EIE-06-085 SOLPOOL

Intelligent Energy Europe

# Solar Energy Use in Outdoor Swimming Pools SOLPOOL

## National Fact sheet Reports on the state of the Demand and Potential of Solar Heating of Outdoor Swimming Pools

## Hungary

***D05 National fact sheets on boundary conditions***

***D06 Requirement sheet for solar thermal use***

***D07 Funding sheet on existing grant schemes and new approaches***


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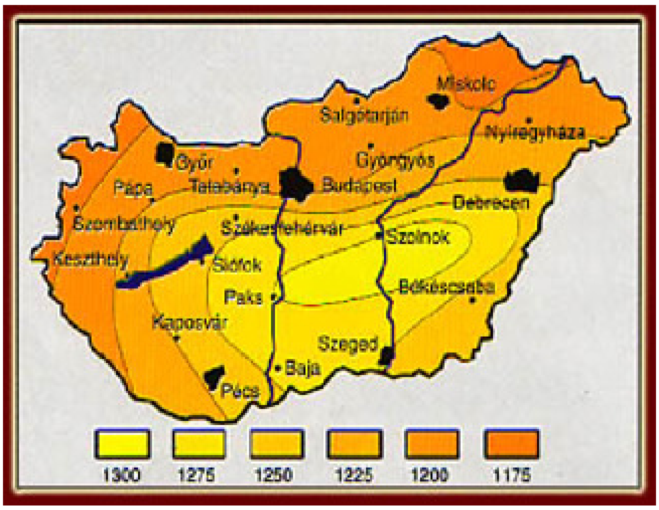
## 1 Introduction

Within the SOLPOOL project, the SAVE-REMA Energy Agency created an overview of the owners and operators of large swimming pools, and also a list of installers and manufacturers of solar thermal equipment. This document contains an overview of the current status of the potential of applications of solar thermal energy for heating the water of outdoor swimming pools in Hungary.

## 2 Environmental conditions for the use of Solar Thermal systems

Hungary has a temperate continental climate with Mediterranean and Atlantic influences. Depending on the location, winters can be cold, cloudy and damp or windy, the summers warm and sometimes very hot. The number of hours of sunshine a year varies between 1900 and 2500 – among the highest in Europe. From April to the end of September, you can expect the sun to shine for about 10 hours a day. July is the hottest month (average temperature 23.2° C) and January the coldest (-1.3° C). The average annual temperature is 11° C. The outdoor swimming pool season is from the beginning of May till the end of August. The air is usually too cold for using outdoor swimming pools from the beginning of September till the end of April.

The figure below shows the solar radiation in Hungary in kWh / m$^2$ /year units. (Source: http://www.solaris45.hu/napsugarzas.html). It is clear that the solar radiation is higher in South-Eastern Hungary. The reason is that the Northern and the Western part of Hungary is covered by hills, while the Great Hungarian Plane is located in the South-Eastern part of the country. The sky is more frequently clear above the plane; this is why the annual solar radiation is stronger in this area. The radiation is the strongest in the middle of the Carpathian basin.



# 3 State of the art of thermal applications for open air swimming pools

Solar heating of open-air swimming pool water has some decisive advantages over other methods of using solar energy thermally:

- Temperature level: The required temperature level is comparatively low at 18℃ to 25℃. This permits the use of inexpensive plastic absorbers.
- Solar radiation and time of use: The time of the highest solar radiation matches the time of use very well. Commonly at latitudes in Central Europe open-air pools are operated from beginning/middle of May until the middle of September. During this period approximately 65 – 75% of the annual solar radiation occurs.
- Simple system design:The pool water flows directly through the absorber. The storage tanks normally required for solar energy systems are not required since the pool itself takes over this function.

Solar heating for open-air swimming pools have been used for several decades now and are a well- established technology. However, this does not mean that this application of solar thermal energy has reached its limits yet.

According to statistics in Sun in Action II, about 3-4.000 $m^2$ of unglazed collectors have been placed yearly in the 90's. The estimated production and sales for 2000 and 2001 is 10.000 $m^2$ yearly.

If we look at the developments over recent years, heating of the pool is too costly for most swimming pool owners. Existing older conventional heating systems are however often replaced either by absorber systems or the owners do without heating altogether.

## 3.1 Absorber systems

### 3.1.1 Systems without auxiliary eating

Solar circuits in public open-air baths are normally operated with a separate solar circuit or absorber circuit pump. The hydraulic construction is much more complex than for private swimming pools because of the hygiene requirements.

A system in a large open-air pool functions according to the following principle:

The wastewater is led from the pool into a central water storage tank. This tank acts as a "water level display" for the whole swimming pool water circuit. Evaporated water is replaced here by fresh water. The water is pumped through the filter from the water tank. One (or according to the design of the filter system) several parallel-connected filter pumps are responsible for this. After this the water is returned to the pool via the water treatment system.

