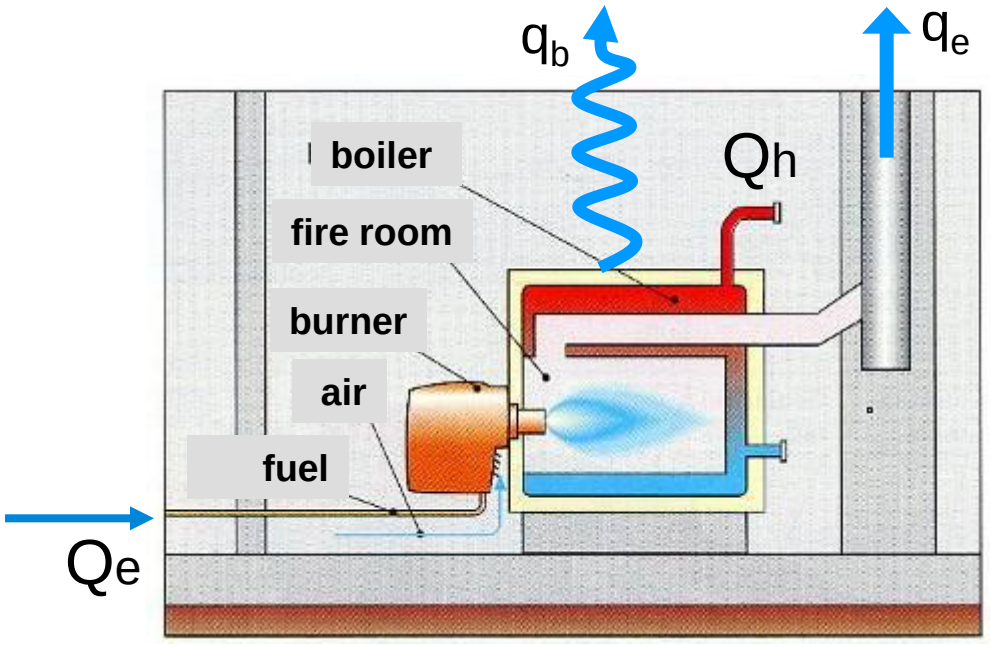
# Efficiency of gas / oil boilers




$$\eta = 100\% - q_b - q_e$$

$$\eta = \frac{Q_h}{Q_e}$$

| | |
|---|---|
| $\eta$ | coefficient of performance in % |
| $q_e$ | exhaust losses in % |
| $q_b$ | boiler losses (heat absorption, convection) in % |
| $Q_h$ | heat energy in kWh |
| $Q_e$ | end energy in kWh |

# Boilers with different Efficiency

## Standard Boiler (until about 1978)

- is used with high temperatures (> 70°C) due to ist construction to avoid condensation in exhaust
- $\eta$ = 65 … 75 %

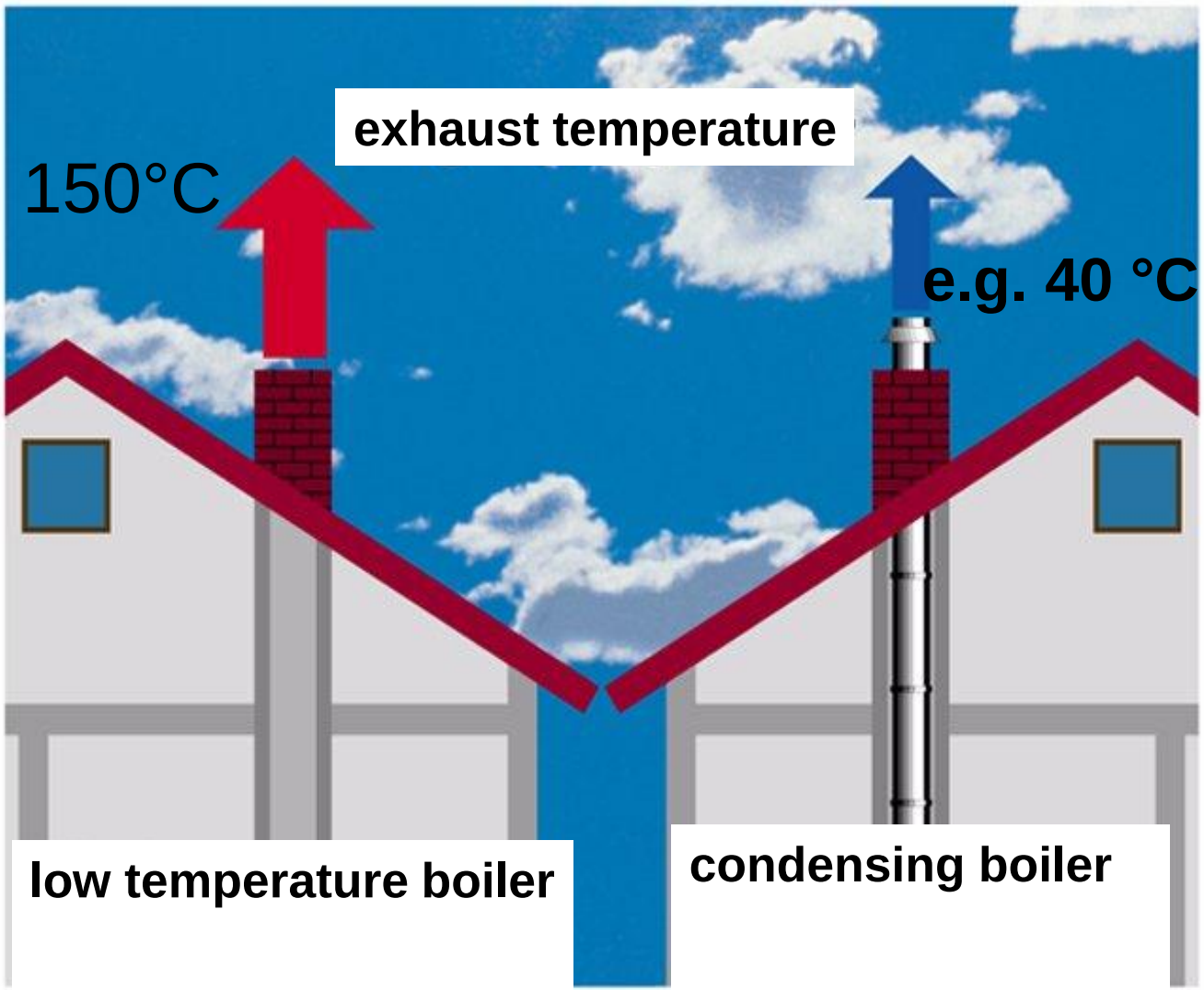
## Low Temperature Boiler (since about 1979)

