SolarKeymark-II

Large open EU market for solar thermal products

Deliverable D 16

SOLEN – Guide for user

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CONTENT

1 INTRODUCTION

The EN 15316-4.3 European standard: Heating systems in buildings — Method for calculation of system energy requirements and system efficiencies — Part 4-3: Heat generation systems, thermal solar systems is one of the 43 standards used to assess the overall energy performance of a building. **EN 15316-4.3 was adopted in June 2007**.

This European Standard gives methods for calculation of the thermal solar system input for space heating and/or domestic hot water requirements and the thermal losses and auxiliary energy consumption of the thermal solar system. The calculation is based on the performance characteristics of the products given in product standards and on other characteristics required to evaluate the performance of the products as included in the system.

The following typical thermal solar systems are considered:

- domestic hot water systems characterized by EN 12976 (factory made) or ENV 12977 (custom built);
- combisystems (for domestic hot water and space heating) characterized by ENV 12977 or the Direct Characterisation method developed in Task 26 'Solar Combisystems' of the IEA Solar Heating and Cooling programme;
- space heating systems characterized by ENV 12977.

A software called SOLEN has been developed in the framework of the European SolarKeymark II project on the basis of this calculation method. This software allows calculating the monthly and annual thermal performance of a thermal solar system as well as the energy savings and the quantity of CO_2 avoided compared with a conventional system. This software can be downloaded at http://enr.cstb.fr (directory Logiciels), free of charge. SOLEN is fully compatible with EN 15316-4.3.

SOLEN must be considered as a decision-making tool rather than a design tool such as POLYSUN, TSUN or TRANSOL. It allows with a limited set of data to decide whether a thermal solar project is relevant or not in a given context (location, heat needs…). Targeted end users are mostly decision makers but of course it can also be used at the early stage of a project by architects or engineers.

This report contains a user-friendly manual giving a support for the utilization of the SOLEN software.

2 GUIDE FOR USER

The purpose of this manual is to give support to potential users of the SOLEN software. The manual is set out in a step by step format. Each step explains what information is needed to perform calculation and where the information is input. The manual shows examples of screens at every step of the SOLEN program to make easier understanding.

Run the "interfacesharp.exe" file. You should now see the screen shown Figure 1.

Figure 1 – Main screen

Create a new project clicking on File/New. You should get the screen shown Figure 2.

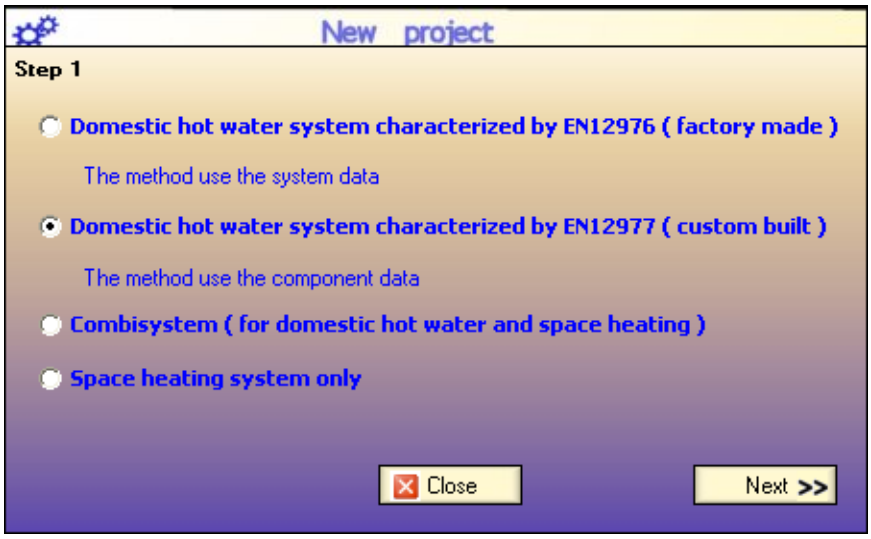

Figure 2 – New project

The following typical thermal solar systems are considered:

- domestic hot water systems characterized by EN 12976 (factory made) or ENV 12977 (custom built);
- combisystems (for domestic hot water and space heating) characterized by ENV 12977
- space heating systems characterized by ENV 12977.

One of the 4 options should be selected.

2.1 DOMESTIC HOT WATER SYSTEMS CHARACTERIZED BY EN 12976

This method uses system data, i.e. input data from system tests or default system input values given in the format of EN 12976-2 (performance indicators). So far this method is only valid for systems delivering only domestic hot water and which have been tested according to EN 12976-2. The test results shall include performance indicators for the actual climate and for a heat use higher than or equal to the actual heat use as well as for a heat use lower than or equal to the actual heat use.

You have to define the configuration of your domestic hot water system (Figure 3).

