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Intelligent Energy  Europe

Solar Energy Use in Outdoor Swimming Pools SOLPOOL

The Impact Advisor MANUAL

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The Impact Advisor

1. Introduction

The solar heating of open air swimming pools is one of the most suitable applications for solar thermal systems. Although the advantages and benefits of using solar energy for heating swimming pool water clearly apparent, owners and operators need some decision guidance for the investment – free of sales interests and easy to handle. This tool has been developed within the frame of the SOLPOOL project as an Excel based calculation help.

The basic idea of the Impact Advisor is that there is a quasi linear dependency between a mean water temperature and the ratio of the collector- to the pool surface. This relationship is characteristic for every location and there is additional a slight dependence on the pool size.

Further assumptions have been made:

- Begin and end of the operating period is mainly determined by the air temperature. As experience has shown the threshold value is 20 °C. Therefore the simulation period covers those months when this temperature will be predominant achieved.
- For the Mediterranean locations (Spain, Italy and Greece) due to the hot temperatures in summer the maximum water temperature of the pool is limited to 28 °C.
- The operating mode of the open air pool heating system is monovalent without a fossil preheating system.

Important remark:

The mean pool water temperature is the targeted temperature and basic parameter of this tool. It must be emphasized that thi temperature is not a guaranteed one. The real pool water temperature may differ and vary from this value considerably depending on the daily solar input and air temperature.

Based on computer-aided calculations made with the T*SOL program, version Expert 4.2, the following relations have been analyzed for every location in the table:

- Number of guests per day: 1 swimmer per 10 m² pool surface
- The daily fresh water requirement is calculated by the program
- No heating systems installed
- Inclination angle for absorbers: 0°
- Inclination angle for flat plate collectors: 30°, south oriented

These assumptions present realistic conditions and sensitive analysis simulations have shown that deviations from these conditions have rather small influence on the result compared to the most important parameters **Location, Pool size, desired pool temperature** and **collector type**.

2. Input parameters

2.1 First step

At the beginning of the session one has to select the language:

- Czech
- English
- French
- German
- Greek
- Hungarian
- Slovenian
- Italian

2.2 Second step

Afterwards the coordinates of the owner of the pool can be put in the according cell:

- Name
- First Name
- Street
- Postal code, City

SOLPOOL - IMPACT ADVISOR	
Select Language	English <input type="button" value="v"/> Language English
Legend	
=	Input cell
=	Output cell
Owner/operator of the pool	
Name	Walter
First name	Fritz
Street	Betzenberg
Postal code, city	67655 Kaiserslautern

2.3 Third step – Basic Data

Now the basic data will be required. At first one has to determine if it is a new pool or an existing one. If a new pool is planned the energy demand will be calculated based on the planned pool surface and the desired mean seasonal water temperature. This energy demand is exactly the same that a solar system will produce if it equipped with a sufficient large absorber or collector field.

If the option existing pool is chosen than one can later fill in the cells with the figures of Energy consumption and Energy costs.

Basic data			
Existing/New Pool	Existing pool		
Pool size	Small		
Approx. Pool surface	< 100 m ²		
Heating system	Electric		
Global radiation reference to city	D - Hamburg - 947 kWh/m ² a		
Annual irradiation	947 kWh/m ² a		
Mean outside temperature	9,2 °C		
Mean seasonal water temperature without addition of energy	17,68 °C		
Pool surface	m ²		
Mean seasonal water temperature with solar energy	20,00 °C		
Energy consumption	kWh/a	Energy demand	MWh/a
Energy costs	€/a	Energy price	€/kWh
Energy price	€/kWh	Energy costs	€/a

As the relationships and costs of open air swimming pools depend on the size of the pool three categories have been chosen:

- Small pools, surface < 100 m²
- Medium pools, surface 100 – 500 m² and
- Large pools, surface > 500 m²

Although all calculations have been made without an auxiliary heating system the reduced CO₂ Emissions can be calculated by choosing a heating system, based on

- Electricity
- Heat pump, air, soil or water
- Liquefied Petroleum Gas (LPG)
- Natural Gas
- Oil
- Solar Thermal
- Wood

Next step is choosing the location of the swimming pool. Therefore radiation maps of the country can be selected and the global radiation colour of the location can be chosen. The Impact Advisor will automatically select the corresponding city from the data base. The Annual radiation and mean outside temperatures of this city will be shown in the following blue cells. An important information for choosing not too unrealistic target temperatures for the swimming pool water is the temperature generated only by the sun without techniques. This is shown as the Mean seasonal water temperature without addition of energy. Normally a moderate dimensioned solar system can increase this temperature by 3 to 4 Kelvin.