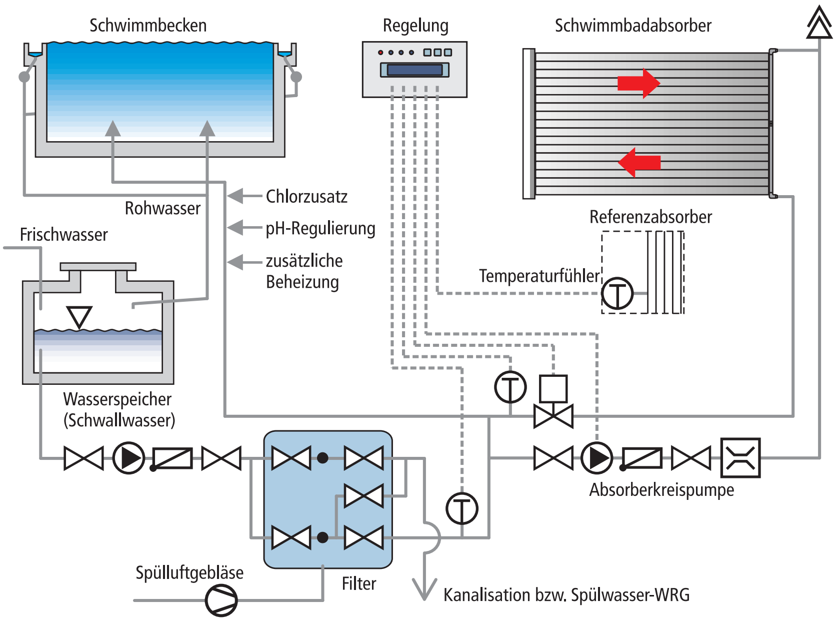



**Figure 1: Circuit diagram of open-air swimming pool heating**

In front of the water treatment system, the absorber field is connected to the circuit in a by-pass system. The solar loop pump diverts part of the volumetric flow and pumps it through the absorber field. The size of the partial volumetric flow depends on the size of the absorber field. The solar heated water is led to the main flow again after the diversion and finally arrives back in the pool.

A motorized valve should be installed in the absorber circuit feed line and a non-return valve after the solar pump. These two fittings prevent the absorber field from running empty when the system is not in operation.

Before the water reaches the pool the hygiene parameters are set. Chlorine and chemicals are introduced to regulate the pH value as necessary. The chlorine injection point should always be integrated behind the absorber field diverter since the chlorine concentration in the absorber circuit must not exceed 0.6 mg/l. If there is a pulse of chlorine (under certain circumstances up to 10 mg/l) the absorber may be damaged.

### 3.1.2 Integration of auxiliary heating

Conventionally operated auxiliary heating is necessary if the pool water has to be maintained at a constant temperature. Some open-air pools wish to offer their visitors warm swimming pool water independently of the sunshine, which requires auxiliary heating when the solar radiation is insufficient.

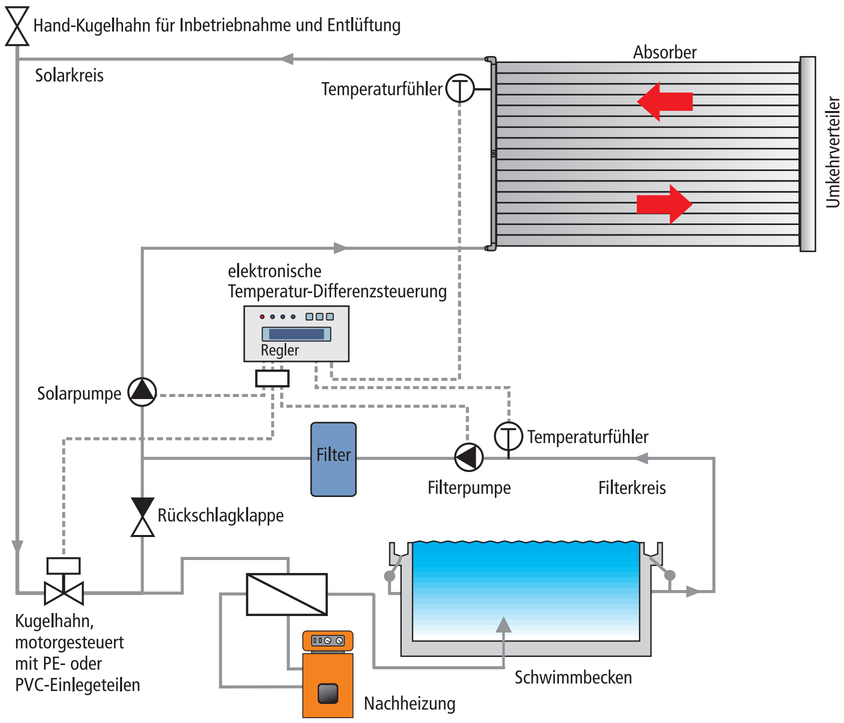



**Figure 2: Circuit diagram of large absorber systems with additional heating**

Auxiliary heating is operated by means of a conventional system (preferably gas heating systems) and an additional heat exchanger. In a dual-heated system, the auxiliary heating should always follow solar heating. If the water is not of the required temperature after recirculation to the filter circuit the auxiliary heating covers the residual heat requirement.