- is able to work with minimal temperatures of 35–40°C
- typical temperature: 70°C
- $\eta$ up to 90 %

## Condensing Boiler (since about 1995)

- constructed for condensing everytime
- low return temperatures of about 50 °C (natural gas) or 45 °C (gas oil)
- $\eta$ up to 98 % (gas) / up to 92 % (gas oil)

# *Boilers with different Efficiency*




source: Viessmann

# *Condensing Boilers - state of the art*

## Benefits

- Condensing technology is well-established
- simple integration into existing systems
- low investment costs
  (4.000 – 5.000 EUR for a single family house)

## Characteristic application features

- High output, high temperature, quickly available
- systems for natural gas and gas oil available
- Return temperatures < 50/45°C raise efficiency

## Implementation during modernisation

- Integration into the living area using an operating concept independent of indoor air
- Often in combination with solar thermal systems, can then also claim subsidies

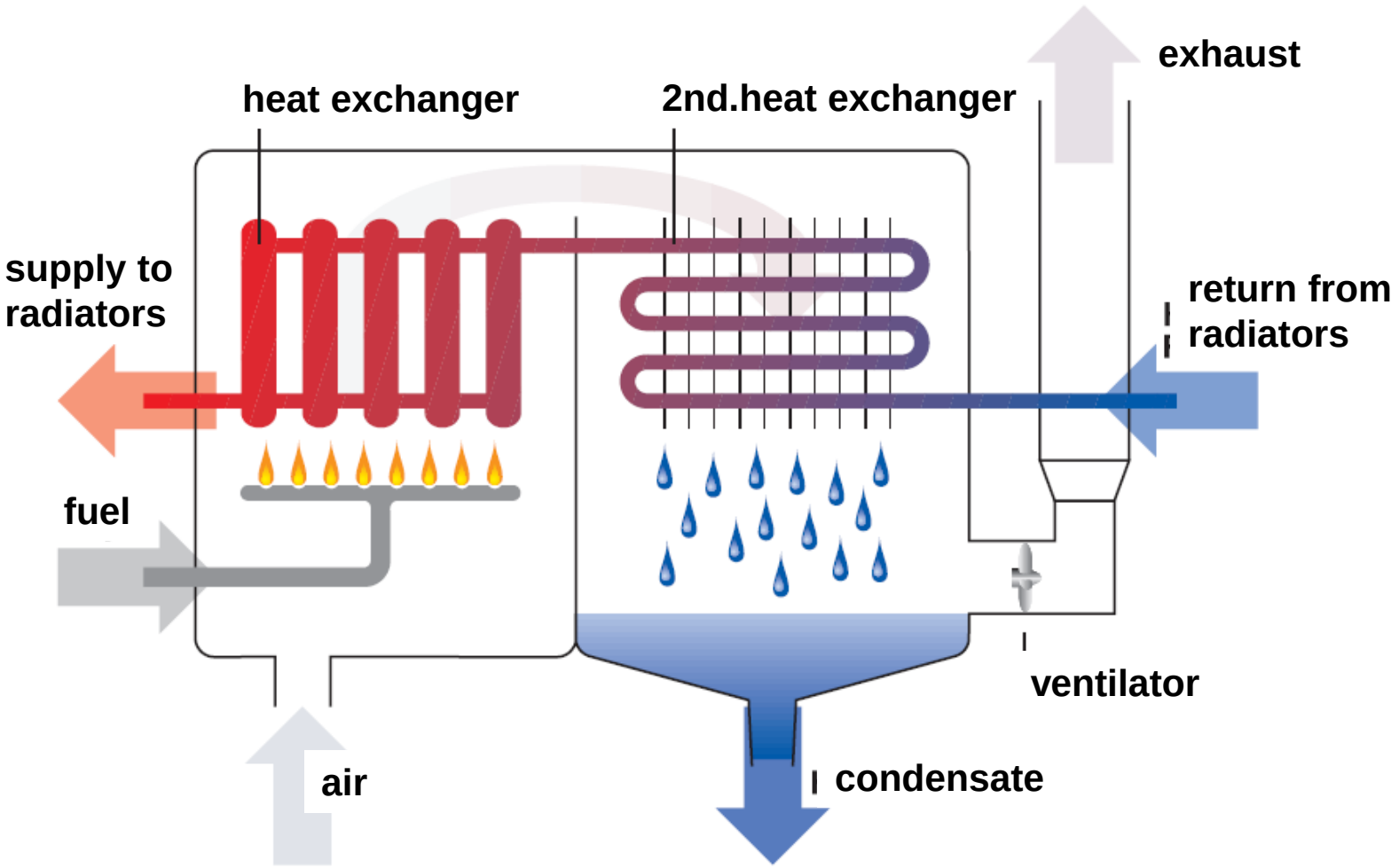
# Condensing Boilers – big range of output

- big range of output availabe
- advantage for gas-fired boilers: modulation under 20 % of max. output
- oil-fired boilers adapt heat requirement with two-stage burner
- cascades provide output up to 1.000 kW

