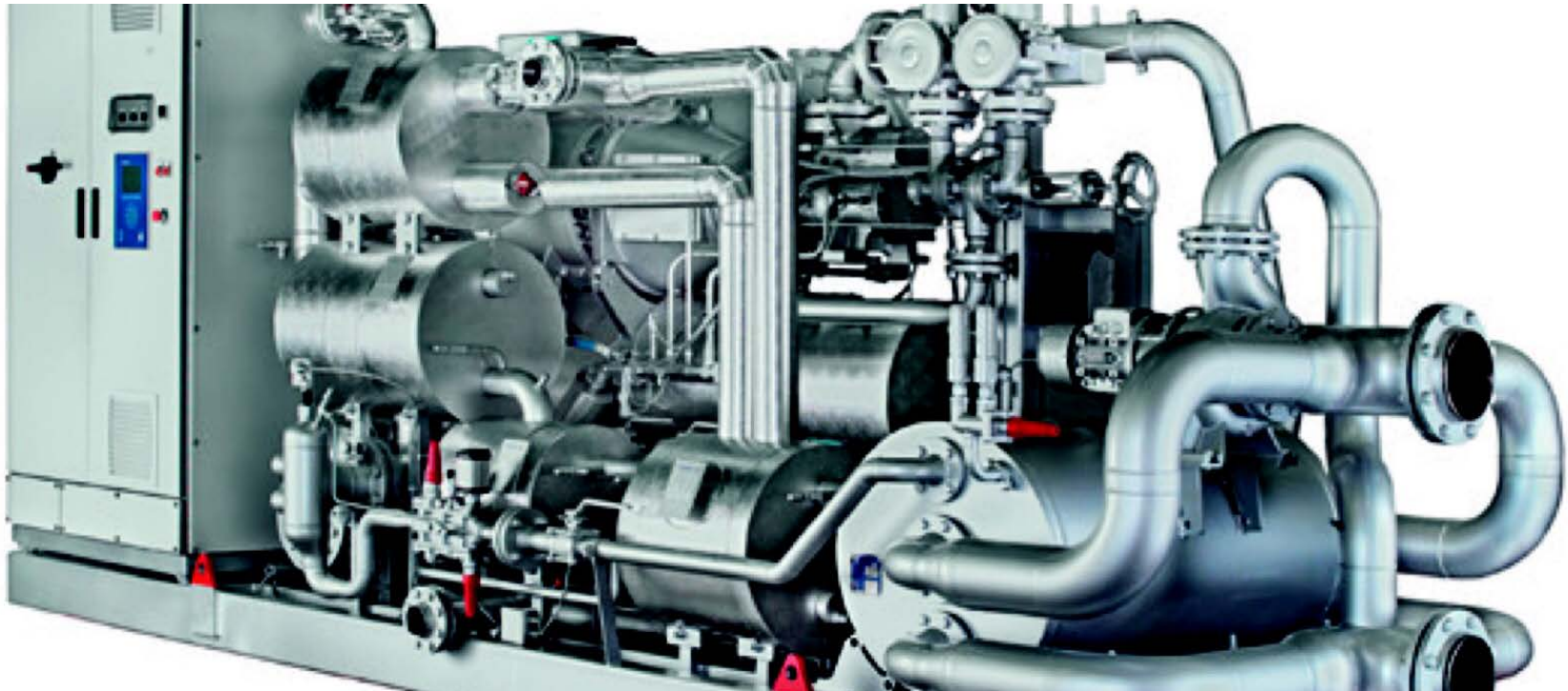


# Industrial Heat Pumps

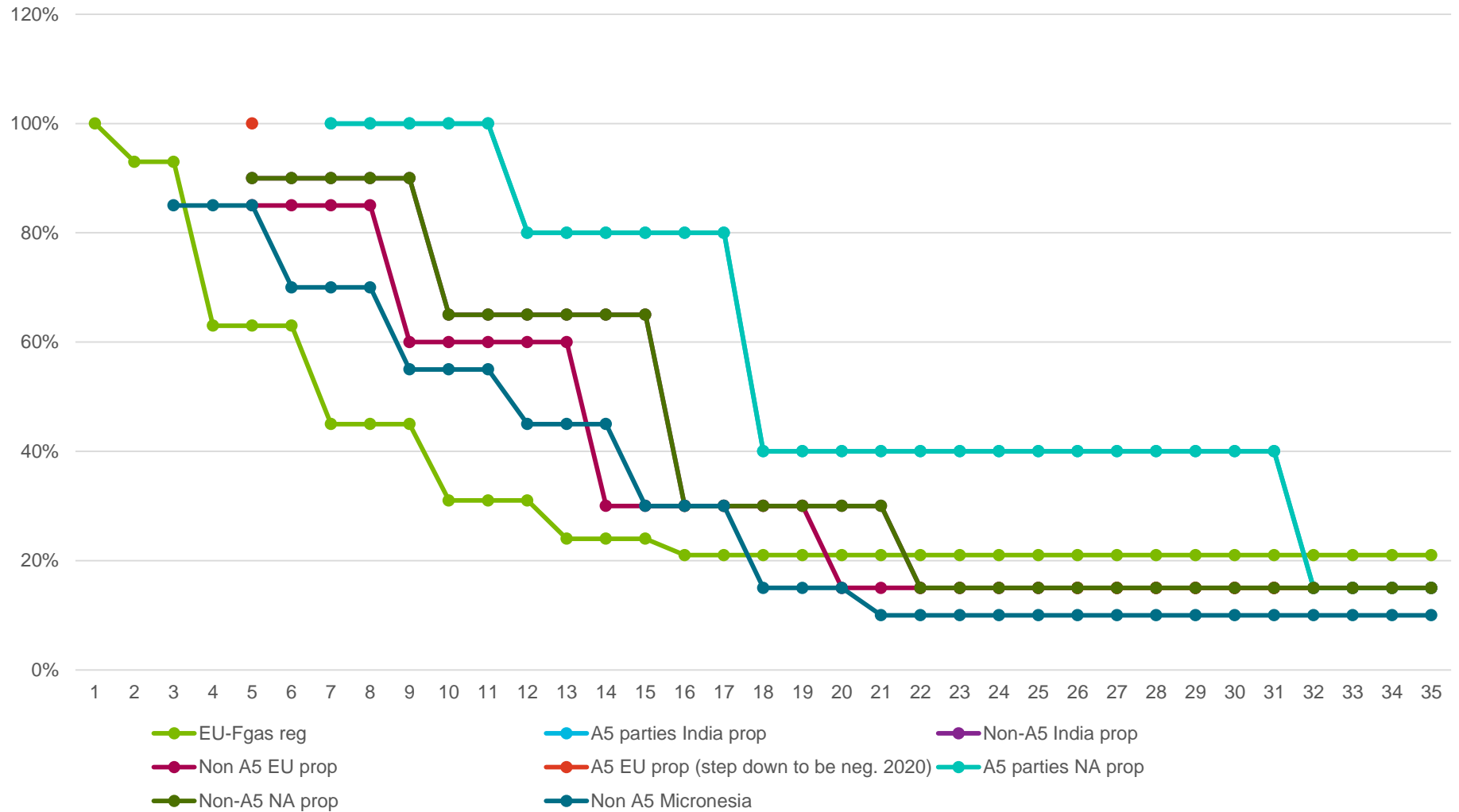


**Heat pumps in industrial applications**



# Changes on the horizon

Diagramrubrik



# The impact of a Low GWP substance

Figure 1

Atmospheric abundances of major HFCs (in parts per trillion)

