Energy Labelling of Custom Built Systems

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1 Summary

The energy consumed by water heaters and hot water storage tanks accounts for a significant share of the energy demand in the Union, and water heaters with equivalent functionality have a wide disparity in term of energy efficiency and standing loss. The energy efficiency of water heaters and the standing loss of hot water storage tanks can be significantly improved. Water heaters and hot water storage tanks should therefore be covered by requirements on energy labelling.

Solar water heaters are water heaters which use solar energy for heat generation. There are two groups of solar water heaters: factory made systems which are highly prefabricated and sold as one unit and custom built systems which are assembled from an assortment of components. This document discusses only issues relevant for custom built systems.

Custom built solar thermal systems are included in the scope of the regulation acc. to Directive 2010/30/EU, which is aiming for harmonized testing procedures for all kind of water heaters. This document will explain how custom built systems are tested according to current standards, it will show an investigation of application of transitional calculation method for conversion of existing test methods to the reference conditions given by the new regulation and at least it will suggest amendments to the current standard to implement the harmonised, energy labelling specific boundary conditions to procedures used for evaluation of custom built solar thermal systems.

2 Introduction to custom built systems

2.1 Definition and Standards

The term “custom built systems” is defined in the FprEN12977-1:2011 as follows:
“Custom built solar heating systems are either uniquely built or assembled by choosing from an assortment of components. Systems of this category are regarded as a set of components. The components are separately tested and test results are integrated to an assessment of the whole system“.

Requirements for custom built solar heating systems are given in FprEN 12977-1. Test methods are specified in FprEN 12977-2, FprEN 12977-3, FprEN 12977-4 and FprEN 12977-5. This series will be released as full EN standard series in fall 2012.

2.2 Standardised testing procedures for custom made systems

All main components of custom build systems are tested separately and composed to the whole system using a simulation tool. This method is called “CTSS” (Component Testing - System Simulation). The main components are collectors, stores and controllers.

2.2.1 Collectors

The collectors shall be tested according to EN 12975-2. The main output parameters obtained by the test procedure are:

- Aperture area of solar collector, A_a (EN 12975-2; §6.1.2.8)
- Conversion Factor, η_0 (EN 12975-2; §6.1 / 6.2 / 6.3)
- First order heat loss coefficient, a_1 (EN 12975-2; §6.1 / 6.2 / 6.3)
- Second order heat loss coefficient, a_2 (EN 12975-2; §6.1 / 6.2 / 6.3)
- Incidence angle modifier IAM (EN 12975-2; §6.1.7 / 6.2.7 / 6.3.6)

2.2.2 Stores

The stores shall be tested according to EN 12977-3 in case of stores for domestic hot water preparation or according to EN 12977-4 in case of combistores. The output parameters obtained by the test procedures are specified in section 6.3.1 of both standards:

a. Stored water:
    1. height;
    2. effective volume respectively effective thermal capacity;
    3. heights of the inlet and outlet connections;
    4. heat loss capacity rate of the entire store;

5. if the insulation varies for different heights of the store, the distribution of the heat loss capacity rate should be determined for the different parts of the store;
6. a parameter describing the degradation of thermal stratification during stand-by.
   NOTE 1: One possible way to describe this effect in a store model is the use of a vertical thermal conduction. In this case, the corresponding parameter is an effective vertical thermal conductivity.
7. a parameter describing the characteristic of thermal stratification during direct discharge.
   NOTE 2: An additional parameter may be used to describe the influence of different draw-off flow rates on the thermal stratification inside the store, if this effect is relevant.
8. positions of the temperature sensors (e.g. the sensors of the collector loop and auxiliary heater control).

b. Heat exchangers:
   1. heights of the inlet and outlet connections
   2. heat transfer capacity rate as a function of temperature, mass flow rate (in case the mass flow rate is variable) and thermal power
   3. information on the capacity in respect of stratified charging
      NOTE 3: The capacity in respect of stratified charging can be determined from the design of the heat exchanger as well as from the course in time of the heat exchanger inlet and outlet temperatures.
   4. heat loss rate from the heat exchanger to the ambient (necessary only for mantle heat exchangers and external heat exchangers)

c. Electrical auxiliary heat source:
   1. position in the store
   2. axis direction of heating element (horizontal or vertical). If the auxiliary heater is installed in a vertical way, its length is also required
   3. efficiency that characterises the fraction of the electric power converted to thermal and transferred inside the store

2.2.3 Controllers

The controllers shall be tested according to EN 12977-5. Thereby the control strategy to be implemented within the system simulation will be verified. Additionally indicators as stand-by electric power and pump operation electric power shall be determined.

2.2.4 System Simulation

“The modelling of the system should be carried out using a detailed dynamic simulation programme fitted for the different system and store configurations considered, including their control strategy. The simulation programme should operate on the basis of all parameters determined in the component tests.”

A common approach is to use the simulation program TRNSYS to perform the annual performance prediction. A TRNSYS simulation is configured by a deck file. A TRNSYS deck file for a typical domestic hot water system contains the following components:

- Same store and collector model as used for characterisation:
  - TYPE 340 MULTIPORT STORE MODEL
  - TYPE 132 CEN Solar Collector
- Control strategy with characteristic set points
  - TYPE 2 ON/OFF differential controller
    * collector loop controller
  - TYPE 2 ON/OFF differential controller
    * for thermal auxiliary heating via heat exchanger
- Reading/converting of input data
  - TYPE 9 Data Reader PRESIM TYPE 1109
    *data reader for weather data
  - TYPE 16 Sol Rad Proc, Ib and Id
- Writing of simulation results:
  - TYPE 28 simulation summary
  - TYPE 28 simulation summary for energy balance
- Generic hydraulic components:
  - TYPE 31 Pipe 1 store -> collector
  - TYPE 31 Pipe 2 collector -> store
  - TYPE 6 ON/OFF AUXILIARY HEATER
- Thermostat mixer or equivalent which reduces the store outlet fluid temperature
  - TYPE 11
    * Temperature Controlled Flow Diverter Mode 4/5
  - mixing is realized by an equation statement
- Daily tapping profile
  - TYPE 14 (Time dependent forcing function)
    * sets the mass flow rate of the tapping
  - constant hot water demand temperature

The main goal of the simulation is to determine the amount of energy delivered by the solar system. Therefore the most important indicators gained from the simulation are the heat load (Q_{load}), the heat delivered by the auxiliary heating (Q_{aux}) and the solar fraction (F_{sol}).

3 EU Energy Labelling Directive

The implementation of the Directive 2010/30/EU introduces a harmonised scheme for the indication of energy efficiency consumption by labelling and standard product information for the benefit of consumers. The current state of the implementation is described in the working documents [1] and [2]. This chapter will shortly summarise the content of the documents relevant for custom built systems.

3.1 Information provided on the energy label

Custom built systems are consisting of the solar part containing the store. Additionally a conventional backup heater is necessary to cover the load under low irradiation conditions. The energy labelling scheme envisages separate labels for the conventional backup heater and solar system as well as one label for the heat store. The following figure shows the labels for these components:

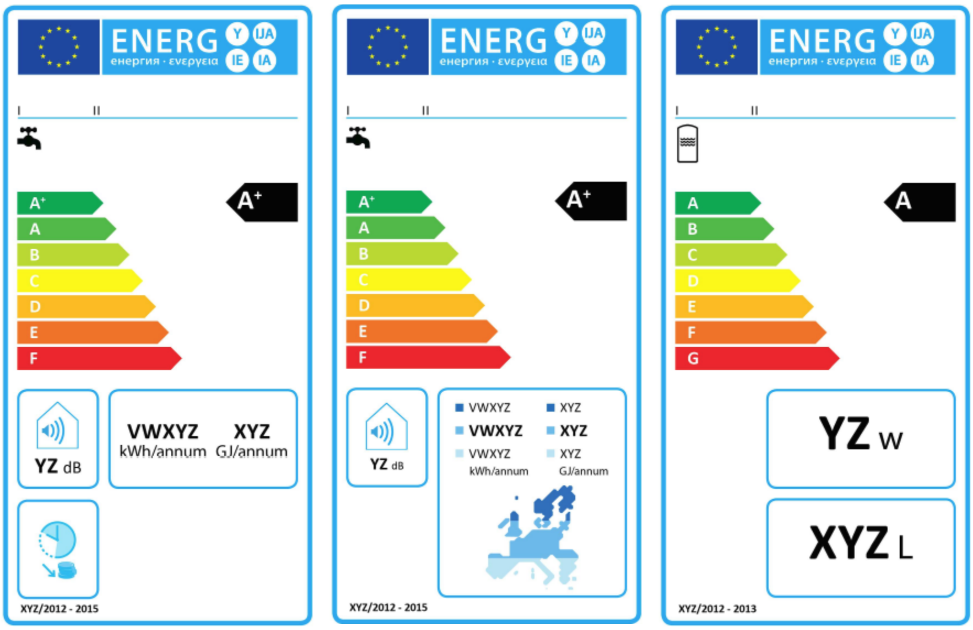

Fig. 1: Energy label of a conventional heater (left), a solar system (middle) and a heat store (right)