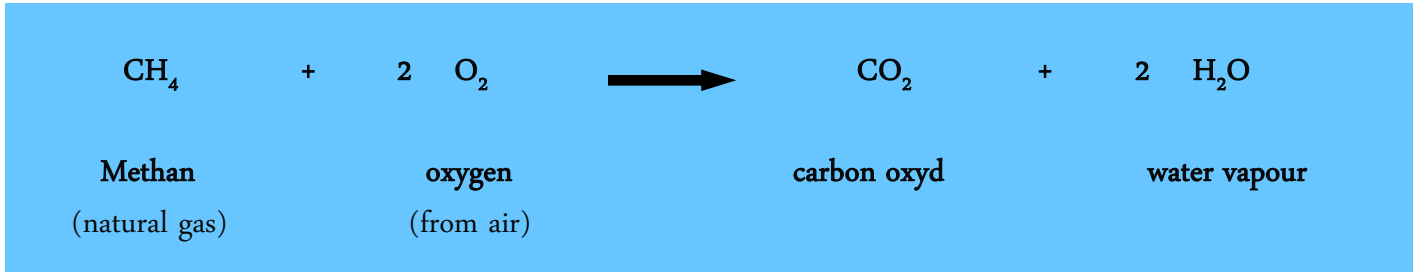
**Available cascade outputs**

| Output [kW] | Combination | 45 kW | 60 kW | 80 kW | 105 kW |
|---|---|---|---|---|---|
| 90 | 2 x 45 kW | X X | | | |
| 120 | 2 x 60 kW | | X X | | |
| 135 | 3 x 45 kW | X X X | | | |
| 160 | 2 x 80 kW | | | X X | |
| 180 | 4 x 45 kW | | | | |
| | 3 x 60 kW | | X X X | | |
| 210 | 2 x 105 kW | | | | X X |
| 240 | 4 x 60 kW | | | | |
| | 3 x 80 kW | | | X X X | |
| 315 | 4 x 80 kW | | | | |
| | 3 x 105 kW | | | | X X X |
| 420 | 4 x 105 kW | | | | X X X X |