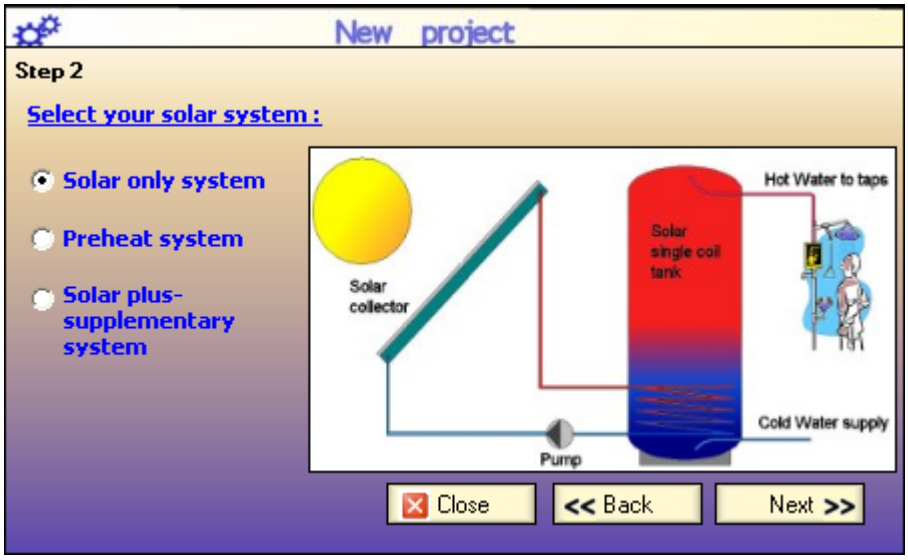

Figure 3 – Domestic hot water systems characterized by EN 12976

3 configurations are proposed.

- Solar only system: thermal solar system without any back-up heat source
- Solar preheat system: thermal solar system to preheat water prior to its entry into any other type of water heater
- Solar plus supplementary system: thermal solar system which utilizes both solar and auxiliary energy sources in an integrated way and is able to provide a specified heating service independent of solar energy availability

One of the 3 options should be selected.

2.1.1 Solar only system

2.1.1.1 Weather

The next step consists in selecting the weather file. Select the relevant weather file corresponding to the project location from the climatic database (Figure 4).

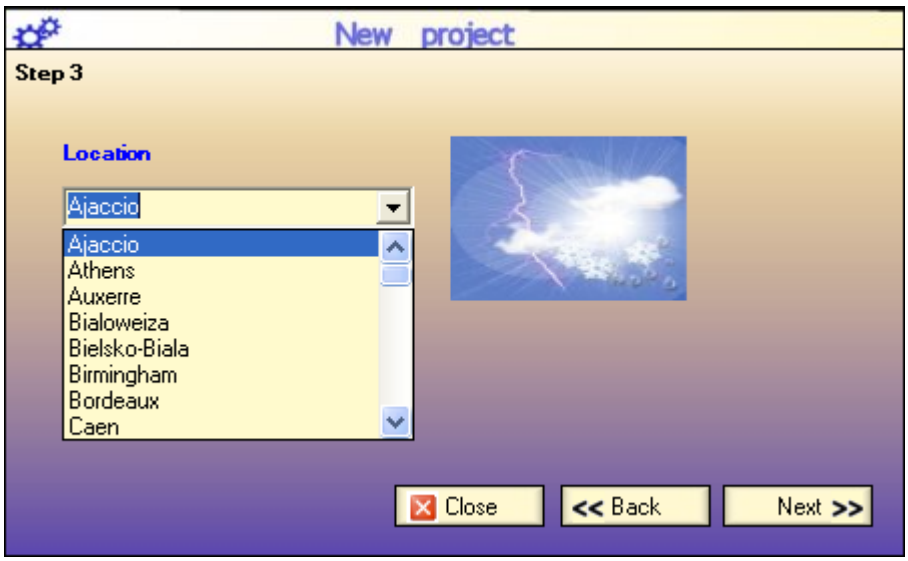

Figure 4 – Weather file

Note:

You can customize the climatic database adding/deleting weather files (Database/Climate) as you want (Figure 5)