The following information shall be included in the label of a solar system:

I. supplier's name or trade mark;
II. supplier's model identifier;
III. the water heating function, displayed as pictogram of the declared load profile in accordance with Table 3 of [2] Annex III;
IV. the energy efficiency class under average climate conditions, determined in accordance with point 1 of [2] Annex II. The head of the arrow containing the energy efficiency class of the water heater shall be placed at the same height as the head of the relevant energy efficiency class;
V. the annual electricity consumption in kWh in terms of final energy or the annual fuel consumption in GJ in terms of GCV, under average, colder and warmer climate conditions, rounded to the nearest integer and calculated in accordance with point 4 of [2] Annex VIII;
VI. European solar map with a display of three indicative global solar irradiance zones;
VII. the sound power level LWA, indoor measured, in dB, rounded to the nearest integer.

The following information shall be included in the label of the heat store:

I. supplier's name or trade mark;
II. supplier's model identifier;

III. the water storage function;
IV. the energy efficiency class, determined in accordance with point 2 of [2] Annex II. The head of the arrow containing the energy efficiency class of the storage tank shall be placed at the same height as the head of the relevant energy efficiency class;
V. the standing loss in W, rounded to the nearest integer;
VI. the storage tank volume in litres, rounded to the nearest integer.

To provide the necessary information on the basis of existing test results, the transitional calculation methods described in 3.2 and 3.3 are introduced.

The combination of a solar system with a backup heater will be covered by an additional label provided by the supplier. The following figure shows such a label:

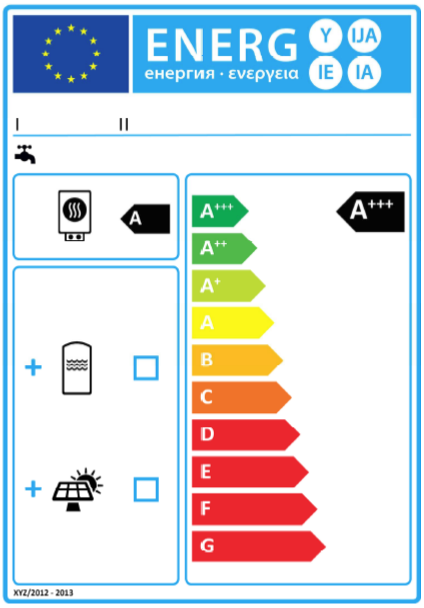

Fig. 2: Energy label for a package consisting of a solar system and backup heater

The following information shall be included in the label:

I. dealer's name or trade mark;
II. dealer's model(s) identifier;
III. the water heating function, displayed as pictogram of the declared load profile in accordance with Table 3 of [2] Annex III;
IV. the energy efficiency class of the water heater, determined in accordance with point 1 of [2] Annex II;
V. indication that a storage tank and solar collector may be included in the package of water heater and solar-only system;
VI. the energy efficiency class of the package of water heater and solar-only system, determined in accordance with point 4 of Annex IV. The head of the arrow containing the energy efficiency class of the package of water heater and solar-only system shall be

placed at the same height as the head of the relevant energy efficiency class.

3.2 Transitional calculation method for custom built systems

The referenced versions of the working documents [1] and [2] on the implementation of Directive 2010/30/EU and Directive 2009/125/EC introduce "*transitional methods of measurement and calculation. It is intended that these transitional methods will ultimately be replaced by harmonised standard(s).*"[1]

These transitional methods are utilising existing test results to estimate the main indicators given on the product label and the harmonized product information. For the assessment of the annual non-solar heat contribution of custom built systems the document [1] defines the „SOLCAL"-method. This procedure is based on EN 15316-4-3 "Method B" requiring separate test of solar collector and solar hot water storage tank, pump and controller. The utilized input parameters are described in the following section.

3.3 Availability of required input parameters and standard amendments

3.3.1 Solar collector testing

The collector parameters needed for the SOLCAL procedure are:

- Aperture area of solar collector, Asol (EN 12975-2; §6.1.2.8)
- Start efficiency, n0 (EN 12975-2; §6.1 / 6.2 / 6.3)
- First order heat loss coefficient, a1 (EN 12975-2; §6.1 / 6.2 / 6.3)
- Second order heat loss coefficient, a2 (EN 12975-2; §6.1 / 6.2 / 6.3)
- Incidence angle modifier IAM (EN 12975-2; §6.1.7 / 6.2.7 / 6.3.6)

Test procedures from EN 12975-2 can be used.

3.3.2 Testing of solar hot water storage tank

The storage parameters needed for the SOLCAL procedure are:

- Total effective volume of storage, Vs (EN 12977-3 §6.3.1 a.2)
- Back-up volume, Vbu (EN 12977-3 §6.3.1 a.2/a.3)
- Heat loss capacity rate of the entire store, psbsol (EN 12977-3 §6.3.1 a.4)

Test procedures from EN 12977-3 can be used.

Note: Also e.g. storage tank test procedures in 4.8 in [1] can be used.

3.3.3 Testing controller system

The controller system parameter needed for the SOLCAL procedure is:

[1] see [1], p.2 (WD_Testing Calculation Water Heater-2-2-12.pdf)

- Electrical standby consumption, solstandby

Test procedure from EN 12977-5 can be used.

Note: Also e.g. test procedure in EN 62301 can be used (Household Electrical Appliances: Measurement of standby power).

3.3.4 Testing pump

The pump parameter needed for the SOLCAL procedure is:

- Electrical consumption by pump(s), solpump

Test procedure from EN 12977-5 can be used.

Note: Also e.g. solar pump power test procedure given in 4.9 in [1] can be used.

3.4 Working documents

[1]: Working Document on a Draft Commission communication in the framework of the implementation of Commission Regulation (EU) No …/… implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for water heaters and hot water storage tanks and of the implementation of Commission Delegated Regulation (EU) No …/… supplementing Directive 2010/30/EU of the European Parliament and of the Council with regard to energy labelling of water heaters, hotwater storage tanks and packages of water heater and solar-only system (Text with EEA relevance) (2012/C …/…). Given date: February 2nd 2012

[2]: Working Document on a Draft COMMISSION DELEGATED REGULATION (EU) No …/.. of XXX supplementing Directive 2010/30/EU of the European Parliament and of the Council with regard to energy labelling of water heaters, hot water storage tanks and packages of water heater and solar-only system. Given date: February 2nd 2012

4 Application of the CTSS method for Energy Labelling

4.1 Calculation methodology

The transitional methods are necessary to transform existing test results to the energy labelling specific boundary conditions. The information that shall be provided on the label, mainly the energy efficiency, the annual electricity consumption Q_{aux} and annual non-solar heat contribution Q_{nonsol}, could be directly derived from the transient simulation acc. to EN 12977-2. This requires changing of the current or introducing additional, energy labelling specific boundary conditions in the standard EN 12977-2. This approach increases the accuracy of the results because detailed numerical component models are used for the calculation and complex interactions between components as well as advanced control strategies are taken into account.

4.2 Boundary conditions

The boundary conditions for system simulation as described in 2.2.4 are given in EN 12977-2 Annex A. The Tab. 1 presents the differences between the current reference boundary conditions and the energy labelling specific boundary conditions. The boundary conditions conform to both, the EN 12977-2 and the energy labelling scheme are marked with a green NA (No Amendments). Required amendments are indicated in red.