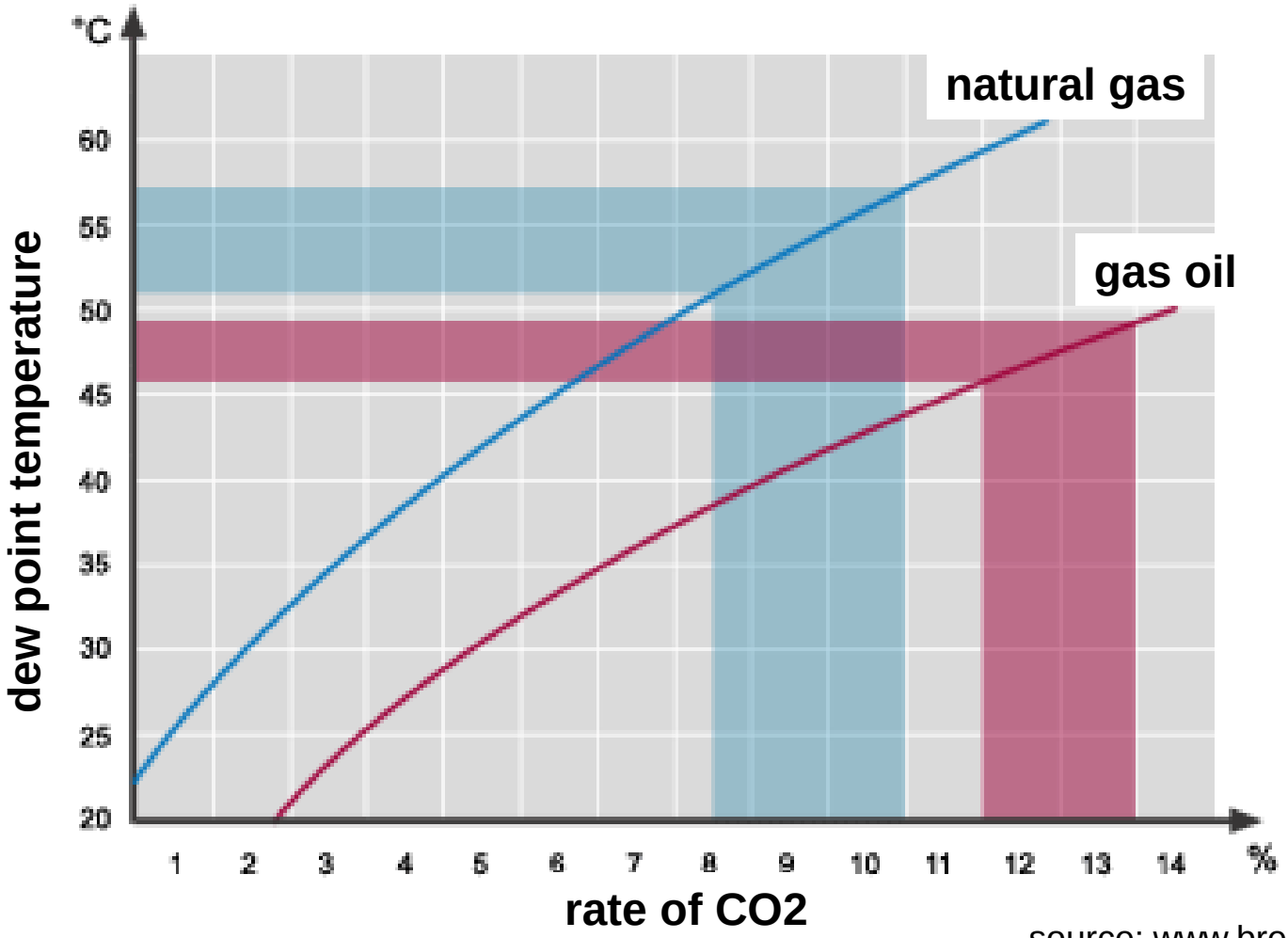
# Function of a Condensing Boiler



# Function of a Condensing Boiler

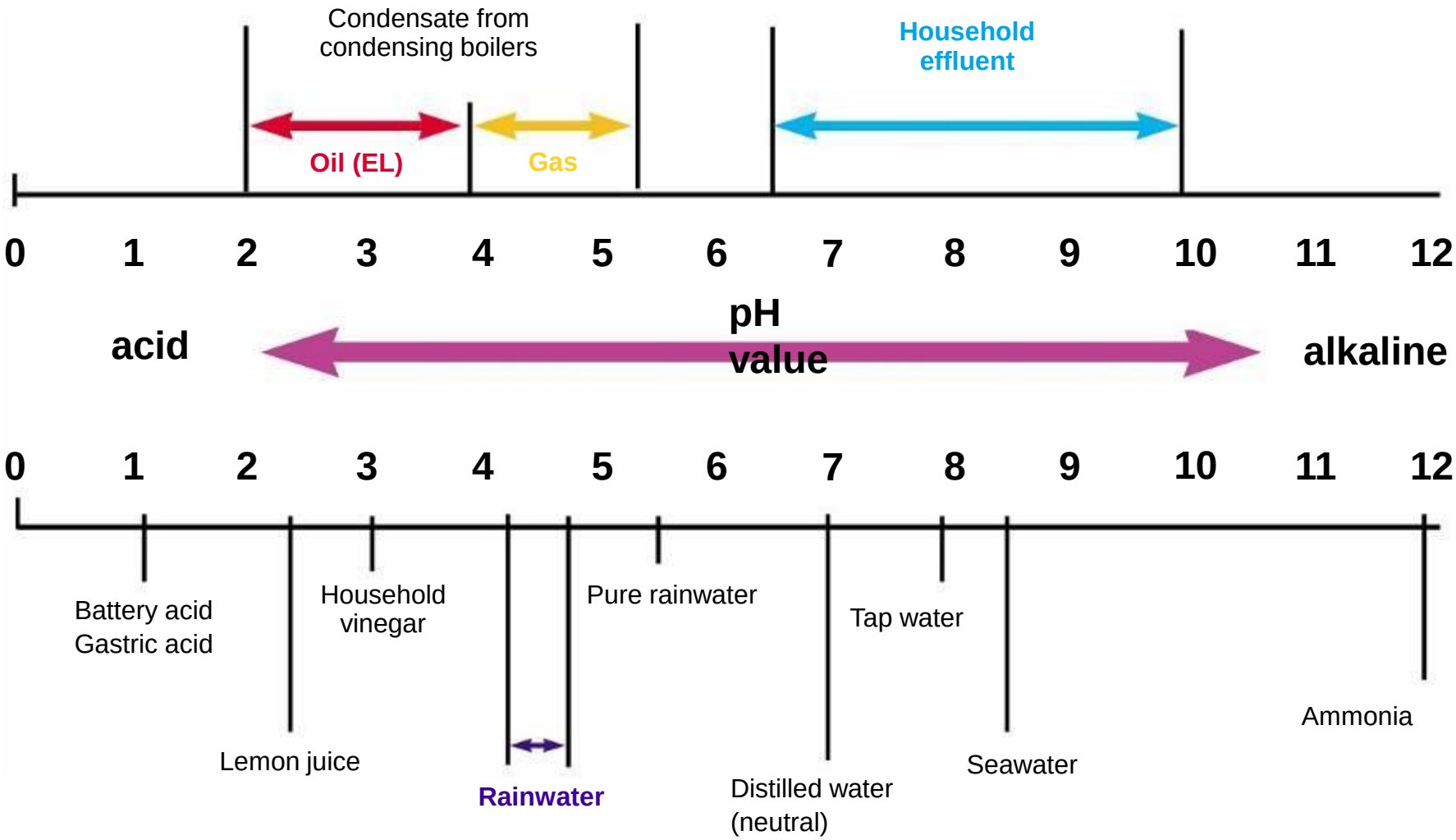



# Start of Condensation




source: www.brennwert.info

# *pH values of various substances*




source: Viessmann

# Condensation and Neutralisation

## oil-fired boiler:

- about 1 liter of condensate per 1 liter of fuel
- **condensate is schwefelhaltig and has to be neutralised before entering the canalisation**
- **neutralisation through box with magnesium-hydroxid**

| Fuel | Amount of condensing water in kg/kWh | Amount of condensing water in kg/kWh |
|---|---|---|
| natural gas | 0,16 | 1,55…1,7 |
| gas oil | 0,09 | 0,9 |

neutralisation box

# Condensation and Neutralisation

| boiler output | neutralisation for | |
|---|---|---|
| | gas or oil (low sulphur) | oil conventional |
| < 25 kW | no | yes |
| 25 … 200 kW | no | yes |
| > 200 kW | yes | yes |

