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

Czech Republic

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

Solar heating has tradition in Czech republic for 30 years. About 2000 m^2 of flat plate collectors installed in 80^{th} are still in operation. Globally there is in operation about 130 000 m^2 of flat plate and vacuum tube collectors. Nearly all of large installations (about 18 000 m^2 in 200 systems) were subsidised or financed from public sources [2].

Solar thermal heating avoid consumption about 40 000 tons of brown coal or about 150 000 tons of CO_2 emissions. It takes 0,17 % share in energy produced by renewable sources; it is about 0,01 % share in primary energy consumption of Czech Republic. In year 2007 there was installed about 19 000 m^2 of flat plate collectors, 6 000 m^2 of vacuum-tube collectors, 4 000 m^2 of them with subsidy. Market growth is about 20 to 30 % in recent years, it depends mostly on growth of fossil fuel prices. Mostly for heating of private pools there was installed another 70 000 m^2 of absorbers [2] – much more then it is usual in EU.

There are not many heated public outdoor swimming pools in the Czech Republic, approximately 10 % of outdoor pools. The heated ones mostly use district heating (fossil fuels – coal or natural gas). For outdoor pool heating some solar systems with flat plate collectors were installed in the eighties. More recently there are installed heat pumps and cogeneration units because of subsidy policy of the Czech government.

2 Environmental conditions for the use of Solar Thermal systems

Surface area of the Czech Republic is relatively small. This implies that climatic conditions depend mostly on elevation. With the exception of higher elevations year-average temperature varies between 6 and 10 °C, mean temperature in July varies between 14 and 19 °C, see picture below.

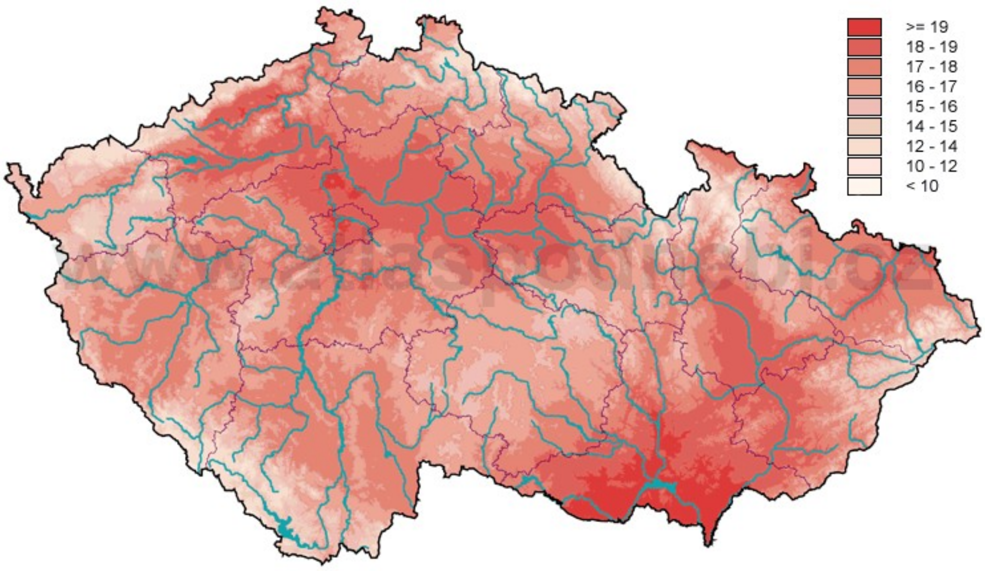


Figure 1: Mean temperature in July [1]

In the Czech Republic there are available at minimum two data sources of solar irradiation data [1, 3]. There are some differences between them, see pictures below. Solar irradiation grows from north-west to south-east. Average irradiation is about 1030 W/(m^2.a) ±70 W/(m^2.a) or 3750 MJ/(m^2.a) ±350 MJ/(m^2.a). Year by year variation is about ± 20 %. Proportion of irradiation occurred during operational season of outdoor swimming pool (May to September) is about 65 % [1].

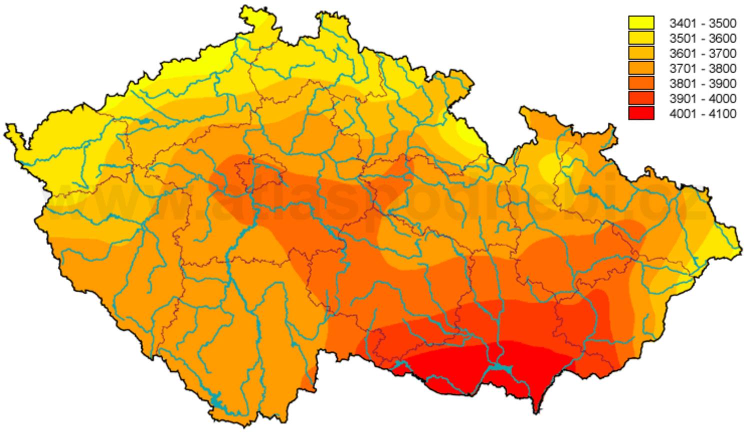


Figure 2: Distribution of solar irradiation (MJ/(m^2.a) in the Czech Republic [1]

