Chapter:	System
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Description:	The position of the solar thermal (ST) plant in the heating grid, feed-in principles, feed-in direction and feed-in capacities are described in this fact sheet.
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Position in the heating grid

If the position of the solar thermal plant is decentral, thorough analysis of the district heating (DH) grid has to be performed in advance. “Decentral” means that the solar thermal plant is not close located to another major heat generator like a biomass or fossil fuel fired plant. A central feed-in point can also be a transfer station from a connection line to a remote power or heat plant.

Feed-in principles

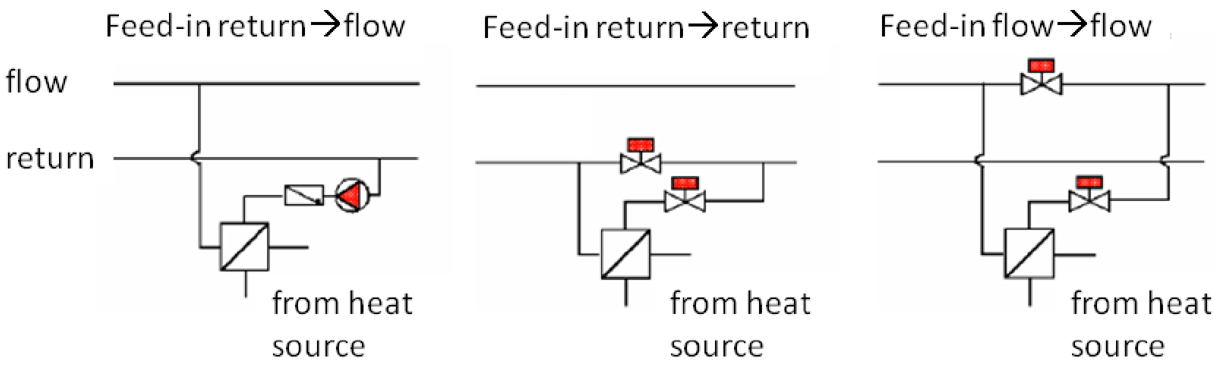

Fig. 6.2.1. Hydraulic integration of solar thermal feed-in. (Source: Streicher)

Feed-in return→flow

At this feed-in mode, the required temperature hub in the heat generator is defined by flow and return temperatures of the heating grid. The solar plant has to be operated at matched flow volumes, adjusted to the required flow temperature. The feed-in pump has to overcome the pressure difference between return and flow. This temperature difference is at several bar quite high compared to the pressure loss of collectors and pipes (several 100 mbar). Heating grid operators prefer this feed-in principle, as there is no change in return temperatures and part of the pump cost has to be beared by feed-in-operator.

Feed-in return→return

Here operating temperature of the solar plant is lowest compared to other feed-in modes. Thus highest solar yields can be expected. No pumping energy is required at feed-in point as pressure loss of pipes and heat exchangers is covered by grid pumps. Mass flow in the collector circuit can be constant. Return-return-feed-in is not favourable for heating grid operators as they have to install a flow resistance in the grid pipe for control of the flow in the heat exchanger for feed-in. Additionally high return temperatures are not favourable for most heating grid operators as heat losses rise and the efficiency of other heat generators tends to decrease.

Feed-in flow→flow

This feed-in mode results in high collector temperatures and low efficiencies of the solar plant. Here also the grid operator has to install a flow resistance in the grid pipe for control of the flow in the heat exchanger for feed-in. Due to low efficiency, this principle is normally not in use.

Feed-in capacities

For decision about installing and sizing a heat storage at the solar plant, it is important to know the heat demand of the feed-in area during peak irradiation times. Overheating or stagnation of the solar plant is to avoid for both technical and economical reasons.

Yield from solar plant: as a rule of thumb, 3 kWh/m² collector area during 6 hours (9-15h) can be assumed as maximum for most locations worldwide. The exact value depends on collector tilt angle, orientation, temperature levels etc.

When heat supply and demand match in summer months, operation during shoulder season and winter is normally possible with sufficient heat demand. But temperature levels in the DH grid could rise in winter months and thus an efficient operation strategy has to be found, see chapters below.

Summer months operation

As the majority of solar irradiation is in most regions not during heating season, summer time operation is crucial for economics of a solar thermal plant.

Heat demand (9-15h) in the feed-in area (to be examined for summer days, when no room heating is required):

- domestic hot water consumption in supplied buildings
- hot water consumption of large consumers (industry, hospitals etc.); to be checked also for weekends and holidays
- circulation losses in supplied buildings
- heat losses in district heating grid (can be significant in summer months)
- if possible, using the district heating grid as heat storage.