please check if there are any requirements in Ireland

# *Wall Mounted or Ground Standing?*

Federal Ministry of Economics and Technology

wall mounted boiler

conventional boiler

# *Wall Mounted or Ground Standing?*

Federal Ministry of Economics and Technology

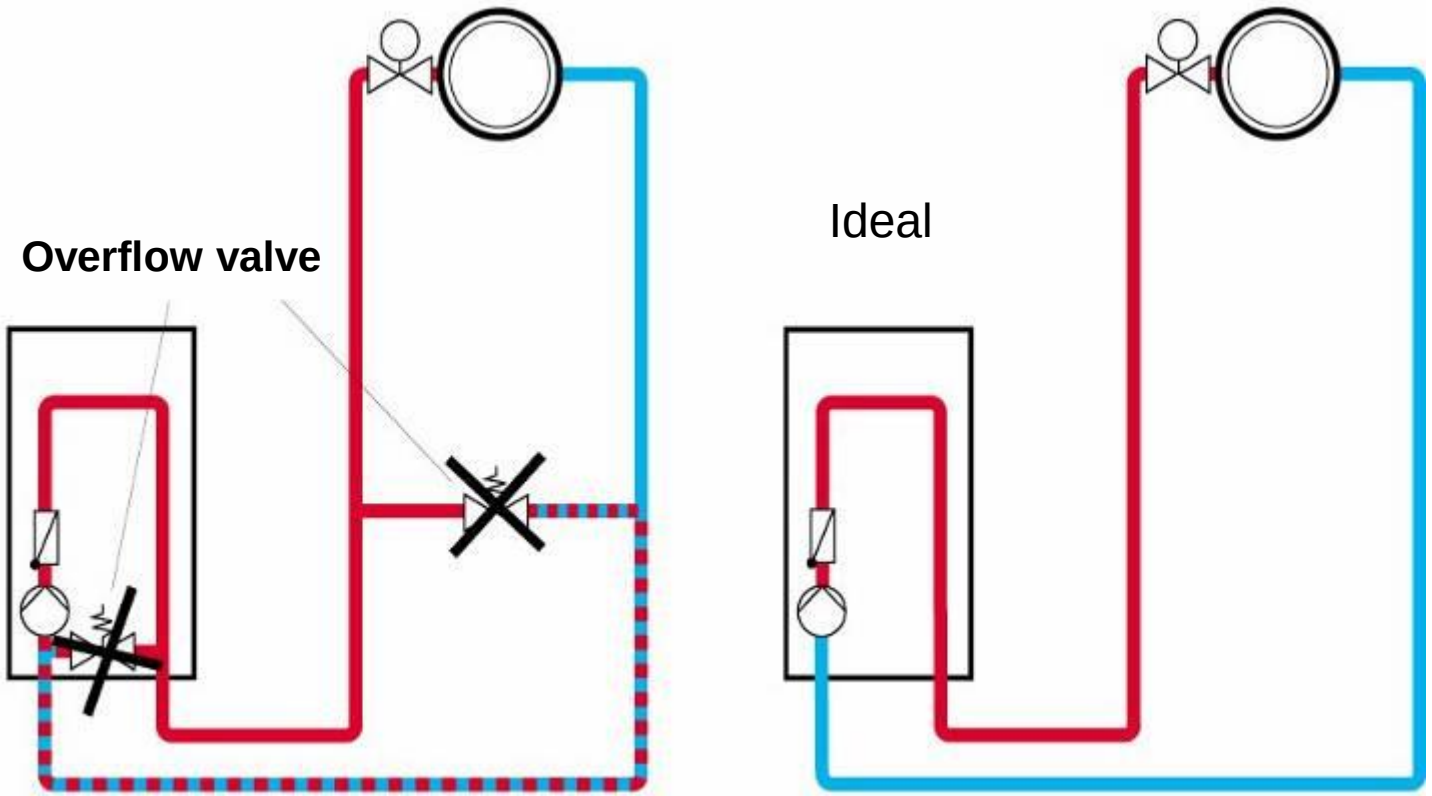
## Wall Mounted Boilers …

**… need bigger pumps because of compact design.**

**… in most cases have an integrated pump which has to abdecken a broad area. So the pump ist oversized in almost every boiler.**

**… need a minimal flow to protect the boiler against overheating. To provide this minimal flow, overflow valves are installed.**