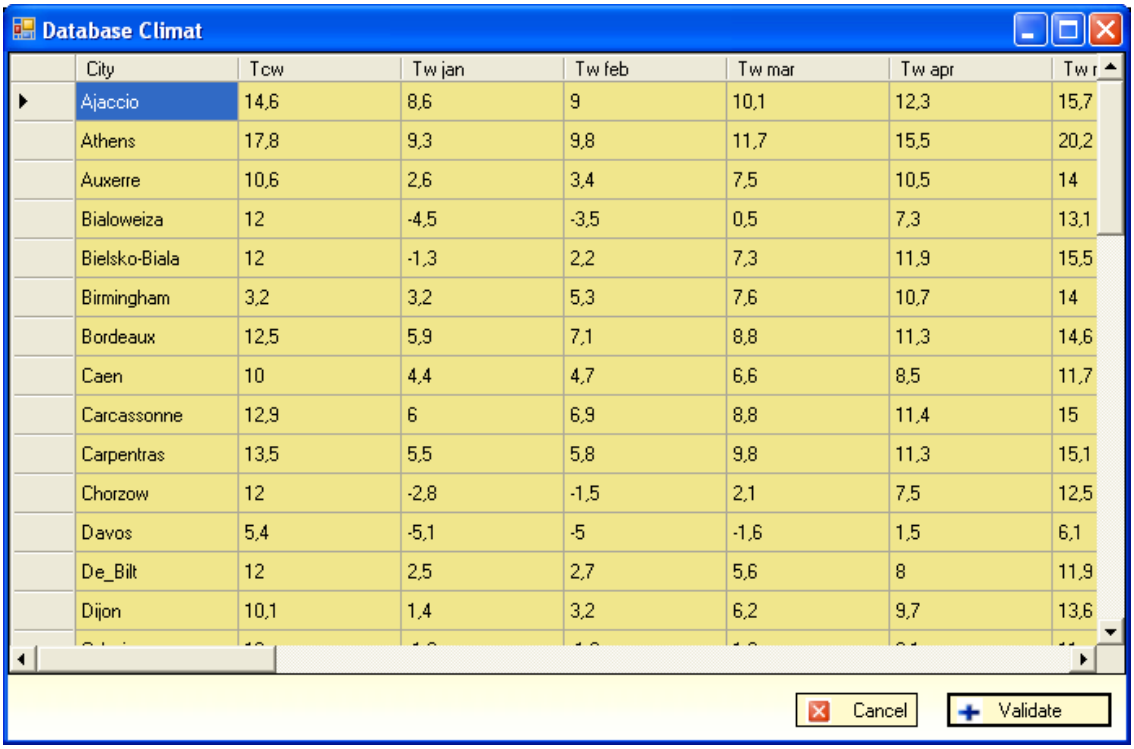

Figure 5 – Climatic database

The climatic database contains:

- Annual average mains water supply temperature (Tcw); °C
- Monthly outside air temperatures (Tw); °C
- Monthly solar irradiance on a flat plane facing South with a tilt angle of 45° (Im); W/m²
- Latitude of the site

Click on Validate once new weather file has been created.

2.1.1.2 Heat needs

The heat use to be applied shall take into account the domestic hot water needs and the thermal losses of the distribution systems. The value of this heat use to be applied is an input data to this method (Figure 6).

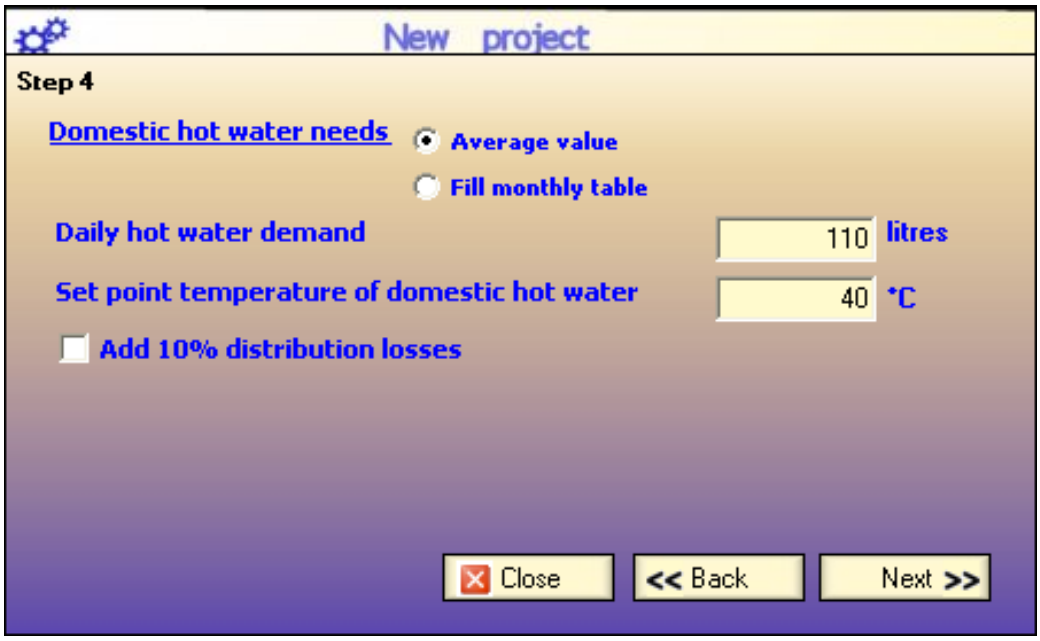

Figure 6 – Hot water demand

For rough calculations, you can just enter:

- an average value for the daily hot water demand, in litres (the same figure applies all the days of the year)
- the set point temperature of the domestic hot water, °C

If you want more accurate results, then you have to enter monthly domestic hot water needs (in kWh). Fill in the corresponding table (Figure 7).

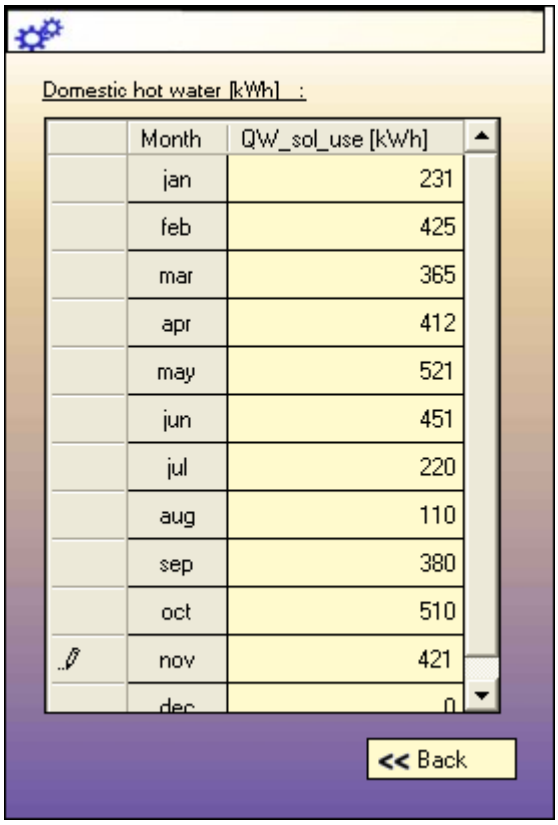

Figure 7 – Domestic hot water needs

2.1.1.3 Performance indicators

The next step consists in defining performance indicators from test reports according to EN 12976-2 (Figure 8).