### 3.1.3 Unglazed absorbers

Solar open-air pool heating uses absorbers to collect the energy. The collector design is characterized by the lack of transparent cover and housing as well as thermal insulation. This simple construction is possible since the systems operate with low temperature differences between the absorber and the surroundings and with relatively uniform return temperatures (10 °C – 18 °C).

The swimming pool absorber is always made from plastic.

The use of unglazed and un-insulated absorbers for solar open-air pool water heating has some advantages due to the special operating conditions:

In the typical operating range, with a temperature difference $\Delta\vartheta$ between the outside temperature and the mean absorber temperature of 0-20 K, absorbers often operate with a higher efficiency than glazed collectors. This can be explained by the fact that the optical losses (normally about 10 to 15% with respect to the amount of solar radiation) through a transparent cover do not arise and that the thermal losses are not so significant because of the low temperature difference $\Delta\vartheta$. These thermal losses increase with operating temperatures, which however rarely occur due to the moderate absorber temperatures found under normal operating conditions. The wind speed is the decisive factor, which causes losses and hence has a negative effect on the absorber efficiency. This was established in an investigation of absorber testing and test results of solar open-air pool heating.

Apart from a few special designs plastic absorbers can be subdivided into two groups:

- Tube absorbers (small tube absorbers)
- Flat absorbers

The tube absorber is the simplest design. A number of smooth or ribbed tubes (small tubes) are arranged in parallel and according to the design 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 rooflights can easily be circumvented.

In the case of flat absorbers, sometimes also called plate or cushion 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.

The influence of the design form on the conversion factor with different inclination angles can be measured but it is minimal. Variations of the angle of incidence lead to small differences in the conversion factor only for flat collectors. In the case of ribbed tube absorbers they lead to larger variations than with normal tube absorbers.

All absorbers are very easy to handle (see also the installation chapter), thus for example all common types can be walked on.

The following figures show a summary of the absorbers available on the market and the different methods of connecting the absorber to the collecting and distributing pipes.