Reference condition	Value	Remarks
SYSTEM		
Collector orientation	45° NA	
Total length of collector circuit	20 m (10 m + 10 m) NA	
Pipe diameter and insulation thickness of collector circuit	See B.2 NA	
Location of collector circuit pipes	Indoor, for systems with store situated indoors; Outdoor, for systems with store situated outdoors NA	
Store ambient temperature	15 °C 20°C for indoor store Outdoor temperature for outdoor store	For systems where the store is located outside, the ambient temperature from the climate data shall be used.
For systems with indirect (hydraulic) auxiliary heating: Power to be applied on auxiliary heat exchanger	(100 ± 30) W per litre of store volume above the lowest end of heat exchanger NA	If the auxiliary heater is not delivered with the system and no restrictions have been given in the documentation. The auxiliary heater shall be modelled as an ideal heat source with no heat capacity and constant heating power.
Flowrate through auxiliary heat	The flowrate through the heat exchanger shall be chosen such that the temperature difference between the inlet and outlet of the auxiliary heat exchanger is (10 ± 2) K under	

exchanger	steady state conditions, unless specified otherwise by the manufacturer. NA	
For systems with electrical auxiliary heating: Power of electrical element	If an electrical element is normally delivered with the system or specified by the manufacturer, this element shall be used. Otherwise, (25 ± 8) W per litre of store volume above the electrical element. By declaration	
Temperature of integrated auxiliary heating	52,5 °C (minimum temperature of hysteresis) By declaration - minimum 60°C Timer control: By declaration	Or a higher temperature, if recommended by the manufacturer
CLIMATE		
Reference locations	Stockholm, Würzburg, Davos, Athens average, colder and warmer climate conditions *Average: Strasbourg* Colder: Helsinki Warmer: Athens	In the reporting form, the performance of a different location of choice may also be given.
Climate Data	For Stockholm: CEC Test Reference Year; for Davos, Würzburg and Athens: Test Reference Year. Average daytime temperature in °C for average, colder and warmer climate conditions and average global solar irradiance in W/m2 for average, colder and warmer climate conditions *according to [2]* Hourly values for global solar irradiance and ambient temperature according to an appropriate CEC test reference - data not given! (see 4.3)	

Tab. 1: Comparison between the EN 12977-2 reference conditions for performance prediction and the energy labelling specific boundary conditions

4.3 Meteorological Data for Average, Colder and Warmer Climates

A set of hourly data for irradiation and ambient temperatures has been extracted from the meteonorm database for the locations Helsinki=colder climate, Strasbourg = average climate and the data of the test reference year for Athens = warmer climate has been prepared. These data sets have been compared to the monthly data given in [2]. The Fig. 3, Fig. 4 and Fig. 5 show the comparison of the monthly average irradiation values.

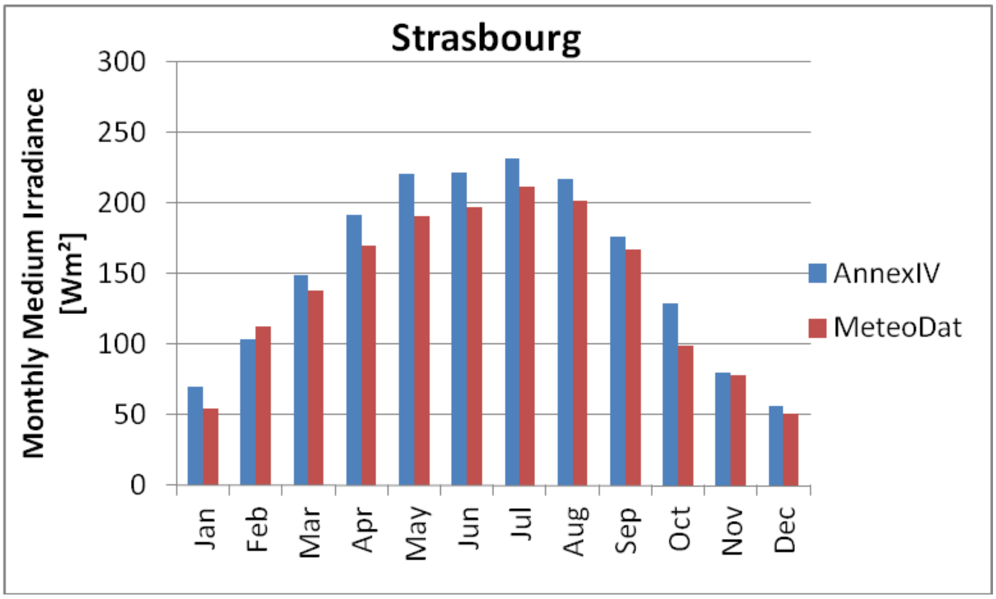

Fig. 3: Comparison of monthly average irradiation based on data extracted from the meteonorm database and the monthly values given in [2] for the location of Strasbourg (average climate)

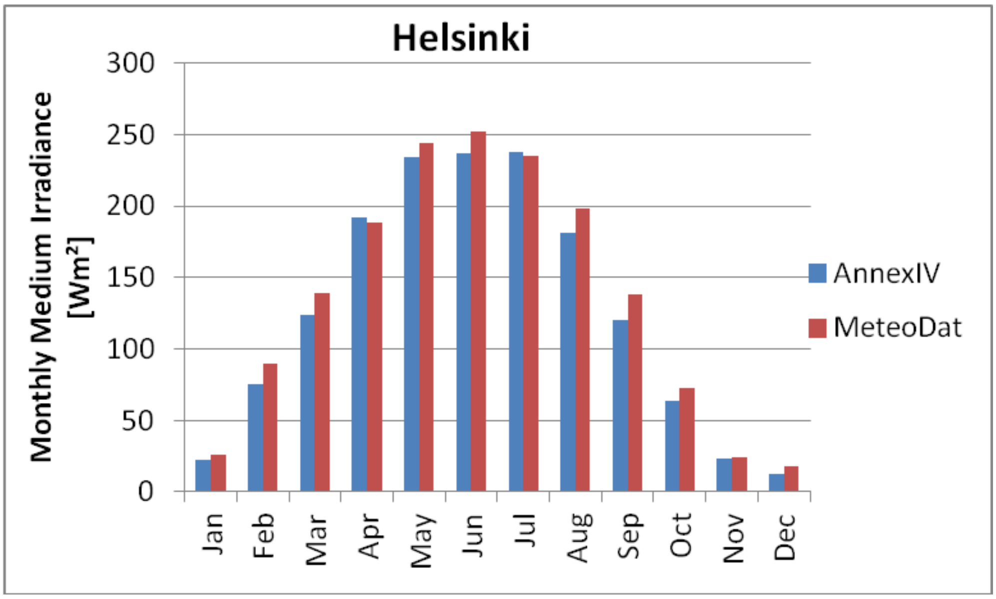

Fig. 4: Comparison of monthly average irradiation based on data extracted from the meteonorm database and the monthly values given in [2] for the location of Helsinki (colder climate)

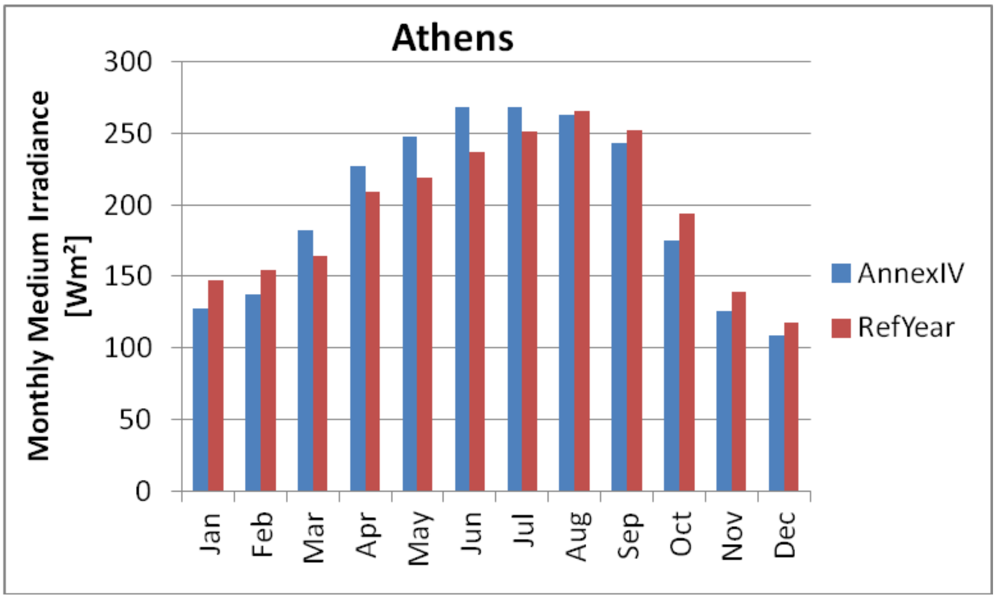

Fig. 5: Comparison of monthly average irradiation based on data extracted from the meteonorm database and the monthly values given in [2] for the location of Athens (warmer climate)

All figures are showing some deviations between the values based on hourly data (MeteoDat and RefYear) and the monthly data given in [2]. Unfortunately it was not possible to access hourly values of the data set given in [2]. The elaborated data is included in Annex B.

