**T*SOL** camp

# Simulation programme for the quick design and calculation of solar thermal systems

## User Manual




On behalf of:

www.solcamp.eu

# Contents



# 1. Introduction

## 1.1. Programme Information

T*SOL camp is the quick and easy design programme for solar thermal water systems. It is the right choice for Solarchekers who need a reliable tool to design solar thermal systems quickly and precisely. A number of different systems can be selected for hot water supply. The programme is user-friendly, taking you through a few simple steps with clearly laid-out dialogues, allowing you to work quickly and efficiently.

With T*SOL camp you can use the symbols in the simple navigation bar to go directly to the corresponding position in the programme. You can also use the Continue and Back buttons to work through the programme from start to finish, so that you don't miss any entries.

T*SOL camp offers you a selection of 4 different systems for calculation. For hot water supply, there is a thermosyphon system, a bivalent (twin coil) system with one storage tank and a two-tank system with a solar and stand-by tank as well as a large-Scale System.

T*SOL camp is a reliable planning tool which calculates the collector area and storage tank volume, so that dimensioning errors are avoided. The required number of collectors, selected from five different collector types, is determined by inputting the hot water requirement or the number of piches in the camping site.

T*SOL camp has a large selection of climate data for locations in Europe and worldwide. After entering the inclination and orientation, a detailed yield calculation is carried out for the selected system components. The calculation is based on the calculation algorithms in T*SOL®.

T*SOL camp produces a simple project report for your customers with clear presentation of the system data and results, as well as a system overview. The report can either be printed out or sent as an e-mail attachment in pdf format.

## 1.2. Computer System Requirements

Hardware

- Pentium II 266 MHz
- 128 MB RAM
- 24 MB free on your hard disk drive
- Additional space on your hard disk drive for the meteorological data - up to 94MB for full installation
- CD-ROM drive
- 1024x768 screen resolution

Operating System (with the latest service pack)

- Windows 2000
- Windows XP

System Requirements:

- Internet Explorer 5.01 or higher
- Data Access Components (MDAC) 2.8

## 1.3. Programme Installation

To install the programme put the programme CD into your computer's CD drive. The installation programme will start automatically and you will be taken through the installation procedure step by step (unless the CD drive autorun function has been deactivated on your computer).

If the autorun function has been deactivated, you will need to start the "Setup.exe" file which is on the CD. To do this you can start File Manager or Explorer and double click on the "Setup.exe" file in the CD drive.

If you install T*SOL camp onto a computer with WIN2000 or WinXP, you will need to have administrator access to the operating system.

To run the programme, you will need to have full rights (read and write) to the T*SOL camp programme directory (e.g. C:\Programme\Valentin EnergieSoftware\TSOLcamp 1.0).

## 1.4. Programme Activation

After installing and opening the programme, a small window appears asking whether you wish to start the programme as a Demo Version or Register the Full Programme. This dialogue appears every time the programme is started, until you have activated the programme successfully.

The Demo Version gives you the opportunity to test and familiarise yourself with the programme. However, you are not able to save any projects or print the results. Once you have activated/registered the software, all programme functions will be fully available to you.


You can also carry out the registration procedure from within the programme. To do this, click on the **Info** button in the lower programme control bar and then on the **Registration** tab.

Programme **Activation** is carried out by following the instructions, requesting a **Key Code** and then entering it in the programme. The Key Code is provided by the programme manufacturer on request.

First you will need to make sure that:

- You have a Serial Number
- The programme has already been installed
- When you start the programme, you click on the **License Full Version** button

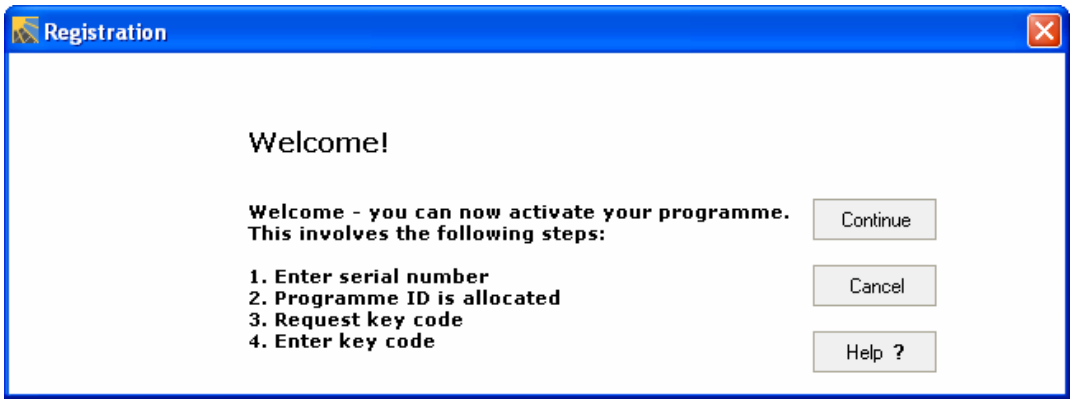
Programme Activation is carried out in four steps:

- Enter Serial Number
- Programme ID is Allocated
- Request Key Code

- Enter Key Code

The corresponding dialogue introduces the registration procedure.



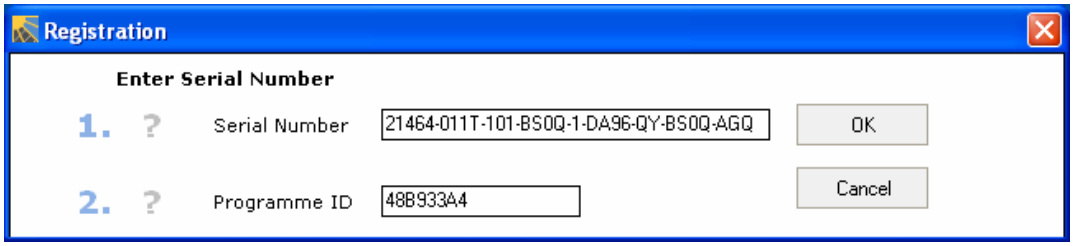

Click on **Continue** to start the registration procedure.

### 1.4.1. Enter the Serial Number

If you purchased the programme from the manufacturer, you will already have a Serial Number. You will find this on the CD cover, on the invoice or we will have sent it to you by e-mail. The Serial Number has the following format:

12345-123T-123-1NN-1-VW2R-RY-Z62-AGNH1

It needs to be entered exactly as it appears, including all character and without any spaces. After the Serial Number has been entered, the programme allocates a Programme ID, which is based on the Serial Number and a code for your PC.