**Figure 3: Unglazed absorber field**

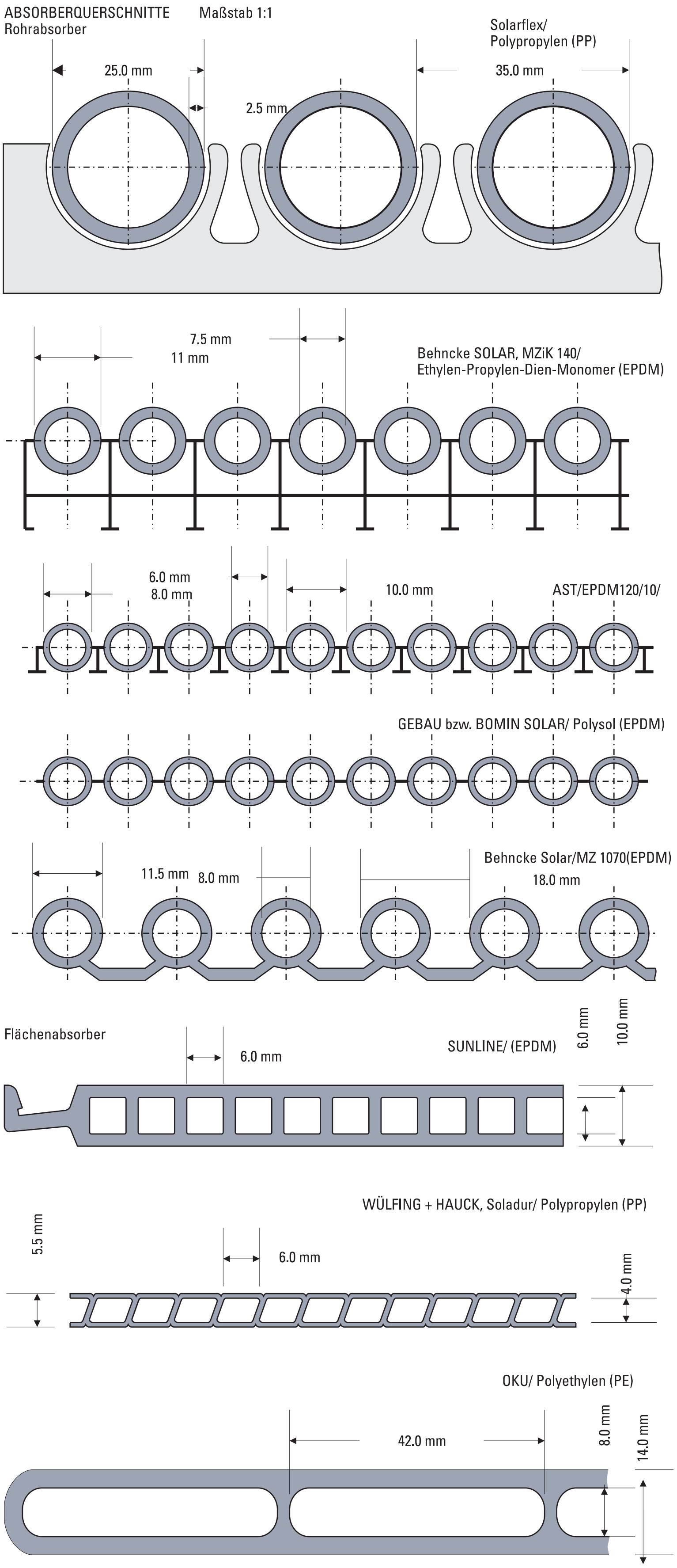



**Figure 4: Different designs of absorber in cross-section**

Solar absorbers are exclusively made from plastic. They can be hard and rigid or soft and flexible according to the plastic mixture. The use of plastic permits operation of the solar system with chlorinated swimming pool water. It is however necessary to consider the chlorine content. A high dose (from about 5 mg/l) can damage the absorber. The exact limits, from which damage can occur, depend on the plastic composition.

Plastics are also used for pipelines. These are however made from rigid materials.

The following plastics are basically the ones that can be used:

| | |
|---|---|
| EPDM | Ethyl Propylene Diene Monomer |
| PP | Polypropylene |
| PE | Polyethylene |
| ABS | Acrylnitrile Butadiene Styrene copolymer |
| PVC | Polyvinyl Chloride (hard or soft) |

## 3.2 Flat plate collectors

In open air swimming pools flat plate collectors may be installed if also a solar heating of domestic hot water for showers is required. Almost all glazed flat-plate collectors currently available on the market consist of a metal absorber in a flat rectangular housing. The collector is thermally insulated on its back and edges, and is provided with a transparent cover on the upper surface. Two pipe connections for the supply and return of the heat transfer medium are fitted, usually to the side of the collector.

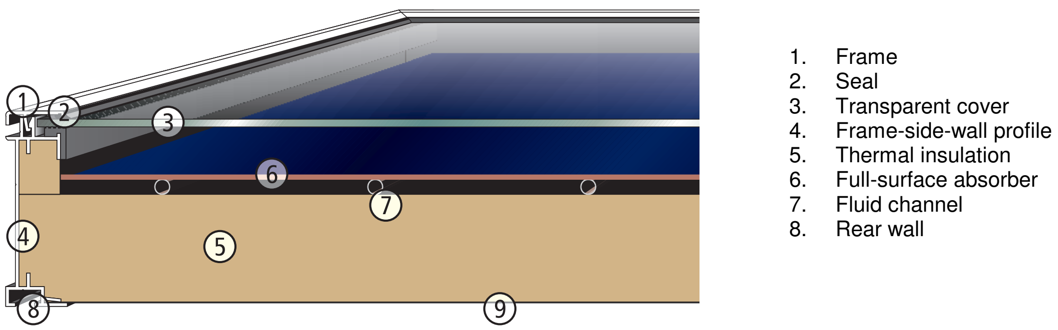



**Figure 5: Section through a glazed flat-plate collector**

Because of the risk of corrosion of thermal collectors with copper absorbers, these can only be operated in solar systems for swimming pool heating if a separate solar loop is installed (i.e. indirect) including an external heat exchanger.

## 3.3 Vacuum tube collectors

In special cases, e.g. if there is not enough area for the required absorber surface or additional applications like cooling are desired vacuum tube collectors may be chosen.

To reduce the thermal losses in a collector, glass cylinders with internal absorbers are evacuated in a similar way to Thermos flasks. For evacuated tube collectors the absorber is installed as either flat or upward-vaulted metal strips or as a coating applied to an internal glass bulb in an evacuated glass tube. An evacuated tube collector consists of a number of tubes that are connected together and which are linked at the top by an insulated distributor or collector box, in which the feed and return lines run. There are two main sorts of evacuated tube collector: the direct flow-through type and the heat-pipe type.