4.4 Implementation of the Tapping Cycles in the TRNSYS simulation

One of the major changes in the energy labelling specific boundary conditions are harmonised tapping cycles. These are given in Table 4 of [2], Annex VII. The tapping cycles are defined as a set of the following parameters: heat demand per tapping (Q_{tap} [kWh]), minimum volume flow rate (f [l/min]), minimum temperature (T_m [°C]) and peak temperature (T_p [°C]). For solar water heater the profiles M to 4XL shall be used. These are listed in the Tab. 3 and Tab. 4.

Since the implementation of the tapping cycle in TRNSYS requires different input values (inlet and outlet temperatures and the mass flow rate), the given profiles must be recalculated:

value	calculation
inlet temperature T_{cw}	constant
outlet temperature (T_l)	during the tapping: max(T_m, T_p)
mass flow rate (m_dot)	m_dot = Qtab/(N*dt*cp*(Tl-Tcw)

	with: dt = 90s N: discrete number of time steps additionally: m_dot >= rho * f

Tab. 2: Calculation of inlet/outlet temperature and the mass flow rate of a single tapping

	M				L				XL			
	Q_{tap}	f	T_m	T_p	Q_{tap}	f	T_m	T_p	Q_{tap}	f	T_m	T_p
h	kWh	l/mn	°C	°C	kWh	l/min	°C	°C	kWh	l/min	°C	°C
07:00	0,105	3	25		0,105	3	25		0,105	3	25	
07:05	1,4	6	40		1,4	6	40					
07:15									1,82	6	40	
07:26									0,105	3	25	
07:30	0,105	3	25		0,105	3	25					
07:45					0,105	3	25		4,42	10	10	40
08:01	0,105	3	25						0,105	3	25	
08:05					3,605	10	10	40				
08:15	0,105	3	25						0,105	3	25	
08:25					0,105	3	25					
08:30	0,105	3	25		0,105	3	25		0,105	3	25	
08:45	0,105	3	25		0,105	3	25		0,105	3	25	
09:00	0,105	3	25		0,105	3	25		0,105	3	25	
09:30	0,105	3	25		0,105	3	25		0,105	3	25	
10:00									0,105	3	25	
10:30	0,105	3	10	40	0,105	3	10	40	0,105	3	10	40
11:00									0,105	3	25	
11:30	0,105	3	25		0,105	3	25		0,105	3	25	
11:45	0,105	3	25		0,105	3	25		0,105	3	25	
12:00												
12:30												
12:45	0,315	4	10	55	0,315	4	10	55	0,735	4	10	55
14:30	0,105	3	25		0,105	3	25		0,105	3	25	
15:00									0,105	3	25	
15:30	0,105	3	25		0,105	3	25		0,105	3	25	
16:00									0,105	3	25	
16:30	0,105	3	25		0,105	3	25		0,105	3	25	
17:00									0,105	3	25	
18:00	0,105	3	25		0,105	3	25		0,105	3	25	
18:15	0,105	3	40		0,105	3	40		0,105	3	40	
18:30	0,105	3	40		0,105	3	40		0,105	3	40	
19:00	0,105	3	25		0,105	3	25		0,105	3	25	
19:30												
20:00												
20:30	0,735	4	10	55	0,735	4	10	55	0,735	4	10	55
20:45												
20:46									4,42	10	10	40
21:00					3,605	10	10	40				
21:15	0,105	3	25						0,105	3	25	
21:30	1,4	6	40		0,105	3	25		4,42	10	10	40
21:30												
21:45												
Q_{ref}	5,845				11,655				19,07			

Tab. 3: Profiles M-XL of the European reference tapping cycles

	XXL				3XL				4XL			
	Q_{tap}	f	T_m	T_p	Q_{tap}	f	T_m	T_p	Q_{tap}	f	T_m	T_p
h	kWh	l/min	°C	°C	kWh	l/min	°C	°C	kWh	l/min	°C	°C
07:00	**0,105**	3	25		**11,2**	48	40		**22,4**	96	40	
07:05												
07:15	**1,82**	6	40									
07:26	**0,105**	3	25									
07:30												
07:45	**6,24**	16	10	40								
08:01	**0,105**	3	25		**5,04**	24	25		**10,08**	48	25	
08:05												
08:15	**0,105**	3	25									
08:25												
08:30	**0,105**	3	25									
08:45	**0,105**	3	25									
09:00	**0,105**	3	25		**1,68**	24	25		**3,36**	48	25	
09:30	**0,105**	3	25									
10:00	**0,105**	3	25									
10:30	**0,105**	3	10	40	**0,84**	24	10	40	**1,68**	48	10	40
11:00	**0,105**	3	25									
11:30	**0,105**	3	25									
11:45	**0,105**	3	25		**1,68**	24	25		**3,36**	48	25	
12:00												
12:30												
12:45	**0,735**	4	10	55	**2,52**	32	10	55	**5,04**	64	10	55
14:30	**0,105**	3	25									
15:00	**0,105**	3	25									
15:30	**0,105**	3	25		**2,52**	24	25		**5,04**	48	25	
16:00	**0,105**	3	25									
16:30	**0,105**	3	25									
17:00	**0,105**	3	25									
18:00	**0,105**	3	25									
18:15	**0,105**	3	40									
18:30	**0,105**	3	40		**3,36**	24	25		**6,72**	48	25	
19:00	**0,105**	3	25									
19:30												
20:00												
20:30	**0,735**	4	10	55	**5,88**	32	10	55	**11,76**	64	10	55
20:45												
20:46	**6,24**	16	10	40								
21:00												
21:15	**0,105**	3	25									
21:30	**6,24**	16	10	40	**12,04**	48	40		**24,08**	96	40	
21:30												
21:45												
Q_{ref}	**24,53**				**46,76**				**93,52**			

Tab. 4: Profiles XXL-4XL of the European reference tapping cycles

The European reference tapping cycles have been implemented in TRNSYS using the TYPE 14 (Time dependent forcing function). One unit of TYPE 14 has been defined to control the mass flow rate and one for the outlet temperature (T_l). The created profiles will be attached to this report in the file EUTabInputDataSet.zip containing one file for each profile.

5 Annex: Tapping profile implementation in TRNSYS

XXS-Profile:

```
EQUATIONS       4
* cold water temperature [°C]
Tcw = 10
* storage ambient temperature [°C]
Tsa = 20
* set temperature for the auxiliary heating [°C]
TsetHW = 35
* demand temperature data binding
Td = [21,1]
* tapping mass flow rate:
mtap = [20,1]
```

```
UNIT 20 TYPE 14 time depending forcing function
* load sequencer, mass flow:
* sequence: eco0_XXS
PARAMETERS 164
 00.000    0.0
 07.000    0.0
 07.000 120.286
 07.050 120.286
 07.050    0.0
 07.500    0.0
 07.500 120.286
 07.550 120.286
 07.550    0.0
 08.500    0.0
 08.500 120.286
 08.550 120.286
 08.550    0.0
 09.500    0.0
 09.500 120.286
 09.550 120.286
 09.550    0.0
 11.500    0.0
 11.500 120.286
 11.550 120.286
 11.550    0.0
 11.750    0.0
 11.750 120.286
 11.800 120.286
 11.800    0.0
 12.000    0.0
 12.000 120.286
 12.050 120.286
 12.050    0.0
 12.500    0.0
 12.500 120.286
 12.550 120.286
 12.550    0.0
 12.750    0.0
 12.750 120.286
 12.800 120.286
 12.800    0.0
 18.000    0.0
 18.000 120.286
 18.050 120.286
 18.050    0.0
 18.250    0.0
 18.250 120.286
 18.300 120.286
 18.300    0.0
 18.500    0.0
```

```
UNIT 21 TYPE 14 time depending forcing function
*load sequencer, demanded temp:
*sequence: eco0_XXS
PARAMETERS 164
 00.000 10.000
 07.000 10.000
 07.000 25.000
 07.050 25.000
 07.050 10.000
 07.500 10.000
 07.500 25.000
 07.550 25.000
 07.550 10.000
 08.500 10.000
 08.500 25.000
 08.550 25.000
 08.550 10.000
 09.500 10.000
 09.500 25.000
 09.550 25.000
 09.550 10.000
 11.500 10.000
 11.500 25.000
 11.550 25.000
 11.550 10.000
 11.750 10.000
 11.750 25.000
 11.800 25.000
 11.800 10.000
 12.000 10.000
 12.000 25.000
 12.050 25.000
 12.050 10.000
 12.500 10.000
 12.500 25.000
 12.550 25.000
 12.550 10.000
 12.750 10.000
 12.750 25.000
 12.800 25.000
 12.800 10.000
 18.000 10.000
 18.000 25.000
 18.050 25.000
 18.050 10.000
 18.250 10.000
 18.250 25.000
 18.300 25.000
 18.300 10.000
 18.500 10.000
```