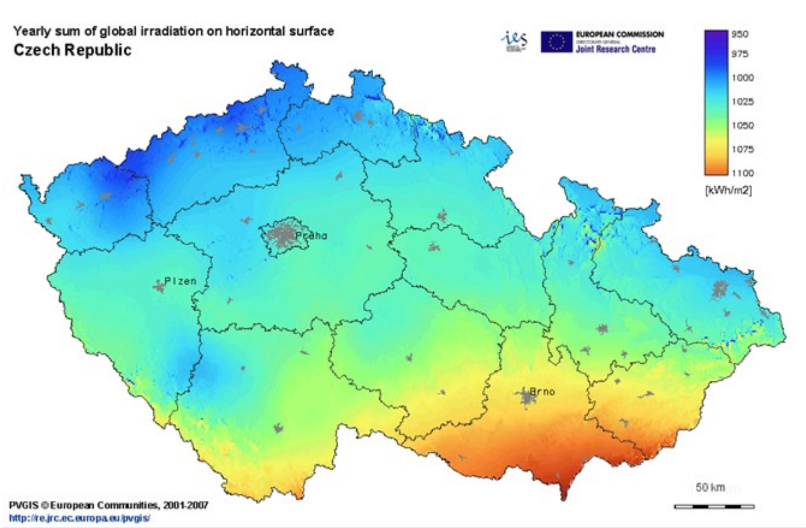


Figure 3: Distribution of solar irradiation (kWh/(m^2.a) in Czech Republic [3]

Operational season of outdoor swimming pools in Czech Republic is usually from June to August. Some of the pools – especially heated ones - operate in case of acceptable conditions in May and September too.

Year by year variation of monthly sum of global solar irradiation is about ± 20 %, variation of monthly average of air temperature is about ± 3 °C [4].

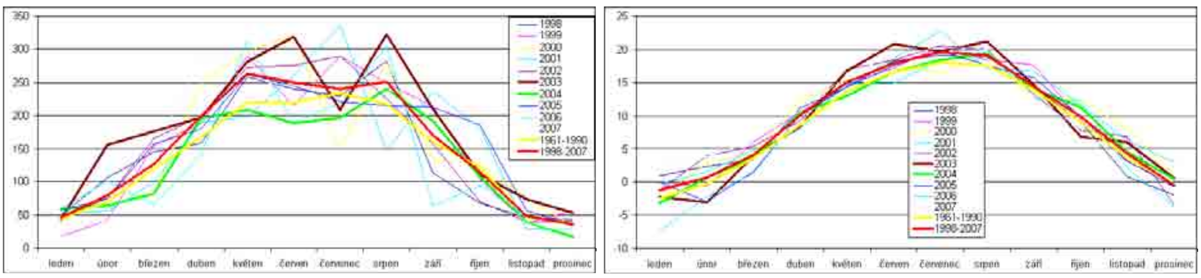


Figure 4: Variations of solar irradiation (left) and temperature (right)

3 State of the art of thermal applications for outdoor swimming pools

Solar heating of outdoor swimming pool water has some advantages over other methods of use of solar thermal energy, which implies relatively simple design:

- correlation between operational season of the pools and high solar irradiation
- required temperature is relatively low – 22°C to 26°C (plastic absorbers are applicable)
- no need of accumulation
- no need of heat exchanger in case of use of plastic absorbers

In Czech Republic for public outdoor pool heating some solar systems with flat plate collectors were installed in the 80^{th}. Recently are installed combined systems mostly with heat pump because of subsidy policy of the Czech government. Nearly all of new large systems were installed with subsidy [2]. According of statistics of Ministry of Industry and Trade [2], there is annual sale of 70 000 m^2 of plastic absorbers for heating of private pools – much more than it is usual in EU.

3.1 Absorber systems

3.1.1 Systems without auxiliary heating

Solar systems on public outdoor swimming pools are usually operated with a separate solar 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. Then the water is pumped through the water preparation unit. After filtering the water is returned to the pool via the water treatment system.

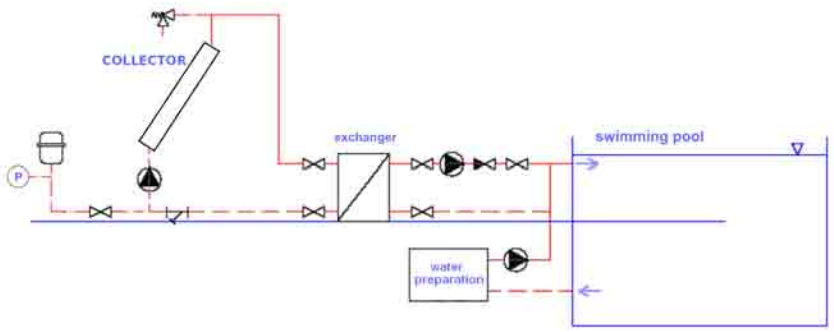


Figure 5: Hydraulic scheme of the pool heated by solar collector

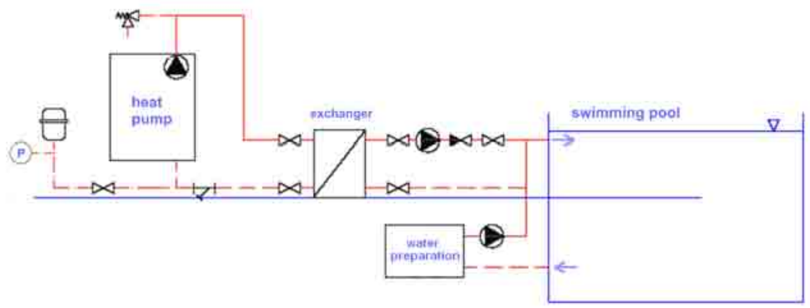


Figure 6: Hydraulic scheme of the pool heated by heat pump

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 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

