Optimized System, Denmark
SDHW system with heat storage and polymer inlet stratifier* **INFO** Sheet B01

Description:	*Single-family Solar domestic hot water system with heat storage and polymer inlet stratifier*
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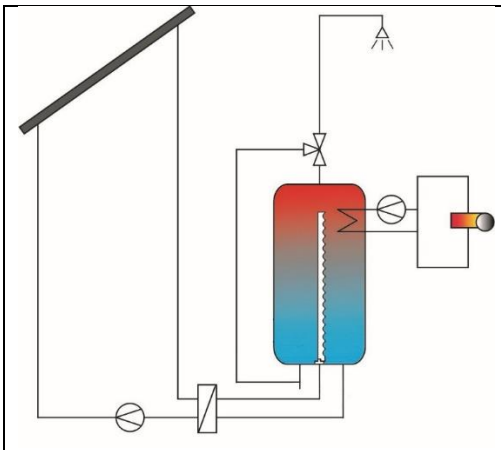
Download possible at:	http://task54.iea-shc.org/

Intro

This info sheet gives information on an optimized solar domestic hot water system with heat storage with polymer inlet stratifier in Denmark [1].

Hydraulic Scheme of the System



Key data	
Collector area (one collector)	2.36 m²
Heat store volume	255 l
Location	Copenhagen, Denmark
Hemispherical irradiance on horizontal surface	$\Sigma G_{hem,hor}$ =1150 kWh/(m^2 a)
Lifetime of system	30 years

Levelized Cost of Heat (LCOH)

LCOH solar part without VAT	**0.0948 €/kWh**

*SDHW: Solar domestic hot water

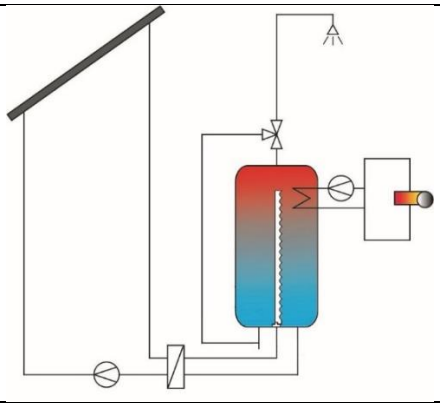
Definition of Reference System

The basic information appears from the table below.

Basic information

Location	Denmark
Type of system	Solar Domestic hot water system
Weather data including - beam irradiance on horizontal surface - diffuse irradiance on horizontal surface - ambient temperature in hourly values	Danish Test Reference Year (TRY)
Collector orientation - Collector tilt angle to horizontal - South deviation of collector	 45° 0°
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)	Yearly hot water consumption: 1700 kWh Average inlet temperature of cold water: 10°C Cold water inlet temperature amplitude: 0 K Hot water drawn at 7 am, noon and 7 pm in three equally sized volumes Tapping temperature: 50°C

Solar thermal system

hydraulic scheme of reference system	
Collector information	
Number of collectors	1
Collector aperture area	2.36 m²
Maximum collector efficiency	0.827
Incidence angle modifier for direct irradiance	$K_\theta = 1 - \tan^{3.7}(\theta/2)$
Incidence angle modifier for diffuse irradiance	0.87

Linear heat loss coefficient	3.247 W/(m²K)
2nd order heat loss coefficient	0.020 W/(m²K²)
Effective heat capacity	6.0 kJ/(m²K)
Heat store parameters	
Heat store volume	255 l
Auxiliary volume for DHW preparation	95 l
Inlet stratifier produced by	EyeCular Technologies ApS
2-layer inlet stratifier with small closing zone	Material: 25 µm ETFE
Set temperature for DHW	50.5°C
Overall heat loss capacity rate of store	2.0 W/K
Maximum heat store temperature	95°C
Ambient temperature of heat store	20°C
Solar thermal controller and hydraulic piping	
Total pipe length of collector loop	34 m
Inner diameter of collector loop pipe	8 mm
Temperature difference collector start-up	10 K
Temperature difference collector shut-off	2 K
Electric consumption of solar thermal controller	2 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	2400 h
Electric consumption of other el. components	-
Conventional system	
Type of auxiliary heating	Gas condensing boiler
Boiler capacity	23 kW
Daily hot water tank heat loss	2 kWh
Efficiency factor of boiler	0.9
Cost calculation	
Heat store unit	1493 €
Solar collector	670 €
All other components	630 €
Installation	1350 €
Overall costs	4143 €
Cost calculation	
Type of incentives	-
Type and amount of incentives	-
Lifetime of system	30 years
Yearly maintenance cost	13 €
Collector gain	918 kWh
Solar fraction	54 %
Cost per kWh electric energy	0.28 €
VAT rate	25 %
LCOH [2,3]	0.0948 €/kWh

References

[1] Advantages using inlet stratification devices in solar domestic hot water storage tanks. Janne Dragsted, Simon Furbo, Federico Bava. EuroSun 2016 Conference Proceedings, Palma (Mallorca), Spain.

[2] Y. Louvet, S. Fischer et. al. IEA SHC Task 54 Info Sheet A01: Guideline for levelized cost of heat (LCOH) calculations for solar thermal applications“, March 2017. Download: http://task54.iea-shc.org/

[3] 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.