When using the district heating grid as heat storage, also the return flow heats up during plant operation. For effective and safe solar plant operation, return temperature should be as low as possible. Thus when heating up the DH grid, return temperature should be as low as possible in the morning before start of feed-in from solar plant.

The yield of the solar plant decreases when return temperature rises. This is important in late afternoon, when return temperature increases and irradiation decreases. In this case the solar plant has to be switched off earlier in the afternoon than with constant return temperature. The resulting loss of operation time impairs the economics of the solar plant.

For evaluating the heat demand between 9 and 15 o'clock in summer months in a certain part of the heating grid, a profound analysis is necessary and in most cases also measurements on heat demand, flow volumes and temperature levels.

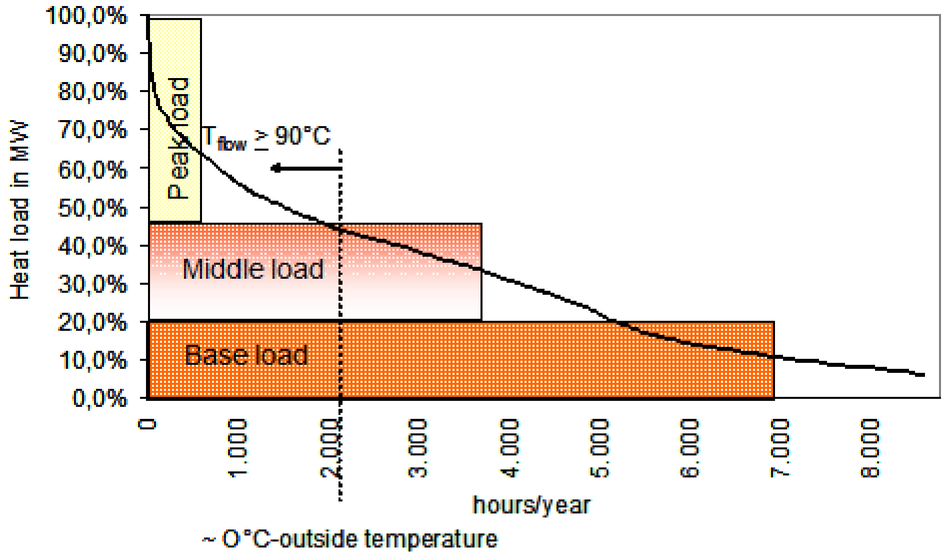

Fig. 6.2.2: Typical heat load of a DH-System in Germany over the year, combined with the check mark for the flow pipe temperature > 90℃. (Source: AGFW e.V.)

Winter months operation

In winter months, the minimum feed-in temperature of the flow can go beyond 90 or 100 ℃, depending on the operation parameters determined by the DH grid operator. It is possible to generate these temperatures with solar thermal also in winter. For economical and technical reasons, maximum temperatures of 60 to 80 ℃ are more favourable for winter time operations of a solar thermal plant. If heat can't be fed in at these temperatures to the grid, the solar plant can supply other buildings directly. As heat demand is mainly early in the morning, a heat storage needs to be integrated. Also a heat pump can be integrated in the solar circuit or the heat storage for increasing the efficiency at low temperature operation time.

Heat storage

For increasing the flexibility in operation of the solar plant, a heat storage can be useful (see factsheet 7.2 *"Storage"*).

The heat storage should be used both for the solar thermal plant and for load management of the DH grid. It is hardly feasible to finance a large heat storage by solar-only use.

Operation of district heating grid

For maintenance and installation work at the district heating grid, shut-off of a branch of the grid might be needed for some hours. Shut-off should be done at times, when no feed-in from the solar plant is planned. I.e. when there is enough capacity for charging the buffer tank or, even better, in hours when there is no solar irradiation on the collector field.

Otherwise unplanned shut-off of the district heating grid might cause stagnation in the solar system (see factsheet 8.2 *"Safety equipment"*).

References

[1] Wolfgang Streicher, Christian Fink: Einspeisung von Solaranlagen in (bestehende) FW-Netze, Gleisdorf Solar 2006.

┘ *The SDH fact sheets addresses both technical and non-technical issues, and provide state-of-the-art industry guidelines to which utilities can refer when considering/realizing SDH plants. For further information on Solar District Heating and the SDHtake-off project please visit www.solar-district-heating.eu.* ┌

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