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

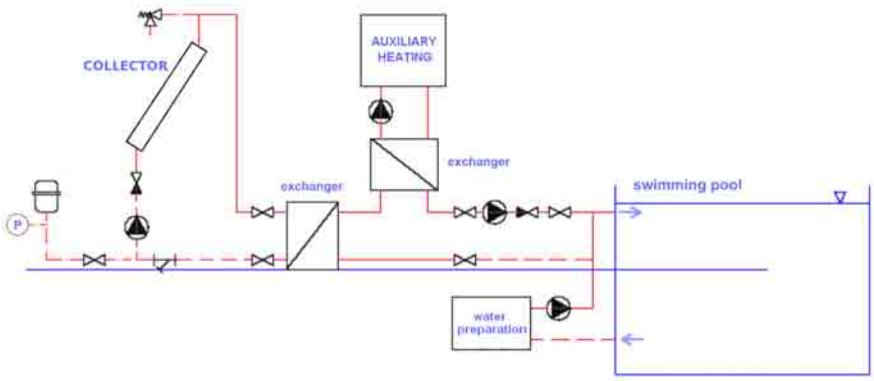


Figure 7: Hydraulic scheme of pool heated by solar system with auxiliary heating

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 usually follow solar heating. If the water is not of the required temperature after recirculation to the filter circuit the auxiliary heating covers the rest of the heat requirement.

3.1.3 Unglazed absorbers

Unglazed absorbers can be used for solar heating of outdoor pools. The design is characterized by the lack of transparent cover and housing as well as thermal insulation. This simple construction is possible as the systems operate with low temperature differences between the absorber and the ambient and with relatively uniform return temperatures (18°C – 25°C).

Two major materials are used for making of swimming pool absorbers:

- EPDM Ethylene Propylene Diene Monomer
- PP Polypropylene

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

In the typical operating range the temperature difference between the ambient temperature and the mean absorber temperature is less than 20 K. At this conditions unglazed absorbers often operate with higher efficiency than glazed ones. 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 occur and that the thermal losses are not so significant because of the low temperature difference. 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, see figure below. This was established in an investigation of absorber testing and test results of solar open-air pool heating.

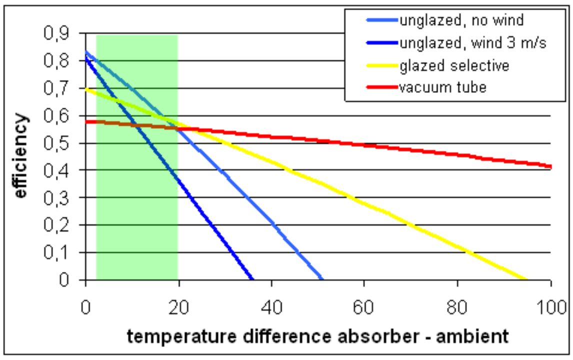


Figure 8: Efficiency of selected types of solar thermal collectors

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, thus for example all common types can be walked on.

Solar absorbers are exclusively made from plastics (there is one producer in Czech Republic who offers inox absorbers). They can be hard or 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 hard materials.

The following figure shows a summary of the absorbers available on the EU market.

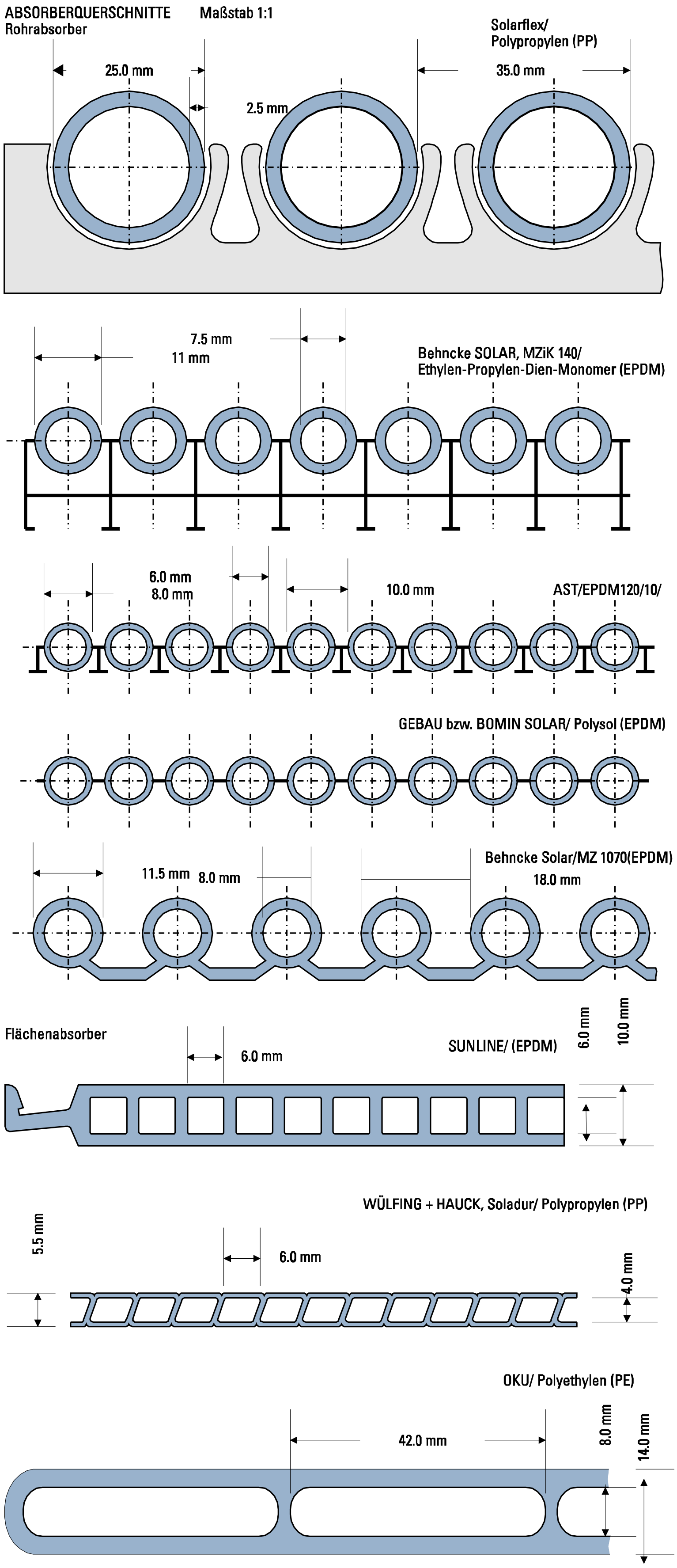
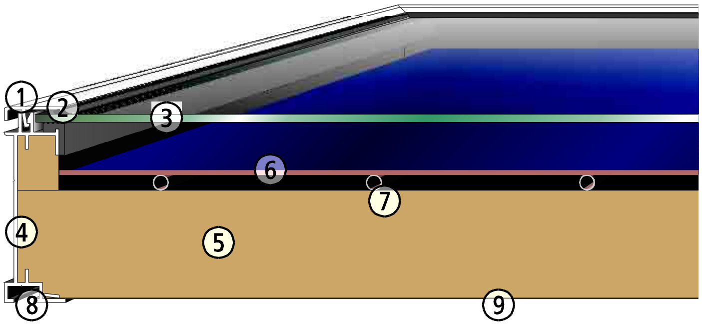