**You Still Don't Have a Serial Number?**

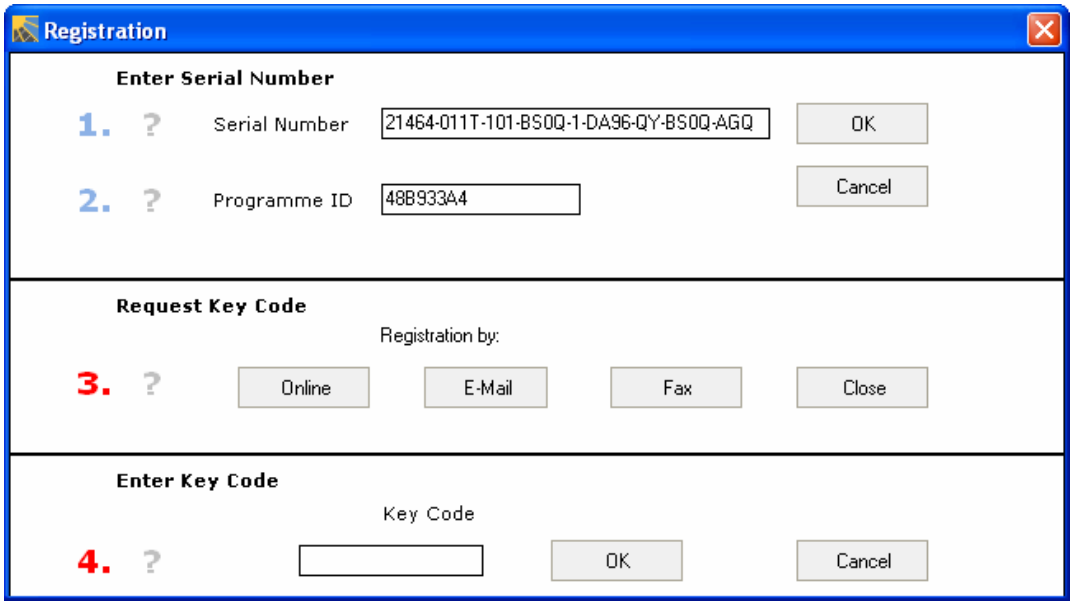
This could be the case if, for example, you have installed the programme from the Demo CD or you have downloaded it from the internet. You will need to purchase a full version of the programme before you can receive a Serial Number.

For that purpose please contact your local Solcamp Partner.

### 1.4.2. Request a Key Code

After entering the Serial Number and automatic allocation of the Programme ID, you will need to provide us with this information, so that we can send you your Key Code. You will see the following window on your screen:




You can request the Key Code in a number of different ways, but the quickest way to do this is online.

#### 1.4.2.1. Request a Key Code Online

This is the simplest and quickest method, requiring that your computer has internet access.

Click on the **Online** button underneath **Programme ID** in the Registration window. A form opens in which you enter the data required to obtain a Key Code. The fields marked: * have to be completed to continue. The serial number and programme ID are included automatically.

After completing the form, you can send it straight off to the programme manufacturer via the internet. You will receive the Key Code in just a few minutes. It will be sent to the e-mail address entered on the form.

#### 1.4.2.2. Request a Key Code by E-Mail

If, on the other hand, you click on the **E-Mail** button in the Registration window, this will open your e-mail programme. The text in the e-mail is almost complete – you just need to enter your customer details and send the e-mail.

You will then receive the Key Code by e-mail, normally within a day. The code will be sent to the e-mail address entered on the form.

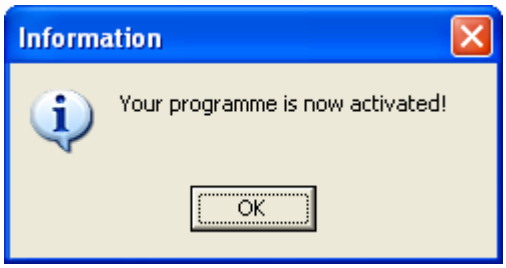
#### 1.4.2.3. Request a Key Code by Fax

If you click on the **Fax** button underneath **Programme ID** in the Registration window, a form opens for you to complete and print off. Send the completed form by fax to: +49 30 588 439 11.

You will then receive the Key Code by fax within one working day. You can also enter an e-mail address to which the Key Code should be sent.

### 1.4.3. Enter the Key Code

Once you receive the Key Code, you will need to enter it by hand or copy and paste it into the field under “Enter Key Code” in the Registration window and then click on the “OK” button. This completes the programme registration and activation procedure. An information window appears with a message that registration has been completed and the programme is now fully functional.



# 2. General Programme Structure

## 2.1. Welcome Page

The ***Welcome*** page opens automatically when you start the programme.

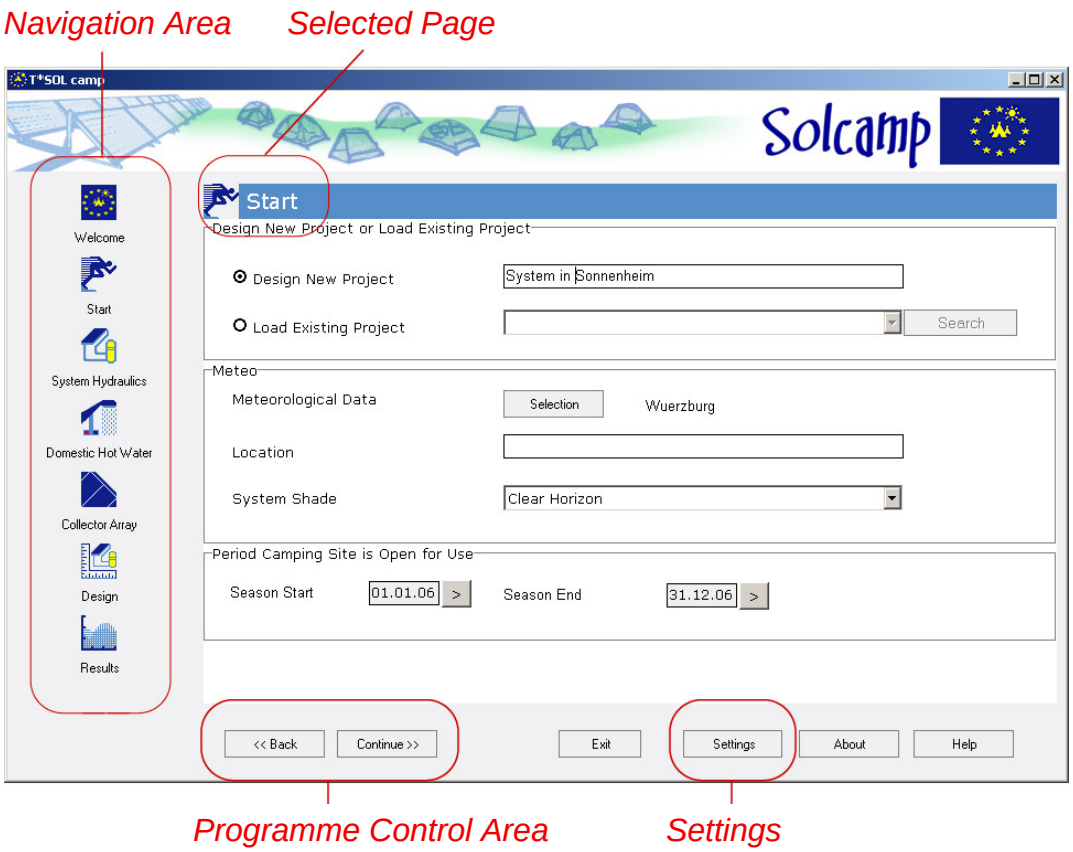

This page contains a general description of the programme. Click on the User Manual link to open the manual (pdf file).

