Reference System, France
Drain-back multi-family solar domestic hot water system **INFO** Sheet A 16

Description:	*Definition of a drainback multi-family solar domestic hot water system as a French reference system*
Date:	26.10.2017. revised 30.10.2017, 19.09.2018
Author:	Daniel Mugnier
Download possible at:	http://task54.iea-shc.org/

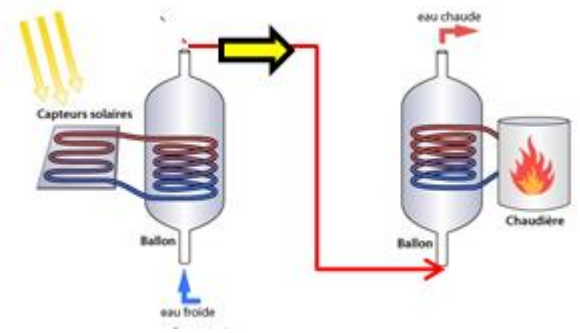
Introduction

This document describes the reference drain-back domestic hot water system for multi-family houses in France. It 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 and the same scheme (drainback for multifamily buildings) 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	50 m²
Heat store volume	3000 l
Location	France. Marseille
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	**0.095 €/kWh**
$LCoH_{conv,\ fin}$ conventional part without VAT	**0.047 €/kWh**
$LCoH_{ov,fin}$ complete system without VAT	**0.064 €/kWh**

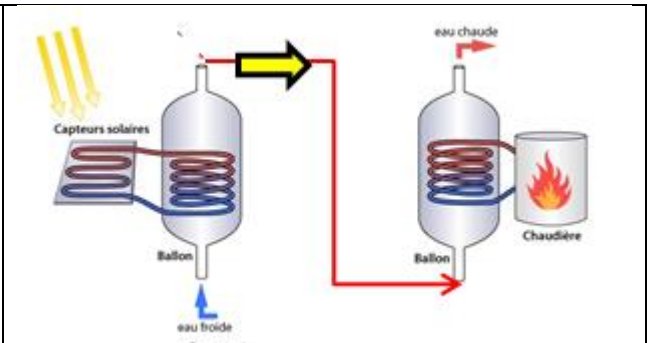
Definition of reference system

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	Drainback Multi 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	 30 ° 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 60°C none

Solar thermal system

Hydraulic scheme of reference system	
Collector information	Generic collectors (improved)
Number of collectors	50
Collector area of one collector	2 m²
Maximum collector efficiency	0.75
Incidence angle modifier for direct irradiance	-
Incidence angle modifier for diffuse Irradiance	-
Linear heat loss coefficient	4 W/(m²K)
2nd order heat loss coefficient	
Effective heat capacity	-

Heat store parameters	
Heat store volume	3000 l
Auxiliary volume for DHW preparation	1000 l
Set temperature for DHW	60 °C
Overall heat loss capacity rate of store	0.1366Wh/(day K)
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	50 W
Operating hours of solar thermal controller per year	8760 h
Electric consumption of solar loop pump	150 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	500 kW
Efficiency factor of boiler	0.7
Cost calculation	
Solar thermal collector	23 333 €
Heat store	14 000 €
Solar thermal controller	2 333 €
Solar thermal hydraulic components	7 000 €
Installation	23 333 €
Overall costs	70 000 €
Cost calculation	
Type of incentives	Investment grant
Type and amount of incentives	0%
Lifetime of system	20 year
Yearly maintenance cost	1000 €
Collector gain (including storage losses)	42 800 kWh
Fractional energy savings	79.9 %
Cost per kWh electric energy	0.12 €
KWh gas price	0.03 € (+1.7%/y)
Actualization rate (mixing interest & inflation rates)	3.9 %
VAT rate	20 %

References

[1] Y. Louvet. S. Fischer et. al. IEA SHC Task 54 Info Sheet A1: Guideline for levelized cost of heat (LCoH) calculations for solar thermal applications". March 2017. Download: http://task54.iea-shc.org/

[2] Y. Louvet. S. Fischer et.al. Entwicklung einer Richtlinie für die Wirtschaftlichkeitsberechnung solarthermischer Anlagen: die LCoH Methode. 27. May 2017. Symposium Thermische Solarenergie. Bad Staffelstein.

- **SOLO tool (www.tecsol.fr) :**

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

Meteo

Month	Jan	Feb	March	Apr	May	June	Jul	Aug	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	100 m2
Tilt angle	30 °/Horiz
Orientation	0°/Sud
Coefficient B	0.75
Coefficient K	4W/m2.°C

Storage

Location	Inside (25 °C)
Temperature DWH	60 °C
Volume of storage	3000 Liters
Thermal losses (storage)	0.1366Wh/day.l.°C
Type of installation	Forced circulation internal exchanger

	Irradiation collectors (Wh/m^2 day)	Load (kWh/month)	Solar Production (kWh/month)	Solar production (kWh/day)	Solar fraction (%)	Volume (liters)
January	2964	4945	2761	89.1	55.8	3000
February	3411	4422	3003	107.2	67.9	3000
March	4846	4766	4102	132.3	86.1	3000
April	5456	4508	4141	138.0	91.9	3000
May	6098	4426	4189	135.1	94.7	3000
June	6610	4079	3902	130.1	95.7	3000
July	6819	4090	3926	126.6	96.0	3000

August	6461	4074	3902	125.9	95.8	3000
September	5649	4183	3905	130.2	93.3	3000
October	4023	4490	3668	118.3	81.7	3000
November	3033	4623	2830	94.3	61.2	3000
December	2546	4912	2448	79.0	49.8	3000

Solar fraction	79.9	%	Annual solar production	42777	kWh/y
Annual load	53518	kWh/y	Annual yield	428	kWh/m2.y

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