**Direct flow –through evacuated tube collectors**

In this design the heat transfer medium is either led via a tube-in-tube system (coaxial tube) to the base of the glass bulb, where it flows back in the return flow and thereby takes up the heat from the highly spectral-selective absorber, or flows through a U-shaped tube.

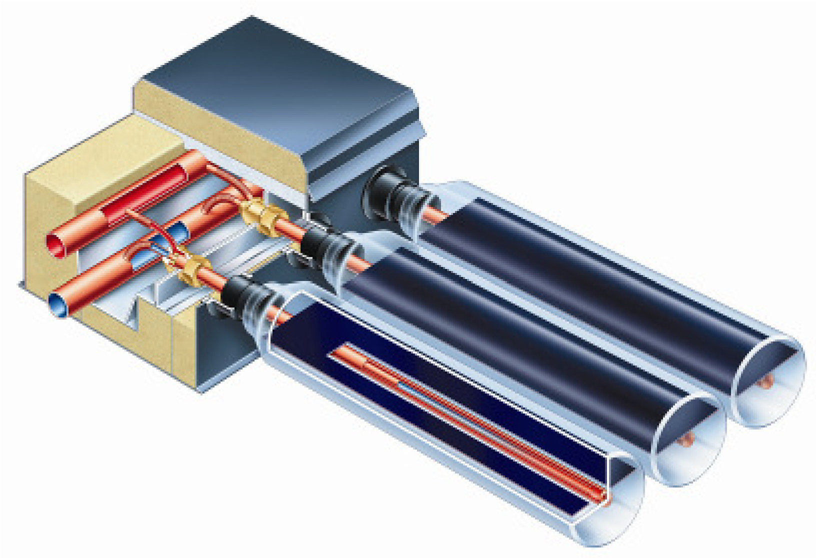


**Figure 6: Cross-section of direct flow-through evacuated tube collector**

**Heat-pipe evacuated tube collectors**

In this type of collector a selectively coated absorber strip, which is metallically bonded to a heat pipe, is plugged into the evacuated glass tube.

The heat pipe is filled with alcohol or water in a vacuum, which evaporates at temperatures as low as 25°C. The vapour thus occurring rises upwards. At the upper end of the heat pipe the heat released by condensation of the vapour is transferred via a heat exchanger (condenser) to the heat transfer medium as it flows by. The condensate flows back down into the heat pipe to take up the heat again.

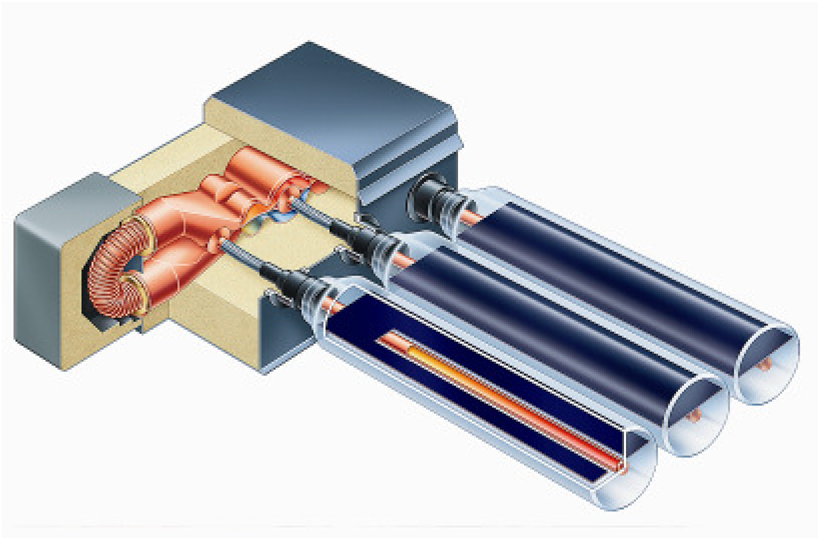


**Figure 7: Cross-sectional view of a heat-pipe evacuated tube collector**

## 3.4 Hybrid systems

In some cases a combination of different collector types may be the appropriate solution for heating an open air swimming pool. In Germany some examples exist were a glazed flat-plate collector is combined with an unglazed absorber field. The flat-plate collector field is thus designed for heating domestic hot water for the showers while the absorber field is directly linked to the swimming pool water for heating.

**Figure 8: Absorber- and flat-plate collectors for solar heating**

Another hybrid solution may be a combination of air collectors and absorbers in order to use different global radiation input for the different oriented collector surfaces.

