TASK 54

SHC SOLAR HEATING & COOLING PROGRAMME INTERNATIONAL ENERGY AGENCY

Reference single family solar domestic hot water system for France

INFO Sheet A 17

Description:	*Definition of reference single family solar domestic hot water system for France*
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Download possible at:	http://task54.iea-shc.org/

Intro

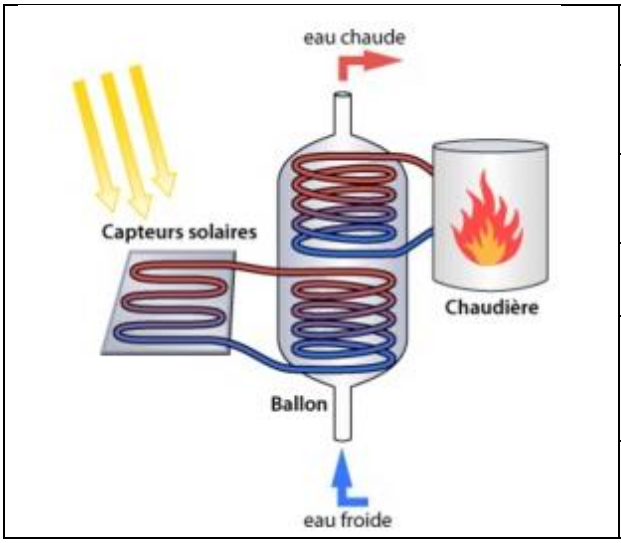
This document lists the minimum information needed for the definition of a reference system. A reference system is a solar thermal system serving as benchmark for any other solar thermal system having the same fractional energy savings with respect to the levelized costs of heat (LCOH).

The basic definition of a reference system is given by:

- System type (e.g. domestic hot water system. combi system. etc.)
- Location: country and city

All further definitions are given below.

Hydraulic Scheme of the System



Key data	
Collector area	4.5 m²
Heat store volume	300 l
Location	Marseille. France
Hemispherical irradiance on horizontal surface	$\Sigma G_{hem.hor}$ = 1534 kWh/(m² a)
Lifetime of system	20 years

Levelized Cost of Heat (LCOH)

$LCoH_{sol,fin}$ solar part without VAT	**0.166 €/kWh_{th}**
$LCoH_{conv,fin}$ conventional part without VAT	**0.120 €/kWh_{th}**
$LCoH_{ov,fin}$ complete system without VAT	**0.142 €/kWh_{th}**

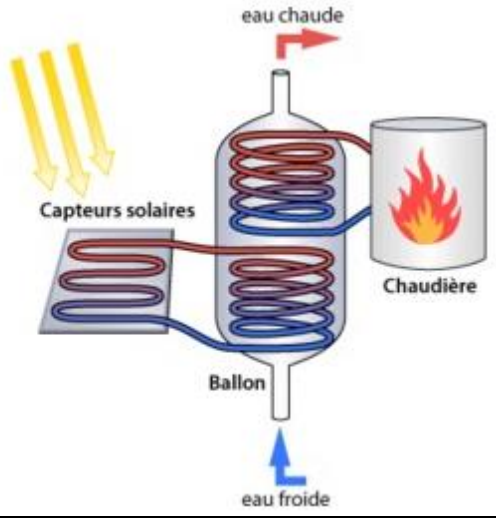
Definition of reference system

This section lists the minimum requirements (not complete yet) for the definition of a reference system as described above.