Figure 9: Different designs of absorber in cross-section

3.2 Flat plate collectors

In outdoor 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.



1. Frame
2. Seal
3. Transparent cover
4. Frame-side-wall profile
5. Thermal insulation
6. Full-surface absorber
7. Fluid channel
8. Rear wall

Figure 10: 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.

Vacuum eliminates heat loss by convection and conduction; only radiation loses occur. For vacuum tube collectors the absorber is installed as flat or upward-vaulted metal strip in evacuated glass cylinder. Selective coating of the absorber eliminates radiation loses. Alternative construction is similar to Thermos flask; selective coating is applied to vacuum-side surface of internal glass cylinder. The heat is carried out or directly by heat-transferring medium or by metal lamella touching other surface of the internal glass cylinder. The alternative construction has lower energy efficiency because of heat transfer from glass cylinder to metal lamella.

Vacuum tube collector consists of a number of tubes that are connected together and linked at the top by an insulated distributor or collector box, in which the feed and return lines run. In term of heat transfer 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.

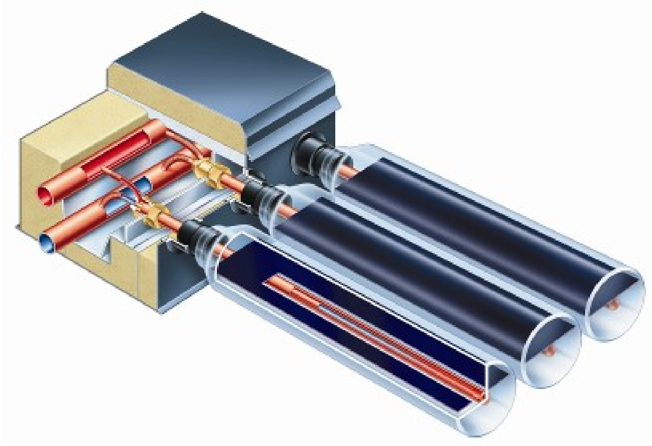


Figure 11: Cross-section of direct flow-through evacuated tube collector

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 on heated parts of the pipe and condenses on cooled parts (upper end). The condensate flows back down into the heat pipe to take up the heat again.

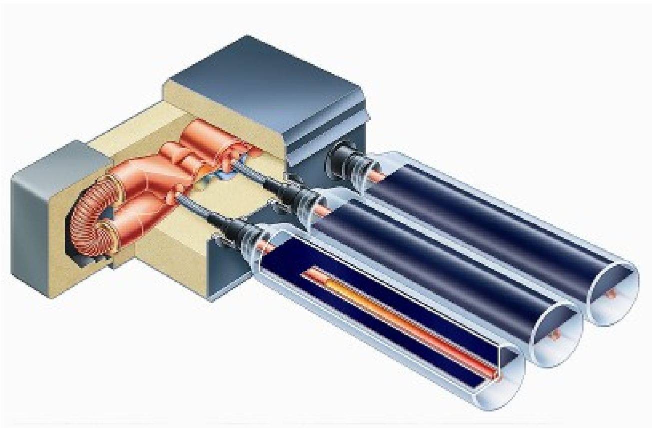


Figure 12: Cross-sectional view of a heat-pipe evacuated tube collector

3.4 Hybrid systems

In some cases a combination of different collector types may be the appropriate solution for heating an outdoor swimming pool. In Germany some examples exist where 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.

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.

3.5 Air collectors

Air collectors can be used in case there is suitable roof. Main advantage is extremely low price. In fact only minor changes in roof construction are needed. Heating system consist of the modified roof, a fan and air-to-water heat exchanger. Other components are similar to other heating systems.