**Figure 9: Combination of air collectors and unglazed absorbers**

### 3.5 Existing norms and standards

Norms and standards, used in other countries of the European Union are also used in Hungary. Most equipment installed in Hungary was manufactured in Germany or Austria. Other solar thermal equipment is produced in Hungary, but primarily for the German, Austrian and Italian market.

# 4 Market analysis

## 4.1 Data collection

The data were collected by screening various Hungarian Web pages. No systematic collection of public swimming pools was found, but an almost complete list could be obtained by merging partial lists and adding further addresses. The situation was better for solar firms, since several Web pages related to renewable energies contained collections of firms dealing with the installation of solar thermal systems. These lists were merged. Also, we found several related institutions, like the “Guild of the installers of swimming pool equipment” or tourist associations.

The Excel database contains contact data in the following categories:

1. Swimming pools
2. Firms for the production or installation of solar thermal equipment
3. Associations for the promotion of development of towns and regions
4. Energy suppliers (gas, electricity, district heating)
5. Guilds and craftsmen associations

We collected many addresses especially for swimming pools (214 addresses) and solar thermal firms (40 addresses). In all cases the postal address of the location, telephone, fax and e-mail address was listed. Most pools and firms have homepage. The name of the contact persons was listed less frequently. In the first part of the project, we sent letters and/or e-mails to all these addresses and let them know about the SOLPOOL project.

## 4.2 Public and private sector

### 4.2.1 Number of pools

About 200 large outdoor swimming pools were found in Hungary. Many pool use thermal water and the water of some other pools are not heated at all. The rest of the pools use some forms of non-renewable energies for heating. There are many small pools in schools, kindergartens, or operated by private people or small communities. Nowadays more and more families install small private pools in the garden if the family house. The pools have an even distribution in Hungary according to regions. Most swimming pools are in towns.

### 4.2.2 Used heating systems

At present, common heating systems for outdoor swimming pools use furnace heating or district heating with heat exchanger. The later approach environmental friendly, because it is usually linked to cogeneration. In furnaces the typically used fuels are natural gas, liquid gas or oil. The most common fuel is the natural gas. We found only one large swimming pool where the water is partially heated by solar thermal energy. The data of this pool are given in the “best practice” example below. We collected the addresses of several small (20-30 $m^2$) swimming pools. These pools are typically privately owned.

### 4.2.3 Cost comparison of the different heating systems

The figures below are characteristic for the various heating systems in swimming pools in Hungary.

| | Conventional heating (gas) | Solar heating |
|---|---|---|
| Investment | 9,360,000 HUF | 21,268,000 HUF |
| Capital cost | 964,000 HUF/a | 2,190,500 HUF/a |
| Usable energy | 343,625 kWh/a | 315,000 kWh/a |
| Auxiliary energy | 1,625 kWh/a = 5850 MJ<br>= 70,660 HUF/a<br>(including all taxes) | 11,625 kWh/a =<br>126,442 HUF/a<br>(including all taxes) |
| Fuel consumption<br>(natural gas) | 342,000 kWh/a<br>= 1,231,200 MJ/a<br>= 4,206,272 Ft/a | - |
| Gas & electricity costs | 4,276,932 HUF/a | 126,442 HUF/a |
| Maintenance | 186,000 HUF/a | 210,000 HUF/a |
| Total annual costs | 4,462,932 HUF/a | 336,442 HUF /a |
| Heat price | 13,00 HUF/ kWh | 1.07 HUF/kWh |

The exchange rate at the time of the preparation of this table is 260 HUF/EUR.

1 kWh=3.6 MJ, 1 $m^3$ gas = 34 $MJ/m^3$

Prices for community users:

The price of the gas is 2.847 Ft/MJ + 20% VAT = 3.4164 Ft/MJ from 1st October, 2008.

The price of electricity is 36,259 Ft/kWh + 20% VAT = 43.511 Ft/kWh from 1st January, 2008.

## 5 Best practice

### Swimming Pool on the campus of the University of Gödöllő

Planning and installation:
Fiorentini Hungary Kft.
http://www.fiorentini.hu/

Operator and Pool:
Szent István University
2103 Gödöllő, Práter K. u. 1-3.

| | |
|---|---|
| Year of installation | 2000 |
| Pool surface area and volume | 363 $m^2$, 11 m × 33 m, water depth 1.9 m |
| Flat absorber surface area | 33.3 $m^2$ |
| Absorber type | glazed flat collectors |
| Auxiliary heating system | 90 kW |
| Specific yield | 473 kWh/($m^2$.a) |
| Energy savings | 8878 kWh gas per year |
| Environmental gain | 1.75 t $CO_2$ pro year |
| Investment costs | 28000 EUR |
| System costs | 843 EUR/$m^2$ absorber |
| Operation costs savings | 419 EUR per year |

