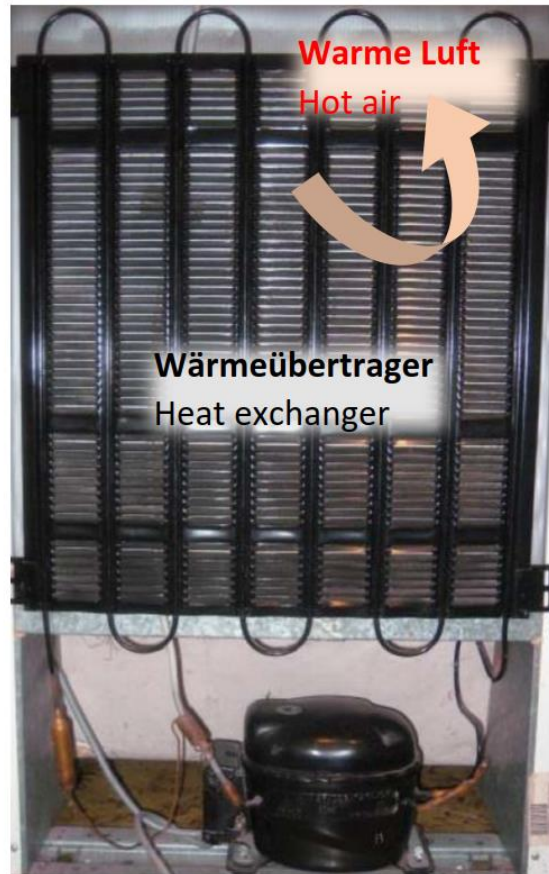
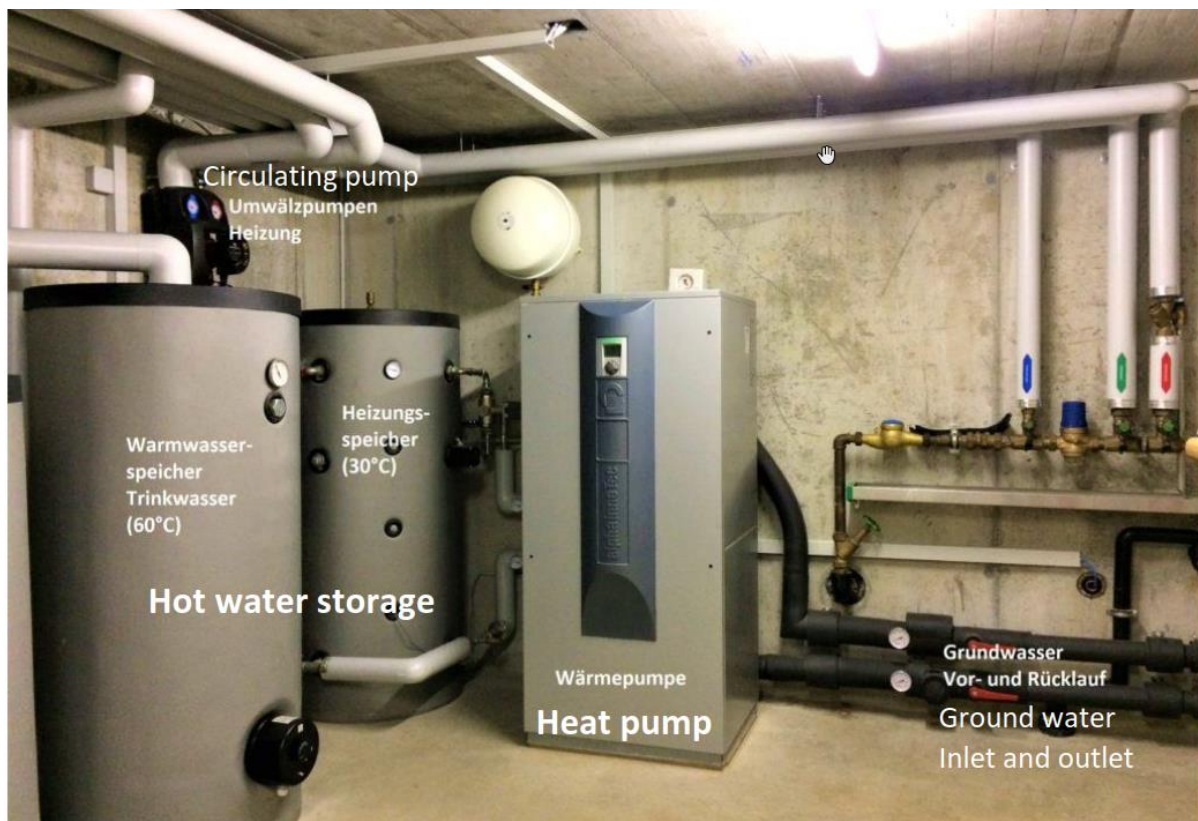


