Generic PVT/Heat pump system for low energy single family house in Copenhagen (Denmark)

INFO Sheet D2-Denmark-SFH-heatdemand-7.1MWh-PVT-HP

Description:	*Definition of a generic PVT/Heat pump system for low energy single family house in Denmark*
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Introduction

This document describes a generic PVT/heat pump system for low energy single family houses in Copenhagen, Denmark. The system covers the total domestic hot water consumption, the total space heating demand and a part of the electricity demand of the houses. The system is modelled with Polysun to calculate the electric energy needed to provide the required domestic hot water, space heating and household electricity (see info sheet D1 for description of the building, weather data and load profiles). The results in terms of electricity bought from the grid and sold to grid will be used as input for the LCA and LCoH calculation.

Results

Electricity supply	
Electricity bought from the grid	3067 kWh/a
Electricity sold to the grid	4022 kWh/a
Detailed results	
Electric consumption of heat pump	1071 kWh/a
Electric consumption of solar collector loop pump	37.8 kWh/a
Electric consumption of circulation pump in heating loop	38.3 kWh/a
Operating hours of heat pump	1902 h
Own electricity production which is used to meet the electricity demand of the heat generators	206 kWh/a
Own electricity production which is used to meet the electricity demand of the household	1374 kWh/a

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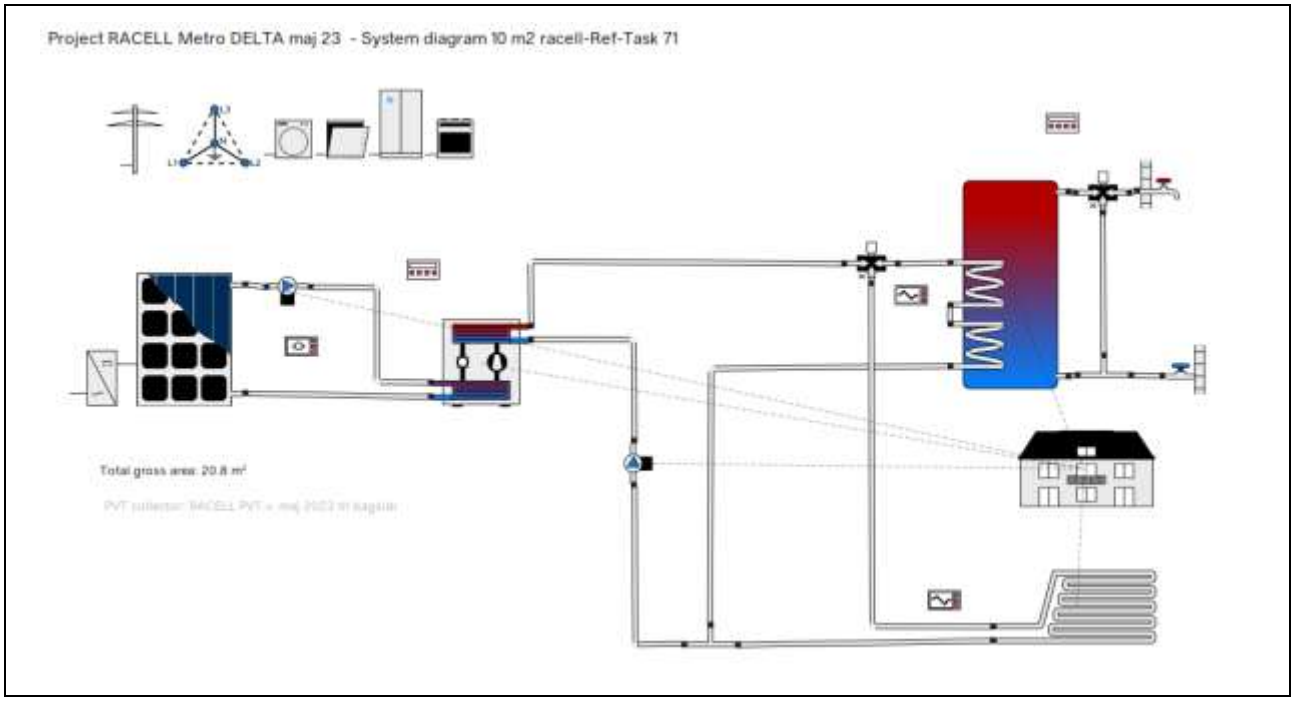
Location and load (further details see Info sheet D DK)

Location	Copenhagen, Denmark
Type of system	PVT/heat pump system
Weather data including - hemispherical irradiance on horizontal surface - beam irradiance on horizontal surface - diffuse irradiance on horizontal surface - ambient temperature	DRY Sjaelsmark, Denmark $\Sigma G_{hem,hor}$ =1038.1 kWh/(m^2 a) $\Sigma G_{beam,hor}$ = 514.5 kWh/(m^2 a) $\Sigma G_{diff,hor}$ = 523.6 kWh/m^2 a) $T_{amb,av}$ = 8.1 °C
Collector orientation - Collector tilt angle to horizontal - South-West deviation of collector - ground reflectance - resulting in hemispherical irradiance on collector surface	 45 ° South 0.2 $\Sigma G_{hem,tilt}$ =1262.3 kWh/(m^2 a)
Load information including - heat demand for space heating - heat demand for DHW - setpoint tapping temperature - inlet temperature of cold water	 3387 kWh/a /1/ 1568 kWh/a /1/ 50°C 10 °C seasonal ± 2 K, see Appendix

Hydraulic scheme of the system



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Description of the components required for simulation

Heat pump (METRO Delta)	
Capacity	3.5 kW
COP and heating power according to EN14511, B0/W35°C	4.2 and 3.0 kW
Electric power of heat pump during standby	10 W
Heat store (METRO THEM Model 160)	
heat store volume	138 l
Tank material	Steel with enamel
Tank outer diameter without insulation	0.4 m
Tank outer height without insulation	1.1 m
Insulation of store	PUR foam
Thickness of insulation of store, top/sides/bottom	50 mm/30 mm/20 mm
Heat loss coefficient	1.23 W/K
Cabinet dimensions	0.46 m x 0.46 m x 1.40 m
Heat loss coefficient	1.23 W/K
Total mass of heat storage	87 kg
maximum heat store temperature	70°C
ambient temperature of heat store	20°C
PVT panel (information based on gross area)	
Electric efficiency	0.21 x [1-0.0047 x (T-25)] [T: cell temperature, °C]
Thermal efficiency: Maximum efficiency	0.55
Thermal efficiency: Linear heat loss coefficient	14.5 W/(m²K)
Thermal efficiency: Wind dependent heat loss coefficient	4.5 x u W/(m²K) [u: wind speed, m/s]
Thermal efficiency: Incidence angle modifier	$K_\theta = 1 - tan^p\left(\frac{\theta}{2}\right), p = 3.8$
Solar thermal controller and hydraulic piping	
Total pipe length of collector loop	20 m
Outer diameter of collector loop pipe	15 mm
Volume flow rate of collector loop	0.4 L/min per m² panel
Other components	
Air vent	
One-way valve	
2 circulation pumps	

References

/1/ info sheet D1 (building)