You can click on the corresponding icon to find out more about the extensive solar thermal simulation programme **T*SOL Professional**. The link will take you to the detailed information on the Valentin Energy Software website.

## 2.2. Moving Around the Programme

The programme window is divided into different areas, to help you move around the programme quickly and easily.




### 2.2.1. Navigation Area

The left-hand side of the programme window contains the active icons, so that you can move directly to a particular page. This part of the programme window is the ***Navigation Area***. Click on the icons to go to the page selected from any part of the programme, whether before or after the page you are currently on.

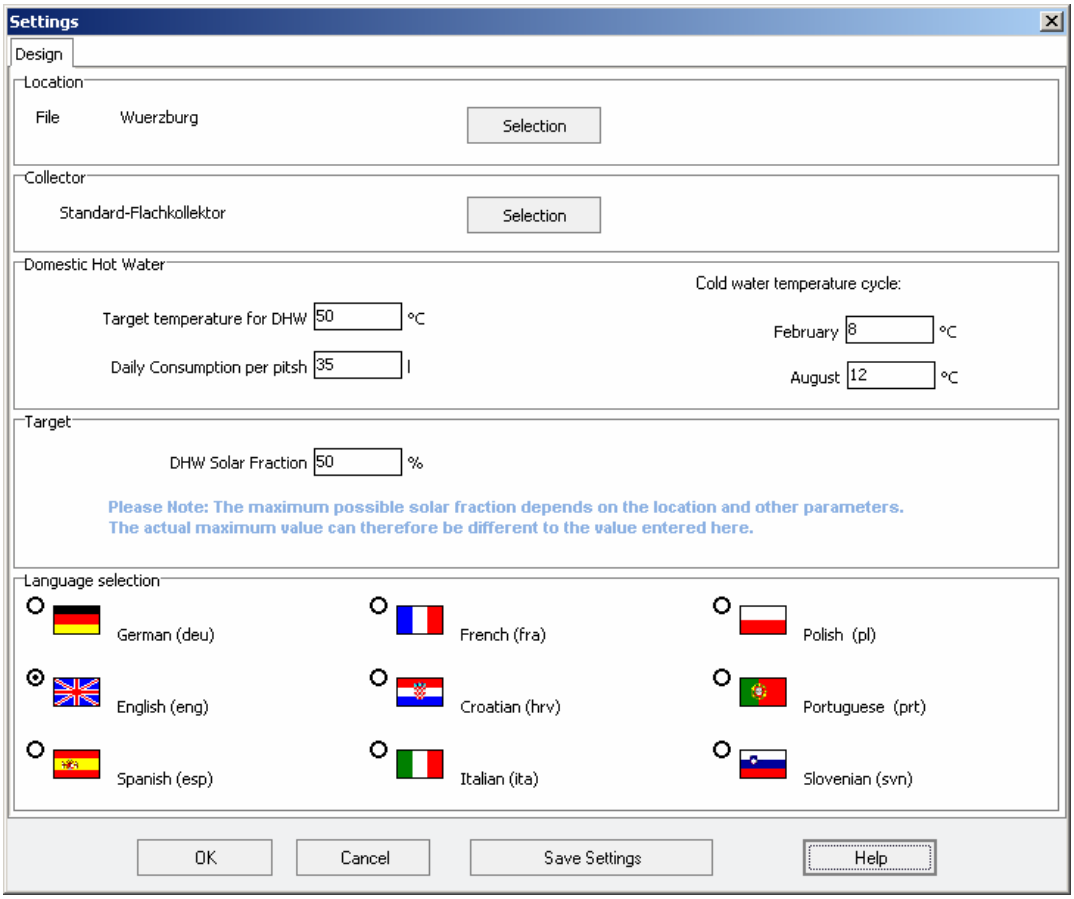
### 2.2.2. Programme Control Area

There are a number of other buttons at the bottom of the programme window in the ***Programme Control Area*** to help you use the programme. Click on ***Continue*** and ***Back*** to move to the next or previous page. This allows you to work systematically through each page of the programme, without missing any entries.

Click on ***Settings*** to open a window where you can enter and change the settings for your projects.

You can select the settings for the climate data record, the collector type and enter various other system parameters on the ***Design*** tab sheet. These settings appear automatically in the programme each time you open a new project. You should use this facility to define the parameters that you generally use as standard. You can also set the Solar Fraction for your system designs here.

You can select your language by choosing on of the language options.



Click on the ***Info*** button to the right of the ***Programme Control Area*** to take a look at the general information on your programme, such as the version number, and details on your hardware and operating system. You can also register your software from here. Select the tabs at the top of the Info window to get to the corresponding sheet.

On the ***Further Information*** tab sheet you will find a ***Mail*** button, which you can use to send a query to the Valentin hotline. When you click on this button, your e-mail programme will open automatically. All the information that we require in addition to your hotline query are already entered in the text area.

You serial number and key code are included on the ***Registration*** tab sheet, provided that the programme has been activated. You can also change or renew the registration by clicking on the ***Change Registration*** button.

Click on the ***Help*** button to the right of the ***Programme Control Area*** to open the help text for the programme page that you are currently on. You can use the navigation area in the help window to go direct to other help texts, or you can use the ***Index*** or ***Search*** tabs to search for particular texts.

Click on the ***Exit*** button to the right of the ***Programme Control Area*** to close the programme. A message window usually appears asking whether you want to save the current project.

# 3. Creating Projects with T*SOL camp

## 3.1. Example Project

Here we will use an example project to illustrate how you set up a project in T*SOL camp. This example project is also saved within the programme.

The data that you require to create the example project are as follows:

| | |
|---|---|
| Project Name: | Combination System in Sonnenheim |
| Climate File: | Würzburg |
| Design System: | With Bivalent DHW Storage Tank |
| Type of Collector: | Flat-plate collector |
| Roof Angle: | 55° |
| Orientation (Azimuth): | -10° east from the south |
| Length of Piping: | 10 m |
| Target Solar Fraction: | 20% |

First of all, you want the programme to determine the size of the storage tank and the required collector area for the above example project data. Then, by carrying out a simulation over the period of one year, the programme will calculate the energy yields, the primary energy savings and the $CO_2$ emissions avoided.

If you are still on the ***Welcome*** page, click on the ***Continue*** button to the right of the ***Programme Control Area***, or click on the ***Start*** icon in the ***Navigation Area***.

## 3.2. Start

You can either create a new project or open an existing project on this page.