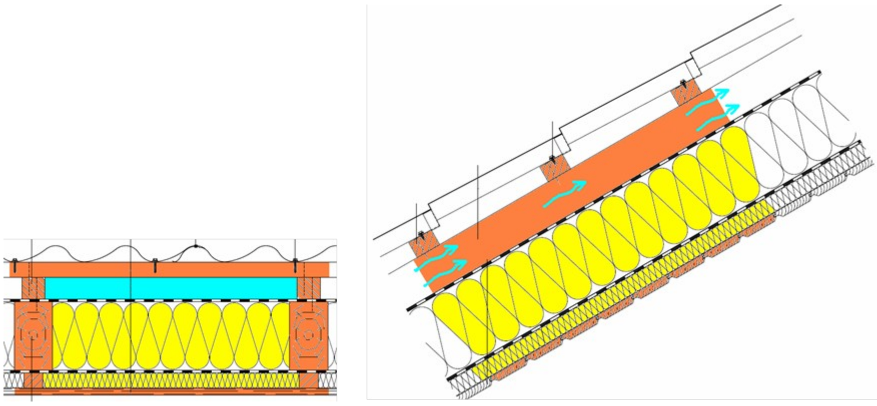


Figure 13: Cross-section of the air collector

3.6 Existing norms and standards

In the following there are referred existing standards and norms for the installation and use of solar thermal heating devices. No additional outdoor swimming pool norms and standards concerning solar thermal heating systems exist in Czech Republic. A list of all important standards, which impact the installation and usage of a solar thermal system cited here, will be furthermore considered during the development of the campaign strategies

Solar Thermal pool heating:

- N/A

Outdoor pool operation concerning solar thermal heating:

- N/A

Solar thermal applications:

- CSN 06 0830:1996
- CSN EN 12975-1:2002
- CSN EN 12975-2:2003
- CSN EN 12976-1
- CSN EN 12976-2

Certification of solar collectors:

- CSN 06 0009N/A
- CSN 06 0830
- CSN 06 0212 (in conjunction with CSN EN 306)

4 Market analysis

4.1 Public sector

4.1.1 Number of pools

We tried to take contacts to swimming pools from sanitary inspection, which supervise quality of water in every public swimming pool. It was refused by the inspection. Than we have to buy database of members of ABAS (Czech Pool and Sauna Association). There is also comprehensive database of 567 outdoor swimming pools available on Internet but it contains only a few contact information [5].

Table: Statistics of outdoor swimming pools

Total number of outdoor swimming pools	**567**
Total number of questioned outdoor swimming pools	**89**
• **thereof solar thermal heated**	15 (flat-plate collectors only) 5 combined with heat pump 1 with steam heating
• **thereof gas heated**	8
• **thereof oil heated**	0
• **thereof wood heated**	0
• **thereof district heating**	10
• **thereof heat pump heated**	6
• **thereof no heated**	50

We spread questionnaires to all outdoor swimming pools in ABAS database (255), but only about 35 of them come back. Because of it is not representative selection there was selected 3 regions NUTS2 according to climatic conditions (Jihomoravský, Jihočeský a Zlínský) in which there is 81 pools in database of ABAS.

We was succeeded to contact 31 of them, thereof 6 have solar heating. In near future other 3 planed to install new solar system. Contacting of other 50 pools was miscarried, proportion of heated pools in this group we estimate[1] at most 10 %. Additionally was discovered informations about 5 uncontacted pools by other information sources – no of that is heated, it looks to confirm our presumption. Overview is in the table below:

Based on presented survey and presumptions we estimate total number of outdoor swimming pools 570 thereof 58 solar heated and 65 heated by other sources.

Table: Selected outdoor swimming pools from database ABAS

[1] We suppose the heated pools require better management therefore owner/operator have to be easier to contact. For example every aquapark with heated pools (best management) has own web pages. On other hand only a few unheated pools have web pages.

Contacted 31 thereof	13 heated		18 not heated
	State of the art	Planned changes	Planned new
Solar	4		2
Solar + additional	2		
Heat pump	1		3
District heating	3	1 to solar	1
Cogeneration unit	2		2
Gas	1		

4.1.2 Used heating systems

There are not many heated public outdoor swimming pools in the Czech Republic, approximately 10 % of outdoor pools. The heated ones mostly use district heating (fossil fuels – coal or natural gas). For outdoor pool heating some solar systems with flat plate collectors were installed in the eighties. More recently there are installed heat pumps and cogeneration units because of subsidy policy of the Czech government. In the year 2008 there were installed systems with flat plate or vacuum tube collectors. Unglazed absorbers are used only for domestic pool heating; nevertheless market potential of this sector is large.

4.1.3 Cost comparison of the different heating systems

Fuel cost

- Natural gas – 280 CZK/GJ
- Brown coal – 170 (160 to 180) CZK/GJ (including ecological tax)
- District heat – 380 (280 to 520) CZK/GJ
- Wood – 150 (120 to 180) CZK/GJ (wood chips 90 to 120 CZK/GJ)
- Heat pump – 140 CZK/GJ (electricity – 690 CZK/GJ, tariff for heat pump; COP = 5,0)

4.2 Domestic sector

In domestic sector there is not statistics of number of pools. According of statistics of Ministry of Industry and Trade [2], there is annual sale of 70 000 m^2 of plastic absorbers for heating of private pools in the year 2007 – much more than it is usual in other countries of EU.

For the heating of domestic pools there is frequently used energy surplus of overdimensioned solar systems for hot water heating as well as energy surplus of the systems for space heating. The pool in those cases is used as protection against overheating of the solar system.