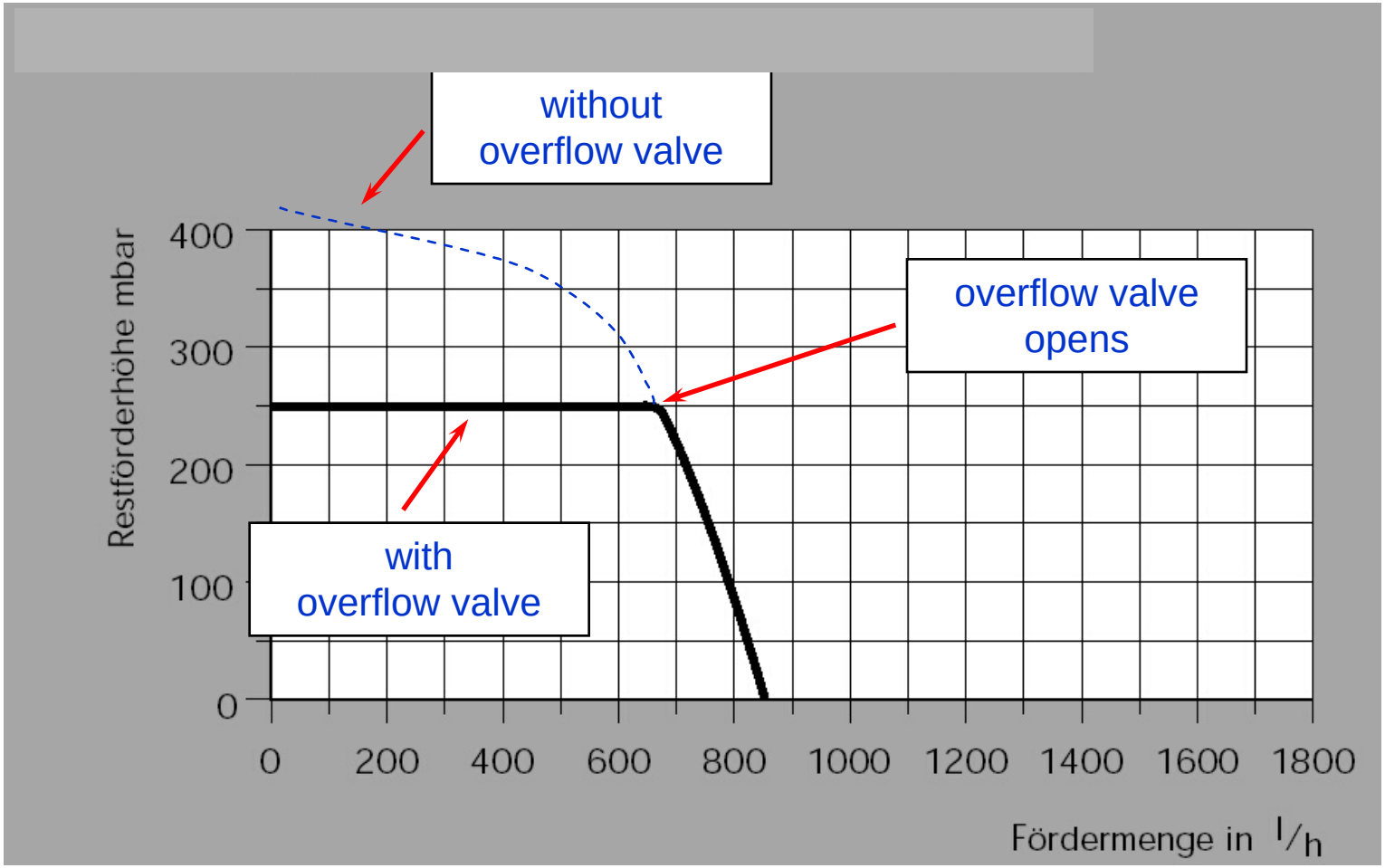
# *Overflow Valves*




Overflow valves reduce condensation !

pictures: Viessmann

# Overflow Valves



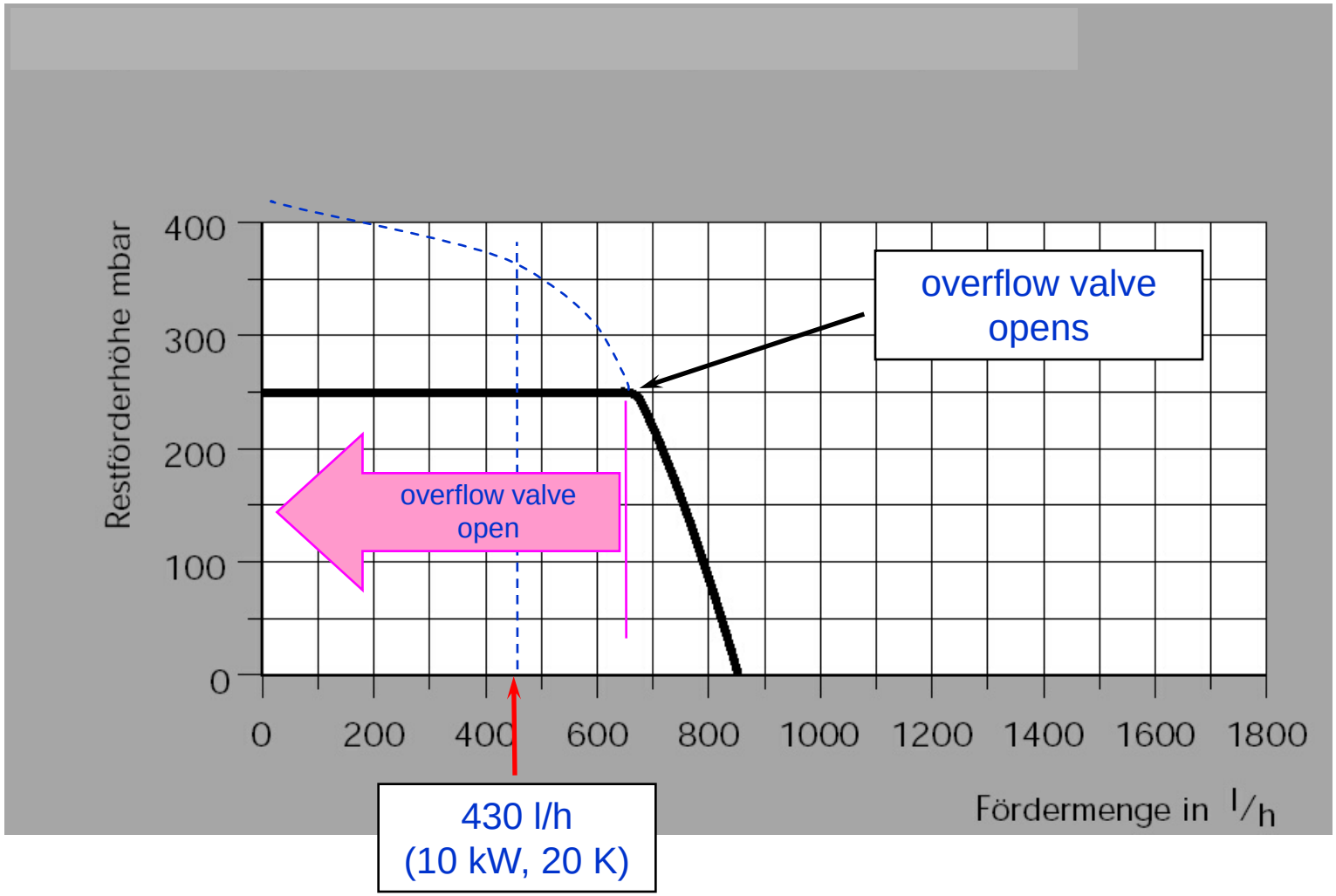
# *Overflow Valves*

## Example

- new house
- new gas condensing boiler
- heat load: 10 kW
- temperature: 20 K

➔ 43 l/h at 1 kW and 20 K

# Overflow Valves



# *Overflow Valves*

- even on the coldest day at 10 kW heat load the overflow valve is opened

  ➔ no or only very little condensation !

| | |
|---|---|
| $\eta$ without overflow valve: | 98 % |
| $\eta$ with overflow valve: | 91 % |

- when searching for a gas condensing boiler take care there is no overflow valve installed and that there is no requirement for a minimum flow