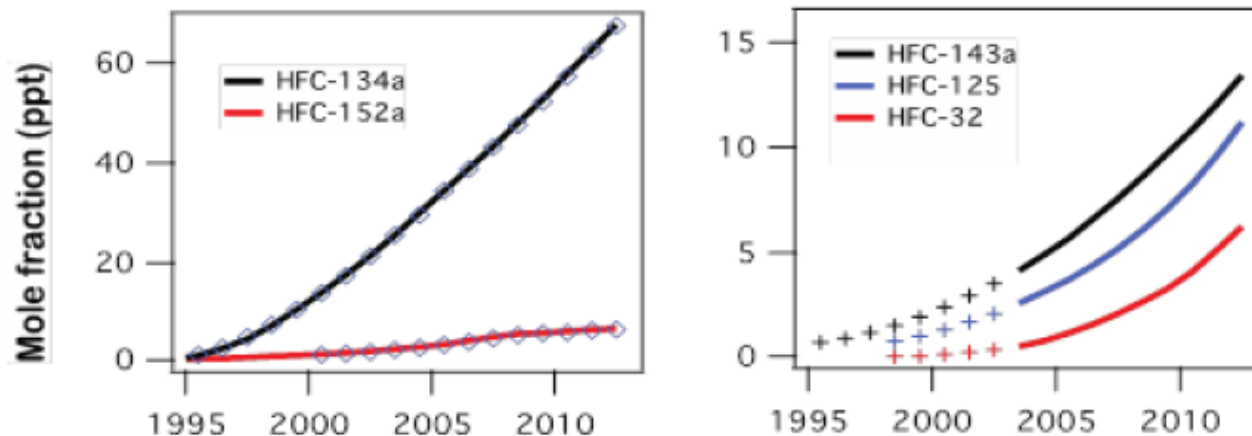
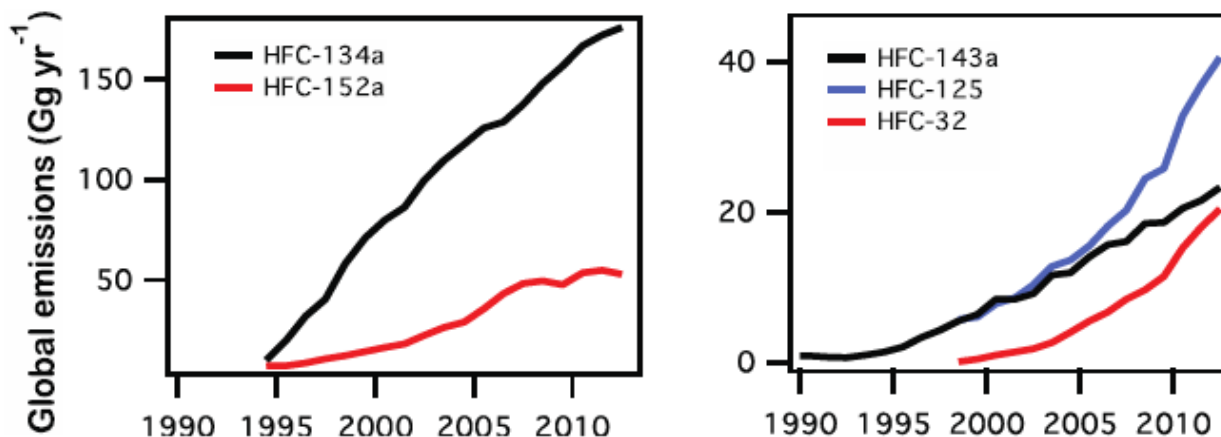


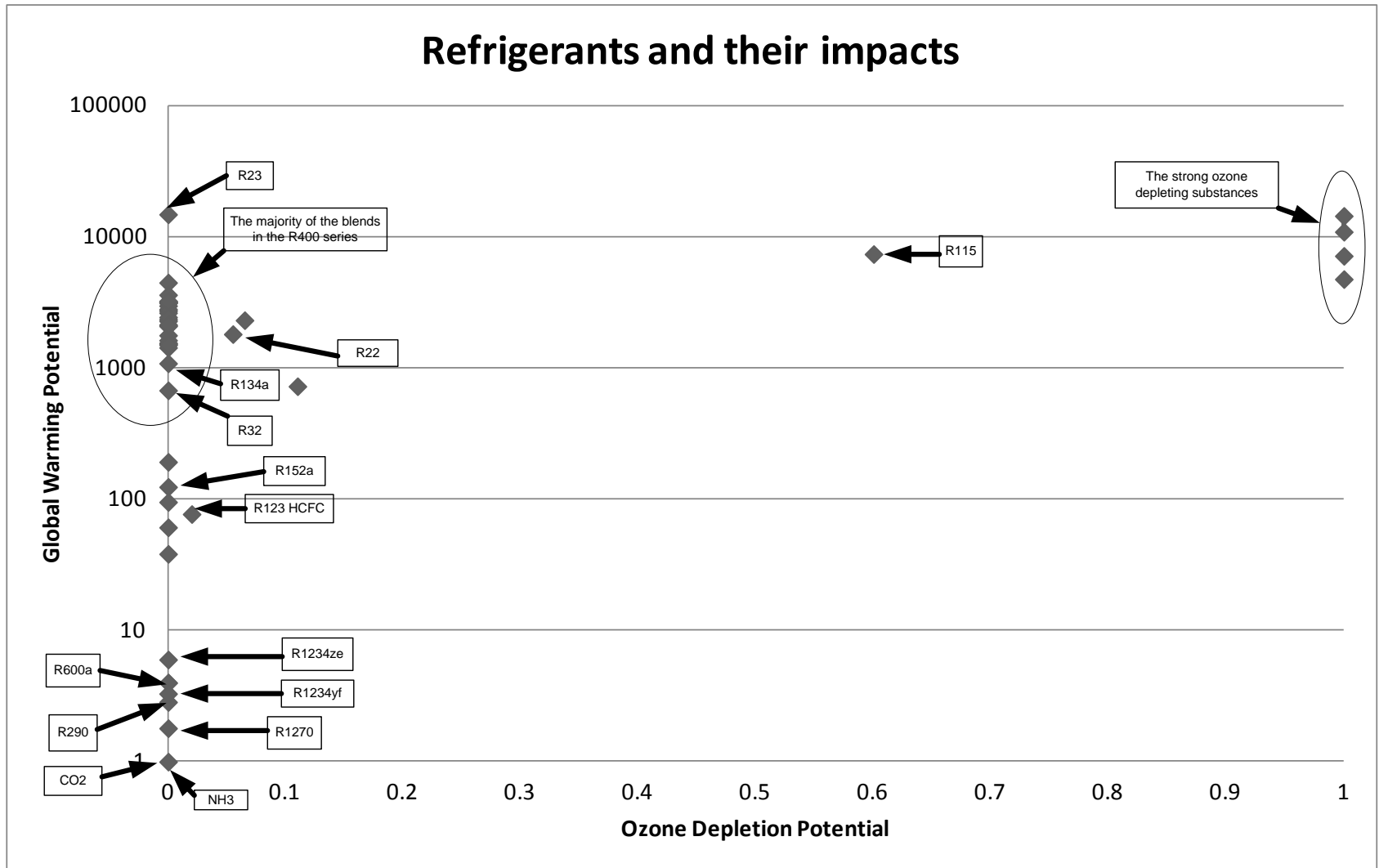
Figure 2

Global emissions of major HFCs (in Gigagrams per year)