Basic information

Location	France. Marseille
Type of system	Single Family Domestic hot water system
Weather data including - beam irradiance on horizontal surface - diffuse irradiance on horizontal surface - ambient temperature in hourly values	test reference year (TRY) Monthly average values : - Ambient temperature - Cold water temperature - Overall irradiance on horizontal
Collector orientation - Collector tilt angle to horizontal - South deviation of collector	 17 ° 0° (east = -90°. south = 0°. west = 90°)
Load information including - average inlet temperature of cold water - cold water inlet temperature amplitude throughout year - tapping profile - tapping temperature - space heating load profile (in case of space heating application)	 17.94 14.27°C-22.32°C Average monthly day 50°C none

Solar thermal system

Hydraulic scheme of reference system	

Collector information	Generic collectors
Number of collectors	2
Collector area of one collector	2.25 m²
Maximum collector efficiency	0.75
Incidence angle modifier for direct irradiance	-
Incidence angle modifier for diffuse Irradiance	0.92
Linear heat loss coefficient	4.5 W/(m²K)
2nd order heat loss coefficient	
Effective heat capacity	-
Heat store parameters	
Heat store volume	300 l
Auxiliary volume for DHW preparation	100 l
Set temperature for DHW	50 °C
Overall heat loss capacity rate of store	0.1327Wh/jour.l.°C
Maximum heat store temperature	85 °C
Ambient temperature of heat store	25 °C
Solar thermal controller and hydraulic piping	
Total pipe length of collector loop	
Inner diameter of collector loop pipe	
Temperature difference collector start-up	7 K
Temperature difference collector shut-off	2 K
Electric consumption of solar thermal controller	10 W
Operating hours of solar thermal controller per year	8760 h
Electric consumption of solar loop pump	30 W
Operating hours of solar loop pump	2500 h
Electric consumption of other el. components	-
Conventional system	
Type of auxiliary heating	Gas condensing boiler
Boiler capacity	24 kW
Efficiency factor of boiler	0.7
Cost calculation	
Solar thermal collector	1700 €
Heat store	900 €
Solar thermal controller	150 €
Solar thermal hydraulic components	450 €
Installation	1500 €
Overall costs	4700 €
Cost calculation	
Type of incentives	Investment grant
Type and amount of incentives	0%
Lifetime of system	20 years
Yearly maintenance cost	45 €

Collector gain (including storage losses)	2000 kWh
Fractional energy savings	75 %
Cost per kWh electric energy	0.12 €
KWh gas price	0.0463 € (+1.7%/y)
Actualization rate (mixing interest & inflation rates)	3.9 %
VAT rate	20 %

References

SOLO tool (www.tecsol.fr) :

Marseille. Latitude: 43°15	**08/02/2017**

Donnees meteo

Mois	Jan	Feb	Mar	Apr	May	June	July	Augt	Sept	Oct	Nov	Dec
T° external	7.6	8.5	10.9	12.9	17.2	21.1	23.4	23.7	19.1	16	10.7	8.2
T° cold water	14.27	14.72	15.92	16.92	19.07	21.02	22.17	22.32	20.02	18.47	15.82	14.57

T° cold water : Method ESM2 +3.0°C

Installation

Collectors

Surface	4.5 m2
Tilt angle	17 °/Horiz
Orientation	0°/South
Coefficient B	0.75
Coefficient K	4.5W/m2.°C

Storage

Situation	Inside (25 °C)
Temperature DWH	50 °C
Volume of storage	300 Liters
Thermal losses (storage)	0.1327Wh/d.l.°C
Type of installation	Forced circulation internal exchanger

	Irradiation collectors (Wh/m2.jour)	Load (kWh/month)	Solar Production (kWh/month)	Solar production (kWh/day)	Solar fraction (%)	Volume (liters)

Januaryr	2519	251	113	3.7	45.1	195
February	3074	224	129	4.6	57.8	195
March	4545	240	193	6.2	80.4	195
April	5407	225	204	6.8	90.9	195
May	6253	217	210	6.8	96.5	195
June	6901	197	194	6.5	98.2	195
July	7073	196	193	6.2	98.5	195
August	6478	195	191	6.2	98.1	195
September	5379	204	190	6.3	93.3	195
October	3668	222	165	5.3	74.4	195
November	2628	232	118	3.9	50.7	195
December	2151	249	99	3.2	39.8	195

Solar fraction	75.4	%	Annual solar production	1999	kWh/y
Annual load	2651	kWh/ay	Annual yield	444	kWh/m2.y

Etude des retombées socio-économiques du développement de la filière solaire française (ENERPLAN / ADEME / ICARE. feb. 2017)