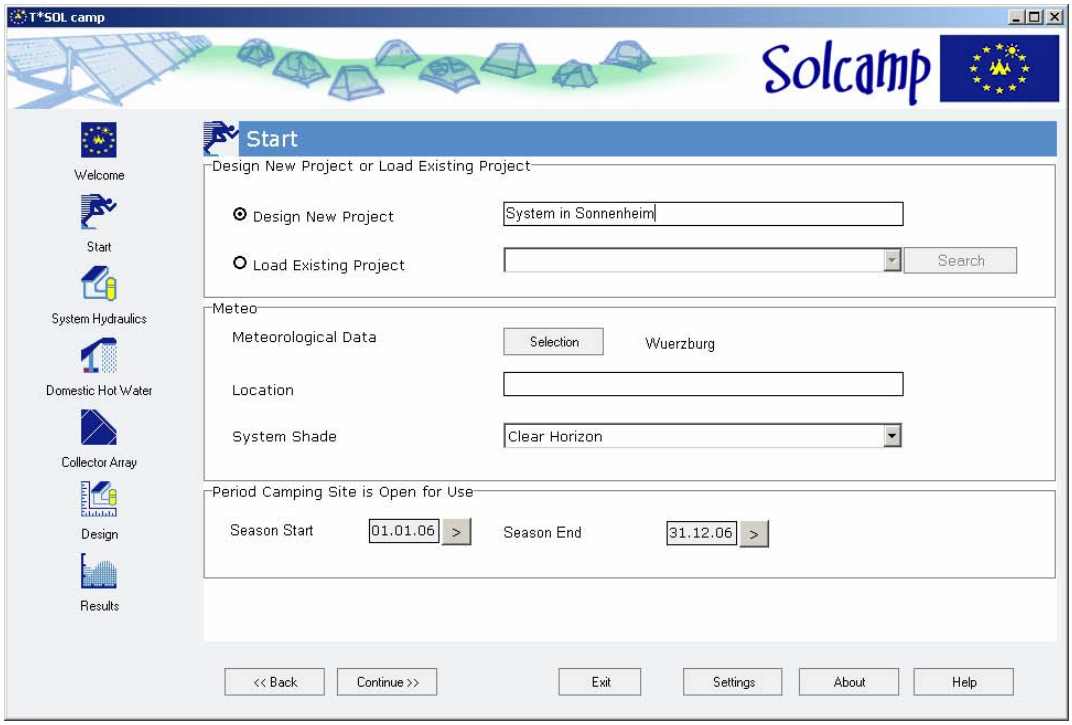
You should enter an easily recognisable name for the project that you wish to create, so that you can easily find the project later on, when you want to work on the project again or make any changes. The name that you enter will be automatically saved as the file name. Projects are either saved to the default directory called ***projects***, or to another directory if you prefer.

All projects saved have the file ending ***.tva** and are normally saved in the following programme directory: C:\ Documents and Settings\ ...\ Own Files\ Valentin EnergieSoftware\ TSOLcamp 1.0\ projects.

Type in a name, e.g. **System in Sonnenheim**.

If you select ***Load Existing Project***, you can open a project that has been previously created and saved. Click on ***Search*** to get to the directory where your files are saved and look at the list of existing projects.

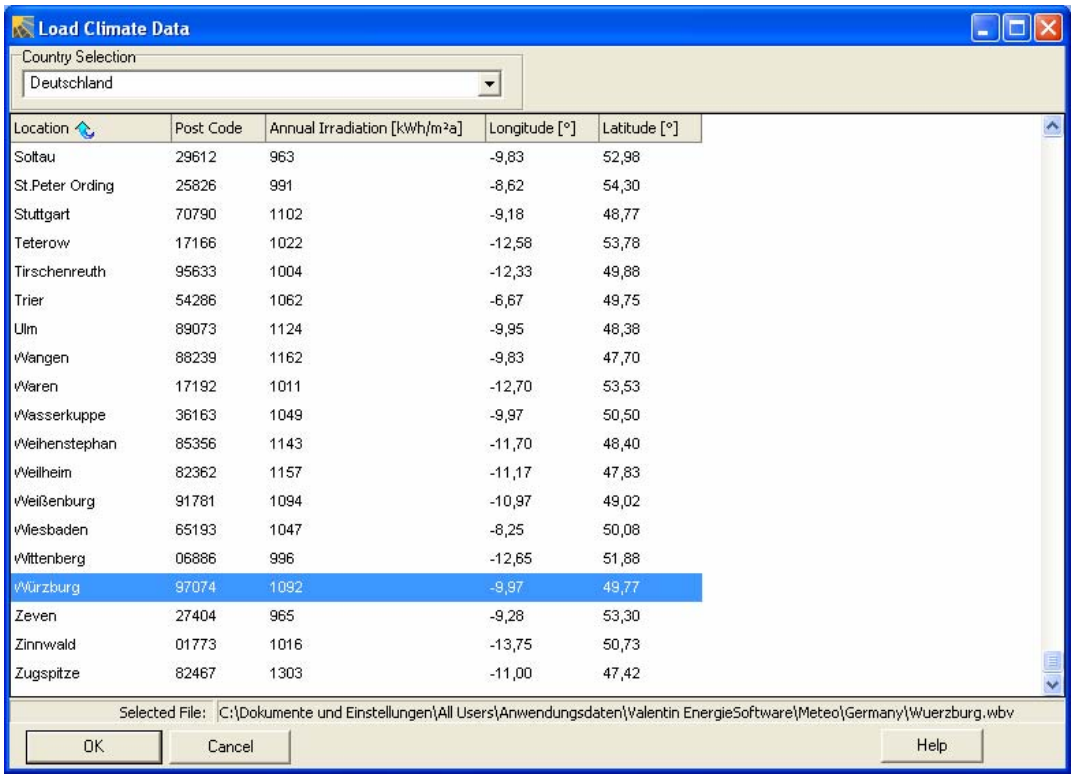
Select a project, e.g. **System in Sonnenheim**.



You also select the climate data for the project location in this dialogue. Click on ***Select*** to open an extensive list of climate data records from Germany and other countries – depending on which data records you selected when the programme was installed. The postal codes, longitudes and latitudes will help you to find the data record closest to the project location.

After clicking on the ***Select*** button, you will see the following list:




If you have installed climate data for a number of countries, you can first select the country from the ***Country Selection*** field at the top of the dialogue. When you have selected a country, only the data records for that country will be shown.

For our example project, select ***Germany***.

Click on a column heading to sort the database either by city, postal code, longitude or latitude. This will help you to find the data record closest to the project location. Click again on the same column to sort in the opposite direction. If you type in the first character of the text you want to find in the column that has been selected, you will jump direct to the first entry with this character.

Sonnenheim is located, for example, close to Würzburg. Therefore you should click on the ***Location*** column heding and enter a “w”. The first location starting with the letter “w” is then shown. Move down and select ***Würzburg*** and then click on ***OK***. Alternatively, you can click on the Postal/Zip Code column heading to sort by postal code. Type in “9” and the first location that has a postal code starting with “9” is selected.

Click on ***OK*** to accept the data record into the project and return to the ***Start*** page.