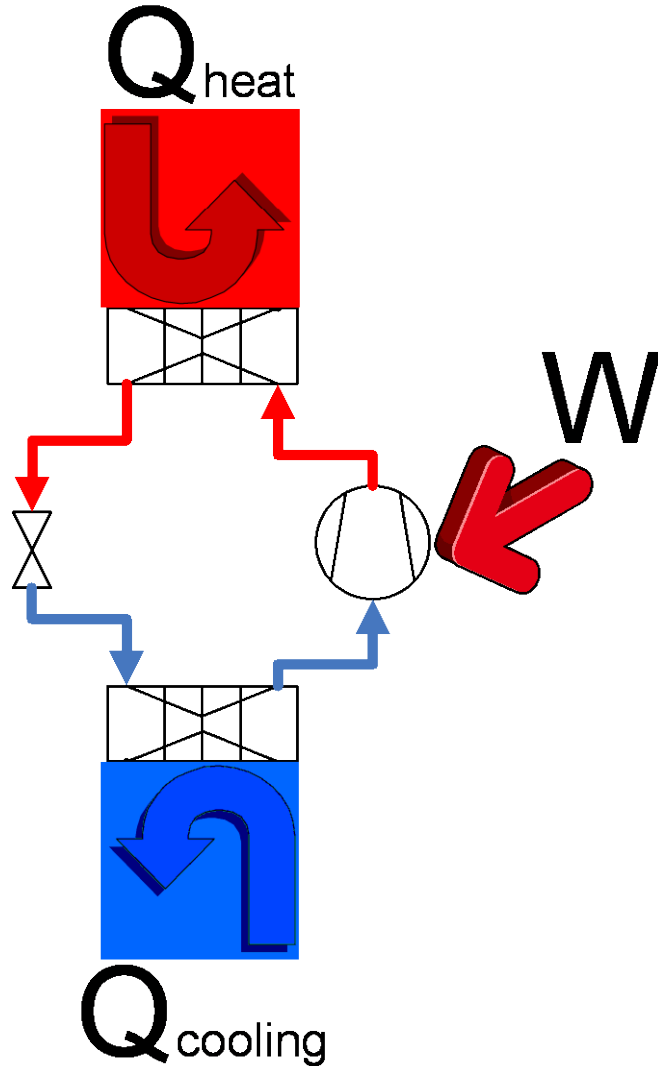




# Choosing the future refrigerant



# Ground source heat pumps



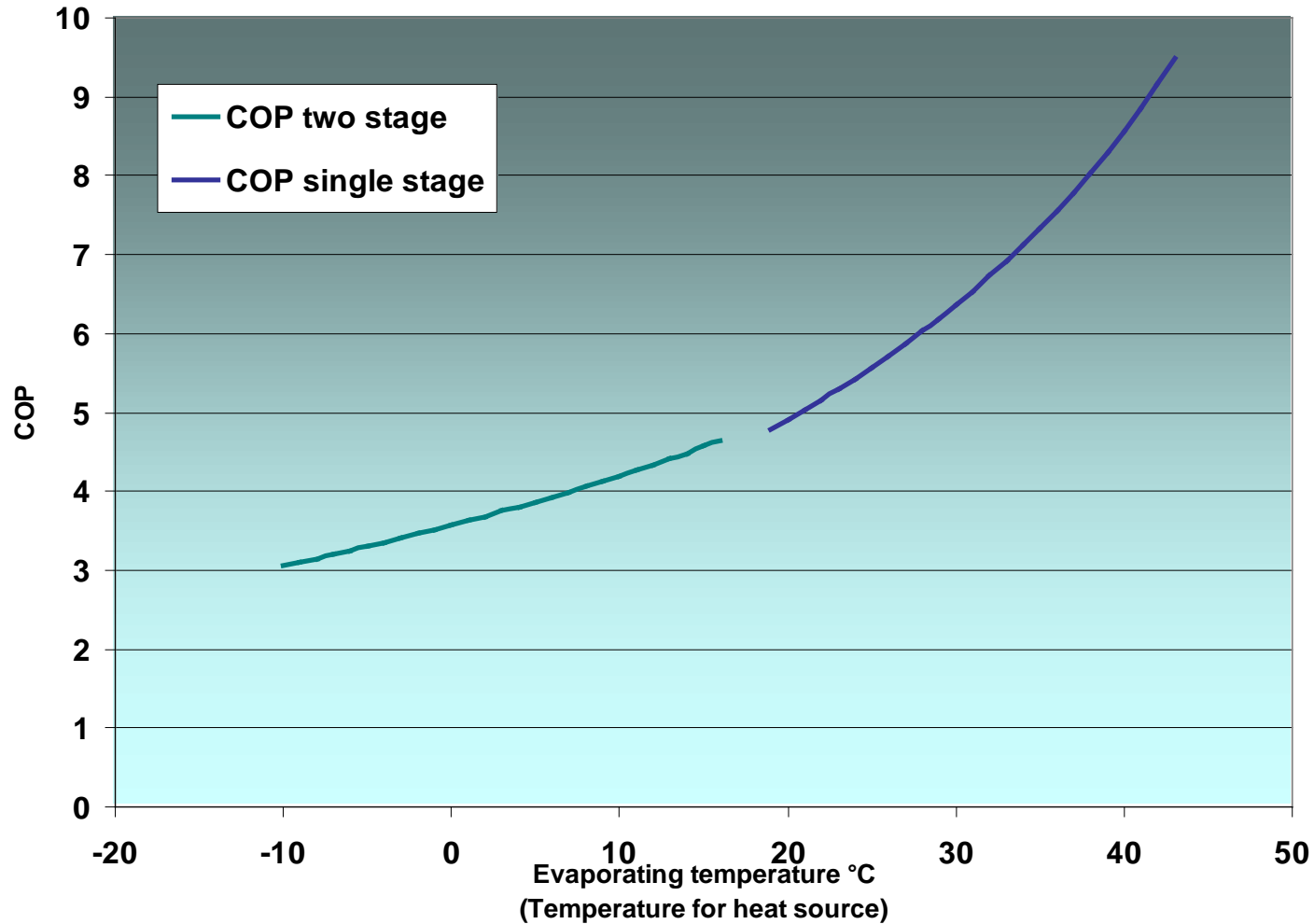
# Considerations when choosing source

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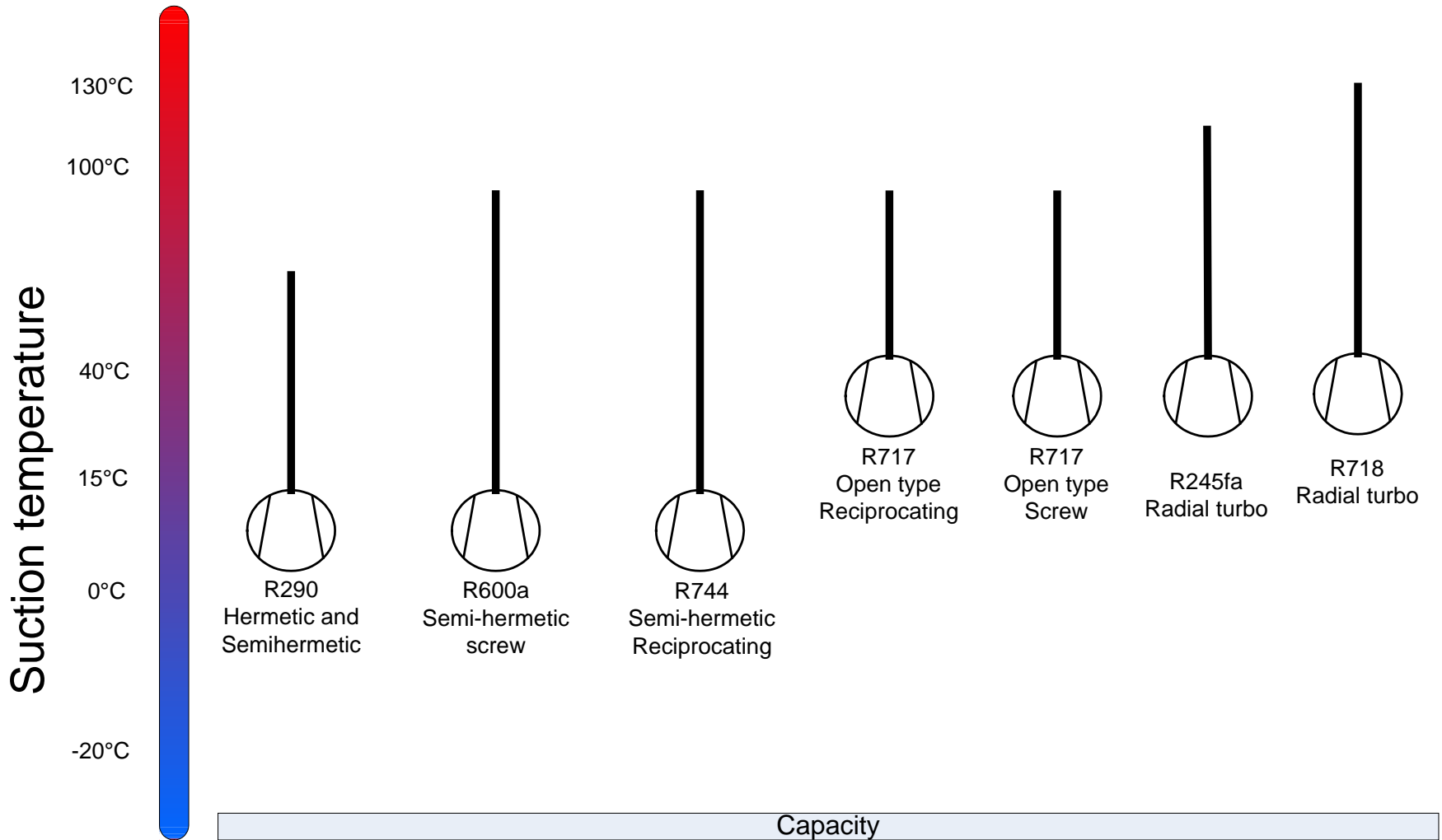
- Low source heat can be attractive for moderate heat sink
- Low temperature heat source may command two stage heat pump
- Very high temperature lifts can result in low efficiency
- You cannot get a high heating COP without a high COP cooling