5 Best practices

5.1 Pool 1 – Physiotherapy Centre of the Podhostýnský Microregion

Figure 1: Solar system on outdoor swimming pool at Rusava, left: western part of the collector area (© Czech RE Agency, o.p.s.), right: satellite view, collectors on upper part (© www.geodis.cz, © mapy.seznam.cz)

Technical Data of the Absorber System

Flat plate collector surface area	540 m^2
Pool surface area and volume	770 m^2, 1000 m^3
Year of installation	2004
Operator	Community of Rusava
System installer	Ekosolaris
Planning	Ekosolaris
Collector type	Ekostart Therma II
Auxiliary heating system	Heat pump
Previous heating system	Solar, flat plate collectors, 600 m2
Specific yield	380 kWh/m² and season
Environmental gain	40 tons/year of CO_2 (compare to heat pump only)
Cost of the solar system	8 000 000 CZK (320.000 €) (including heat pump)
Specific system cost	14 800 CZK/m^2 (450 €/m^2) (including heat pump)
Subsidy	50 % grant, 30 % loan
Operation costs savings	???

Short description of the system

The swimming pool is located in a valley with slightly colder climate. It is operated by municipality of Rusava as part of The Physiotherapy Centre of the Podhostýnský Microregion. The system is the largest solar-thermal heating system in the Czech Republic in whole, not only in segment of swimming pools. The new collector system replaced the old one installed in the early eighties. Mainly due to this installation the small community of Rusava is the leader of the Solar League in category solar collector area per person.

Partners :

- Owner/operator : municipality of Rusava,
- Planning and installation: Ekosolaris

Contact Address

RUSAVAK, s.r.o., Rusava 248, 768 61 Bystřice pod Hostýnem 7, tel. 573 392 066

Ekosolaris, a.s., www.ekosolaris.cz, tel. +420 573 330 344

5.2 Pool 2 – Lázně Zlín

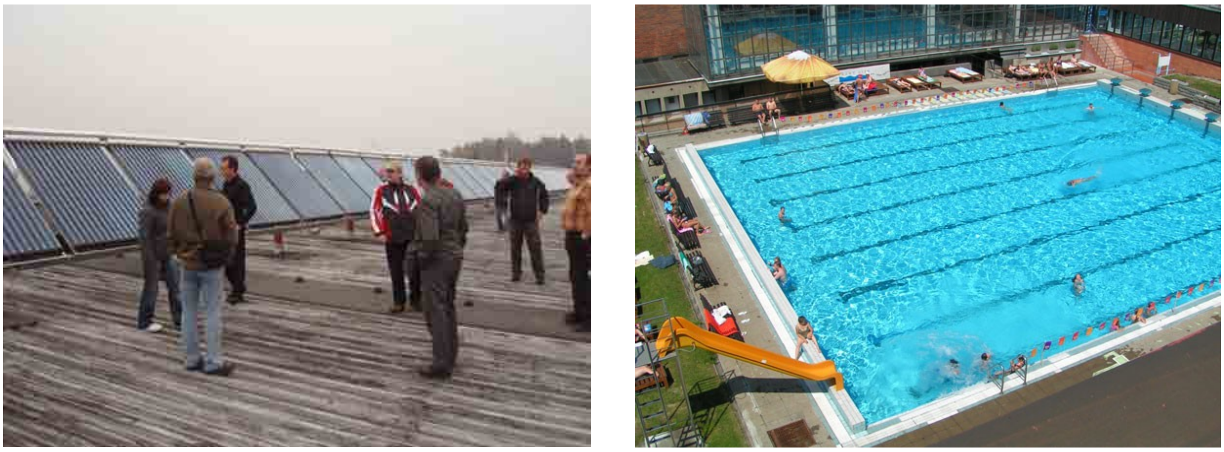


Figure 2: Swimming pool of Lázně Zlín

Technical Date of the Absorber System

Vacuum tube surface area (for pool water)	195 m^2 (about 260 m^2 gross area)
Pool surface area and volume	650 m^3 outdoor, 2100 m^3 indoor
Year of installation	2008
Operator	STEZA Zlín, s.r.o.
System Installer	SOLLUX, s.r.o., Zlín
Collector type	SUNERGY KVS 16
Auxiliary heating system	District heating (steam)
Previous heating system	District heating (steam)
Specific yield	572 kWh/(m^2.a)
Energy savings	111 MWh/a
Environmental gain	???
Costs of the solar system	5 830 000 CZK (240 000 €)
Subsidy	2 040 500 CZK (Concerto – Energy in Minds!)
System costs in EUR/m²absorber area	29 900 CZK/m^2 (1200 €/m^2)
Operation costs savings	250 000 CZK/a (10 000 €/a)

Short description of the system

There are four swimming pools in area of Lázně Zlín; 50m and 25m indoor swimming pools, children pool and 25m outdoor swimming pool. Solar heating system made of 76 vacuum tube collectors in two lines is installed on the roof of the 50m indoor pool. Energy from solar system is used prior for heating of the indoor pool. Only energy surplus in summer season is used for heating of neighbouring outdoor swimming pool.

Partners

Operator STEZA Zlín, s.r.o.

System Installer SOLLUX, s.r.o., Zlín

Contact Address

STEZA Zlín, s.r.o., Ing. Lubomír Matoušek (director), Hradská 888, 760 01 Zlín

SOLLUX, spol. s r.o., tř. T. Bati 32, 760 01 Zlín, www.sollux.cz, mail: sollux@sollux.cz, tel.: +420 576 776 091, GSM: +420 773 161 161

6 Finances

6.1 System costs in Czech Republic

Cost of solar thermal system varies according to type of collectors. Every of three main types have some advantages. Unglazed absorbers are relatively cheep; on other end there are vacuum tube collectors with high efficiency in winter.

6.1.1 System costs according pool surface area

There was selected three representatives of swimming pool according to surface area – small (10 m^2), medium (100 m^2) and large (500 m^2). Comparison of investment cost of whole system including installation is described in the table below. The numbers for 500 m^2 area in the table below are averages of bid prices we asked for. The numbers for 100 m^2 and 10 m^2 are derived according to particular costing of the 500-m^2 system and prices of smaller components. Shorter piping is assumed for the smaller systems. Prices of 10 m^2 systems were compared with prices of one-family system for domestic water heating. The prices for vacuum collectors are indicative only because of they are based on parameters of only one system. All values are for gross area of collector system (including spaces between collectors).