18.500 120.286 18.550 120.286 18.550 0.0 19.000 0.0 19.000 120.286 19.050 120.286 19.050 0.0 19.500 0.0 19.500 120.286 19.550 120.286 19.550 0.0 20.000 0.0 20.000 120.286 20.050 120.286 20.050 0.0 20.750 0.0 20.750 120.286 20.800 120.286 20.800 0.0 21.000 0.0 21.000 120.286 21.050 120.286 21.050 0.0 21.250 0.0 21.250 120.286 21.300 120.286 21.300 0.0 21.500 0.0 21.500 120.286 21.550 120.286 21.550 0.0 21.750 0.0 21.750 120.286 21.800 120.286 21.800 0.0 24.000 0.0	18.500 25.000 18.550 25.000 18.550 10.000 19.000 10.000 19.000 25.000 19.050 25.000 19.050 10.000 19.500 10.000 19.500 25.000 19.550 25.000 19.550 10.000 20.000 10.000 20.000 25.000 20.050 25.000 20.050 10.000 20.750 10.000 20.750 25.000 20.800 25.000 20.800 10.000 21.000 10.000 21.000 25.000 21.050 25.000 21.050 10.000 21.250 10.000 21.250 25.000 21.300 25.000 21.300 10.000 21.500 10.000 21.500 25.000 21.550 25.000 21.550 10.000 21.750 10.000 21.750 25.000 21.800 25.000 21.800 10.000 24.000 10.000
XS-Profile:	
EQUATIONS 5 * cold water temperature [°C] Tcw = 10 * storage ambient temperature [°C] Tsa = 20 * set temperature for the auxiliary heating [°C] TsetHW = 45 * demand temperature data binding Td = [21,1] * tapping mass flow rate: mtap = [20,1]	
UNIT 20 TYPE 14 time depending forcing function * load sequencer, mass flow: * sequence: eco0_XS PARAMETERS 28 00.000 0.0 07.500 0.0 07.500 240.573 07.575 240.573 07.575 0.0 12.750 0.0 12.750 240.573 12.825 240.573 12.825 0.0 20.500 0.0 20.500 240.573 20.650 240.573 20.650 0.0 24.000 0.0	UNIT 21 TYPE 14 time depending forcing function *load sequencer, demanded temp: *sequence: eco0_XS PARAMETERS 28 00.000 10.000 07.500 10.000 07.500 35.000 07.575 35.000 07.575 10.000 12.750 10.000 12.750 35.000 12.825 35.000 12.825 10.000 20.500 10.000 20.500 35.000 20.650 35.000 20.650 10.000 24.000 10.000

S-Profile:

```
EQUATIONS      5
* cold water temperature [°C]
Tcw = 10
* storage ambient temperature [°C]
Tsa = 20
* set temperature for the auxiliary heating [°C]
TsetHW = 65
* demand temperature data binding
Td = [21,1]
* tapping mass flow rate:
mtap = [20,1]
```

```
UNIT  20  TYPE  14  time  depending
forcing function
* load sequencer, mass flow:
* sequence: eco0_S
PARAMETERS 92
 00.000   0.0
 07.000   0.0
 07.000 240.573
 07.025 240.573
 07.025   0.0
 07.500   0.0
 07.500 240.573
 07.525 240.573
 07.525   0.0
 08.500   0.0
 08.500 240.573
 08.525 240.573
 08.525   0.0
 09.500   0.0
 09.500 240.573
 09.525 240.573
 09.525   0.0
 11.500   0.0
 11.500 240.573
 11.525 240.573
 11.525   0.0
 11.750   0.0
 11.750 240.573
 11.775 240.573
 11.775   0.0
 12.750   0.0
 12.750 240.573
 12.775 240.573
 12.775   0.0
 18.000   0.0
 18.000 240.573
 18.025 240.573
 18.025   0.0
 18.250   0.0
 18.250 120.286
 18.275 120.286
 18.275   0.0
 20.500   0.0
 20.500 320.764
 20.525 320.764
 20.525   0.0
 21.500   0.0
 21.500 257.757
 21.550 257.757
 21.550   0.0
 24.000   0.0
```

```
UNIT  21  TYPE  14  time  depending
forcing function
*load sequencer, demanded temp:
*sequence: eco0_S
PARAMETERS 92
 00.000 10.000
 07.000 10.000
 07.000 25.000
 07.025 25.000
 07.025 10.000
 07.500 10.000
 07.500 25.000
 07.525 25.000
 07.525 10.000
 08.500 10.000
 08.500 25.000
 08.525 25.000
 08.525 10.000
 09.500 10.000
 09.500 25.000
 09.525 25.000
 09.525 10.000
 11.500 10.000
 11.500 25.000
 11.525 25.000
 11.525 10.000
 11.750 10.000
 11.750 25.000
 11.775 25.000
 11.775 10.000
 12.750 10.000
 12.750 55.000
 12.775 55.000
 12.775 10.000
 18.000 10.000
 18.000 25.000
 18.025 25.000
 18.025 10.000
 18.250 10.000
 18.250 40.000
 18.275 40.000
 18.275 10.000
 20.500 10.000
 20.500 55.000
 20.525 55.000
 20.525 10.000
 21.500 10.000
 21.500 45.000
 21.550 45.000
 21.550 10.000
 24.000 10.000
```

M-Profile:

```
EQUATIONS      5
* cold water temperature [°C]
```

```
Tcw = 10
* storage ambient temperature [°C]
Tsa = 20
* set temperature for the auxiliary heating [°C]
TsetHW = 65
* demand temperature data binding
Td = [21,1]
* tapping mass flow rate:
mtap = [20,1]
```

```
UNIT 20 TYPE 14 time depending
forcing function
* load sequencer, mass flow:
* sequence: eco0_M
PARAMETERS 188
 00.000   0.0
 07.000   0.0
 07.000 240.573
 07.025 240.573
 07.025   0.0
 07.083   0.0
 07.083 400.955
 07.183 400.955
 07.183   0.0
 07.500   0.0
 07.500 240.573
 07.525 240.573
 07.525   0.0
 08.017   0.0
 08.017 240.573
 08.042 240.573
 08.042   0.0
 08.250   0.0
 08.250 240.573
 08.275 240.573
 08.275   0.0
 08.500   0.0
 08.500 240.573
 08.525 240.573
 08.525   0.0
 08.750   0.0
 08.750 240.573
 08.775 240.573
 08.775   0.0
 09.000   0.0
 09.000 240.573
 09.025 240.573
 09.025   0.0
 09.500   0.0
 09.500 240.573
 09.525 240.573
 09.525   0.0
 10.500   0.0
 10.500 120.286
 10.525 120.286
 10.525   0.0
 11.500   0.0
 11.500 240.573
 11.525 240.573
 11.525   0.0
 11.750   0.0
 11.750 240.573
 11.775 240.573
 11.775   0.0
 12.750   0.0
 12.750 240.573
 12.775 240.573
 12.775   0.0
 14.500   0.0
 14.500 240.573
```

```
UNIT 21 TYPE 14 time depending
forcing function
*load sequencer, demanded temp:
*sequence: eco0_M
PARAMETERS 188
 00.000 10.000
 07.000 10.000
 07.000 25.000
 07.025 25.000
 07.025 10.000
 07.083 10.000
 07.083 40.000
 07.183 40.000
 07.183 10.000
 07.500 10.000
 07.500 25.000
 07.525 25.000
 07.525 10.000
 08.017 10.000
 08.017 25.000
 08.042 25.000
 08.042 10.000
 08.250 10.000
 08.250 25.000
 08.275 25.000
 08.275 10.000
 08.500 10.000
 08.500 25.000
 08.525 25.000
 08.525 10.000
 08.750 10.000
 08.750 25.000
 08.775 25.000
 08.775 10.000
 09.000 10.000
 09.000 25.000
 09.025 25.000
 09.025 10.000
 09.500 10.000
 09.500 25.000
 09.525 25.000
 09.525 10.000
 10.500 10.000
 10.500 40.000
 10.525 40.000
 10.525 10.000
 11.500 10.000
 11.500 25.000
 11.525 25.000
 11.525 10.000
 11.750 10.000
 11.750 25.000
 11.775 25.000
 11.775 10.000
 12.750 10.000
 12.750 55.000
 12.775 55.000
 12.775 10.000
 14.500 10.000
 14.500 25.000
```