Figure 8 – Performance indicators

2.1.2 Solar preheat system

Similar to § 2.1.1

2.1.3 Solar plus supplementary system

Similar to § 2.1.1

2.2 DOMESTIC HOT WATER SYSTEMS CHARACTERIZED BY EN 12977

This method uses component data, i.e. input data from component tests (or default component input values). The calculation method is based on the f-chart method. In this case, the output from the thermal solar system is calculated with the general calculation method using only the applied domestic hot water use and the characteristics of the domestic hot water system (collector area, solar storage tank volume, etc.).

Once again, you have to define the configuration of your domestic hot water system (Figure 3). One of the 3 options should be selected.

2.2.1 Solar only system

2.2.1.1 Weather

Similar to § 2.2.1.1

2.2.1.2 Heat needs

Similar to § 2.1.1.2

2.2.1.3 System characteristics

The main characteristics of the domestic hot water system must be defined.

2.2.1.3.1 Solar collection

Click on the collection button. The following screen appears (Figure 9):

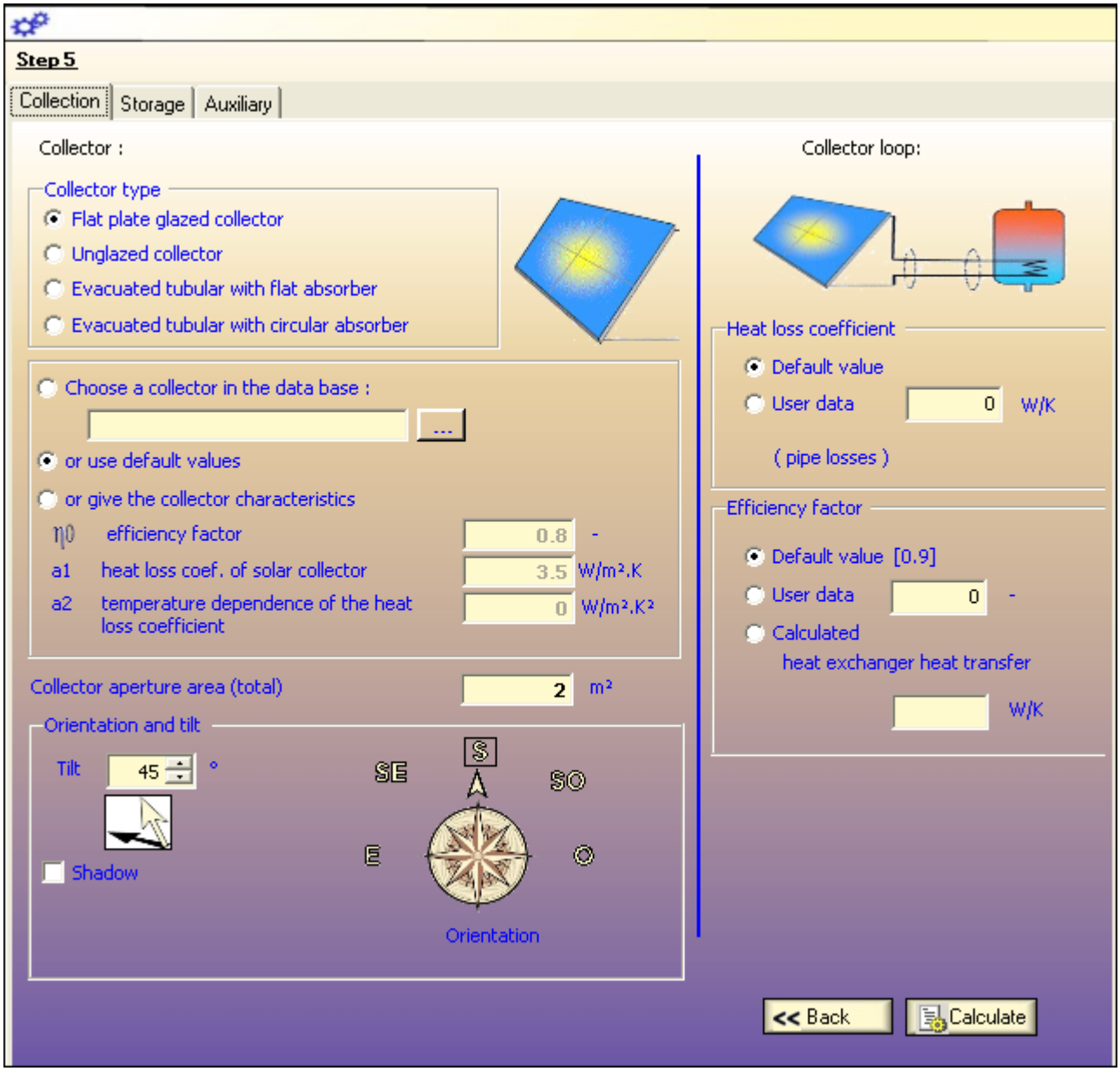

Figure 9 – Solar collection

Solar collector characteristics must be defined. 3 options exist:

- Performance coefficients (η0, a1, a2) are known;
- Performance coefficients (η0, a1, a2) are unknown and default values are used (for use when the purpose is to make a calculation of a typical thermal solar system);
- Performance coefficients (η0, a1, a2) are unknown but solar collector has been tested according to EN 12975-2. A database with SolarKeymarked solar collectors has been defined and can be customized (Figure 10).