Gödöllő is a small university town about 30 km northeast from Budapest. The water of the swimming pool at the campus of the Szent István University (Gödöllő, Hungary) is partially heated by solar energy. The 7.3 million HUF installation was financed by the Department of Agriculture and Rural Development of Hungary and the Self-government of the Town of Gödöllő. The solar collector consists of 18 glazed flat collectors having a total area of 33.3 $m^2$. The collectors are facing south and have a decline of 45°. Between May and September, the system is heating the 700 $m^3$ swimming pool, while during the rest of the year the system is heating the 2 $m^3$ hot water tank of the nearby nursery. During a monitoring period of 1st July – 31 December, 2000, the collector utilized 4.3 MWh solar energy leading to 470 $m^3$ saving of natural gas. The whole system is also used for educational purposes at the Szent István University.

**Contact Address:**

Szent István Egyetem, 2103 Gödöllő, Páter Károly utca 1,

Phone: +36 28 522 000, Fax: +36 28 410 804, e-mail: info@szie.hu

# 6 Finances

## 6.1 Specific System costs in your country

In Hungary, we have found only one swimming pool near 500 $m^2$, where the water is partially heated by solar thermal energy. There are several operating private and small community pools with water surface area of 20-40 $m^2$. The figures below are actual costs and are based on the costs of recently installed equipments. The data were obtained from the installers. Sources: Alfasol Ltd., www.alfasol.hu; Schill Bt. www.schillbt.hu, Olympic Hungary Kft. www.napkollektor.hu We cannot present figures for really large pools (above 500 $m^2$), since the largest swimming pool with solar thermal heating is 450 $m^2$.

| | **Small Pools surface: <100 m²** | **Medium pools surface: 100 to 500 m²** | **Large pools Surface: >500 m²** |
|---|---|---|---|
| **Absorber systems** | PP or CPVC absorber | | |
| Investment cost range in EUR/m² | 100 euro/ $m^2$ | | |
| Operation costs in EUR/year | 200 euro / year | | |
| **Flat plate collectors** | | | |
| Investment cost range in EUR/m² | | 230 euro/ $m^2$ | |
| Operation costs in EUR/year | | 200 euro / year | |
| **Vacuum tube collectors** | | | |
| Investment cost range in EUR/m² | 420 euro/$m^2$ | | |
| Operation costs in EUR/year | 200 euro / year | | |

Exchang rate: 1 euro = 260 HUF, prices include VAT.

## 6.2 Funding and Financing schemes

No specific grant scheme exists in Hungary for the application of solar energy for heating outdoor swimming pools. The NEP-2008-5 programme is intended to spread the application of renewable energies in Hungary for private homes.

| | |
|---|---|
| **Programme Name** | NEP-2008-5 |
| **Organisation** | Energy Centre Hungary |
| **Street** | Váci út 45. |
| **Postal code** | 1134 |
| **City** | Budapest |
| **Email** | ugyfelszolgalat@energiakozpont.hu |
| **Telephone** | +36 1 802 4301 |
| **Type of Support** | Low-interest loan only OR financial support+loan |
| **Available Money** | 10 million euro for financial support and 61.5 million euro for low-interst loan |
| **Share of total budget** | Financing 30% of investment costs (maximum 4600 euro) and 70% loan with reduced interest rate (max. 10770 euro) |
| **Who can apply** | House owners or community multiflat houses |
| **Requirements for application** | Completed form, proof of investment costs. |
| **Targeted areas** | Increase of the application of renewable energies |
| **Short description** | |
| **Documents** | |
| **Source of information** | www.energiakozpont.hu |
| **Year of beginning** | 2008 |
| **Information website** | www.energiakozpont.hu |

## 6.3 Cost Benefit Analysis

For a time frame of 15 years and interest rates of 6 % the investment in an absorber system for a 1600 m² outdoor swimming pool would be amortised in 4,5 years already, see table below.

**Amortisation of a absorber system for a outdoor pools with 1600 m² pool surface**

| Heating system | Gas | Absorber | Unit |
|---|---|---|---|
| Investment costs | 36.000 | 81.800 | € |
| Capital costs | 3.700 | 8.425 | €/a |
| Net Energy | 325.000 | 276.000 | kWh/a |
| Auxiliary energy | 1.625 | 5.520 | kWh/a |
| Fuel demand | 342.000 | 0 | kWh/a |
| Gas- and Electricity costs | 19.005 | 662 | €/a[1] |
| Maintenance | 715 | 818 | €/a |
| Total yearly costs | 23.420 | 9.905 | €/a |
| Heat price | 0,072 | 0,036 | €/kWh |
| Amortisation time | | 4,5 | a |

| **Calculation assumptions:** | | | |
|---|---|---|---|
| Electricity costs: | | 0,12 | €/kWh |
| Gas costs | | 0,055 | €/kWh |
| Absorber surface | | 900 | m² |
| Time frame | | 15 | years |
| Interest rates | | 6 | % |