14.525 240.573	14.525 25.000
14.525 0.0	14.525 10.000
15.500 0.0	15.500 10.000
15.500 240.573	15.500 25.000
15.525 240.573	15.525 25.000
15.525 0.0	15.525 10.000
16.500 0.0	16.500 10.000
16.500 240.573	16.500 25.000
16.525 240.573	16.525 25.000
16.525 0.0	16.525 10.000
18.000 0.0	18.000 10.000
18.000 240.573	18.000 25.000
18.025 240.573	18.025 25.000
18.025 0.0	18.025 10.000
18.250 0.0	18.250 10.000
18.250 120.286	18.250 40.000
18.275 120.286	18.275 40.000
18.275 0.0	18.275 10.000
18.500 0.0	18.500 10.000
18.500 120.286	18.500 40.000
18.525 120.286	18.525 40.000
18.525 0.0	18.525 10.000
19.000 0.0	19.000 10.000
19.000 240.573	19.000 25.000
19.025 240.573	19.025 25.000
19.025 0.0	19.025 10.000
20.500 0.0	20.500 10.000
20.500 280.668	20.500 55.000
20.550 280.668	20.550 55.000
20.550 0.0	20.550 10.000
21.250 0.0	21.250 10.000
21.250 240.573	21.250 25.000
21.275 240.573	21.275 25.000
21.275 0.0	21.275 10.000
21.500 0.0	21.500 10.000
21.500 400.955	21.500 40.000
21.600 400.955	21.600 40.000
21.600 0.0	21.600 10.000
24.000 0.0	24.000 10.000

L-Profile:

```
EQUATIONS      5
* cold water temperature [°C]
Tcw = 10
* storage ambient temperature [°C]
Tsa = 20
* set temperature for the auxiliary heating [°C]
TsetHW = 65
* demand temperature data binding
Td = [21,1]
* tapping mass flow rate:
mtap = [20,1]
```

UNIT 20 TYPE 14 time depending forcing function * load sequencer, mass flow: * sequence: eco0_L PARAMETERS 196	UNIT 21 TYPE 14 time depending forcing function *load sequencer, demanded temp: *sequence: eco0_L PARAMETERS 196
00.000 0.0	00.000 10.000
07.500 0.0	07.500 10.000
07.500 240.573	07.500 25.000
07.525 240.573	07.525 25.000
07.525 0.0	07.525 10.000
07.083 0.0	07.083 10.000
07.083 400.955	07.083 40.000
07.183 400.955	07.183 40.000
07.183 0.0	07.183 10.000
07.500 0.0	07.500 10.000
07.500 240.573	07.500 25.000
07.525 240.573	07.525 25.000

07.525 0.0 07.750 0.0 07.750 240.573 07.775 240.573 07.775 0.0 08.083 0.0 08.083 589.976 08.258 589.976 08.258 0.0 08.417 0.0 08.417 240.573 08.442 240.573 08.442 0.0 08.500 0.0 08.500 240.573 08.525 240.573 08.525 0.0 08.750 0.0 08.750 240.573 08.775 240.573 08.775 0.0 09.000 0.0 09.000 240.573 09.025 240.573 09.025 0.0 09.500 0.0 09.500 240.573 09.525 240.573 09.525 0.0 10.500 0.0 10.500 120.286 10.525 120.286 10.525 0.0 11.500 0.0 11.500 240.573 11.525 240.573 11.525 0.0 11.750 0.0 11.750 240.573 11.775 240.573 11.775 0.0 12.750 0.0 12.750 240.573 12.775 240.573 12.775 0.0 14.500 0.0 14.500 240.573 14.525 240.573 14.525 0.0 15.500 0.0 15.500 240.573 15.525 240.573 15.525 0.0 16.500 0.0 16.500 240.573 16.525 240.573 16.525 0.0 18.000 0.0 18.000 240.573 18.025 240.573 18.025 0.0 18.250 0.0 18.250 120.286 18.275 120.286 18.275 0.0 18.500 0.0 18.500 120.286 18.525 120.286 18.525 0.0	07.525 10.000 07.750 10.000 07.750 25.000 07.775 25.000 07.775 10.000 08.083 10.000 08.083 40.000 08.258 40.000 08.258 10.000 08.417 10.000 08.417 25.000 08.442 25.000 08.442 10.000 08.500 10.000 08.500 25.000 08.525 25.000 08.525 10.000 08.750 10.000 08.750 25.000 08.775 25.000 08.775 10.000 09.000 10.000 09.000 25.000 09.025 25.000 09.025 10.000 09.500 10.000 09.500 25.000 09.525 25.000 09.525 10.000 10.500 10.000 10.500 40.000 10.525 40.000 10.525 10.000 11.500 10.000 11.500 25.000 11.525 25.000 11.525 10.000 11.750 10.000 11.750 25.000 11.775 25.000 11.775 10.000 12.750 10.000 12.750 55.000 12.775 55.000 12.775 10.000 14.500 10.000 14.500 25.000 14.525 25.000 14.525 10.000 15.500 10.000 15.500 25.000 15.525 25.000 15.525 10.000 16.500 10.000 16.500 25.000 16.525 25.000 16.525 10.000 18.000 10.000 18.000 25.000 18.025 25.000 18.025 10.000 18.250 10.000 18.250 40.000 18.275 40.000 18.275 10.000 18.500 10.000 18.500 40.000 18.525 40.000 18.525 10.000

19.000 0.0	19.000 10.000
19.000 240.573	19.000 25.000
19.025 240.573	19.025 25.000
19.025 0.0	19.025 10.000
20.500 0.0	20.500 10.000
20.500 280.668	20.500 55.000
20.550 280.668	20.550 55.000
20.550 0.0	20.550 10.000
21.000 0.0	21.000 10.000
21.000 589.976	21.000 40.000
21.175 589.976	21.175 40.000
21.175 0.0	21.175 10.000
21.500 0.0	21.500 10.000
21.500 240.573	21.500 25.000
21.525 240.573	21.525 25.000
21.525 0.0	21.525 10.000
24.000 0.0	24.000 10.000

XL-Profile:

```
EQUATIONS      5
* cold water temperature [°C]
Tcw = 10
* storage ambient temperature [°C]
Tsa = 20
* set temperature for the auxiliary heating [°C]
TsetHW = 65
* demand temperature data binding
Td = [21,1]
* tapping mass flow rate:
mtap = [20,1]
```

UNIT 20 TYPE 14 time depending forcing function	UNIT 21 TYPE 14 time depending forcing function
* load sequencer, mass flow:	*load sequencer, demanded temp:
* sequence: eco0_XL	*sequence: eco0_XL
PARAMETERS 244	PARAMETERS 244
00.000 0.0	00.000 10.000
07.000 0.0	07.000 10.000
07.000 240.573	07.000 25.000
07.025 240.573	07.025 25.000
07.025 0.0	07.025 10.000
07.250 0.0	07.250 10.000
07.250 347.494	07.250 40.000
07.400 347.494	07.400 40.000
07.400 0.0	07.400 10.000
07.433 0.0	07.433 10.000
07.433 240.573	07.433 25.000
07.458 240.573	07.458 25.000
07.458 0.0	07.458 10.000
07.750 0.0	07.750 10.000
07.750 632.936	07.750 40.000
07.950 632.936	07.950 40.000
07.950 0.0	07.950 10.000
08.017 0.0	08.017 10.000
08.017 240.573	08.017 25.000
08.042 240.573	08.042 25.000
08.042 0.0	08.042 10.000
08.250 0.0	08.250 10.000
08.250 240.573	08.250 25.000
08.275 240.573	08.275 25.000
08.275 0.0	08.275 10.000
08.500 0.0	08.500 10.000
08.500 240.573	08.500 25.000
08.525 240.573	08.525 25.000
08.525 0.0	08.525 10.000
08.750 0.0	08.750 10.000
08.750 240.573	08.750 25.000
08.775 240.573	08.775 25.000
08.775 0.0	08.775 10.000
09.000 0.0	09.000 10.000