Performance of the solar collector loop (efficiency of the collector loop, heat loss coefficient of the collector loop pipes) must be documented. When unknown or for rough calculations, default values can be used.

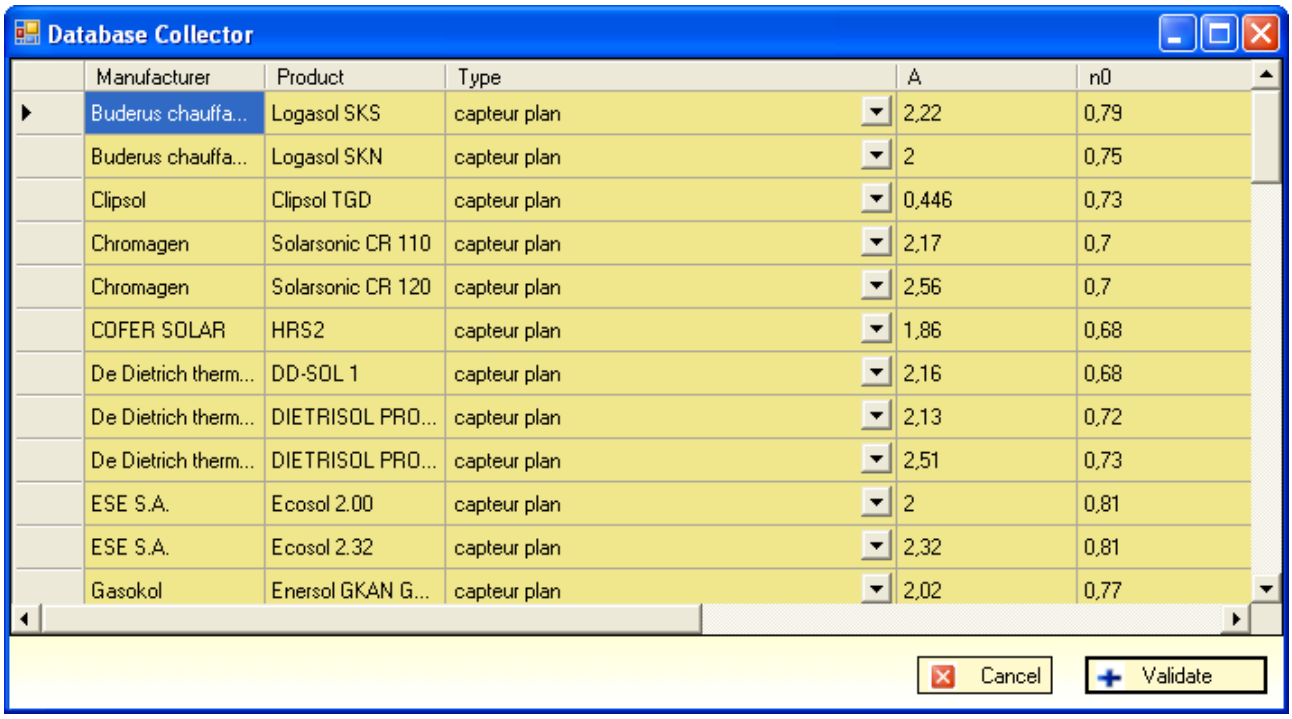

Figure 10 – Solar collector - Database

2.2.1.3.2 Solar storage

Click on the storage button. The following screen appears (Figure 11):

