Description:	*Definition of the reference, conventional system for domestic hot water preparation and space heating in a single-family house (SFH), Austria*
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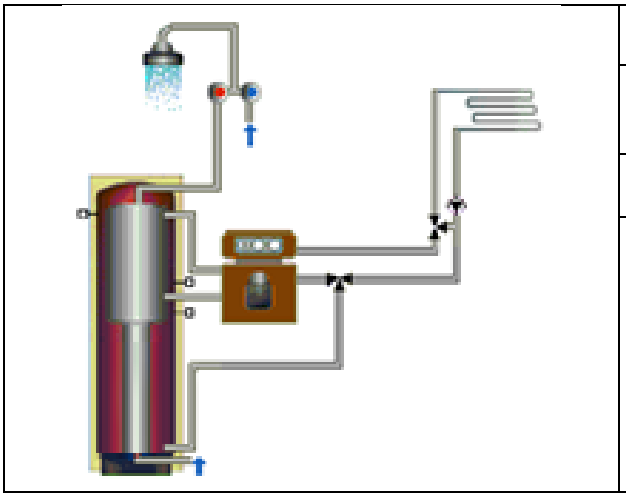
Introduction

This document describes the reference conventional system for domestic hot water preparation and space heating in a single-family house in Austria. The system is modelled with TSol to calculate the fuel consumption and electric energy needed to provide the required domestic hot water and space heating. Using this result the levelized costs of heat (LCOH) for the reference conventional system in Austria is calculated using Equation 1, with the reference costs for the investment of the system (including installation costs), fuel and electricity costs.

Hydraulic Scheme of the System

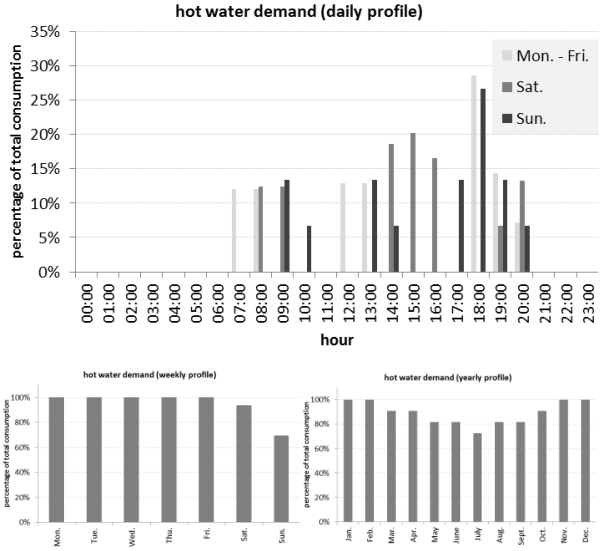
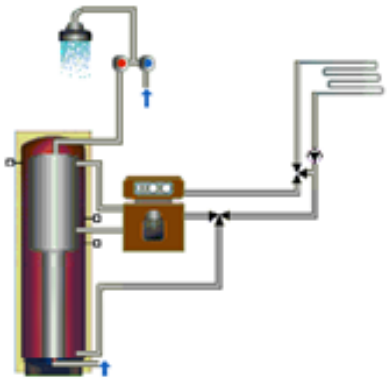


Key data	
Heat store volume	120 l
Location	Austria, Graz
Lifetime of system	25 years

Levelized Cost of Heat (LCOH)

LCOH complete system without VAT	**0.0971 €/kWh**

Details of the system

Location	Austria, Graz
Type of system	Domestic hot water and space heating system
Load information including - heat demand space heating - tapping profile	 10.29 MWh/a [1] 3.19 MWh/a [1] 
- tapping temperature - average inlet temperature of cold water - cold water inlet temperature amplitude	60 °C 9.6 °C 0 K
Hydraulic scheme of the system	
Heat store parameters	**T*SOL Database**
Heat store volume	120 L
Store inner diameter	0.6 m
Rel. Height of boiler inlet	0.9
Rel. Height of boiler outlet	0.04
Rel. Height of sensor for boiler heating	0.75
Set temperature for DHW	60.0 °C +- 3 K
Overall heat loss capacity rate of store	1.75 W/K
Effective vertical conductivity	1.2 W/(mK)