Kühlschrank von hinten

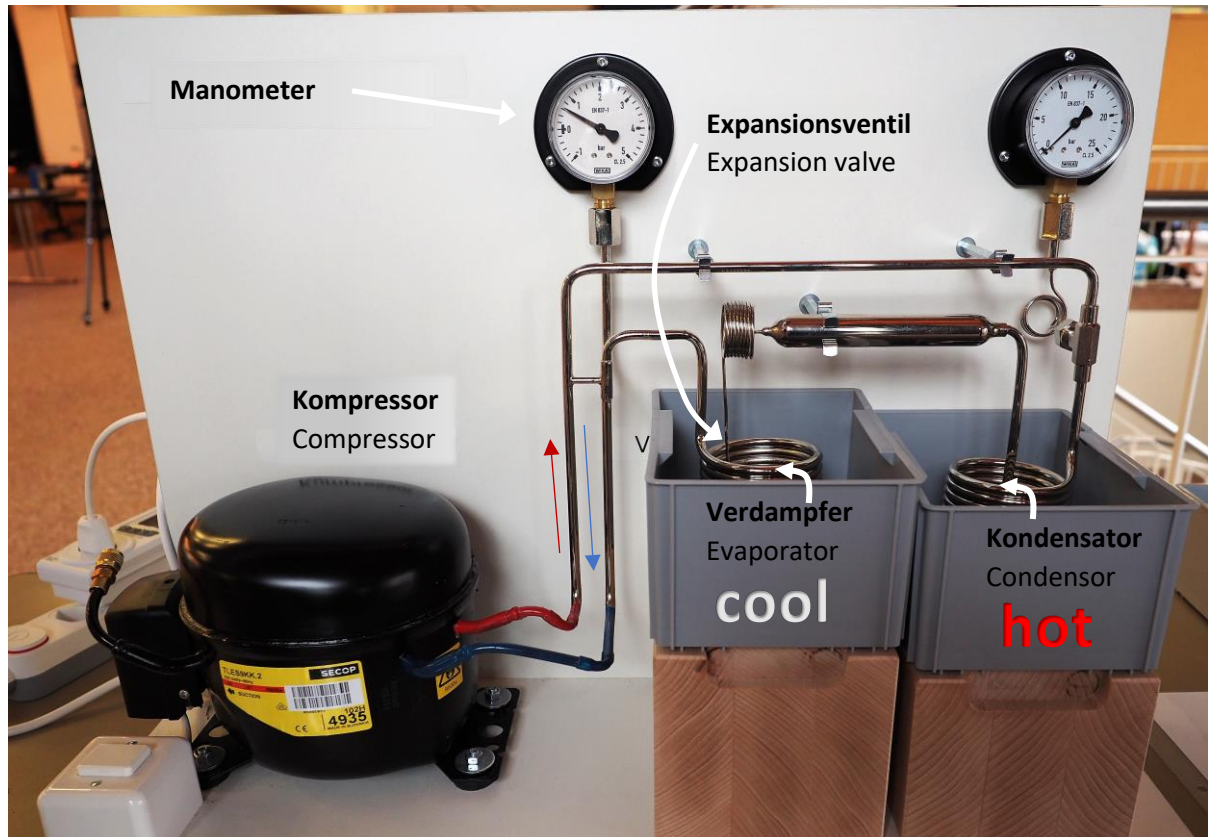
Back of a refrigerator
(Wikipedia)