$$Q_{\text{heat}} = Q_{\text{cooling}} + W$$
$$\text{COP}_{\text{heat}} = \frac{Q_{\text{cool}} + Q_{\text{Heat}}}{W}$$

# Evaporating temperature and COP

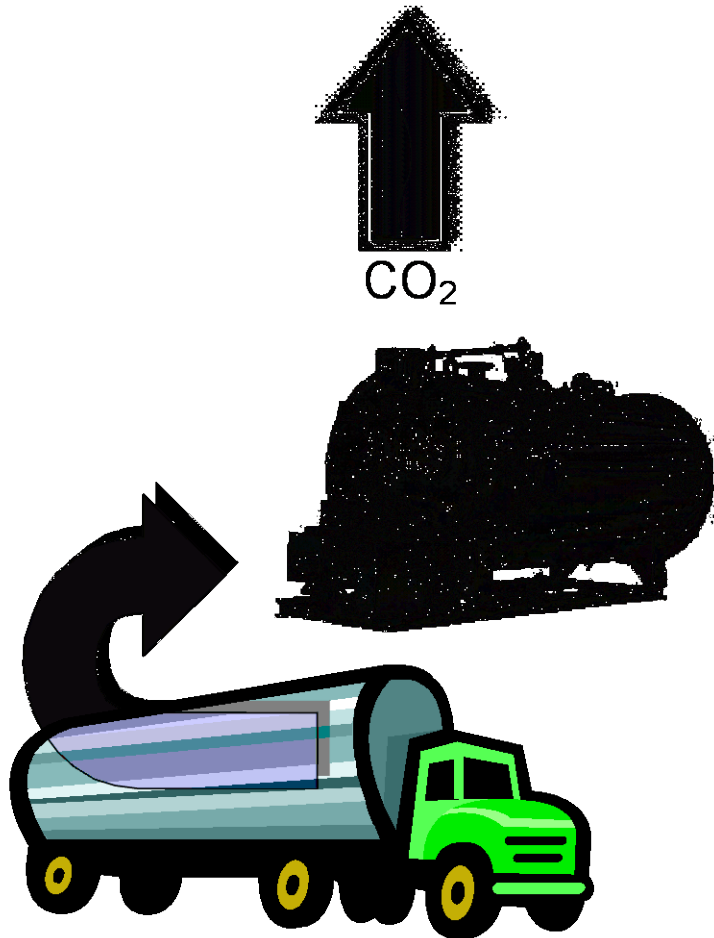


# Operating limits

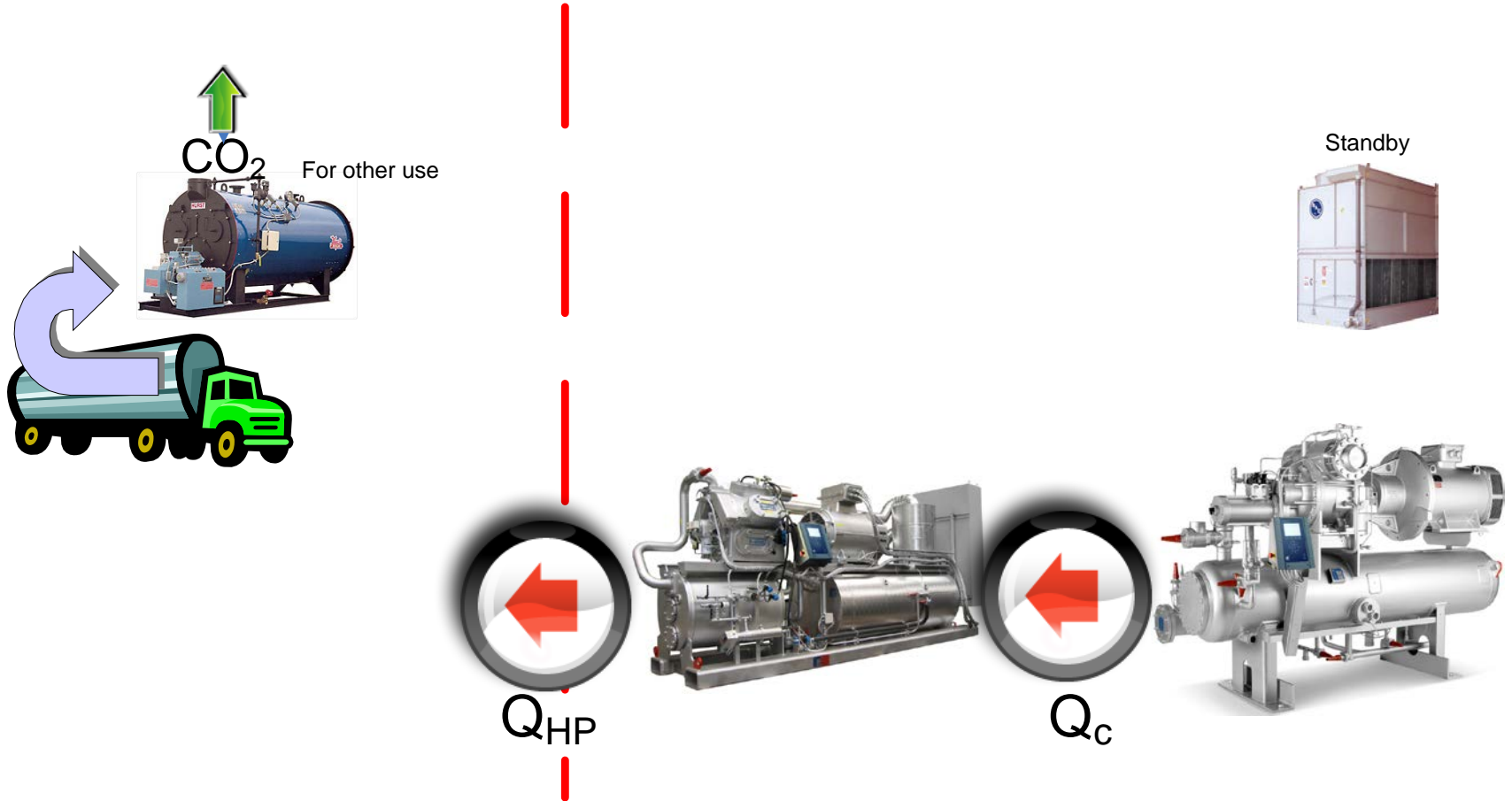


# Current technology in use

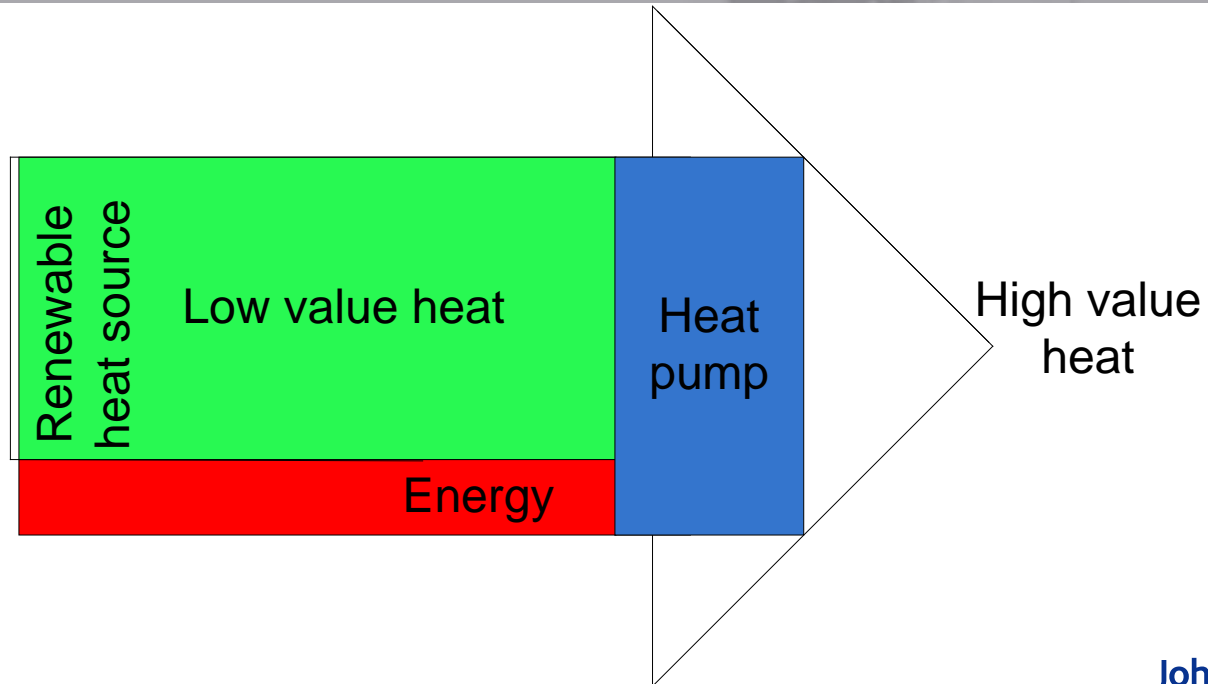
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# Another way of thinking



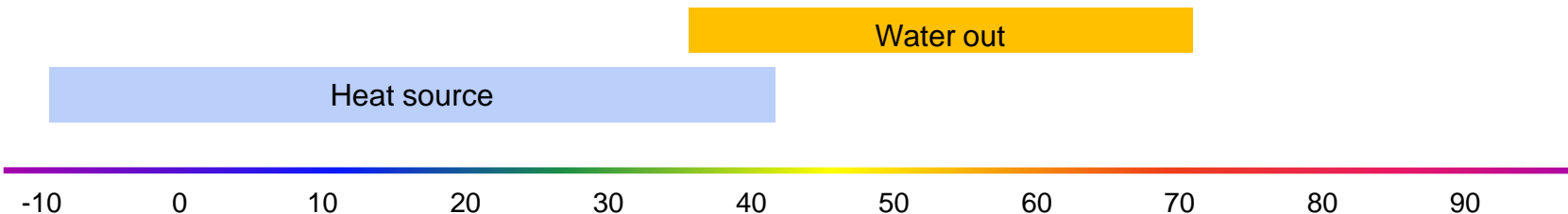
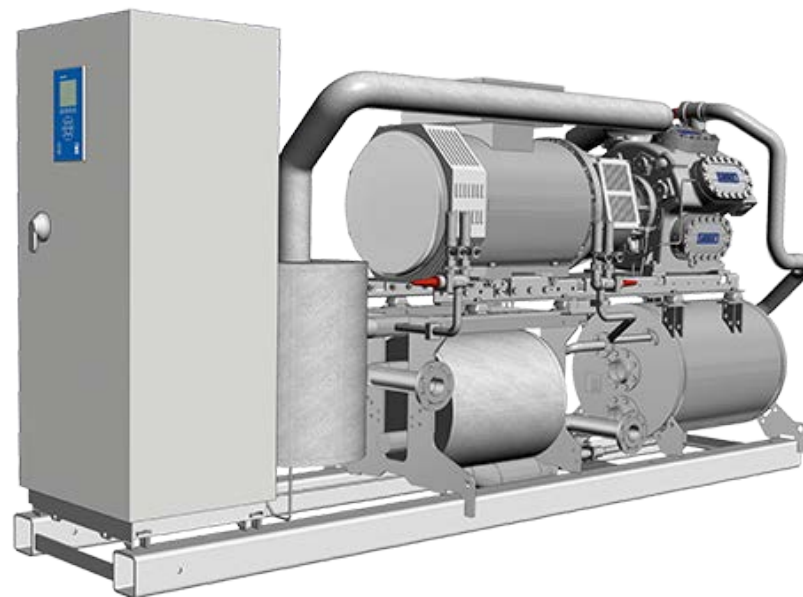