09.000 240.573 09.025 240.573 09.025 0.0 09.500 0.0 09.500 240.573 09.525 240.573 09.525 0.0 10.000 0.0 10.000 240.573 10.025 240.573 10.025 0.0 10.500 0.0 10.500 120.286 10.525 120.286 10.525 0.0 11.000 0.0 11.000 240.573 11.025 240.573 11.025 0.0 11.500 0.0 11.500 240.573 11.525 240.573 11.525 0.0 11.750 0.0 11.750 240.573 11.775 240.573 11.775 0.0 12.750 0.0 12.750 280.668 12.800 280.668 12.800 0.0 14.500 0.0 14.500 240.573 14.525 240.573 14.525 0.0 15.000 0.0 15.000 240.573 15.025 240.573 15.025 0.0 15.500 0.0 15.500 240.573 15.525 240.573 15.525 0.0 16.000 0.0 16.000 240.573 16.025 240.573 16.025 0.0 16.500 0.0 16.500 240.573 16.525 240.573 16.525 0.0 17.000 0.0 17.000 240.573 17.025 240.573 17.025 0.0 18.000 0.0 18.000 240.573 18.025 240.573 18.025 0.0 18.250 0.0 18.250 120.286 18.275 120.286 18.275 0.0 18.500 0.0 18.500 120.286 18.525 120.286 18.525 0.0 19.000 0.0 19.000 240.573	09.000 25.000 09.025 25.000 09.025 10.000 09.500 10.000 09.500 25.000 09.525 25.000 09.525 10.000 10.000 10.000 10.000 25.000 10.025 25.000 10.025 10.000 10.500 10.000 10.500 40.000 10.525 40.000 10.525 10.000 11.000 10.000 11.000 25.000 11.025 25.000 11.025 10.000 11.500 10.000 11.500 25.000 11.525 25.000 11.525 10.000 11.750 10.000 11.750 25.000 11.775 25.000 11.775 10.000 12.750 10.000 12.750 55.000 12.800 55.000 12.800 10.000 14.500 10.000 14.500 25.000 14.525 25.000 14.525 10.000 15.000 10.000 15.000 25.000 15.025 25.000 15.025 10.000 15.500 10.000 15.500 25.000 15.525 25.000 15.525 10.000 16.000 10.000 16.000 25.000 16.025 25.000 16.025 10.000 16.500 10.000 16.500 25.000 16.525 25.000 16.525 10.000 17.000 10.000 17.000 25.000 17.025 25.000 17.025 10.000 18.000 10.000 18.000 25.000 18.025 25.000 18.025 10.000 18.250 10.000 18.250 40.000 18.275 40.000 18.275 10.000 18.500 10.000 18.500 40.000 18.525 40.000 18.525 10.000 19.000 10.000 19.000 25.000

19.025 240.573	19.025 25.000
19.025 0.0	19.025 10.000
20.500 0.0	20.500 10.000
20.500 280.668	20.500 55.000
20.550 280.668	20.550 55.000
20.550 0.0	20.550 10.000
20.767 0.0	20.767 10.000
20.767 632.936	20.767 40.000
20.967 632.936	20.967 40.000
20.967 0.0	20.967 10.000
21.250 0.0	21.250 10.000
21.250 240.573	21.250 25.000
21.275 240.573	21.275 25.000
21.275 0.0	21.275 10.000
21.500 0.0	21.500 10.000
21.500 632.936	21.500 40.000
21.700 632.936	21.700 40.000
21.700 0.0	21.700 10.000
24.000 0.0	24.000 10.000

XXL-Profile:

```
EQUATIONS      5
* cold water temperature [°C]
Tcw = 10
* storage ambient temperature [°C]
Tsa = 20
* set temperature for the auxiliary heating [°C]
TsetHW = 65
* demand temperature data binding
Td = [21,1]
* tapping mass flow rate:
mtap = [20,1]
```

UNIT 20 TYPE 14 time depending forcing function * load sequencer, mass flow: * sequence: eco0_XXL PARAMETERS 244	UNIT 21 TYPE 14 time depending forcing function *load sequencer, demanded temp: *sequence: eco0_XXL PARAMETERS 244
00.000 0.0	00.000 10.000
07.000 0.0	07.000 10.000
07.000 240.573	07.000 25.000
07.025 240.573	07.025 25.000
07.025 0.0	07.025 10.000
07.250 0.0	07.250 10.000
07.250 347.494	07.250 40.000
07.400 347.494	07.400 40.000
07.400 0.0	07.400 10.000
07.433 0.0	07.433 10.000
07.433 240.573	07.433 25.000
07.458 240.573	07.458 25.000
07.458 0.0	07.458 10.000
07.750 0.0	07.750 10.000
07.750 1021.207	07.750 40.000
07.925 1021.207	07.925 40.000
07.925 0.0	07.925 10.000
08.017 0.0	08.017 10.000
08.017 240.573	08.017 25.000
08.042 240.573	08.042 25.000
08.042 0.0	08.042 10.000
08.250 0.0	08.250 10.000
08.250 240.573	08.250 25.000
08.275 240.573	08.275 25.000
08.275 0.0	08.275 10.000
08.500 0.0	08.500 10.000
08.500 240.573	08.500 25.000
08.525 240.573	08.525 25.000
08.525 0.0	08.525 10.000
08.750 0.0	08.750 10.000
08.750 240.573	08.750 25.000
08.775 240.573	08.775 25.000

08.775 0.0 09.000 0.0 09.000 240.573 09.025 240.573 09.025 0.0 09.500 0.0 09.500 240.573 09.525 240.573 09.525 0.0 10.000 0.0 10.000 240.573 10.025 240.573 10.025 0.0 10.500 0.0 10.500 120.286 10.525 120.286 10.525 0.0 11.000 0.0 11.000 240.573 11.025 240.573 11.025 0.0 11.500 0.0 11.500 240.573 11.525 240.573 11.525 0.0 11.750 0.0 11.750 240.573 11.775 240.573 11.775 0.0 12.750 0.0 12.750 280.668 12.800 280.668 12.800 0.0 14.500 0.0 14.500 240.573 14.525 240.573 14.525 0.0 15.000 0.0 15.000 240.573 15.025 240.573 15.025 0.0 15.500 0.0 15.500 240.573 15.525 240.573 15.525 0.0 16.000 0.0 16.000 240.573 16.025 240.573 16.025 0.0 16.500 0.0 16.500 240.573 16.525 240.573 16.525 0.0 17.000 0.0 17.000 240.573 17.025 240.573 17.025 0.0 18.000 0.0 18.000 240.573 18.025 240.573 18.025 0.0 18.250 0.0 18.250 120.286 18.275 120.286 18.275 0.0 18.500 0.0 18.500 120.286 18.525 120.286 18.525 0.0	08.775 10.000 09.000 10.000 09.000 25.000 09.025 25.000 09.025 10.000 09.500 10.000 09.500 25.000 09.525 25.000 09.525 10.000 10.000 10.000 10.000 25.000 10.025 25.000 10.025 10.000 10.500 10.000 10.500 40.000 10.525 40.000 10.525 10.000 11.000 10.000 11.000 25.000 11.025 25.000 11.025 10.000 11.500 10.000 11.500 25.000 11.525 25.000 11.525 10.000 11.750 10.000 11.750 25.000 11.775 25.000 11.775 10.000 12.750 10.000 12.750 55.000 12.800 55.000 12.800 10.000 14.500 10.000 14.500 25.000 14.525 25.000 14.525 10.000 15.000 10.000 15.000 25.000 15.025 25.000 15.025 10.000 15.500 10.000 15.500 25.000 15.525 25.000 15.525 10.000 16.000 10.000 16.000 25.000 16.025 25.000 16.025 10.000 16.500 10.000 16.500 25.000 16.525 25.000 16.525 10.000 17.000 10.000 17.000 25.000 17.025 25.000 17.025 10.000 18.000 10.000 18.000 25.000 18.025 25.000 18.025 10.000 18.250 10.000 18.250 40.000 18.275 40.000 18.275 10.000 18.500 10.000 18.500 40.000 18.525 40.000 18.525 10.000