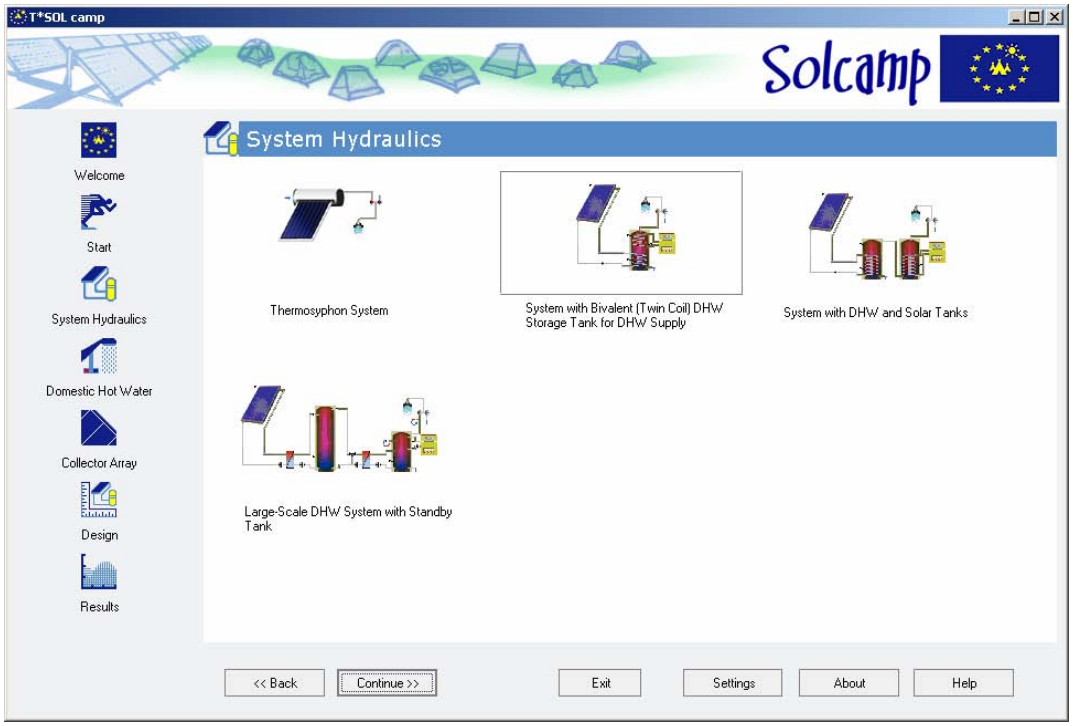
To go on to the next stage, click on ***Continue*** or use the next icon in the Navigation Area on the left.

## 3.3. System Hydraulics

The System Hydraulics page allows you to select a system configuration for your project. There are four systems for domestic hot water supply and two systems for domestic hot water supply and space heating to choose from.

For our example project, click on the system labelled: ***System with Bivalent DHW Storage Tank***.

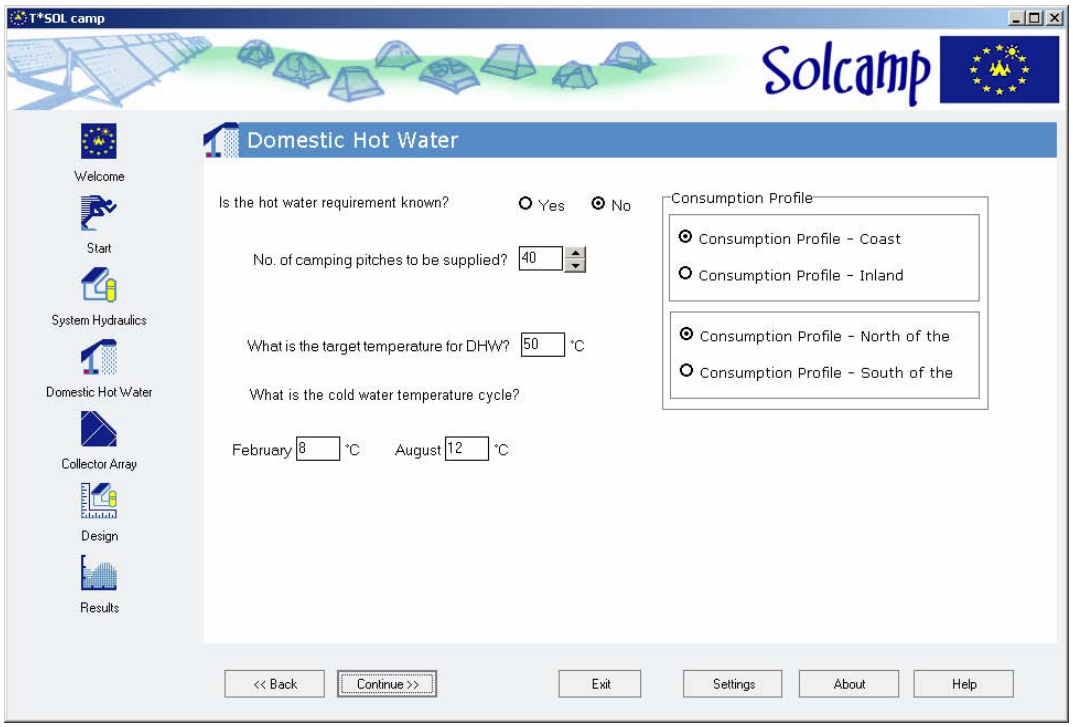



Click on ***Continue*** to accept the system into the project and automatically go to the next stage in the programme.

## 3.4. Domestic Hot Water (DHW)

The DHW requirement is very important for the energy calculation.




You can either enter the average daily requirement in litres or, if you do no know what this amount will be, you can give the number of piches using the system. First you will need to click on the corresponding option to answer the question ***Is the hot water requirement known?***

If you enter the number of piches, the programme calculates the DHW requirement automatically from a specific requirement per person. This value is saved under ***Settings*** on the ***Design*** tab sheet and can be changed there if required.