Table: Investment cost of different types of solar system, prices in CZK for three selected dimensions of collector area

Collector area	Pipe length	Absorbers			Flat plate collectors			Vacuum collector
		PP	EPDM					
m^2	m		min	max	avg.	min	max	
Investment cost including installation (thousands of CZK per installation**)**								
500	**100**	950	1 700	1 950	3 700	3 400	4 500	8 000
100	**50**	220	370	420	850	780	1 000	1 800
10	**20**	28	42	47	125	116	160	240
Specific investment cost (CZK/m^2**)**								
500	**100**	1900	3400	3900	7400	6800	9000	16 000
100	**50**	2200	3700	4200	8500	7800	11000	18 000
10	**20**	2800	4200	4700	12500	11600	16000	24 000
Specific solar yield in kWh/season (depends on temperature of collector)								
min (35 °C)		140			370			300
max (25 °C)		350			450			350

Table: Detailed cost of solar system with glazed collectors (500 m^2 area)

		average	min	max
specific cost	CZK/m^2	**7700**	5000	9000
thereof				
collectors	%	**55**	50	65
supporting construction	%	**14**	12	15
pipes include isolation	%	**10**	5	15
installation	%	**10**	8	12
heat exchanger	%	**2**	2	4
expansion tank	%	**2**	1	2
electronics	%	**1**	1	2
anti-freeze	%	**1**	1	2
Other	%	**5**	2	5

6.2 Funding and Financing schemes

6.2.1 Program 1 – National Program for Energy Efficiency and RES

Programme Name	National Programme for the Energy Effective Management and the Utilisation of Renewable and Secondary Energy Sources
Organisation	Státní fond životního prostředí České republiky (SFŽP) (State Fund of Environment of Czech Republic)
Street	Kaplanova 1931/1
Postal code	148 00
City	Praha 11-Chodov
Email	dotazy@sfzp.cz
Telephone	+420 800 260 500 free of charge
Type of Support	Investment subsidy, soft loan
Available Money	N/A
Share of total budget	N/A
Who can apply	Local authorities, owners and operators of swimming pools
Requirements for application	Apllication form (part G – renewable energy sources), compliance with energy audit conditions (Supplement No. II. 8)
Targeted areas	Solar thermal applications used for heating water in communal buildings
Short description	The National Programme for the Energy Effective Management and the Utilisation of Renewable and Secondary Sources of Energy is managed by the Ministry of Industry and Trade and the Ministry of the Environment
Documents	http://www.sfzp.cz/cs/narodni-programy/dokumenty/
Source of information	http://www.sfzp.cz/sekce/94/narodni-programy/
Year of beginning	2007 announced yearly
Information website	http://www.sfzp.cz/

6.2.2 Program 2 – OPŽP

Programme Name	Operational programme Environment (Operační program Životní prostředí OPŽP)
Organisation	Státní fond životního prostředí České republiky (SFŽP) (State Fund of Environment of Czech Republic)
Street	Kaplanova 1931/1
Postal code	148 00
City	Praha 11-Chodov
Email	dotazy@sfzp.cz
Telephone	+420 800 260 500 free of charge
Type of Support	Investment subsidy
Available Money	5,2 billion Euro (2007-2013)
Share of total budget	N/A
Who can apply	Not entrepreneur subjects (municipalities, regions, allowance organisations, not-for-profit org., Church etc.)
Requirements for application	Technical, economical and ecological terms stated in Document for Implementation
Targeted areas	Renewable energy sources including solar thermal applications
Short description	Operational programme Environment – one of the 7 main programme pillars is targeted to greater use of RES
Documents	Document for Implementation
Source of information	http://www.sfzp.cz/sekce/88/op-zivotni-prostredi/
Year of beginning	2006
Information website	http://www.sfzp.cz/

6.2.3 Program 3 – ROP

Programme Name	Regional Operational Programmes (Regionální operační programy ROP) For NUTS II regions of Czech Republic
Organisation	Regional board of NUTS II according to specific ROP
Street	
Postal code	

City	
Email	
Telephone	
Type of Support	Financial subsidy
Available Money	According to specific ROP and call
Share of total budget	According to specific ROP and call
Who can apply	According to specific ROP and call
Requirements for application	According to specific ROP and call
Targeted areas	According to specific ROP and call
Short description	Regional operational programs are focused to development of given region mainly in area of traffic and tourism
Documents	For example http://www.rr-moravskoslezsko.cz/file/647/
Source of information	For example http://www.rr-moravskoslezsko.cz/rozcestnik/rozcestnik.html
Year of beginning	2008
Information website	For example http://www.rr-moravskoslezsko.cz/

6.2.4 Program 4 – Municipal subsidy

Programme Name	N/A
Organisation	Municipal authorities
Street	
Postal code	
City	Praha, Plzeň, Litoměřice, Náchod (2007)
Email	
Telephone	
Type of Support	Financial subsidy
Available Money	500 to 2000 CZK/m^2 of absorber area depending on city
Share of total budget	N/A
Who can apply	Individuals, non-profit subjects
Requirements for application	N/A
Targeted areas	Solar thermal and photovoltaic systems
Short description	
Documents	N/A
Source of information	www.solarniliga.cz
Year of beginning	2006
Information website	