Next the existing or planned pool surface has to be put in the cell in square meters , followed by the energy consumption and energy costs if these amounts are known (existing pool). Either an energy price in €/kWh will then be calculated or, for a new pool, energy costs will be calculated based on a given energy price.

2.4 Fourth step – The Results

After the basic parameters have been set one has to chose the collector type:

- unglazed collector
- flat plate collector

The main characteristic values for the collectors are:

	Unglazed absorber	Flat plate collector
Optical efficiency/conversion factor	85 %	80 %
Single Thermal Transmittance Coefficient	20 W/m ² K	3,8 W/m ² K
Square Thermal Transmittance Coefficient	0,1 W/m ² K ²	0,03 W/m ² K ²

The flat plate collector is selective coated.

After this last input the results of the calculations will be shown with the following values:

- Ratio absorber area to pool surface area

This ratio is 1,0 if the collector area is the same as the pool area. Under most conditions a factor of 0,8 to 1,0 is the appropriate value for sufficiently increased pool water temperatures by an absorber installation.

- Absorber area

Based on the calculated ratio and given pool surface area the absorber / collector area is calculated. If this surface area is too large for the considered roofage, one may choose the flat plate collector option.

- Specific solar yield

The specific solar yield (kWh/m² season) is a calculated value as a result given by the T*SOL program. It depends on the radiation, collector type, pool size, target pool temperature and operation period of the swimming pool.

- Energy saving amount

The energy saving amount (kWh/season) is the product of the absorber/collector area and the specific solar yield. If a calculation against a conventional heating system is desired, the efficiency of the heater has taken into account.

- Saving Energy costs

Multiplied by the given (new pool) or calculated (existing pool) energy price, the energy saving amount will give the saving energy costs in €/season. Knowing the saving energy costs an owner or operator of a swimming pool can easily estimate the money he can save by choosing a solar thermal system for his swimming pool.

- Specific system costs

These costs have been input value from the data base, depending on the pool size and collector type. They include all components of the system and the installation costs. The specific system costs are net costs. No grants or subsidies have been taken into account

- Investment costs

Investment costs are simply the product of the specific system costs and the system size in squaremeters absorber/collector surface are.

- Operating costs

As the solar thermal system needs electricity for the pumps and additional costs will incur for the maintenance an approach has been made assuming annually operating costs by 1% of the investment costs.

- Pay back time

The amortization or pay back time is calculated by dividing the investment costs and the operating costs for 20 years through the yearly energy saving costs. For the rather cheap absorber systems pay back times of some years can be achieved. Due to higher specific investments costs the pay back time for solar systems with flat plate collectors is significant longer.

- Emission value

Based on the chosen heating system the corresponding emission value in g/kWh is

taken from the data base.

- Saving CO₂-Emission

Calculated from the Energy saving amount and the emission value the CO₂ reduction is calculated and shown.

Results	
Type of collector	Unglazed collector ▼
Ration absorber area to pool surface area	1,03
Absorber area	92,64 m ²
Specific solar yield	214,82 kWh/m ² a
Saving Energy amount	19.900,59 kWh/a
Saving energy costs	4.378,13 €/a
Specific system costs	115,00 €/m ²
Investment costs	10.653,42 €
Operating costs	2.130,68 €/20a
Pay back time	2,92 a
Emission value	647,00 g/kWh
Saving CO ₂ Emission	12.875,68 kg/a

3. Important note

The Impact Advisor offers the possibility of getting a quick and easy handling first estimation. He replaces under no circumstances a planning made by an engineer. If the specific conditions differ strongly from the background assumptions an application of this tool may make no sense.

The calculation of the economy of the invest is based on the assumption of a fixed energy price. Increased energy prices will shorten the pay back time. The stated specific investment costs don't include grant or subsidies which might be taken into account.