**definition „big water volume“: 1 … 1,5 liters per 1 kW**

# Ground Standing Boiler

## Advantages

- big water volume
- no minimum flow
- no pre-installed pump

# Heat Pumps

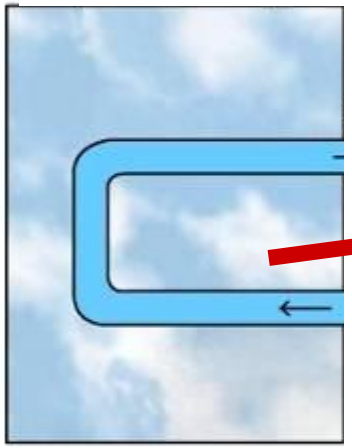
# Heat Pumps

- technology is well-established
- high investment starting at about 9.000 EUR for a single family house
- additional costs for drilling (50 EUR per meter at 40 W per meter)
- limited application area 3 … 100 kW
- special conditions
  - ➔ low temperatures
  - ➔ modernized buildings
  - ➔ floor heating

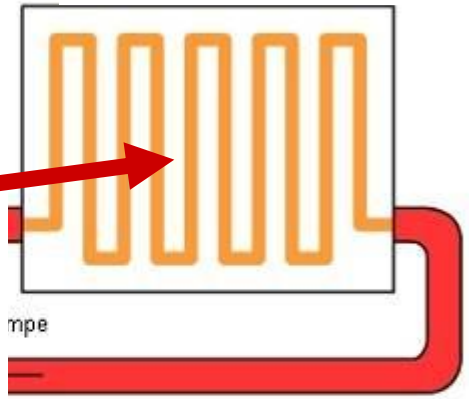
# Heat Pump Process

heat pump

environment



radiators



# *Efficiency Criterium*

$$\text{Coefficient of Performance} = \frac{\text{delivered heat}}{\text{needed amount of electricity}}$$

**depending on:**

- source
- system temperature
- kind of heating system (radiator/floor heating)