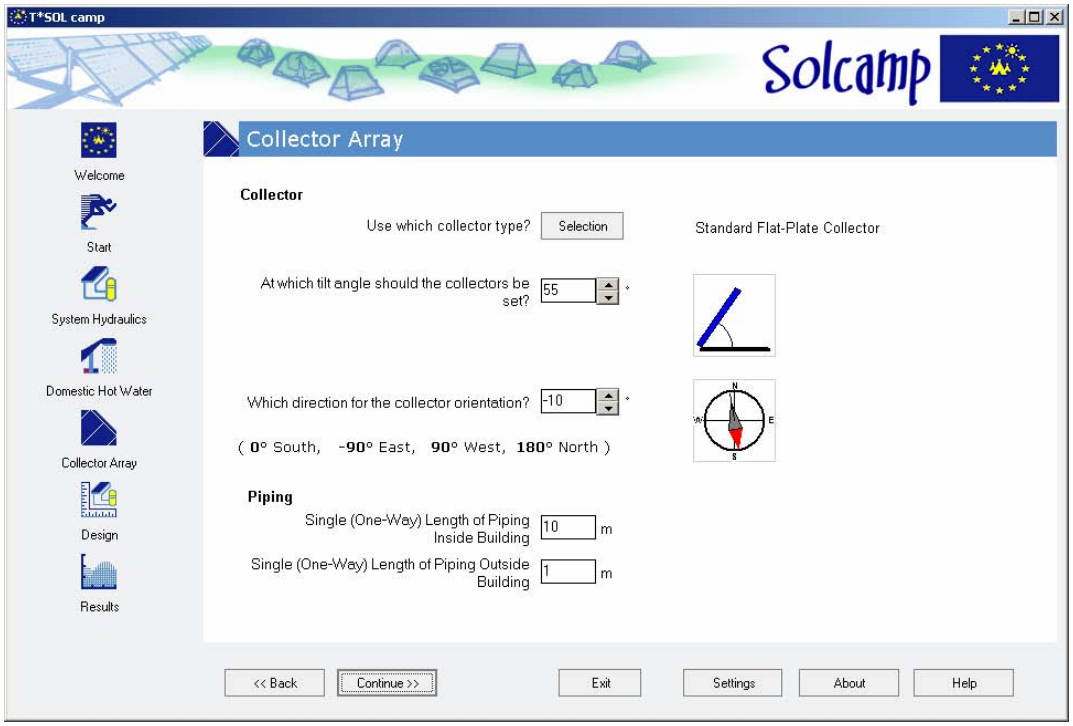
For our example project, select ***No*** in reply to the question ***Is the hot water requirement known?*** And then enter the number “40” for the number of piches.

To calculate the DHW energy requirement, the desired hot water temperature and the cold water temperature cycle need to be entered. For the cold water cycle, you can enter a lower figure (for winter) and an upper figure (for summer). The temperatures for the rest of the year are then interpolated linearly from these two figures.

## 3.5. Collector Array

On this page, you should first select the type of collector that you want to use. You can select from different qualities of flat-plate collectors and evacuated tube collectors and an absorber mat (unglazed collector). The collectors have an area of one square metre, as the number of collectors and collector area will have to match at the design stage later on, so that conversion to other collector sizes is possible.




You should then enter the inclination (tilt angle) and orientation for the collector array. The collector inclination is the angle between the horizontal and the collector surface, with 0° for horizontal installation and 90° for vertical installation. The orientation is the angle between the normal collector orientation and due south. For the northern hemisphere, the orientation equals zero if the collector array faces due south, it is shown in negative figures for orientations to the east and in positive figures for orientations to the west.

Our example system has a 55° pitched roof, facing slightly south east, so the entries are 55° for the inclination and -10 for the orientation.

The images illustrate your entries, as they show the angle for the inclination and corresponding point on the compass for the orientation.

Finally, you should enter the length of the piping inside and outside of the building. These entries are not required for thermosyphon systems, so are not

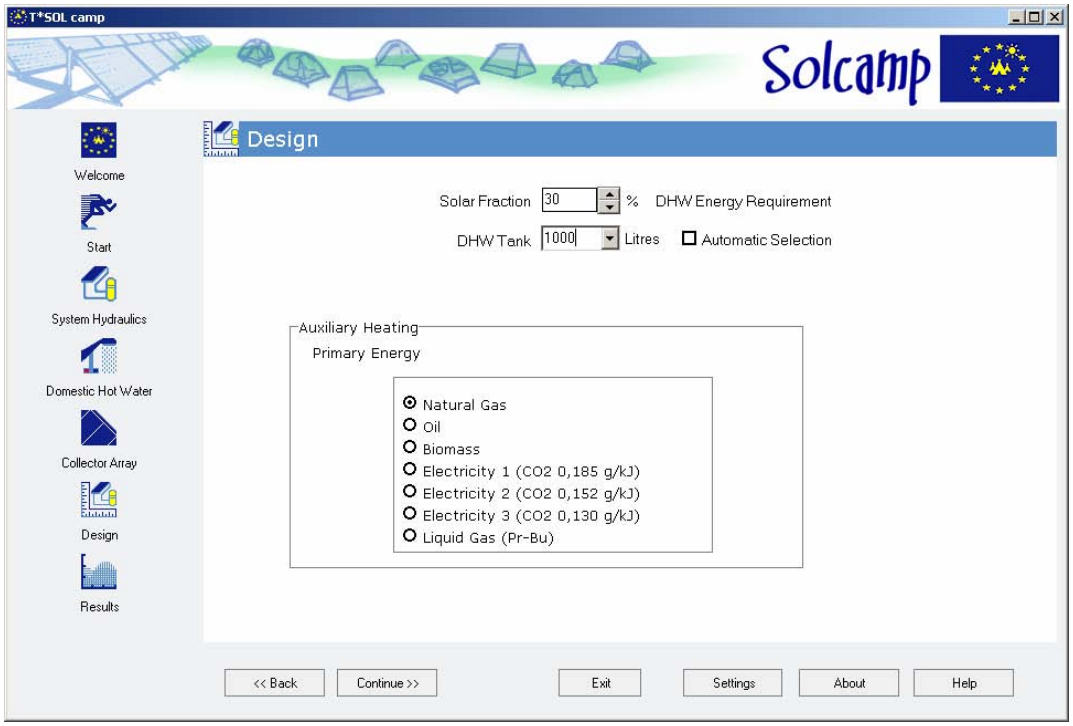
 

visible if this type of system has been selected. The length of piping forms the basis for the calculation of heat losses in the piping between the collector array and the storage tank. The piping is sized automatically for a volumetric flow rate of 0.5 m/s and the thickness of insulation is determined according to German standard DIN. These parameters are then used for the calculation of heat losses.

## 3.6. Design

To calculate the required collector area for a particular case, the programme requires a target. In this case, the target is the solar fraction. For domestic hot water systems with space heating, you will need to enter the total solar fraction. The solar fraction is the proportion of useable solar energy in relation to the total energy used by the system.




For domestic hot water systems in Central Europe the target solar fraction is up to 60% for detached houses. However, as the efficiency of a solar system decreases with increasing solar fractions, a smaller solar fraction should be set.

For systems that also support space heating, the target solar fraction depends heavily on the insulation standard of the building. Sensible target values in this case are in the 10-30% range.