# Heat pumps - part of the solution



# HeatPAC 100 series for 70°C applications

## Standard NH<sub>3</sub> industrial heat pump unit.

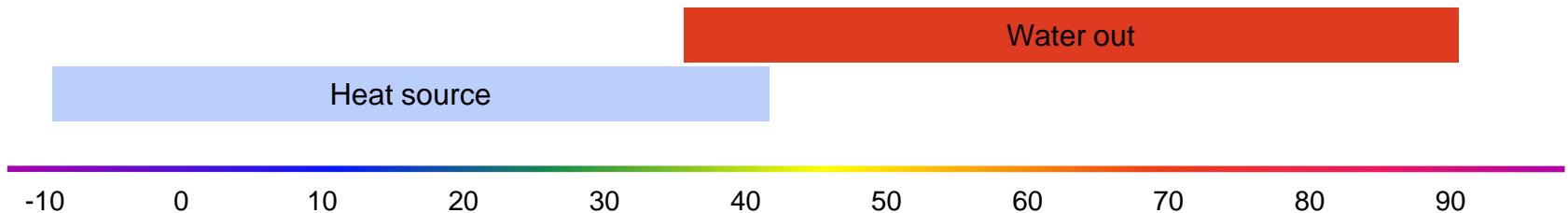
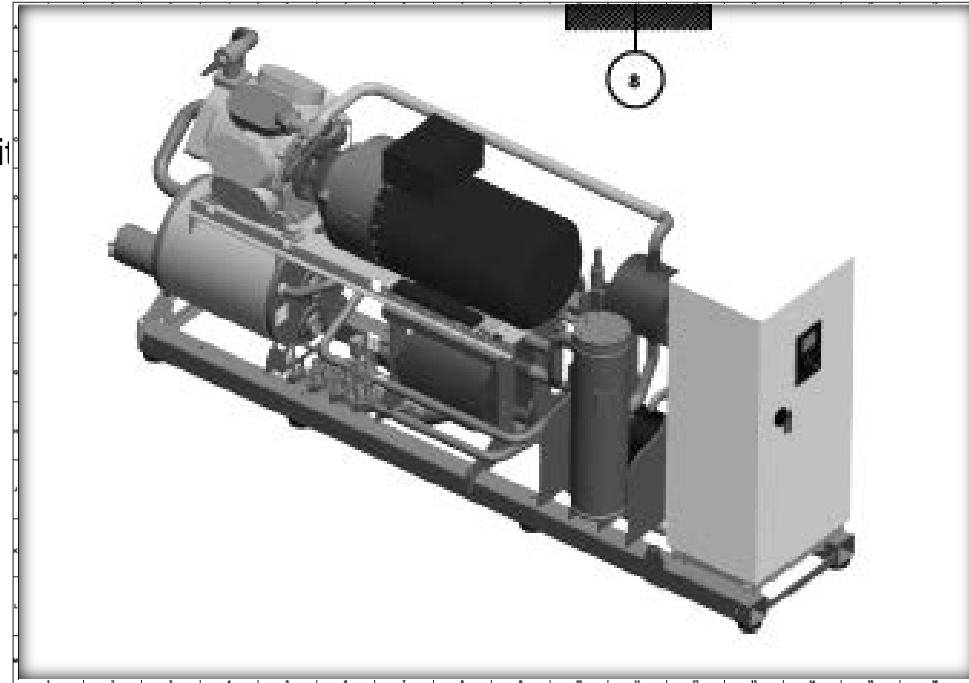
- Range consists of 6 models: 240 kW up to 1150 kW
- Max. outgoing water temperature: 70°C
- Small refrigerant charge: ~50 kg for largest unit
- Max. heating capacity: 1150 kW (40°C /70°C)
  - Cooling capacity 965 kW
  - Power consumption 186 kW
  - COP heat pump = 6.2
- One-stage compression only → **limited lift**
- Cascade evaporator version available
- Application: Brewery, dairy, abattoir, fish processing etc.



