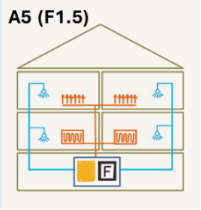
SolarCity, Geneva – Switzerland

Solar assisted HP in combination with unglazed solar collectors for a new multifamily building complex in Geneva, Switzerland.



Key facts

Building

Location	*Geneva, Switzerland*
Construction	*2010*
Type	*Multifamily building*
Heat distribution	*Underfloor heating*
Heated area	*927 m² (one block)*
Level of insulation	*High performance*

Heat pump and source

Number of HP	*1*
Installed capacity	*30 kW_{th}*
Operation mode	*Monoenergetic*
Heat source	*116 m² unglazed solar collectors*
Backup heat source	*Direct electricity*

Space heating

SH share, demand	*28%, 19 kWh/m²/y*
Heating temperature	*Max. 35°C at -5°C*

Domestic hot water

DHW share, demand	*72%, 48 kWh/m²/y*
Type of system	*Decentralized*
Max. temperature	*60°C*
Circulation system	*No*

Other information

HP share, SPF	*80%, measured: 2.7*
Direct solar heat	*19%*
Backup heat source	*1%*
Ventilation	*Double-flow*

Lessons learned

- Excellent system reliability.
- A single heat distribution circuit with decentralized DHW storage which doesn't allow for solar preheating and thus deteriorates the potential of direct solar heat production.
- A high part of the heat is produced at high temperature (60°C) for DHW production, decreasing the expected SPF.

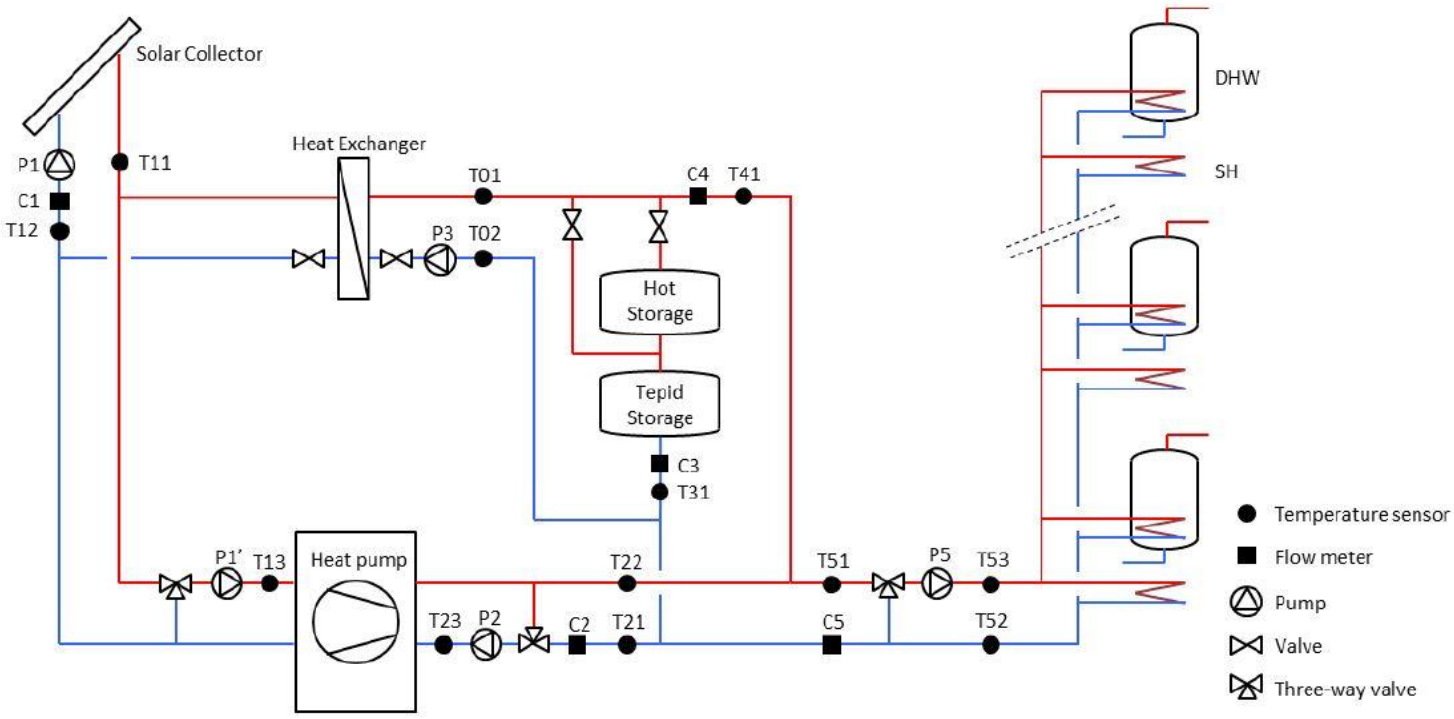
This case study concerns a coupled solar and HP system which was implemented in 2010 in a new housing complex, called SolarCity, located in Geneva (Switzerland).

The complex is composed of 4 buildings, each subdivided in 2 or 3 blocks, for a total of 10 blocks. The buildings present a high thermal performance envelope and a total living surface of 9'552 m².

This case study concern only one of the 10 existing buildings blocks, which are all equipped with their own identical and independent heat production system.

The results show a very low SH demand for Switzerland and an unusually high DHW consumption, which can partly explain the relatively low HP SPF.

SolarCity, Geneva – Switzerland: Technical details



Description of the technical concept

The energy concept consists of solar collectors that can be used for direct solar heat production, via a heat exchanger, but are also the heat source of the HP (they are directly connected to the evaporator). Hence, when there is no solar radiation, the solar collectors work as a heat absorber on ambient air.

For each building block, there is: a 30 kW_{th} heat pump; 116 m^2 of unglazed solar collectors; 2 x 3'000 L of water for centralized heat storage with an electric rod in the storage tank in case of HP failure.

A specificity of the system consists in a single distribution circuit to the flats, so that SH (floor heating) and DHW cannot be supplied simultaneously and therefore are supplied alternatively. Each flat is therefore equipped with a 300 L DHW tank. DHW distribution has priority over SH distribution, which means that when one of the 300 L tanks is at a temperature below 40°C, the system switches automatically to DHW mode and rises the temperature of all the 300 L tanks up to 60°C.

The system has 4 main operating modes, with the following priorities: (i) Direct solar heat production for SH or DHW (bypassing the HP), the surplus being used to charge the heat storage; (ii) Storage discharge, which is activated when the solar production does not reach the required distribution temperature; (iii) Activation of the HP when the storage temperature is below the required distribution temperature, with surplus production used to charge the heat storage; (iv) Direct electric heating, which is activated in case of HP failure (in particular when the evaporator temperature drops below -20°C).

In summer, the system can also be used for night cooling, by activating the floor distribution circuit and dissipating the heat in the solar collectors.

Final report: DE SOUSA FRAGA, Carolina (2017). Heat pump systems for multifamily buildings: which resource for what demand? Thesis, University of Geneva. Url: https://archive-ouverte.unige.ch/unige:94939