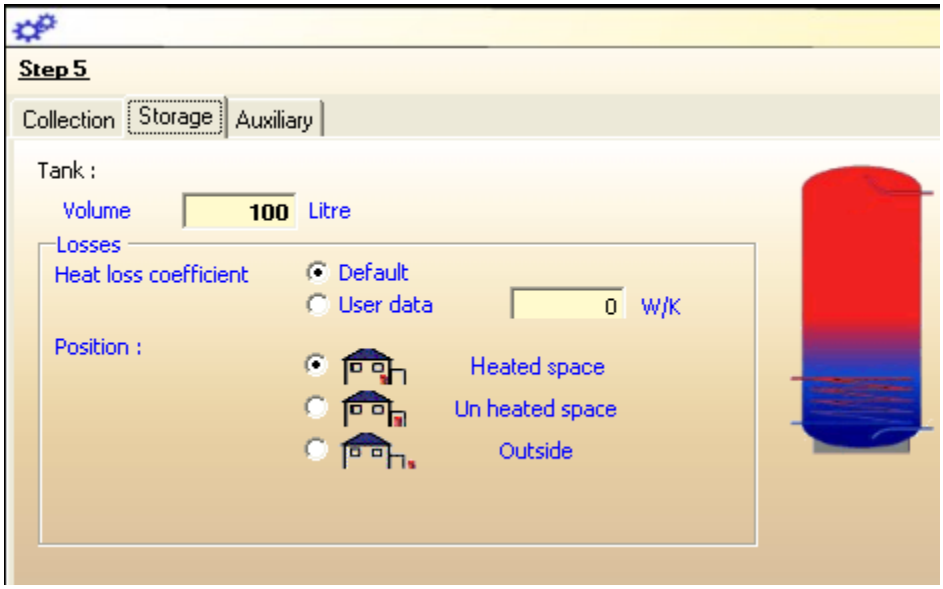

Figure 11 – Solar storage

2.2.1.3.3 Solar auxiliary

This includes energy for fans, pumps, electronics etc. In EN ISO 9488, the energy used for pumps and valves is called "parasitic energy".

Click on the auxiliary button. The following screen appears (Figure 12):

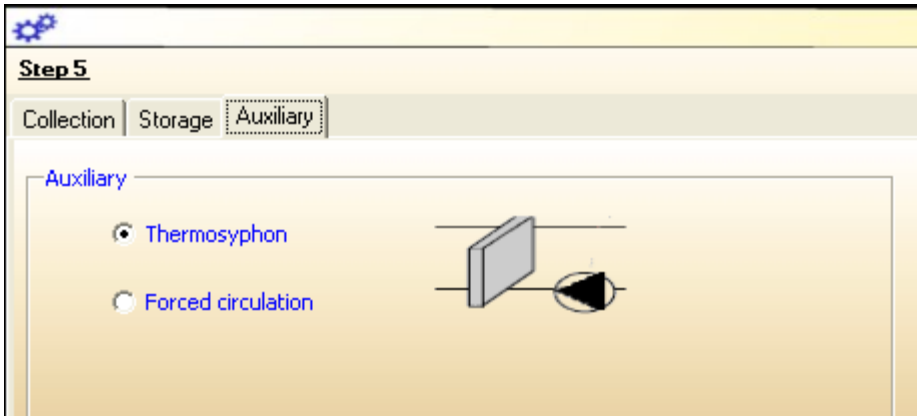

Figure 12 – Solar auxiliary

2.2.1.4 Results

As soon as all system characteristics have been entered, calculations can be processed. This operation is almost instantaneous and results are automatically displayed (Figure 13).

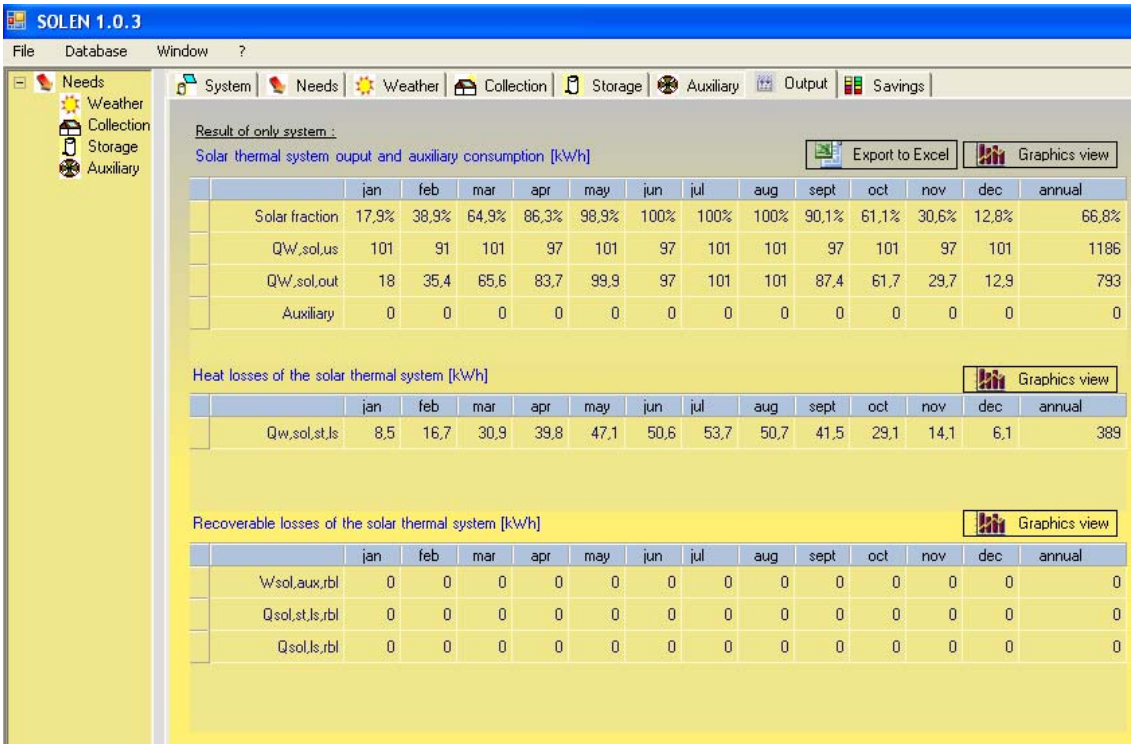

Figure 13 – Results

Outputs are threefold:

- heat delivered by the thermal solar system, solar fraction (energy supplied by the solar part of a system divided by the total system heat use) and auxiliary energy consumption of pump and control equipment in the collector loop;
- thermal losses of the thermal solar system;
- recoverable and recovered thermal losses of the thermal solar system.

