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Vacuum Flat Plate Solar Collector

Factsheet 4: Integration of solar energy in district heating

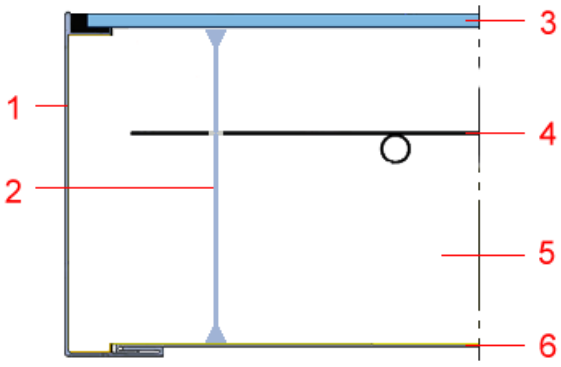
General Information

Vacuum flat plate collectors provide heat for the district heating network of Geneva. Source: TVP Solar

General

Vacuum flat-plate collectors are a further development of the classic flat-plate collectors. A high vacuum inside the collector almost completely prevents losses through heat conduction or convection. The air pressure of approx. 10 t/m² exerts a great load on the front and rear sides, so that the front glass in particular must be supported with regular supports. The manufacture of durable vacuum-tight connections between the front glass and the metal collector housing is the main challenge in the manufacture of flat-plate vacuum collectors. This has been commercialised mainly by spin-off companies from CERN. Evacuated flat-plate collectors have a very good yield of both direct and diffuse solar radiation and can also be used for high temperatures of up to approx. 200 °C.

Construction



1 Casing
2 Internal support
3 Front glass
4 Absorber
5 High vacuum
6 Back sealing

Vacuum flat-plate collectors are similar in design to conventional flat-plate collectors, but use a high vacuum instead of conventional insulating materials to minimise heat loss. The vacuum creates high forces, requiring the front glass and the rear panels to be supported at regular intervals. A selective absorber plate absorbs around 95 % of the solar radiation, but only radiates a small amount of heat. The solar energy is transferred to a tube with a heat transfer fluid by thermal conduction. A glass solder becomes a vacuum-tight seal between the cover glass and the collector frame.

Area	2 m²
Investment cost [a]	120 - 350 CHF/m²
Temperature range	80 - 180 °C
Life expectancy	20-30 years

[a] without planning and heat exchanger cost

Materials

Absorber	Copper	0.2 mm
Piping	Alu/copper	12-40 mm
Cover	Low iron glass	5 mm
Insulation	High vacuum	10^{-3} mbar
Casing	Metal (Steel)	

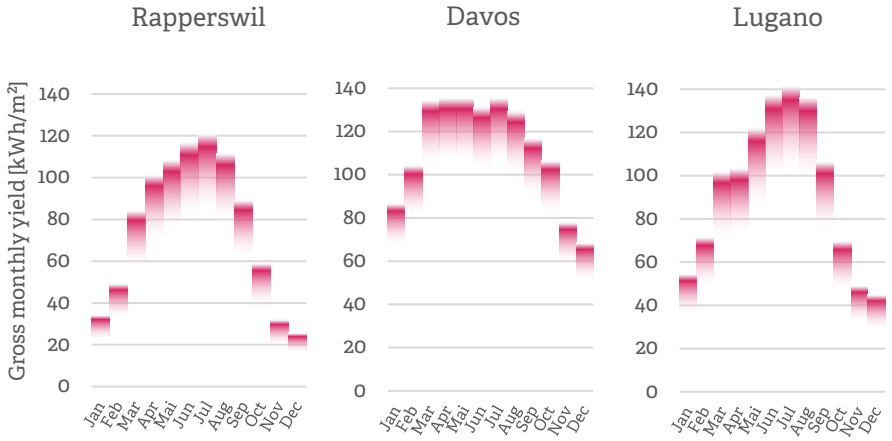
Advantages

- Low heat losses
- Elevated temperatures reachable
- Good harvesting of direct an diffuse radiation

Disadvantages

- Only relatively small units available
- Dominated by one manufacturer
- Experience with several decades of operation not yet available

Typical collector output



Annual yield* [kWh/m²]

	50 °C	80 °C
Rapperswil	848	738
Davos	1238	1106
Lugano	1035	915

* 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

Vacuum flatplate collectors are currently only commercialized by a Swiss company which is a spin off of CERN. Several Installations are operable since several years in different climatic conditions worldwide. Switzerland's largest solar thermal installation for conventional district heating consists of VFPC and an installation of 48'000 m² of ground mounted VFPC is currently under construction in Groningen (NL) .

Examples:

Name	Country	Area	Year
Dorkwerd (Groningen)	NL	48'000 m²	2023
SolCAD II	CH	800 m²	2021
Emmi Burgdorf	CH	160 m²	2022

Collector manufacturers

- TVP Solar

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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