiation between 650 and 700 kWh/m² and that they have an efficiency of 40–50%, which means that half of the irradiated solar energy is available for pool heating.

Yield: 250–350 kWh/m² of absorber area and season
Gas savings: 35–50 m³/m² of absorber area and season.

Depending on the size and type of system to install, the system costs can range from 75 to 130 €/m² absorber surface area (installation included).

System size	Investment costs in €/m² (netto)
Small swimming pools	
Surface area <100 m²	**70 – 130**
Middle-sized swimming pools	
Surface area 100 bis 500 m²	**50 – 90**
Big swimming pools	
Surface area >500 m²	**40 – 85**

If the solar absorber system for a small pool is installed without the help of a professional installer, the investment costs can be reduced to 45–75 €/m².

The operation costs (electricity for pumps and maintenance) usually amount to 1% of the investment costs per year.

Monovalent solar heating systems for swimming pool heating are economically advantageous when compared to conventional heating systems. The pay back time ranges usually between 4 up to a maximum of 7 years.

Contracting models can be interesting for communities and/or municipalities. They consist on investors and operators who sell a service. In this case they provide solar heated water for outdoor pools and thus, communities avoid operating the system as well as potential technical risks.

Loan programmes

The implementation of solar absorber systems for swimming pool heating is, like already previously said, an economic use of the solar energy. Currently there are no subsidies for solar absorber systems. However, german Kreditanstalt für Wiederaufbau (KfW) offers low interest credits, which can be used amongst others, for the implementation of solar thermal systems for outdoor swimming pools.

Five steps leading to a good solar thermal system

Step 1 – Information

Within the framework of the SOLPOOL campaigns, very comprehensive material was prepared. Such materials like flyers, brochures, best practice examples, etc, are all available in the SOLPOOL website: www.solpool.info . Read carefully all the available materials.

Step 2 – Site survey

Download the SOLPOOL checklist available at www.solpool.info and complete the specific data for your pool.

Step 3 – Size and cost estimation with the Impact Advisor.

The data collected from step 2 is subsequently used as input parameters for the Impact Advisor to estimate the size and cost of the system.

Step 4 – Solicit a quotation

Once you experience a positive result in step 3, you can ask for a quotation to experienced companies for a system design and implementation. You can find companies involved in the design and installation of solar thermal systems for pool heating in the database developed for SOLPOOL (www.solpool.info/1976.0.html)

Step 5 – The decision

Once you receive all the offers you have to compare them and select one of them. Independent energy consultants, DGS, and other SOLPOOL info centres can support you on this decision.

SOLPOOL campaigns

These useful information have been produced within the frame of the EC funded SOLPOOL project activities. For further information and contacts you can visit our website

www.solpool.info

DGS services

- DGS information portal: www.dgs.de
- Information for the general public
- Publication of the journal SONNENENERGIE
- Campaigns and publicity
- Project development, expert opinion, energy consulting
- Quality assurance
- Organisation of conferences, congresses, seminars, fairs, and the international solar forum
- Publication of technical literature (Handbooks on Photovoltaic, Solar Thermal, and Bioenergy) and information material
- Free DGS-Newsletter
- Cooperation in technical standards and guidelines in relation to solar energy
- Expert committee in the following fields: Formation and further education, Biomass, Energy consulting, Technical universities, Photovoltaic, Solar Thermal, Simulation, Solar mobility, as well as Heat pumps
- DGS offers several course programmes within the framework of the Solar school in Berlin and other Solar schools across the country:
  - DGS skilled labour in Photovoltaic
  - DGS skilled labour in Solar Thermal
  - Solar technical consultant

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The SOLPOOL project receives funding from the European Commission within the ALTENER programme. The sole responsibility for the content of this document lies with the authors. It does not necessarily reflect the opinion of the European Communities. The European Commission is not responsible for any use that may be made of the information contained therein.