<table>
<tr><td>19.000   0.0
19.000 240.573
19.025 240.573
19.025   0.0
20.500   0.0
20.500 280.668
20.550 280.668
20.550   0.0
20.767   0.0
20.767 1021.207
20.942 1021.207
20.942   0.0
21.250   0.0
21.250 240.573
21.275 240.573
21.275   0.0
21.500   0.0
21.500 595.704
21.800 595.704
21.800   0.0
24.000   0.0</td><td>19.000 10.000
19.000 25.000
19.025 25.000
19.025 10.000
20.500 10.000
20.500 55.000
20.550 55.000
20.550 10.000
20.767 10.000
20.767 40.000
20.942 40.000
20.942 10.000
21.250 10.000
21.250 25.000
21.275 25.000
21.275 10.000
21.500 10.000
21.500 40.000
21.800 40.000
21.800 10.000
24.000 10.000</td></tr>
<tr><td colspan="2">3XL-Profile:</td></tr>
<tr><td colspan="2">EQUATIONS 5
* cold water temperature [°C]
Tcw = 10
* storage ambient temperature [°C]
Tsa = 20
* set temperature for the auxiliary heating [°C]
TsetHW = 65
* demand temperature data binding
Td = [21,1]
* tapping mass flow rate:
mtap = [20,1]</td></tr>
<tr><td>UNIT 20 TYPE 14 time depending forcing function
* load sequencer, mass flow:
* sequence: eco0_XS
PARAMETERS 84
00.000   0.0
07.000   0.0
07.000 3207.637
07.100 3207.637
07.100   0.0
08.017   0.0
08.017 1443.437
08.217 1443.437
08.217   0.0
09.000   0.0
09.000 1283.055
09.075 1283.055
09.075   0.0
10.500   0.0
10.500 962.291
10.525 962.291
10.525   0.0
11.750   0.0
11.750 1283.055
11.825 1283.055
11.825   0.0
12.750   0.0
12.750 1924.582
12.775 1924.582
12.775   0.0
15.500   0.0
15.500 1924.582
15.575 1924.582
15.575   0.0
18.500   0.0</td><td>UNIT 21 TYPE 14 time depending forcing function
*load sequencer, demanded temp:
*sequence: eco0_XS
PARAMETERS 84
00.000 10.000
07.000 10.000
07.000 40.000
07.100 40.000
07.100 10.000
08.017 10.000
08.017 25.000
08.217 25.000
08.217 10.000
09.000 10.000
09.000 25.000
09.075 25.000
09.075 10.000
10.500 10.000
10.500 40.000
10.525 40.000
10.525 10.000
11.750 10.000
11.750 25.000
11.825 25.000
11.825 10.000
12.750 10.000
12.750 55.000
12.775 55.000
12.775 10.000
15.500 10.000
15.500 25.000
15.575 25.000
15.575 10.000
18.500 10.000</td></tr>
</table>

<table>
<tr><td>18.500 1539.666
18.625 1539.666
18.625 0.0
20.500 0.0
20.500 2245.346
20.550 2245.346
20.550 0.0
21.500 0.0
21.500 2758.568
21.625 2758.568
21.625 0.0
24.000 0.0</td><td>18.500 25.000
18.625 25.000
18.625 10.000
20.500 10.000
20.500 55.000
20.550 55.000
20.550 10.000
21.500 10.000
21.500 40.000
21.625 40.000
21.625 10.000
24.000 10.000</td></tr>
<tr><td colspan="2">4XL-Profile:</td></tr>
<tr><td colspan="2">EQUATIONS 5
* cold water temperature [°C]
Tcw = 10
* storage ambient temperature [°C]
Tsa = 20
* set temperature for the auxiliary heating [°C]
TsetHW = 65
* demand temperature data binding
Td = [21,1]
* tapping mass flow rate:
mtap = [20,1]</td></tr>
<tr><td>UNIT 20 TYPE 14 time depending forcing function
* load sequencer, mass flow:
* sequence: eco0_XS
PARAMETERS 84
00.000 0.0
07.000 0.0
07.000 6415.274
07.100 6415.274
07.100 0.0
08.017 0.0
08.017 2886.874
08.217 2886.874
08.217 0.0
09.000 0.0
09.000 2566.11
09.075 2566.11
09.075 0.0
10.500 0.0
10.500 1924.582
10.525 1924.582
10.525 0.0
11.750 0.0
11.750 2566.11
11.825 2566.11
11.825 0.0
12.750 0.0
12.750 3849.165
12.775 3849.165
12.775 0.0
15.500 0.0
15.500 2886.874
15.600 2886.874
15.600 0.0
18.500 0.0
18.500 3079.332
18.625 3079.332
18.625 0.0
20.500 0.0
20.500 4490.692
20.550 4490.692
20.550 0.0
21.500 0.0
21.500 5517.136</td><td>UNIT 21 TYPE 14 time depending forcing function
*load sequencer, demanded temp:
*sequence: eco0_XS
PARAMETERS 84
00.000 10.000
07.000 10.000
07.000 40.000
07.100 40.000
07.100 10.000
08.017 10.000
08.017 25.000
08.217 25.000
08.217 10.000
09.000 10.000
09.000 25.000
09.075 25.000
09.075 10.000
10.500 10.000
10.500 40.000
10.525 40.000
10.525 10.000
11.750 10.000
11.750 25.000
11.825 25.000
11.825 10.000
12.750 10.000
12.750 55.000
12.775 55.000
12.775 10.000
15.500 10.000
15.500 25.000
15.600 25.000
15.600 10.000
18.500 10.000
18.500 25.000
18.625 25.000
18.625 10.000
20.500 10.000
20.500 55.000
20.550 55.000
20.550 10.000
21.500 10.000
21.500 40.000</td></tr>
</table>

21.625 5517.136 21.625 0.0 24.000 0.0	21.625 40.000 21.625 10.000 24.000 10.000

6 Annex: Climate data

6.1 Strasbourg

Monthly mean global irradiation:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
AnnexIV	70	104	149	192	221	222	232	217	176	129	80	56
MeteoDat	54	113	138	170	191	197	212	202	168	99	78	51

Extract of the DFM-File:

Hour of Year	$I_{c,glob}$ [W/m²]	T_{ca} [°C]
1	0	9,2
2	0	9,0
3	0	8,7
4	0	8,6
5	0	8,5
6	0	8,4
7	0	8,4
8	0	8,3
9	0	8,3
10	27	9,1
11	58	9,8
12	80	10,4
13	92	10,9
14	83	11,1
15	61	11,2
16	30	10,9
17	1	10,4
18	0	10,0
19	0	9,7
...	...	...

6.2 Athens

Monthly mean global irradiation:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
AnnexIV	128	137	182	227	248	268	268	263	243	175	126	109
RefYear	148	154	164	209	219	237	252	266	252	194	139	118

Monthly mean ambient temperature:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

AnnexIV	9,5	10,1	11,6	15,3	21,4	26,5	28,8	27,9	23,6	19	14,5	10,4
RefYear	11,2	10,9	12,3	15,3	20,0	24,1	27,5	27,5	24,3	19,8	15,6	12,9

Extract of the DFM-File:

Hour of Year	$I_{c,glob}$ [W/m²]	T_{ca} [°C]
1	0	16,8
2	0	16,6
3	0	16,3
4	0	16,1
5	0	15,9
6	0	15,6
7	0	15,4
8	0	15,2
9	11	15,6
10	39	16
11	1	15,7
12	38	15,9
13	120	16,4
14	106	16,7
15	125	16,9
16	27	16,7
17	34	16,6
18	0	16,4
19	0	16,2
…	…	…

6.3 Helsinki

Monthly mean global irradiation:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
AnnexIV	22	75	124	192	234	237	238	181	120	64	23	13
MeteoDat	26	90	139	188	244	252	235	198	138	73	24	18

Extract of the DFM-File:

Hour of Year	$I_{c,glob}$ [W/m²]	T_{ca} [°C]
1	0	3,7
2	0	3,6
3	0	3,3
4	0	3,1
5	0	3
6	0	2,9
7	0	2,8
8	0	2,7
9	0	2,6
10	0	2,6
11	11	3,3
12	19	3,8
13	25	4,1
14	30	4,4

15	10	4,2
16	0	3,8
17	0	3,7
18	0	3,6
19	0	3,4
…	…	…