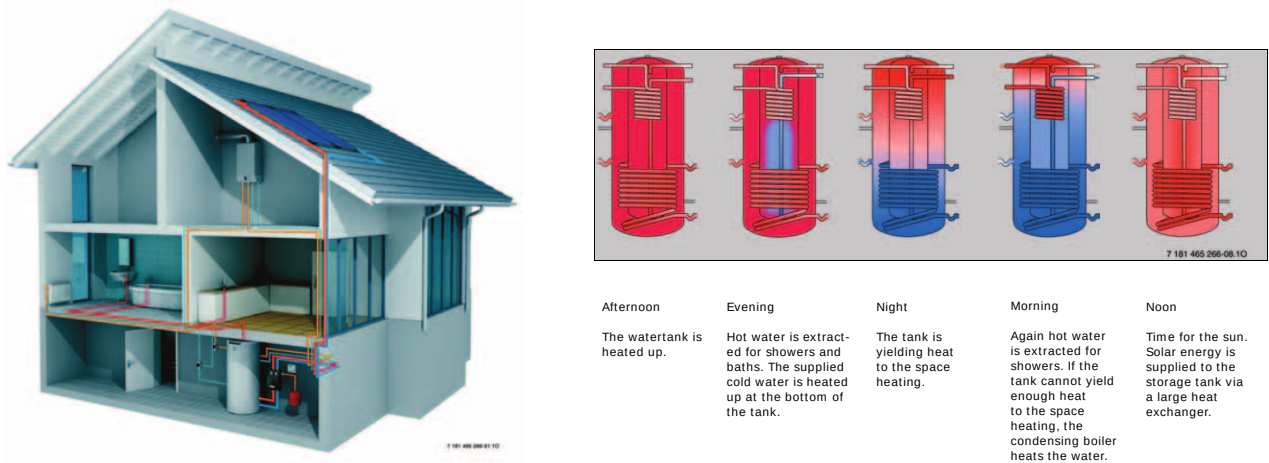# 2   Project task: Solar-thermal heating

For owners of an apartment complex you shall investigate its heating system. It is a solar thermal water heating with space heating support via a hot water tank, as schematically shown in the following figure. The tank is a layered charge storage, heated up over the day by the solar energy and yielding heat to consumed water and the space heating.

| Afternoon	Evening	Night	Morning	Noon
The watertank is heated up.	Hot water is extract-ed for showers and baths. The supplied cold water is heated up at the bottom of the tank.	The tank is yielding heat to the space heating.	Again hot water is extracted for showers. If the tank cannot yield enough heat to the space heating, the condensing boiler heats the water.	Time for the sun. Solar energy is supplied to the storage tank via a large heat exchanger.

Source: Junkers Bosch Gruppe

The weekly average values of certain measured variables such as sunshine duration, outdoor temperature, solar yield, pumping times and gas consumption were stored in a CSV file.

Viewing the gas consumption as the target variable y, how many principal components of the other variables x is best to be considered? What are the essential variables to predict the gas consumption?

Perform a linear regression with the gas consumption as the target variable and the first two principal components of the other variables x.

Background information: The mode of operation of the heating

The solar modules on the roof heat up a special solar fluid, which is pumped by a solar pump (PS1) to the buffer tank when the heat is sufficient and heats it up via a heating coil. The buffer tank is thus warmed up during the day by the solar energy and supplies the fresh water station with heat. If the solar energy is not sufficient sufficient for this, the buffer tank is heated via the gas condensing boiler. If the temperature in the middle area of the buffer tank is sufficient, the heat is used to raise the temperature of the heating return by a 3-way valve (VS1) diverting it via the buffer tank to the gas condensing boiler, which reheats if the temperature is too low. The hydraulic plan of the system is sketched in the following figure.
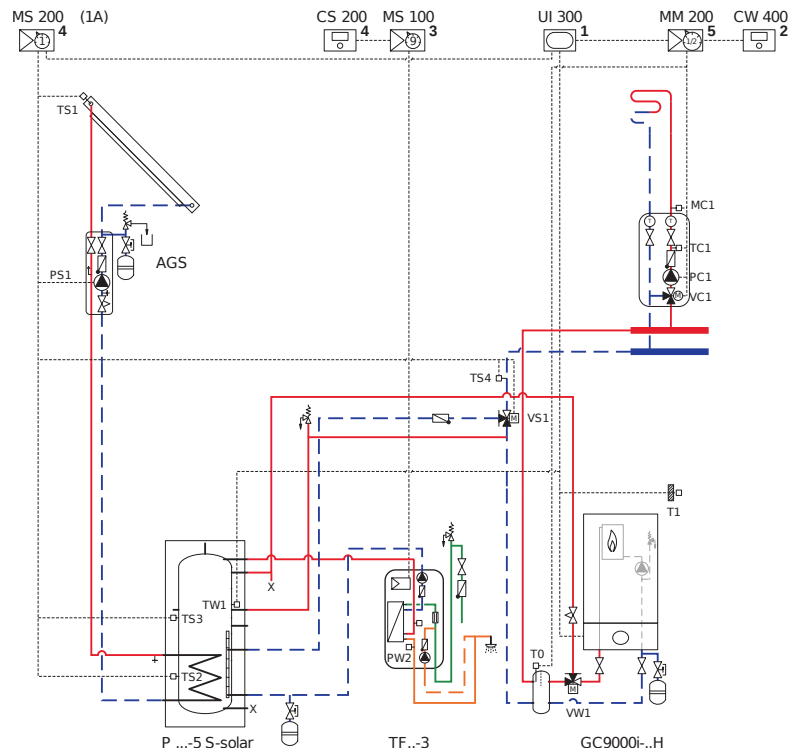
Hintergrund: Die Funktionsweise der Heizung

Die Solarmodule auf dem Dach erwärmen eine spezielle Solarflüssigkeit, die bei ausreichender Wärme von einer Solarpumpe (PS1) zu dem Pufferspeicher gepumpt wird und ihn über eine Heizwendel aufheizt. Der Pufferspeicher wird so tagsüber durch die Solarenergie aufgewärmt und versorgt die Frischwasserstation mit Wärme. Wenn die solare Energie dafür nicht ausreicht, wird der Pufferspeicher über das Gas-Brennwertgerät nachgeheizt. Bei ausreichender Temperatur im mittleren Bereich des Pufferspeichers wird die Wärme zur Temperaturanhebung des Heizungsrücklaufs genutzt, indem ein 3-Wege-Ventil (VS1) ihn über den Pufferspeicher zum Gas-Brennwertgerät umleitet, das bei zu geringer Temperatur nachheizt. Der Hydraulikplan der Anlage ist in der zweiten Abbildung skizziert.