Heat transfer capacity rate of boiler loop Heat Exchanger	$(kA)_{WT,Aux}$ = 300 W/K
Volume boiler loop HX (Heat exchanger)	6 L
Ambient temperature of heat store	15 °C
Conventional boiler	
Type of heating	Oil boiler
Boiler capacity	12 kW
Mass flow	-
Efficiency factor of boiler	0.85
Electric power of controller	3 W
Operating hours of controller per year	8760
Electric consumption of controller per year	26.3 kWh
Electric power of pump	7 W
Operating hours of pump (aux. Heating + space heating)	5824 h
Electric consumption of pump per year	40.8 kWh
Investment costs	
Overall investment costs I_0	7560 € [2]
Operation costs per year	
Heat demand hot water	3651 kWh/a
Fuel demand hot water	4295 kWh/a
Heat demand space heating	10 920 kWh/a
Fuel demand space heating	12 847 kWh/a
Fuel demand hot water + space heating E_t	17142 kWh/a
Cost per kwh fuel (oil)	0.066 €/kWh [2]
Fuel costs	1131.4 €/a
Electricity demand	67 kWh/a
Cost per kwh electric energy	0.17 € [3]
Electricity costs	11.4 €/a
Maintenance costs	220 €/a [2]
Yearly operation and maintenance cost conventional part C_t	1362.8 €
Lifetime of system	25 year
Corporate tax rate TR	0 %
Asset depreciation (year t) dep_t	0 €
Subsidies and incentives (year t) S_t (considered in I_0)	0 €
Residual value RV	0 €
Discount rate r	0 %
VAT rate	20 %
LCOH without VAT	**0.0971 €/kWh**
LCOH with VAT	**0.117 €/kWh**

Calculation of levelized cost LCOH [4,5]:

$$LCOH = \frac{I_0 + \sum_{t=0}^{T} \frac{C_t(1-TR) - DEP_t \cdot TR - S_t - RV}{(1+r)^t}}{\sum_{t=1}^{T} \frac{E_t}{(1+r)^t}} \quad (1)$$

Where:

$LCOH$: Levelized cost of heat in €/kWh
I_0: Initial investment in €
C_t: Operation and maintenance costs (year t) in €
TR: Corporate tax rate in %
DEP_t: Asset depreciation (year t) in €
S_t: Subsidies and incentives (year t) in €
RV: Residual value in €
E_t: Saved final energy (year t)/Fuel demand in kWh
r: Discount rate in %
T: Period of analysis in year

References

[1] AEE INTEC

[2] VOLLKOSTENVERGLEICH für neue Heizsysteme in Österreich - ÖNORM M7140, 21.10.2016 (https://www.wko.at/Content.Node/branchen/oe/Mineraloelindustrie/Vollkostenvergleich-Heizungen-nach-OENORM.pdf)

[3] Oesterreichs Energie - Strompreis (http://oesterreichsenergie.at/daten-fakten/statistik/Strompreis.html)

[4] 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/

[5] 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: Austria_Task 54_Info Sheet_Conv-SFH-Austria_updated3v.docx			
29.10.2017	1	Layout adjustment, header on first page	M. Meir
	4	Added references nr. 4 and 5 and their reference in the text = Calculation of levelized cost LCOH [4,5]	
07.11.2017	1	renamed from info sheet A05 to AR01	M.Meir
	1	added "single-family house" in introduction	
	1,4	replaced kWh_{th} with kWh	
12.11.2017	1	Header: - re-named Info sheet from AR01 to A02	M.Meir