Reference System, Switzerland
Solar Domestic Hot Water system, multi-family house

INFO Sheet A11

Description:	*Definition of a reference solar thermal domestic hot water system with gas auxiliary for multi-family houses, Switzerland*
Date:	03.01.2017, last revision 12.11.2017
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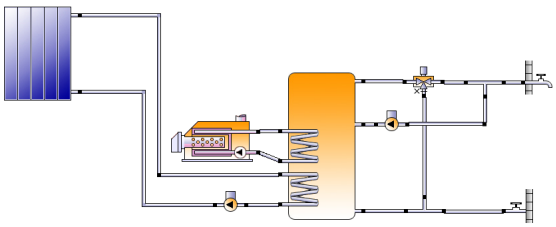
Download possible at:	http://task54.iea-shc.org/

Introduction

This document describes a Swiss reference solar domestic hot water (SDHW) system for multi-family houses that uses a gas burner as auxiliary. The system is modelled in the simulation software Polysun [1] with template No. 8a that was adapted for a larger heat demand of a multi-family house. The reference system is taken from [2]. The costs for investment and maintenance of the gas burner (the device) are allocated to the room heating and are not taken into account here. However, the costs of gas for preparing DHW are included into the calculation.

Hydraulic Scheme of the System



Key data	
Collector area (one collector)	2.5 m²
Heat store volume	300 l
Location	Switzerland, Rapperswil
Hemispherical irradiance on horizontal surface	$\Sigma G_{hem,hor}$ =1143 kWh/(m² a)
Lifetime of system	30 years

Levelized Cost of Heat (LCoH)

LCoH solar part without VAT	**0.21 SFr./kWh**
LCoH conventional part without VAT	**0.18 SFr./kWh**
LCoH complete system without VAT	**0.19 SFr./kWh**

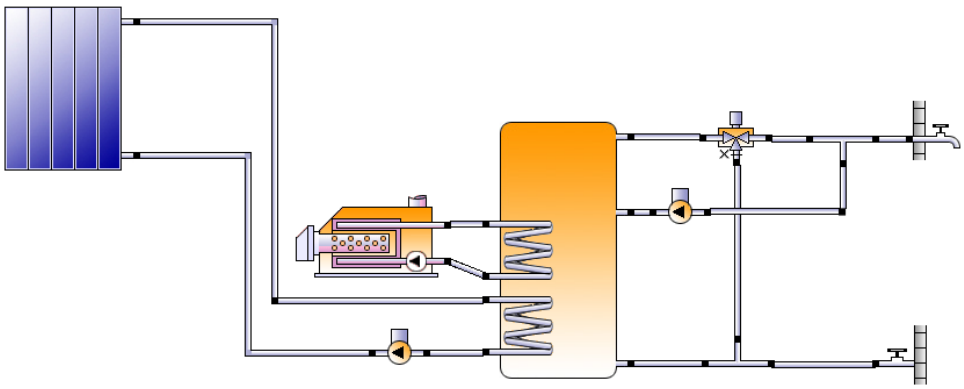
Definition of the reference system

Basic information

Location	Switzerland, Rapperswil
Type of system	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 Rapperswil (TRY) $G_{beam,hor.}$ = 526 kWh/m^2 $G_{diff.,hor}$ = 578 kWh/m^2 T_{amb} = 10.1 °C
Collector orientation - Collector tilt angle to horizontal - South deviation of collector - Resulting hemispherical irradiance on tilted surface	 45 ° south = 0° 1'143 kWh/(m^2 a)
Load information including - Average inlet temperature of cold water - Cold water inlet temperature amplitude throughout year - Tapping profile - Tapping temperature - Draw off volume per day - Heat demand (DHW) per year	 10 °C 0 K Wohngebäude (VDI6002) 60 °C 644 L/d 14'735 kWh/a

Solar thermal system

hydraulic scheme of reference system



Collector information	
Total absorber area of the collectors	15.5 m²
Maximum collector efficiency	0.79
Incidence angle modifier for direct irradiance	Ambrosetti
Incidence angle modifier for diffuse Irradiance	0.89

Linear heat loss coefficient	4.14 W/(m²K)
2nd order heat loss coefficient	0.0071 W/(m²K²)
Effective heat capacity	5.6 kJ/K
Heat store parameters	
Heat store volume	1500 l
Auxiliary volume for DHW preparation	500 l
Set temperature for DHW	60 °C (-0 K/+10 K)
Overall heat loss capacity rate of store	2.5 W/K
Maximum heat store temperature	80 °C
Ambient temperature of heat store	20 °C
Solar thermal controller and hydraulic piping	
Total pipe length of collector loop	30 m
Inner diameter of collector loop pipe	20 mm
Temperature difference collector start-up	6 K
Temperature difference collector shut-off	2 K
Operating hours of solar loop pump	2576 h
Conventional system	
Type of auxiliary heating	Gas condensing boiler
Boiler capacity	15 kW
Efficiency factor of boiler	0.9
Cost calculation	
Overall costs solar thermal part with VAT (8 %)	24613 SFr.
Cost per kWh gas	0.093 SFr./kWh
Gas savings due to solar thermal	8727 kWh/a
Type and amount of incentives	No incentives considered
Lifetime of system (earlier replacement of some parts considered)	30 a
Yearly operation and maintenance cost of solar part	142 Fr./a
Fractional energy savings	35 %
Interest rate	1 % p.a.
Inflation rate	0 % p.a.
VAT rate	8 %
Rise in price of grid-bound energy carriers	1 % p.a.
LCOH solar part with VAT [3,4]	0.21 SFr./kWh
LCOH conventional part with VAT	0.18 SFr./kWh
LCOH complete system with VAT	0.19 SFr./kWh
Energy carrier avoidance costs with VAT [2]	0.13 SFr./kWh

References

[1] Polysun simulation software, Version 9.09, Vela Solaris, 2016.

[2] ReSoTech – Reduktion der Marktpreise solarthermischer Anlagen durch neue technologische Ansätze Teil 1: Potenzialanalyse und Lösungsansätze, Schlussbericht 14. Dezember 2016, SPF on behalf of Swiss Federal Office of Energy.

[3] 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/

[4] 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.

Logg of Revisions

Date	Page	Revision	Author
Previous file name: Switzerland_Task 54_Info Sheet_Reference_System_definition_SDHW_water.docx			
29.10.2017	1	Layout adjustment, header on first page	M. Meir
	3	Added reference [3,4] - before: [3] only.	
	4	Revised under References: reference 3 and added reference 4.	
07.11.2017	1	header: re-named infosheet from A09 to AR13 renamed inforsheet to " Multi-family Solar DHW* system"	M. Meir
12.11.2017	1	Header: - re-named infosheet from AR13 to A11 - small change in name: Solar Domestic Hot Water system, multi-family house"	M. Meir