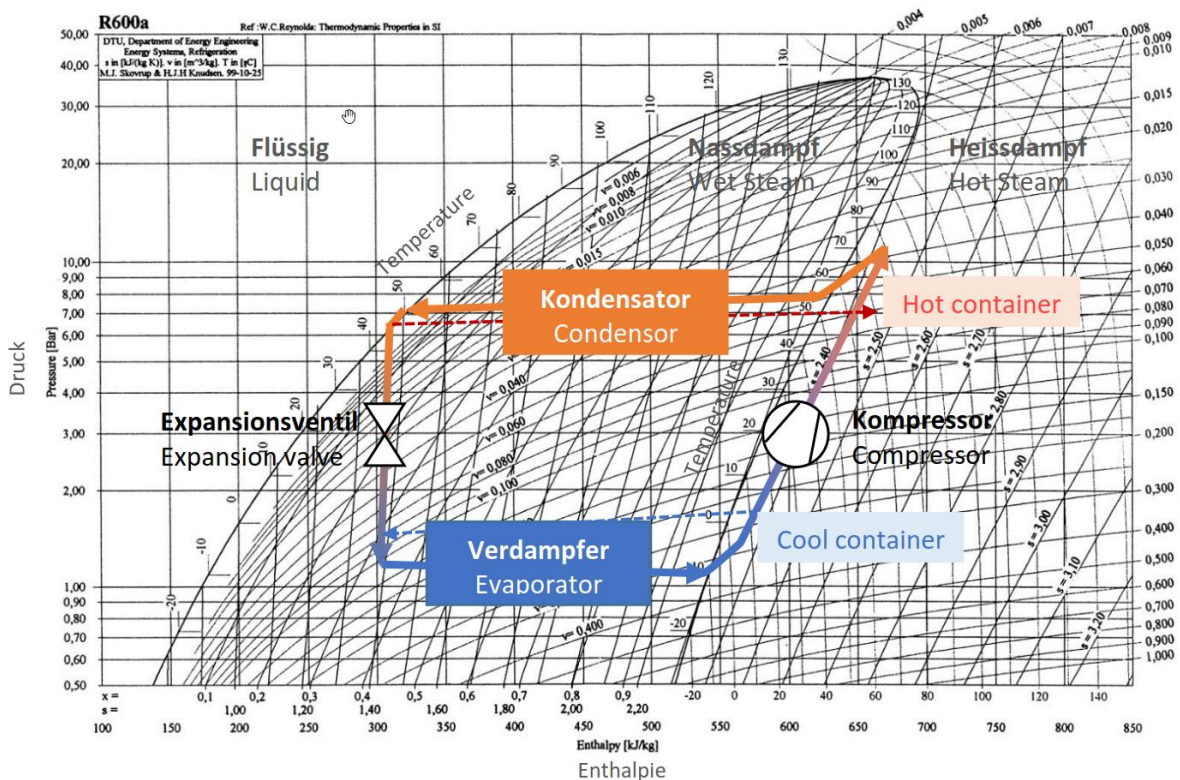
Heating system with heat pump: ground water as energy source



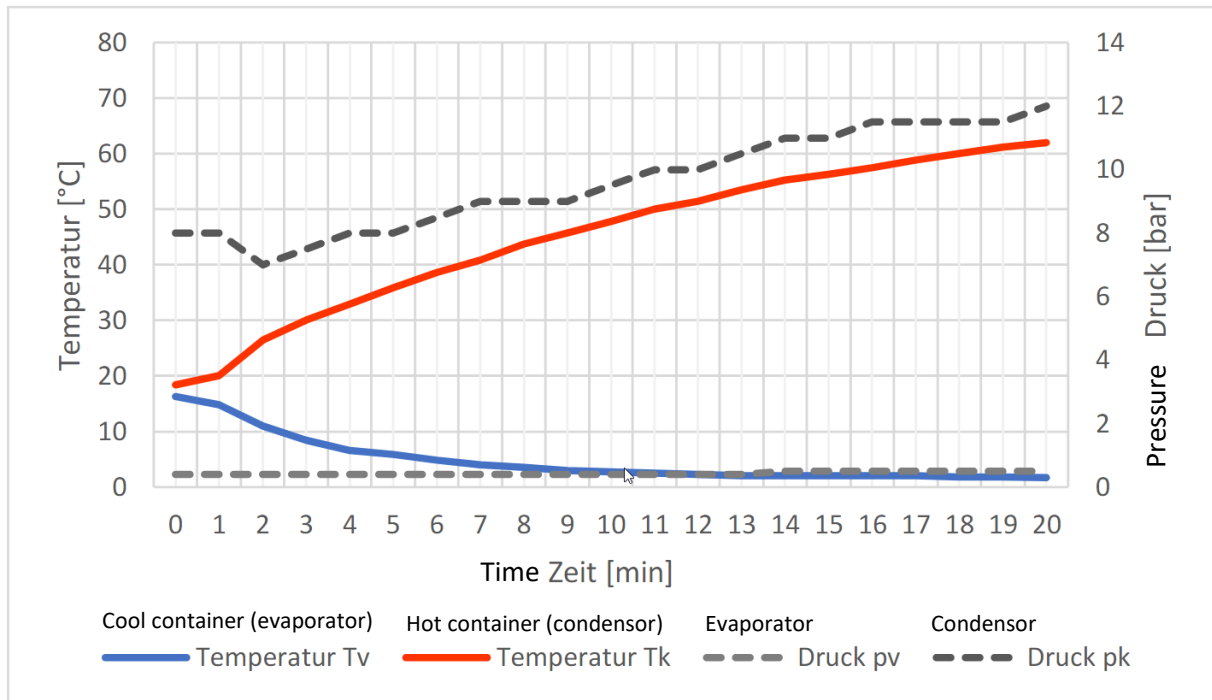
Model plant heat pump and/or cooling system