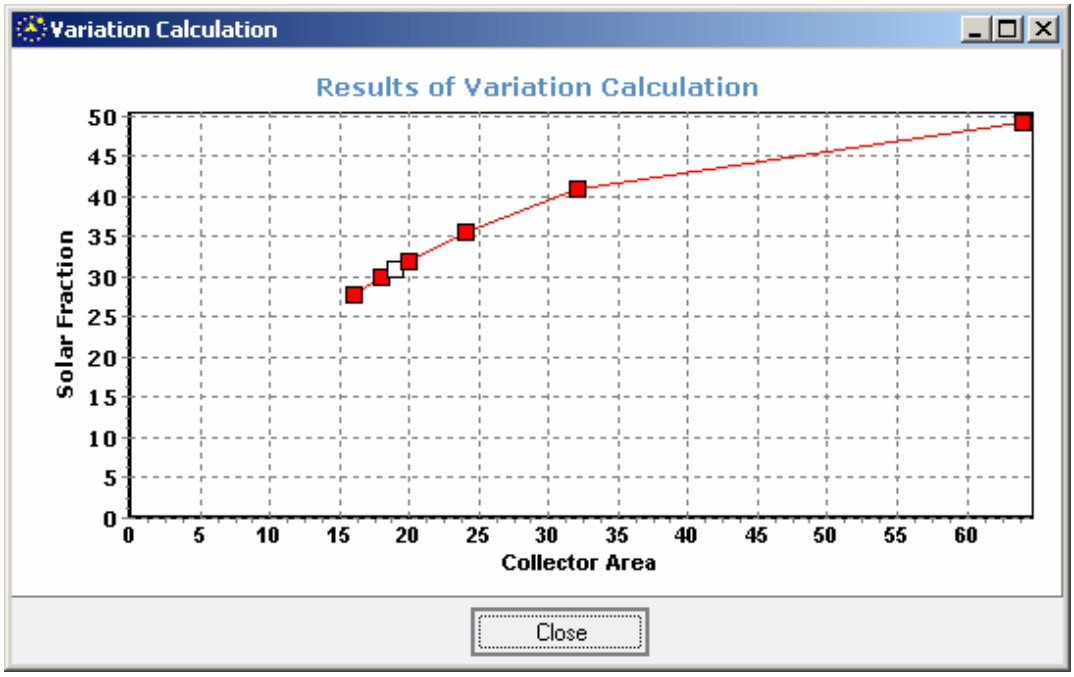
On this page you can enter the size of the storage tank being used or simply click on the Automatic Selection box to let the programme calculate the appropriate size of tank for the consumption that has been entered. You will also need to select the type of primary energy that will be used for the energy requirement not covered by the solar system.

For our example project, enter 30% for the solar fraction. As you want to use a 1,000 litre tank, you can enter this value direct. If you were to choose ***Automatic Selection***, the programme would recommend an 2100 litre tank.

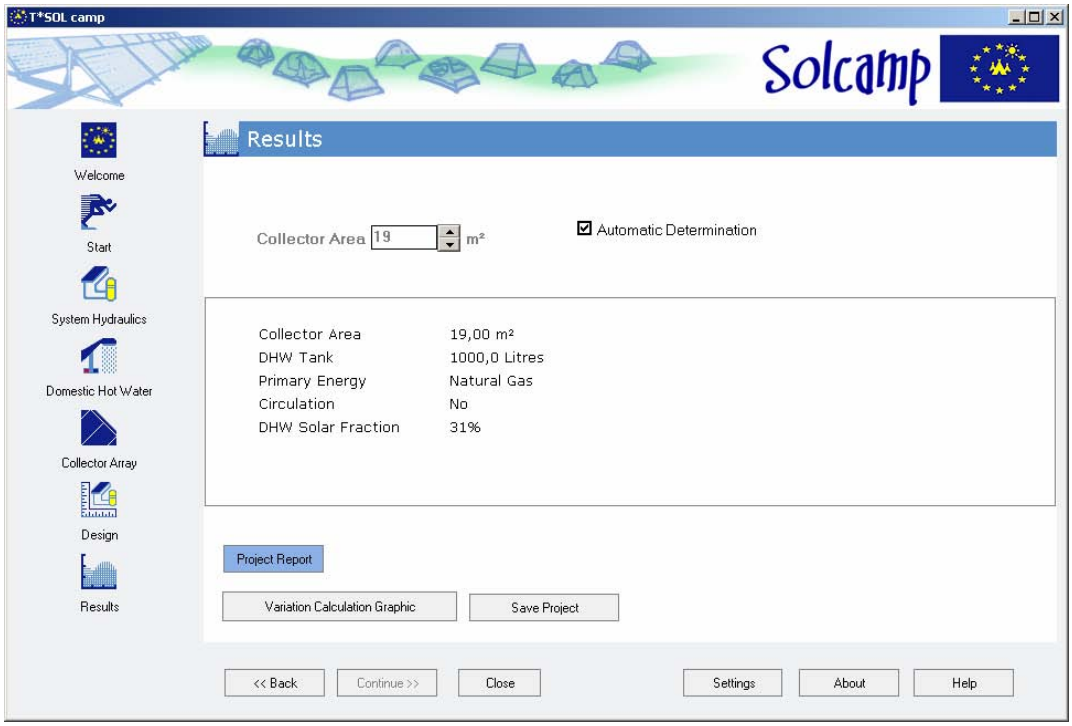
 

## 3.7. Results

First of all the programme automatically determines the required collector area. The number of collectors required is determined with the help of the ***Variation Calculation***. The results are shown in a graph.




Click on the **Close** button to go to the actual Results page.



During the simulation of the system over a period of one year, the programme calculates the energy yields, primary energy savings and the $CO_2$ emission avoided. These results are now on the ***Results*** page or in the ***Project Report***.

Click on ***Simulation*** to get to the ***Project Report*** print preview page, which contains all the data and results for your project.

You can print the report, save it as a pdf file, send it as an e-mail attachment or export it to Word. The corresponding buttons are located in the icon bar at the top of the dialogue screen.

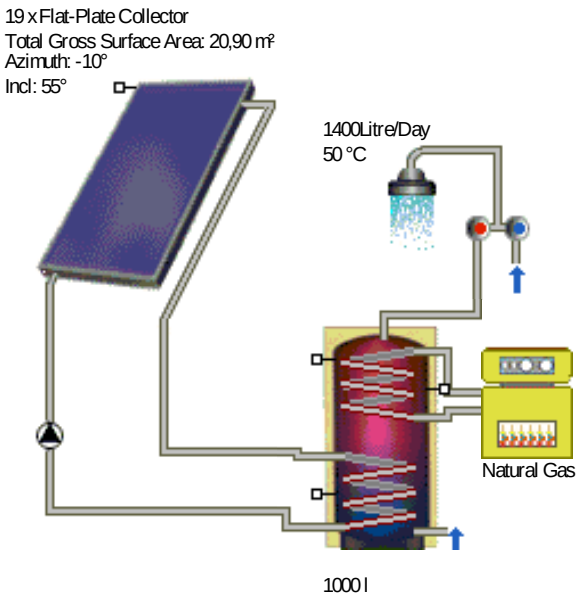
Click on ***Save Project*** to save the current project with the name previously given.

Click on ***Variation Calculation Graph*** to open the variation calculation graph again.