### 6.3.1 Overview

This table was prepared using the Impact Advisor, for the climatic conditions of Budapest and using Hungarian energy prices. In case of of all currently existing swimming pools the solar thermal energy is also used for the generation of utility hot water, therefore the figures below are not identical to the data of existing pools.

| | **Small pool (32 m$^2$)** |
|---|---|
| Specific System costs (EUR/m²) | 100 EUR/m² |
| Unglazed absorber | 16 m$^2$ |
| Specific Yield (kWh/ season) | 4800 kWh / season |
| Heat price (EUR/kWh) | 0.05 EUR/kWh |
| Amortisation time (static) | 6.67 year |
| | **Medium pool (450 m$^2$)** |
| Specific System costs (EUR/m²) | 70 EUR/m² |
| Unglazed absorber | 225 m$^2$ |
| Specific Yield (kWh/m² season) | 33750 kWh / season |
| Heat price (EUR/kWh) | 0.05 EUR/kWh |
| Amortisation time (static) | 4.67 |

### 6.3.2 Conclusion

The figures in the above tables show that the investment is much higher for solar heating than for conventional (natural gas) heating. The maintenance costs are comparable. The total annual costs are much lower for solar system and the price of heat is at least 10 times lower for the solar system. The final conclusion is that the investment return time is in the order of 5 years for this sample case.

# 7 Summary

SAVE-REMA identified about 200 large outdoor swimming pools in Hungary. Questionnaires were sent to the operators of these pools and to 470 self-governments. The obtained information indicated that in Hungary natural gas and district heating are the most common ways for heating the water of outdoor swimming pools. Many firms were found that offer services for the application of solar thermal energy for heating the water of swimming pools. Currently only one large outdoor swimming pool is heated (partially) in Hungary with a solar thermal system, which is on the campus of the Gödöllö University. No specific grant scheme exists in Hungary for the application of solar energy for heating outdoor swimming pools. Data bases were set up about the owners and operators of swimming pools; tourist/spa associations; related municipalities and local authorities; solar thermal energy related firms and craftsmen associations.

We have made contacts with the owners and operators of swimming pools and also with the representatives of Hungarian firms dealing with the planning and installation of solar thermal equipment. Many of them greeted the SOLPOOL project. The swimming pool operators consider the solar thermal energy a useful way for decreasing the energy costs and/or extending the season. The solar thermal energy related firms acknowledged the expected new market possibilities. It was a surprise that in spite of the excellent climatic possibilities, solar thermal energy has not been extensively used for heating the water of large outdoor swimming pools. Lack of information of the swimming pool operators is a main barrier; therefore the SOLPOOL project is expected to will have a significant impact in this field.

## 7.1 Boundaries for the implementation of Solar Heating systems for outdoor swimming pools

**Technical or climatic barriers:**

- Basically there are no technical barriers
- All technical equipment available on the market
- A stock of qualified installers and engineers is existing in the country

**Financial Barriers:**

- Financial barriers existing
- Most pools are operated by low income local authorities
- Installation of solar thermal systems must be supported with grant

**Governmental barriers:**

- No governmental barriers

- Previously permission was needed for the installation of solar systems, but this requirement was recently (September 2008) cancelled

**Social barriers:**

- Lack of knowledge about solar thermal systems

## 7.2 Requirements for the implementation of solar heating 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.

## References


| Name | Web address |
|---|---|
| Magyar Uszodatechnikai Egyesület<br>(Guild of the installers of swimming pool equipment) | http://www.mue.hu/ |
| Collection of solar energy Web sites | http://napenergia.lap.hu/ |
| Zöldtech Web magazine | http://www.zoldtech.hu/rovatok/napenergia |
| Chatforum on solar energy | http://forum.index.hu/Article/showArticle?t=9055259 |
| Address book of Hungarian builders | http://www.m-e-n.hu/ |
| Alba Kontakt Plusz Kft | http://www.napenergia.hu/ |
| Acrux Kft. | http://www.acrux.hu/sun/napenergia.html |
| Naplopó Kft. | http://www.naplopo.hu/ |
| Kardos Labor Kft. | http://www.kardoslabor.hu/ |
| Péter Impex Kft | http://www.solarkollektor.hu/ |
| Solar thermal equipment | http://fenntarthato.hu/epites/termekek/megujulo-energiak/napkollektorok |
| Solar Trade Kft. | http://www.solartrade.hu/ |
| Alfasol Kft. | http://www.alfasol.hu/ |
| Schill Bt. | http://www.schillbt.hu/ |
| Olympic Hungary Kft. | http://www.napkollektor.hu/ |