Description:	*Definition of the reference, conventional heating system for domestic hot water preparation and space heating in a multi-family house (MFH), Austria*
Date:	30.11.2016, revised 10.04.2018[1]
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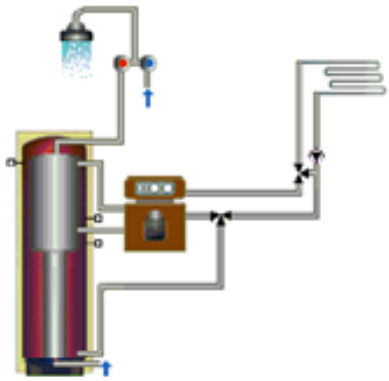
Download possible at:	http://task54.iea-shc.org/

Introduction

This document describes the reference conventional system for domestic hot water preparation and space heating in a multi-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

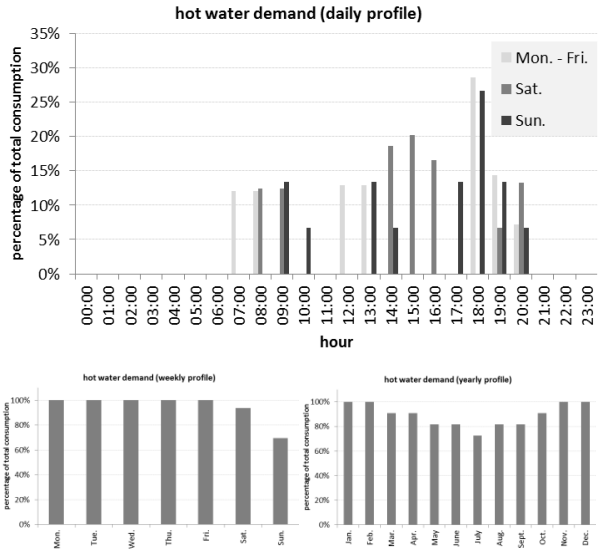
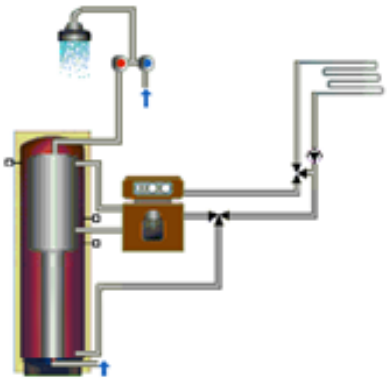


Key data	
Heat store volume	1600 l
Location	Austria, Graz
Lifetime of system	25 years

Levelized Cost of Heat (LCoH)

LCoHc complete system without VAT	**0.072 €/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	 110.4 MWh/a [1] 42.53 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	1600 L
Store inner diameter	1.1 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	3 W/K
Effective vertical conductivity	1.2 W/(mK)
Heat transfer capacity rate of boiler loop Heat Exchanger	$(kA)_{WT,Aux}$ = 4000 W/K
Volume boiler loop HX (Heat exchanger)	-
Ambient temperature of heat store	15 °C
Conventional boiler	
Type of heating	Oil boiler
Boiler capacity	52 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	12 W
Operating hours of pump (aux. Heating + space heating)	4190 h
Electric consumption of pump per year	50.3 kWh
Investment costs	
Overall investment costs I_0	18 500 € [2]
Operation costs per year	
Heat demand hot water	44 212 kWh/a
Fuel demand hot water	52 014 kWh/a
Heat demand space heating	110 400 kWh/a
Fuel demand space heating	129 882 kWh/a
Fuel demand hot water + space heating E_t	181 896 kWh/a
Cost per kwh fuel (oil)	0.066 €/kWh [2]
Fuel costs	12 005 €/a
Electricity demand	76.56 kWh/a
Cost per kwh electric energy	0.17 € [3]
Electricity costs	13 €/a
Maintenance costs	370 €/a [2]
Yearly operation and maintenance cost conventional part C_t	12 388 €
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 %
LCoHc without VAT	**0.072 €/kWh**
LCoHc with VAT	**0.087 €/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 years

References

[1] AEEINTEC.

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

[5] Louvet, Y., Fischer, S. et.al. (2017): "*Entwicklung einer Richtlinie für die Wirtschaftlichkeitsberechnung solarthermischer Anlagen: die LCoH Methode*." Symposium Thermische Solarenergie, Bad Staffelstein.

[1] To avoid confusion with the results of other works ([1], [8], [9]) also using the notion of LCoH for solar thermal systems, new acronyms were introduced in this Info Sheet. As previous studies have considered different assumptions for the definition of the terms of the LCoH equation, it does not make sense to compare the values they obtained with the LCoHs, LCoHc and LCoHo values defined here. A detailed explanation of the differences between the approaches chosen in the framework of IEA-SHC Task 54 and in the Solar Heat Worldwide report [9] can be found in Info Sheet A13 [10].