Our example project delivers the following results in the project report:

**TSOL camp Project Example**




**Season Start: 01.01.2006 Season End: 31.12.2006**

| | | |
|---|---|---|
| Collector Surface Area Irradiation: | 18,88 MWh | 993,66 kWh/m² |
| Energy Produced by Collectors: | 7,65 MWh | 402,51 kWh/m² |
| Energy Produced by Collector Loop: | 7,39 MWh | 388,9 kWh/m² |
| DHW Heating Energy Supply: | 23,23 MWh | |
| Solar Contribution to DHW: | 7,39 MWh | |
| Energy from Auxiliary Heating: | 16,43 MWh | |

**Natural Gas Savings:801,2 m³**

**CO2 Emissions Avoided:1.694,2 kg**

**DHW Solar Fraction:31,0 %**

**System Efficiency39,1 %**

# 4. Attachment

## 4.1. Glossary

**Active Solar Surface**
The specific collector characteristics are not usually related to the gross surface area, but to the active solar surface, which is taken from the test report provided by a testing centre. With flat plate collectors, the active solar surface is, depending on the testing centre, either the absorber area or the aperture area. With evacuated tube collectors (e.g. with mirror constructions with vertically-standing absorbers) the active solar surface is often a purely theoretical value.

**Auxiliary Heating**
Auxiliary heating ensures that, even when there is not enough irradiation, the desired tank temperature is reached and, for systems with space heating, also supplies the heating loop. Auxiliary heating usually refers to the boiler.

**Azimuth Angle**
See Orientation.

**Balancing**
See Energy Balance.

**Boiler Efficiency**
The boiler efficiency describes the relationship between the primary energy used (relating to the calorific value of the fuel used) and the net energy produced.

**Circulation, (secondary)**
(Secondary) circulation can be used for hot water preparation. This increases comfort (hot water is available straight away even with long piping systems), but it is also coupled with losses.

**Climate Data**
The climate data delivered with the programme (for a wide range of European and international locations) contains hourly average values for global horizontal radiation, outside temperature and wind speed.

**Collector Array**
In T*SOL camp, the collector array consists of the collectors and the piping.

**Collector Loop Connection**
In T*SOL camp, the collector loop connection represents the connection between the collector array and the storage tank.

**Collector Loop Efficiency**

Quotient of the energy emitted from the collector loop and the energy irradiated onto the collector area (Active Solar Surface).

**CO2 Emissions**
The CO2 emissions avoided by the use of the solar system are calculated. For this, emissions factors are used according to the (savings on) fuels used. See also Fuel Savings.

**Conversion Factor**
The conversion factor indicates the amount of absorption when the irradiation is vertical to the collector surface, when the collector temperature is equal to the ambient temperature.

**Daily Consumption**
The average daily DHW consumption. This is usually around 35-45 litres per person per day at a water temperature of 50°C.

**Desired Temperature**
The minimum temperature of DHW. If the desired temperature in the upper layer of the tank is not reached, the auxiliary heating is switched on.

**DHW**
Abbreviation for domestic hot water.

**DHW Requirement**
See Daily Consumption.

**Efficiency**
The Collector Loop Efficiency and the System Efficiency are calculated.

**Emissions Calculation**
See CO2 Emissions.

**Energy Balance**
The sum of supplied energy, removed energy and the storage of energy through the heat capacity of system components must equal zero. Balancing does not take place in general for the total system, but for the individual system components.

**Energy Delivery**
See Energy, supplied.

**Energy, dissipated by the solar system**
Comprises of the energy transferred to the standby tank from the solar tank, due to consumption and any existing return circulation control in the solar tank.

**Energy, removed or dissipated**
Removed or dissipated energy is that which is transferred from one component (collector loop, storage tank, etc.) to another.

**Energy, supplied**
Energy supplied to a component, e.g. irradiation, heat transfer at the heat exchanger or heat transfer by mass flow due to consumption or circulation.

**Fuel Consumption**
The calculation of fuel use is based on the energy transferred to the auxiliary heating heat exchanger, with the heat equivalent and the auxiliary heating efficiency, according to the type of fuel (natural gas, oil, biomass, district heating).

**Fuel Savings**
The available solar energy is converted, using the respective auxiliary heating efficiency, to give the corresponding primary energy equivalent.

**Incident Angle Modifier**
The additional reflection losses that occur when the sun is not vertical to the collector surface are camped by the incident angle modifier.

**Inclination (Tilt Angle)**
Describes the angle between the horizontal and the collector surface. It is 0° if the collectors are flat on the ground and 90° if they are vertical (e.g. for façade installation).

**Installation**
For the collector array installation you need to enter parameters for the inclination (tilt angle) and orientation (azimuth angle). The radiation processor uses these two parameters to calculate the irradiation onto the tilted surface.

**Installed Power**
The installed power of a solar generator is the peak output that would be generated with vertical irradiation from the sun and 100 W/m². This value is therefore given in Wp or kWp. The “p” stands for peak.

**kA Value**
The product of the thermal transmittance coefficient and heat exchanger area. The value equals the quotients of transferred power and mean logarithmic temperature difference at the heat exchanger.

**Loading Time**
Describes the period required for the storage tank to be loaded fully.

**Nominal Width**
DIN piping widths are used to calculate the collector loop piping widths. Changes can be made by entering new values.

**Orientation (Azimuth Angle)**
The orientation or azimuth angle describes the angle of deviation of the collector-surface from the south in the northern hemisphere (and from the north in the southern hemisphere). It is 0° when the surface is facing due south. The azimuth is positive when facing west and negative when facing east. An orientation due west corresponds to a value of +90° and an orientation due east is -90°.

**Radiation Model**
The parameters for global horizontal radiation contained in the climate data are split, according to the model from Reindl, into diffuse and direct parts.

**Radiation Processor**
Calculates the irradiation onto the tilted surface from the inclination and orientation of the collector array.

**Roof Parallel**
The collector modules are mounted at a distance from, but parallel to the roofing.

**Roof Integrated**
The collector modules form part of the roofing itself, replacing the part of the roof that has been removed.

**Savings**
The simulation results include the reference fuel savings made during the simulation period due to the use of the solar system.

**Simulation**
Calculation of the influence of the ambient environment, consumption and the different components on the operating conditions of the solar system in hourly intervals over the period of one year.

**Solar Fraction**
The proportion of energy transmitted by the solar system to the standby tank against the total amount of energy transmitted to the standby tank (from the solar system and auxiliary heating).

**Solar Tank**
The solar tank is the tank or part of a tank that is loaded from the collector array.

**System Efficiency**
Quotient of the energy generated by the solar system and the energy irradiated onto the collector surface (active solar surface).

**Tank Destratification**
With activated tank stratification, in the case that the upper solar tank reaches a higher temperature than the upper standby tank, destratification is carried out.

**Tank Model**
The stratified tank model works with variable tank layers. The number of layers is not constant, but is adapted during simulation.

**Temperature**
See Desired Temperature.

**Thermal Conductivity Coefficient**
This gives the specific insulation losses (e.g. of piping).

**Thermal Transmittance Coefficient**
The thermal transmittance coefficient (heat loss coefficient) indicates the amount of heat that the collector loses to its environment per m² of active solar surface and degrees Kelvin temperature difference between the average collector temperature and the surrounding temperature.

**Tilt Angle**
See Inclination.

**Volumetric Flow Rate**
The volumetric flow rate for the collector array is given in l/h and can either be entered as an absolute figure or is related to the collector area.

**Yield, solar**
The energy produced by the collector loop.