Flat Plate Collectors

Factsheet 1: Integration of solar energy in district heating

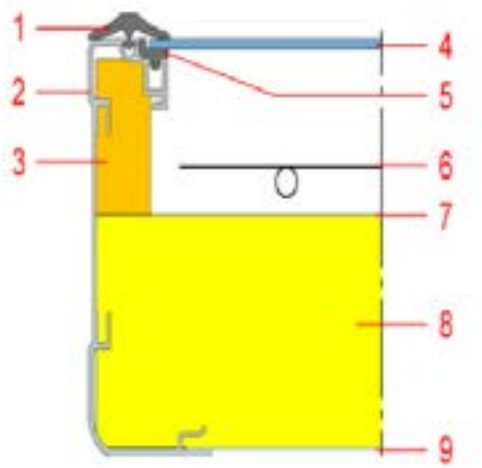
General Information

World's largest collector field in Silkeborg DK with 157'000 m² of flat plate collectors generating 20 % of the district heating energy demand.

General

Flat-plate solar collectors are probably the most fundamental and most studied technology for solar-powered domestic hot water systems. The idea behind it is simple. The sun heats a dark flat surface that collects as much energy as possible. The heat is transferred to a working fluid, (usually an anti-freeze mixture) and transferred to the district heating system via plate heat exchangers. Flat-plate systems typically operate within a temperature range of 30 - 80 °C. With the introduction of selective coatings, the stagnant fluid temperature in flat-plate collectors can reach more than 200 °C. Several manufacturers have produced large collectors specifically designed for large scale solar district heating (DH) systems. These collectors reach aperture areas of up to 25 m² each and facilitate the installation and connection of large fields, lowering the cost of open field installations. With typical operating temperatures between 50 °C and 80°C, flat-plate solar collectors can achieve efficiencies of 60-70% and a typical power of 0.7 kW/m² can be applied. In Switzerland, 500-700 kWh/m² per year can be reached depending on the operating temperature.

Construction



1	Sealing
2	Casing
3	Side insulation
4	Front glass
5	Sealing
6	Absorber
7	Back sheet
8	Back insulation
9	Back cover

The heart of a flat-plate collector is the absorber, which is an aluminium or copper sheet with a selective coating. This coating absorbs as much sunlight as possible, but has minimized radiative losses similar to modern window coatings. The fluid-carrying pipes are welded to the absorber sheet to transfer the absorbed energy to the transport fluid. Thermal losses are reduced by mineral wool insulation at the rear and a transparent glass cover at the front. For higher operating temperatures, a second transparent layer is sometimes introduced to further reduce thermal losses. A steel or aluminium casing is used to provide stability and protect the internal components from environmental influences.

Area	1 - 25 m²
Investment cost [a]	220 - 400 CHF/m²
Temperature range	30 - 80 °C
Life expectancy	>30 years

[a] without cost for planning and permits

Materials

Absorber	Glass or	1.6-2.2 mm
	Alu/Copper	0.15-0.4 mm
Piping	Alu/Copper	12 - 40 mm
Cover	Borosilicat glass	1.6 - 4 mm
Insulation	Vacuum	
Casing	Metal (header: plastic)	
Reflector opt.	Aluminium sheet	

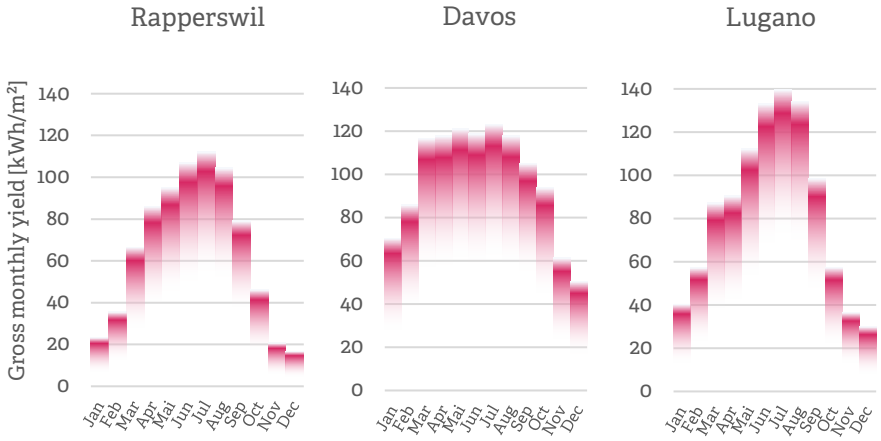
Advantages

- large scale collectors available
- several manufacturers with standard products and production in Europe
- low cost
- established/ long lasting experience with large collector fields
- elevated efficiency at medium temperatures
- elevated recycling rates

Disadvantages

- elevated losses at high temperatures
- stagnation concept needed
- not suitable for the operation with water

Typical collector output



Annual yield* [kWh/m²]

	50 °C	80 °C
Rapperswil	670	414
Davos	1000	656
Lugano	859	550

* Yield of a good product at a constant average operating temperature for a 30° tilted collector facing south. Values refer to gross collector area.

Situation in Switzerland and worldwide

Flat-plate collectors are the most commonly used collector type in district heating (DH). Approximately 1'500'000 m² of collectors are in operation in DH systems worldwide. The solar thermal district heating market was dominated by Denmark in the period from 2010 to 2020. However, large systems have recently been installed in the rest of Europe and China.

Examples:

Name	Country	Area	Year
Marstal	DK	157'000 m²	2016
Vojens	DK	70'000 m²	2018
Zhongba	CN	35'000 m²	2019
Crailsheim	D	7'500 m²	2003
Dailly Lavey	CH	850 m²	2009

Collector manufacturers

- Meriaura Energy (Finnland, former Savo Solar)
- GREENoneTEC (Austria, former Arcon Sunmark)
- Micoe (China)
- Winkler (Austria)
- Soltop Energie (Switzerland, small scale)
- Ernst Schweizer (Switzerland, small scale)

(not exhaustive list)

Relevant sources & further information

- Webpage *on solar district heating*
- IEA-SHC Task68: *Efficient Solar District Heating Systems*
- SolCAD: *Potentiel du solaire thermique dans les chauffages à distance en Suisse*
- BioSolFer: *Integration von Solarwärme in Biomasse Fernwärmenetze*

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