# *Air-Water Heat Pumpe*

**Source:**

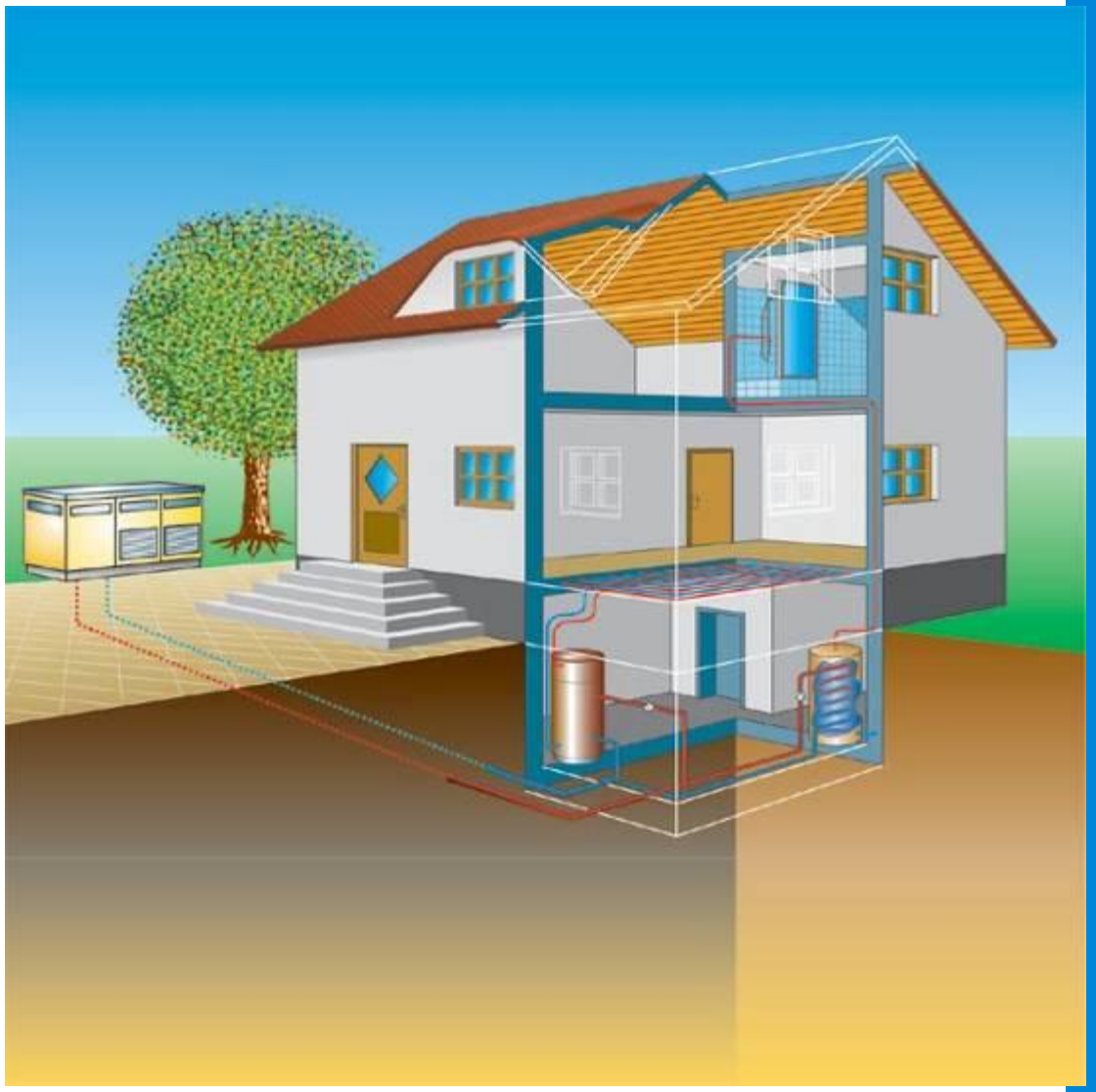
**Air from outsight**

**Temperature in winter:**

**(-14°C)…-5°C…5°C**

**COP:**

**2,0 … 3,5**



# *Soil-Water Heat Pumpe*

**Source:**

**Soil**

**Temperature (whole year):**

**> 5°C**

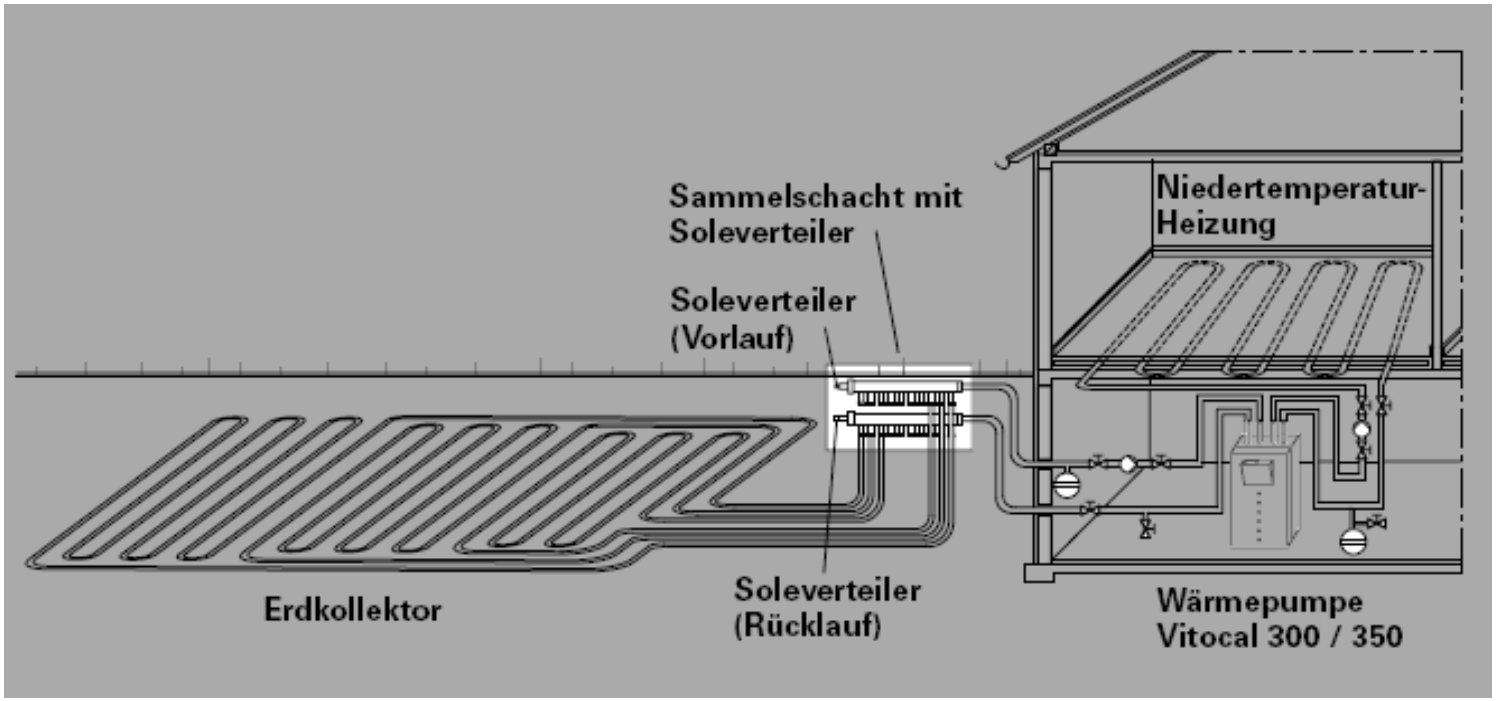
**COP:**

**2,0 … 4,0**

# Soil-Water Heat Pumpe

## Soil collector

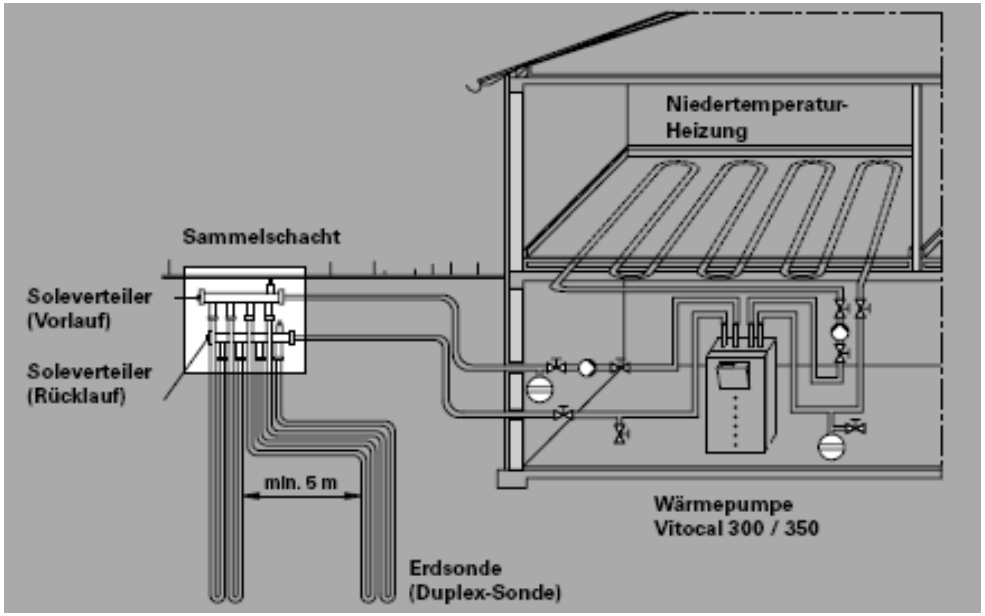
- installing depth: 1,2 … 5 m
- power outpoot from soil:
  - sandy ground  10 - 20 W/m²
  - clayey ground  20 – 30 W/m²



# Soil-Water Heat Pumpe

## Soil Tube

- costs: 30 … 50 €/m



# *Water-Water Heat Pumpe*

**Source:**

**ground water**

**Temperature (whole year):**

**> 10°C**

**COP:**

**2,5 … > 5,0**

# *Wood Pellets*

Quelle: target