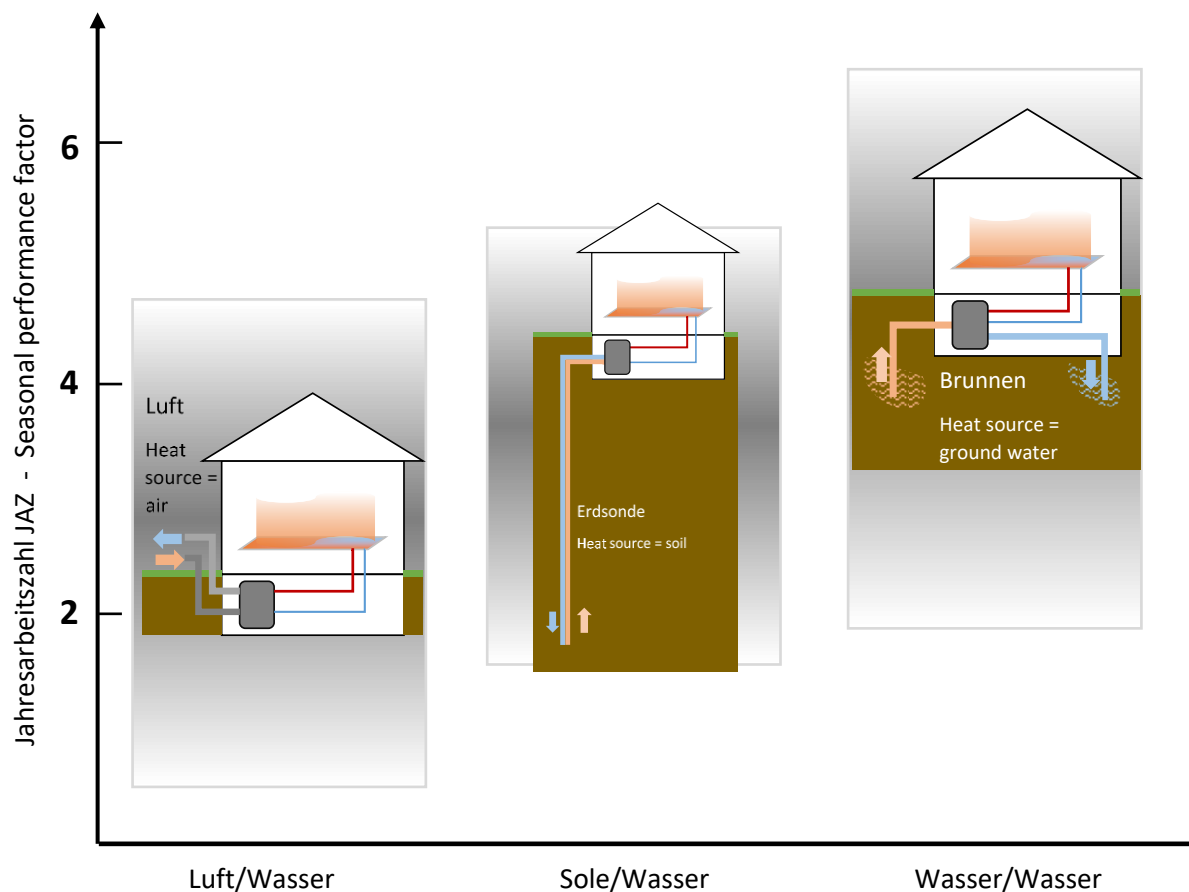
Refrigerant Isobutane (R 600a), Mollier diagram with thermodynamic cycle