6.2.5 Program 5 – EFEKT 2008

Programme Name	EFEKT 2008
Organisation	Ministry of Industry and Trade (MPO)
Street	Na Františku 32
Postal code	110 15
City	Praha 1
Email	posta@mpo.cz
Telephone	+420 224 851 111
Type of Support	Financial subsidy
Available Money	N/A
Share of total budget	Up to 40 %, up to 2 000 000 CZK (80 000 EUR) for call 3.2
Who can apply	Municipalities, schools, enterpreneurs
Requirements for application	According to specific call
Targeted areas	Energy efficiency and renewable energy sources
Short description	A part of National Programme for the Energy Effective Management and the Utilisation of Renewable and Secondary Energy Sources
Documents	http://www.mpo.cz/dokument38960.html
Source of information	http://www.mpo.cz/dokument37411.html
Year of beginning	2006
Information website	http://www.mpo.cz/cz/energetika-a-suroviny/programy-podpory-v-energetice/

6.3 Cost Benefit Analysis

The investment cost for solar heating systems for outdoor pools are higher than that of conventional systems. But lower operation costs induce a very quick amortisation especially for unglazed absorbers. For a time frame of 15 years and interest rates of 6 % the investment in solar systems is preferable to conventional heating, see the table below.

Table: Comparation of different systems with energy production of 200 000 kWh per season

Heating system	Gas bioler	Glazed collector	Unglazed absorber		Unit
			PP	EPDM	
Surface area of solar system		500	800	800	m^2
Investment costs	1 215 000	3 390 000	1 670 000	2 990 000	CZK
Capital costs	125 142	349 161	172 005	307 962	CZK/a
Auxiliary energy	1 400	4 500	4 500	4 500	kWh/a
Fuel demand	222 222	0	0	0	kWh/a
Fuel and Electricity costs	242 334	16 447	16 447	16 447	CZK/a
Maintenance	24 300	33 900	16 700	29 900	CZK/a
Total yearly costs	391 775	399 508	205 153	354 309	CZK/a
Heat price	1 959	1 998	1 026	1 772	CZK/MWh
Heat price	544	555	285	492	CZK/GJ

Calculation assumptions:

- Electricity cost 3655 CZK/MWh including monthly payment
- Gas cost 1078 CZK/MWh including monthly payment
- Specific yield 400 kWh/m^2 glazed collector
- Specific yield 250 kWh/m^2 unglazed absorber

More important is actual trend in prices of fossil fuels or electricity. Annual growth is more than 10 %. From this point of view the solar systems are much more advantageous.

7 Summary

There are about 570 outdoor swimming pools in Czech Republic. Only about 10 % of them are heated and only about 5 % are heated by solar energy. Because of climatic conditions in Czech Republic there is only a little potential to extend outdoor swimming pool season. More actual from visitors' point of view is increasing of water temperature. Intensive growth of prices of conventional energy implies rising of interest in solar heating, some of operators are considered in change of energy supply.

Recently unglazed absorbers are competitive to fossil fuels; glazed ones are on edge of financial efficiency. Vacuum tube collectors are too expensive for outdoor swimming pool heating. Frequently there is combination of indoor and outdoor swimming pools; in this case use of glazed or vacuum tube collectors is more effective. The main barrier of share of solar heating is high investment cost of solar systems; nearly all of large systems were subsidized. Better situation is in segment of domestic pools where there were installed unglazed absorbers in total area of 70 000 m2 in year 2007 [2].

7.1 Boundaries for the implementation of solar systems for outdoor pools

The list below shows the national barriers, which must be overcome to improve the awareness of the end users and the implementation of solar thermal heating systems.

Technical or climatic barriers:

- Incorrectly defined and dimensioned systems
- Problems in the optimal combination with heat pumps
- Lack of certification and certificating test rooms (getting better recently)
- Installation of cheap and low quality components

Financial Barriers:

- Many pool operators are municipalities; they need funding for the installation of solar thermal systems
- Lack of awareness of the existing funding schemes
- High price of combined systems (solar thermal and heat pump for example)

Governmental barriers:

- Permission needed (only a technical expertise and a simply building control)
- More information is needed for the application of funding

Social barriers:

- Lack of knowledge about solar thermal systems and funding schemes
- No concept for a better administration of information

7.2 Requirements for the implementation of solar systems for outdoor pools

In this sheet the requirements of a solar thermal system, regarding the needs of the end users

Requirements of the End Users	Very Important	Less Important
Power gain for heating system	x	
Saving of energy costs	x	
Cost benefit from installing ST system	x	
Long time durability of the system	x	
Low effort for installation		x
Low effort and costs for maintenance	x	
Low required space for collectors	x	
Integration in existent heating systems		x
No problems with the pool hygiene	x	
Plant safety, no risk for pool users	x	
Easy handling of the system		x
Availability of grants /subsidies	x	
Independency from increasing energy costs	x	
Environmental protection		x
Other		

8 References

[1] *Climate Atlas of the Czech Republic*. Praha: Czech Hydrometeorological Institute, 2007. Sample maps available at: http://www.chmi.cz/meteo/ok/atlas/en/menu.html

[2] Bufka, Aleš. *Realizace solárních zařízení v ČR, přehled využívání solárních kolektorů v letech 1977-2007, statistika solárních systémů*. Available at http://www.csvts.cz/csse/Udalosti/2008/ForArch/8_Bufka.pdf

[3] Photovoltaic Geographical Information System (PVGIS). [online]. Available: http://re.jrc.ec.europa.eu/pvgis/

[4] Czech Hydrometeorological Institute. Available at: http://www.chmi.cz

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[6] Ministry of Industry and Trade of Czech Republic. Available at: http://www.mpo.cz

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[9] Solar league. Available at: http://www.solarniliga.cz

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