# New HeatPAC 70 series for 90°C applications

## Standard NH<sub>3</sub> industrial heat pump unit.

- Range consists of 3 models: 230 to >700 kW
- Max. outgoing water temperature: 90°C
- Small refrigerant charge: ~50 kg for largest unit
- Max. heating capacity: > 700 kW (40°C /90°C)
  - Cooling capacity ~ 560 kW
  - Power consumption ~140 kW
  - COP heat pump ~ 5
- One-stage compression only → **HIGH lift**
- Cascade evaporator version available
- Application: Infinite possibilities

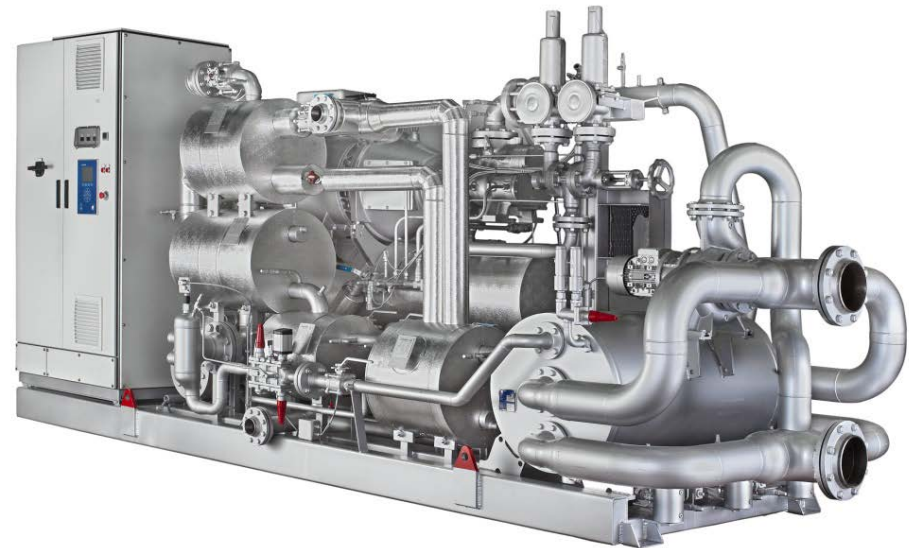


# NEW HeatPAC 157HR for 90°C applications

## HP single-stage R717 heat pump

- High pressure screw compressor designed for heat pump applications
- Max. outgoing water temperature: 90°
- Max. heating capacity: 1600kW (40°C source /85°C water out )
- 1000 – 6000RPM variable speed drive as standard

- Applications:
  - High outgoing temperatures
  - Condenser heat reclaim
  - Ambient heat source
  - District heating.



Heat source

Water out

-10 0 10 20 30 40 50 60 70 80 90 °C

# Refrigeration system/Heat pump Skejby Sygehus DNU



# Det nye universitetshospital (DNU) Skejby, Aarhus

## The new University hospital Skejby, Aarhus

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### Data for the system

Refrigeration/heat pump system consists of:

3 pcs. NS-Heat PAC 116L/157H two-stage heat pump systems type Sabroe

1 pcs. Heat storage på 1.500 m<sup>3</sup>

4 pcs. Drycoolers with combined capacity of 2 MW, pumps, energy loggers and pipe system, electrical panels and controls etc.

The system is designed for following temperatures

Cold side = +18° C / +12° C

Warm side = +30° C / +75° C

Cooling capacity = 4.610 kW

Heating capacity = 6.318 kW

Power absorption heat pumps = 1.708 kW

COP<sub>heating</sub> = 3,7

Yearly heat production at

3.000 hour full load conditions:  $6.318 \times 3.000 = \underline{18.954.000 \text{ kWh}}$



## Gl. Rye Kraftvarmeværk (District heating)

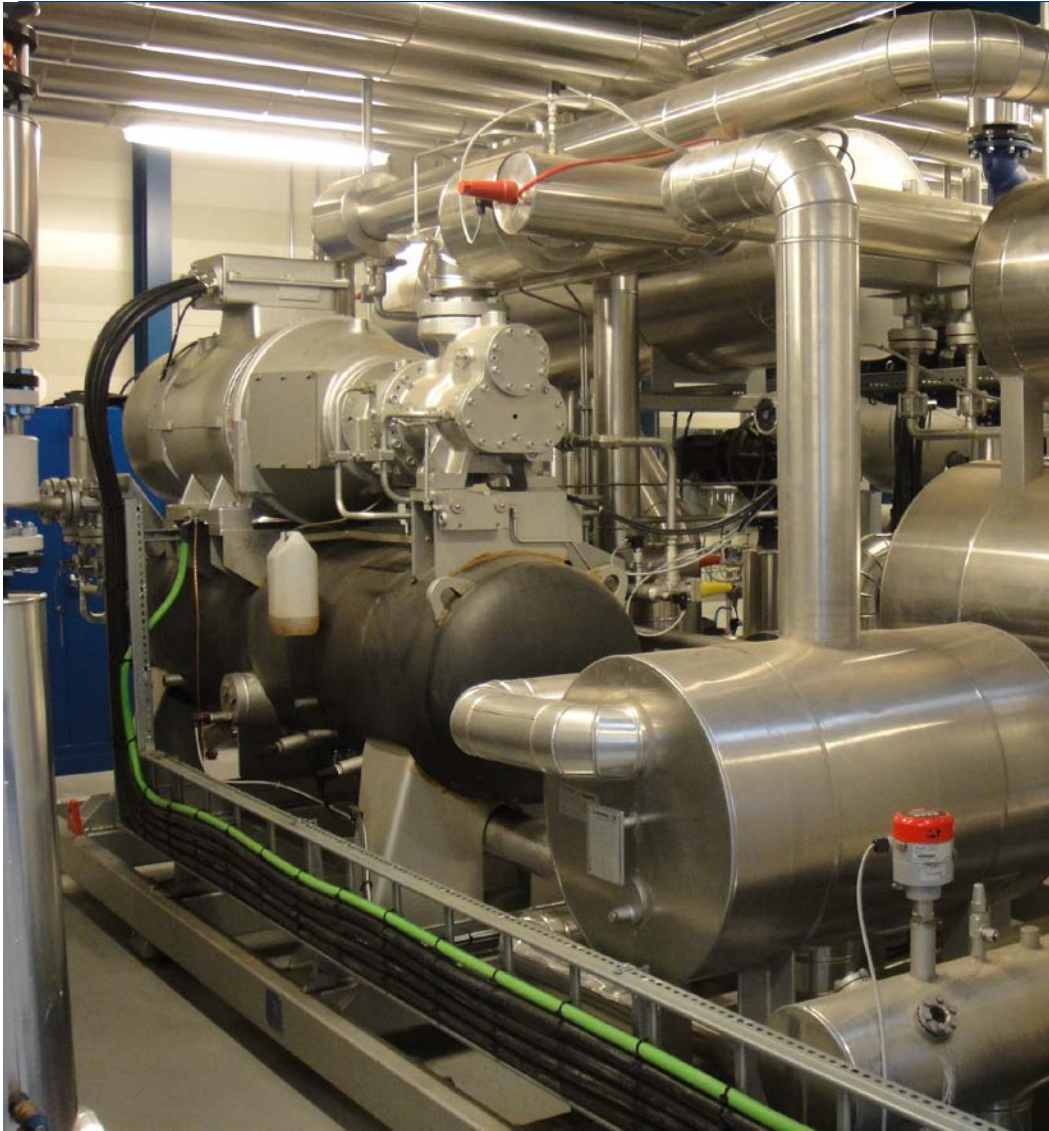
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Data:

Cooling capacity:	ca. 1.500 kW
Ground water cooled from	+9 °C to +2 °C
Heating capacity:	ca. 2.000 kW
Water heated from	+50 °C to +75 °
COPheating:	ca. 4,0

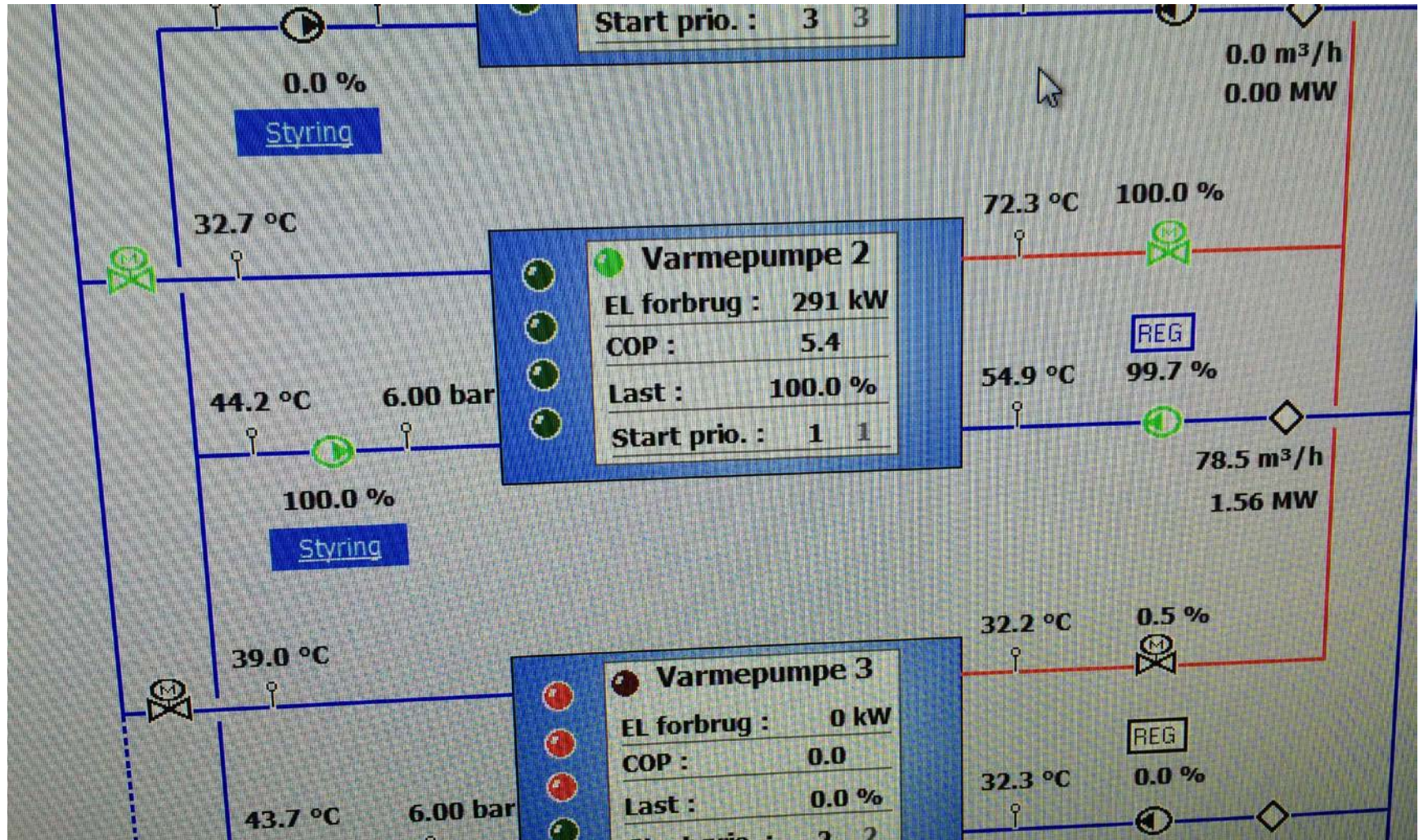


# A district heat system

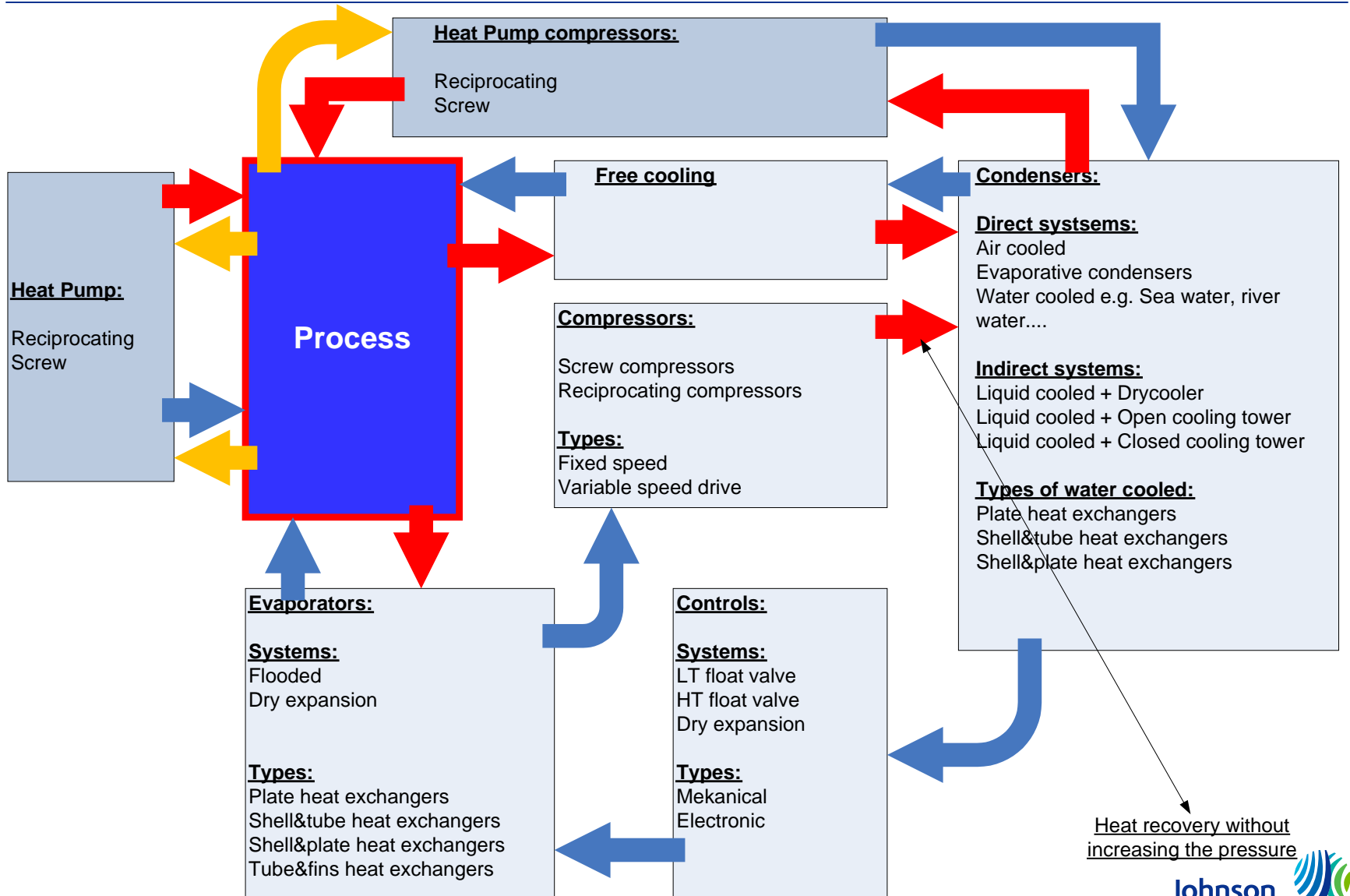


Three heat pump:  
Source Exhaust vapor  
Hot water 70C

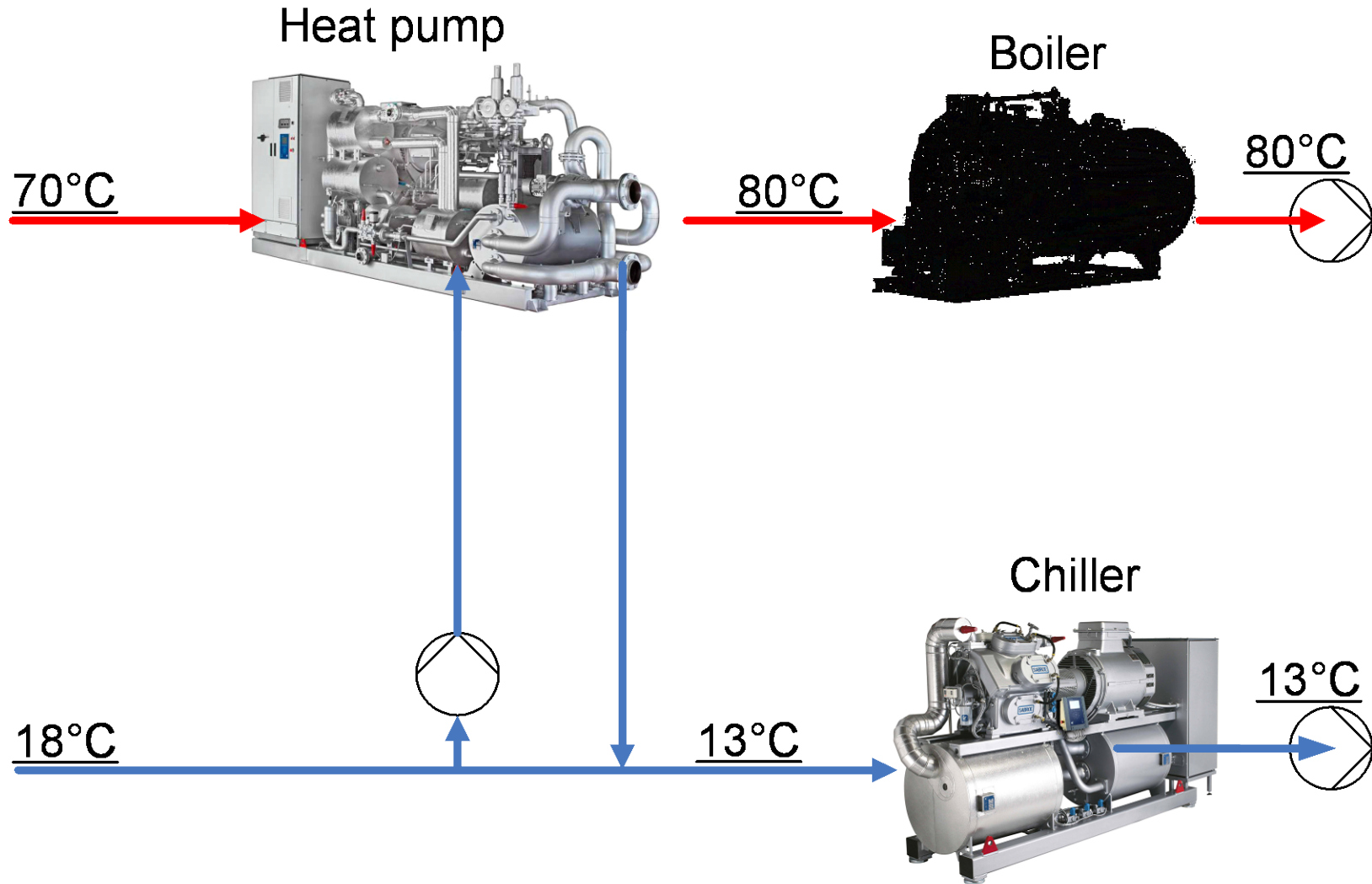
# Some measurements



# Industrial Heat Pumps are different

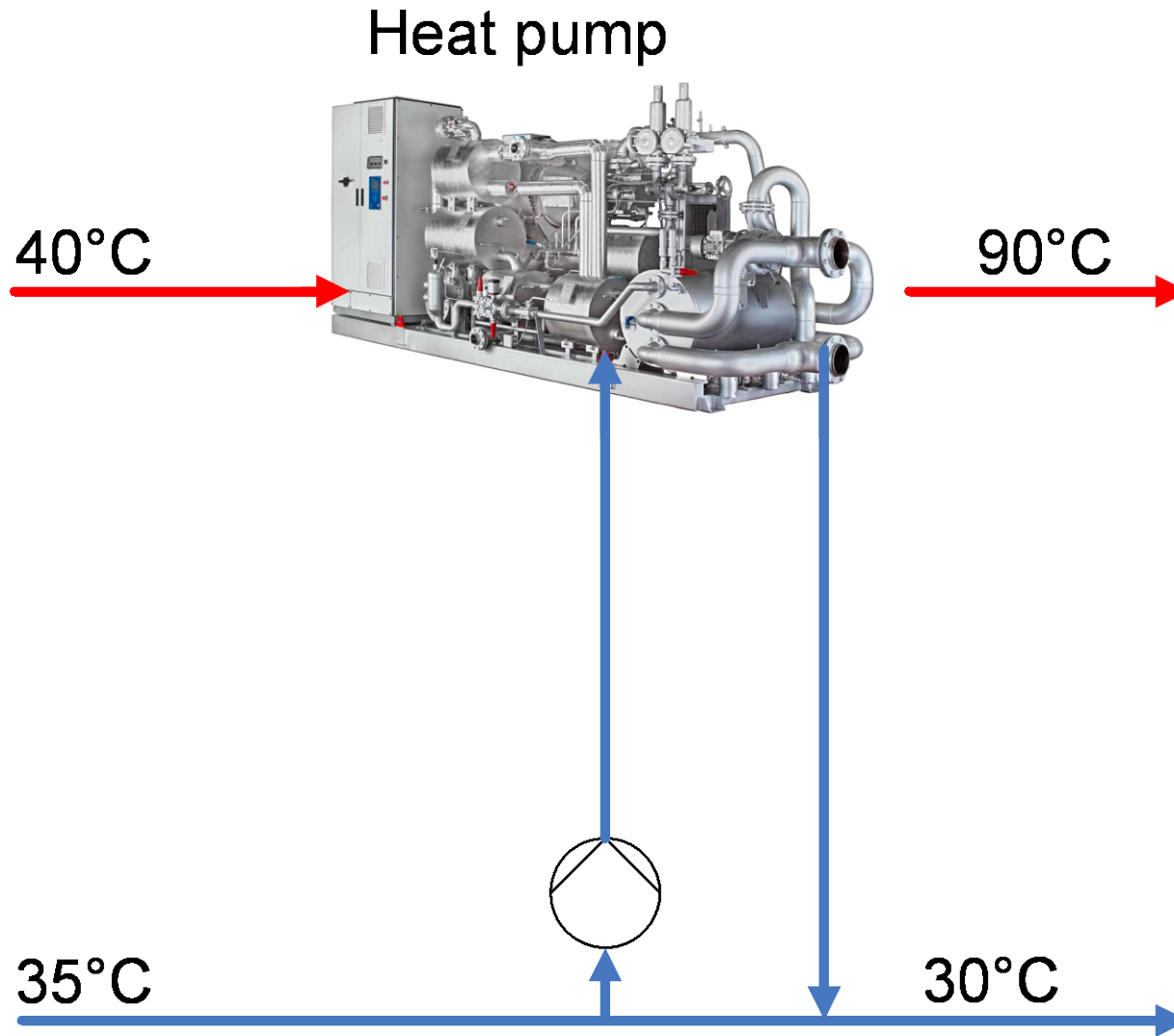


# Heat pump and heat recovery



# Heat pump and heat recovery

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# Heat pumps in industrial applications

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- Reliability is key to the success
- Efficiency is important
- Understanding the technology is requisite
- The number of industrial applications in which heat pumps can be used are infinite – almost 😊
- The temperature lift and reliability will determine the future of the technology in the industrial applications

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**Thank you for your  
attention**