Model plant heat pump – experimental data



Performance of heat pumps

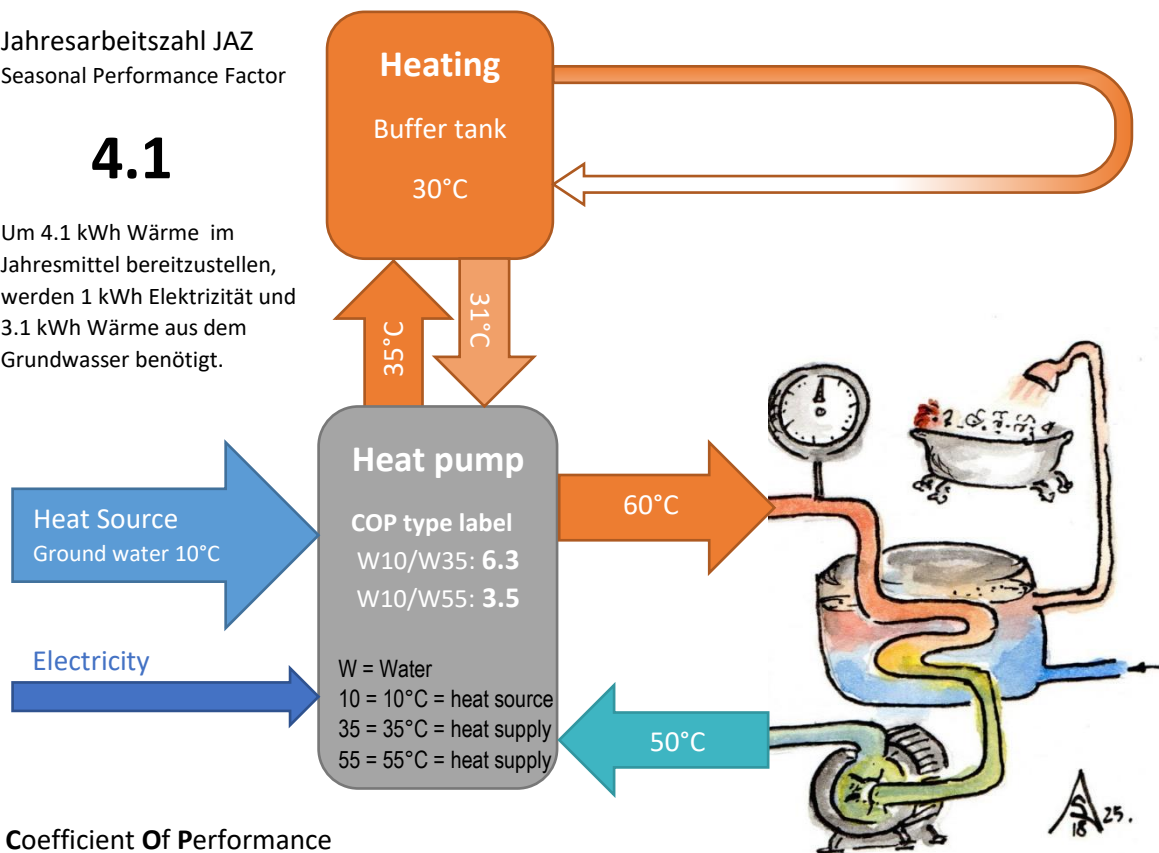


Performance of heat pumps: Example ground water heat pump

Jahresarbeitszahl JAZ
Seasonal Performance Factor

4.1

Um 4.1 kWh Wärme im Jahresmittel bereitzustellen, werden 1 kWh Elektrizität und 3.1 kWh Wärme aus dem Grundwasser benötigt.



Coefficient Of Performance

$$COP = \frac{Q_h \text{ (useful heat supplied to the system)}}{P_{el} \text{ (electricity required by the system)}}$$

Example refrigerants

Refrigerant Kältemittel	Boiling point Siedepunkt	Condensation point Verflüssigung (26 bar)
R134a FKW	-26 °C	80 °C
R404A FKW	-47 °C	55 °C
R407C FKW	-45 °C	58 °C
R410A FKW	-51 °C	43 °C
R744 (Kohlendioxid) CO ₂	-57 °C	-11 °C
R717 (Ammoniak) NH ₃	-33 °C	60 °C
R290 (Propan)	-42 °C	70 °C
R600a (Butan)	-12 °C	114 °C
R1270 (Propen)	-48 °C	61 °C

FKW – Fluorkohlenwasserstoffe
= HFC – Hydrofluorocarbons

Source: www.energie-experten.org