These outputs are given on an annual and monthly basis.

Graphics are automatically plotted (Figure 14) or results can be exported to Excel.

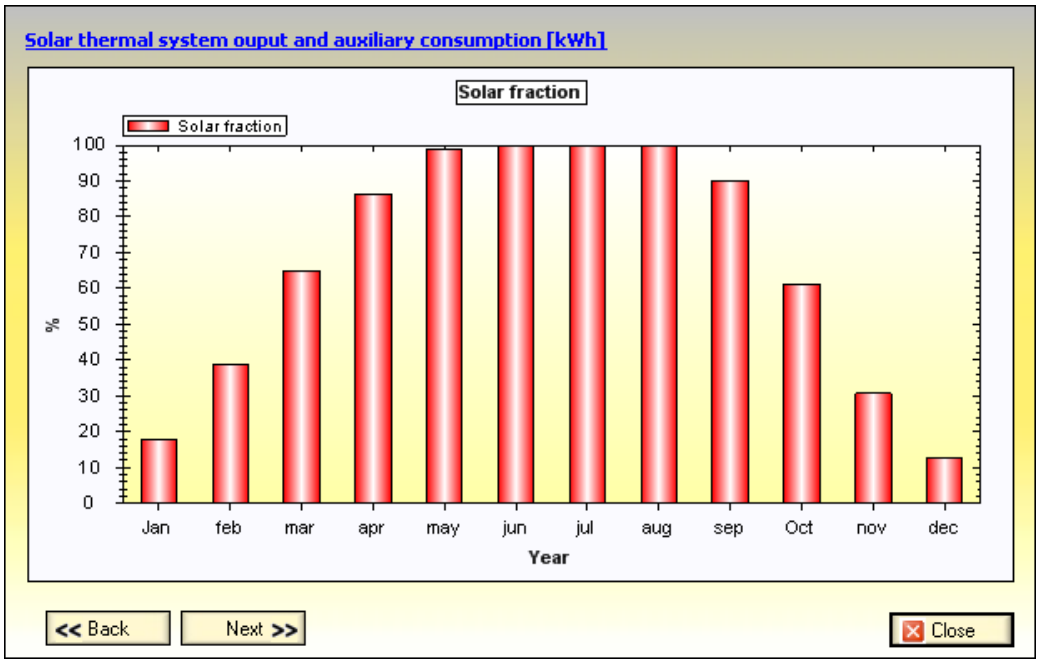

Figure 14 – Graphics

2.2.1.5 Savings

This option allows calculating the annual energy savings and the quantity of CO_2 avoided compared with a conventional system (Figure 15).

The energy savings due to the installation of the thermal solar system is determined as the primary energy consumption of the building without the thermal solar system minus the primary energy consumption of the building with the thermal solar system.

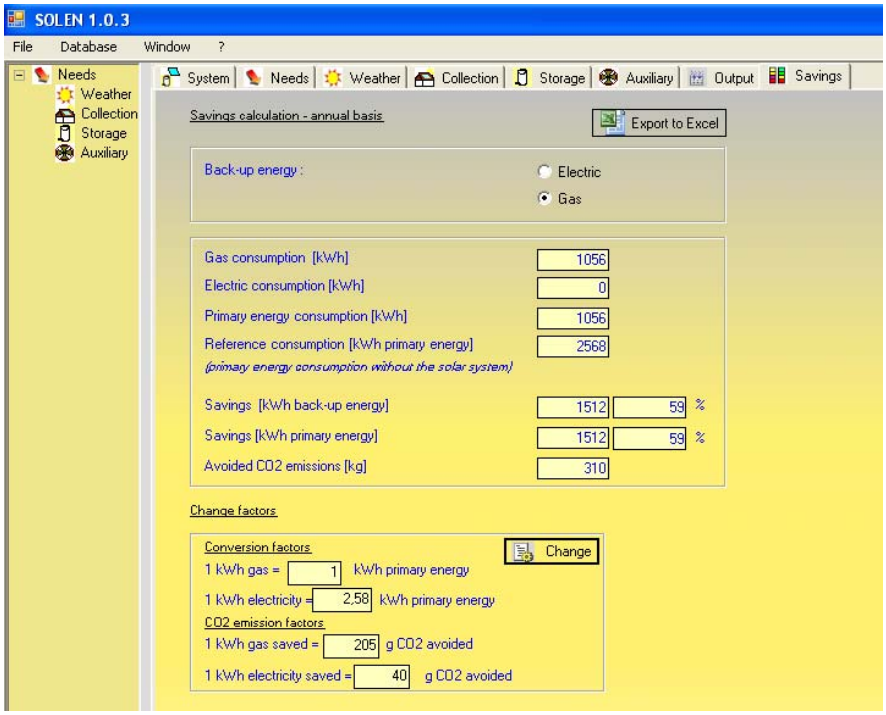

Figure 15 – Savings

2.2.2 Solar preheat system

Similar to § 2.2.1

2.2.3 Solar plus supplementary system

Similar to § 2.2.1

2.3 SOLAR COMBISYSTEM

This method uses component data, i.e. input data from component tests (or default component input values). The calculation method is based on the f-chart method.

For a solar combisystem, the solar output for domestic hot water production and the solar output for space heating requirements are calculated in succession with the general calculation method. The method is applied twice by dividing the collector aperture area and the solar storage tank volume (if there is only one store) into two according to the space heating use ratio and the domestic hot water use ratio.

Once again, you have to define the configuration of your domestic hot water system (Figure 3). One of the 3 options should be selected.

2.3.1 Solar only system

2.3.1.1 Weather

Similar to § 2.2.1.1

2.3.1.2 Heat needs

The heat use to be applied shall take into account the needs (e.g. space heating requirement, domestic hot water) and the thermal losses of the distribution systems. The value of this heat use to be applied is an input data to this method (Figure 16).

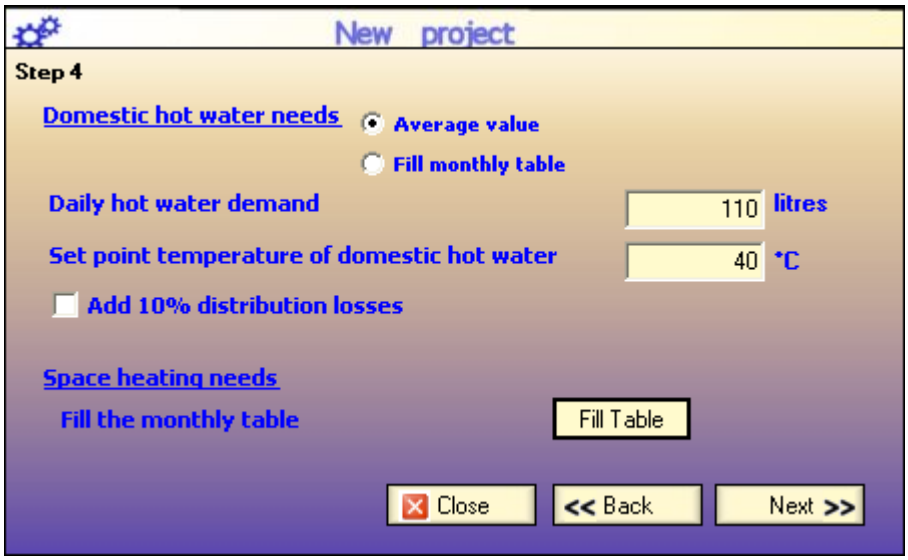

Figure 16 – Heat needs

Needs corresponding to domestic hot water use have already been defined in § 2.1.1.2. Needs corresponding to space heating use must be defined as in Figure 17 in kWh on a monthly basis.

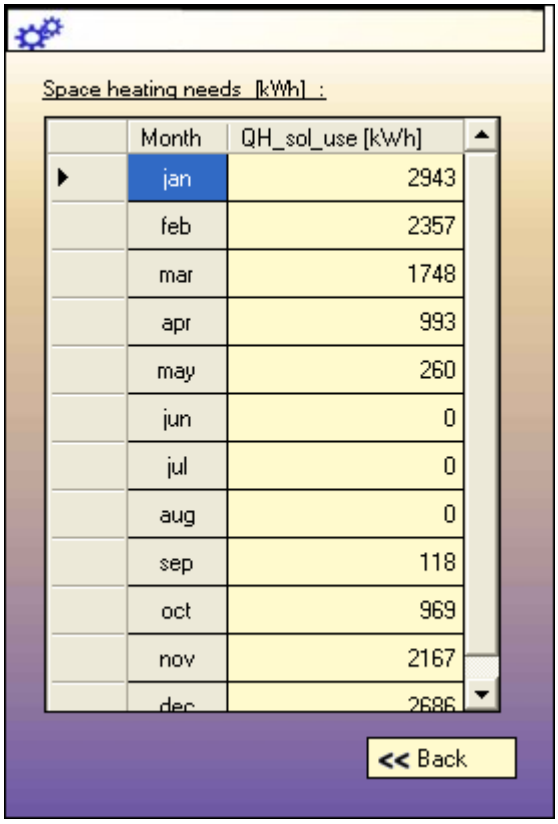

Figure 17 – Space heating requirement

2.3.1.3 System characteristics

Similar to § 2.2.1.3

2.3.1.4 Results

Similar to § 2.2.1.4

2.3.1.5 Savings

Similar to § 2.2.1.5

2.3.2 Solar preheat system

Similar to § 2.3.1

2.3.3 Solar plus supplementary system

Similar to § 2.3.1

2.4 SPACE HEATING SYSTEM

This option is not available yet.

3 CONCLUSION

A software called SOLEN has been developed on the basis of EN 15316-4.3 calculation method. This software allows calculating the monthly and annual thermal performance of a thermal solar system as well as the energy savings and the quantity of CO_2 avoided compared with a conventional system.

This software has been partially validated (see Deliverable D15). Validation relies on different test cases coming from thermal solar systems having been the subject of a measurement campaign in single-family houses, residential buildings or in the non-residential sector.

EN 15316-4.3 will be revised in 2009 and SOLEN will be adapted to these changes accordingly.