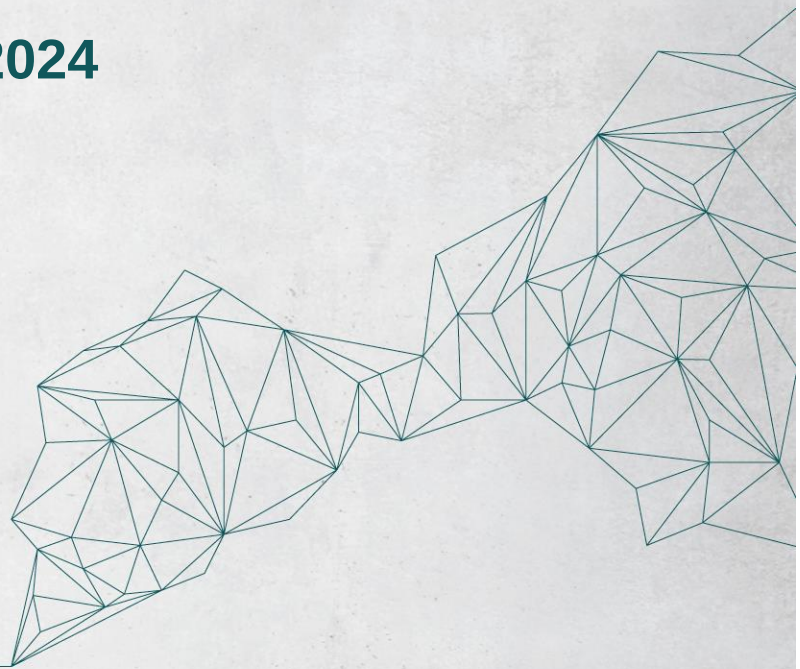
CHILLVENTA

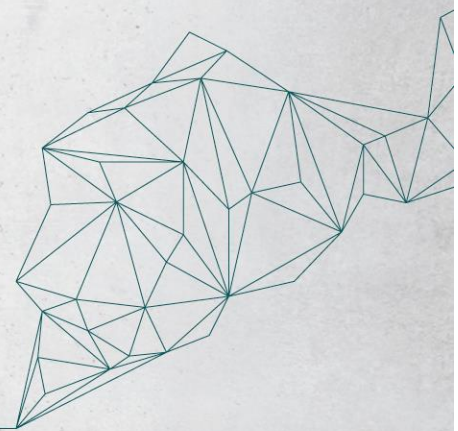
Chillventa Specialist Forums 2024
Chillventa Fachforen 2024

CONNECTING EXPERTS.



More heat to cool: GEA heat pumps now and in the future

CONNECTING EXPERTS.



GEA - Engineering for a better world

The company at a glance:

The technology group GEA is one of the world's largest suppliers of systems and components to the food, beverage, pharmaceutical, and a whole range of further industries.

Founded in 1881, GEA's focus today are machinery and plants, as well as advanced process technology, components, and comprehensive services.

The "Heating & Refrigeration Technologies" division (formerly Refrigeration Technologies only) provides components and solutions for industrial cooling and heating based on reciprocating and screw compressor technologies from own development and production.

GEA Heating & Refrigeration Technologies Portfolio

Reciprocating compressors and packages

Screw compressors and packages

Reciprocating and screw Chillers and Heat Pumps

Control technologies and digital solutions

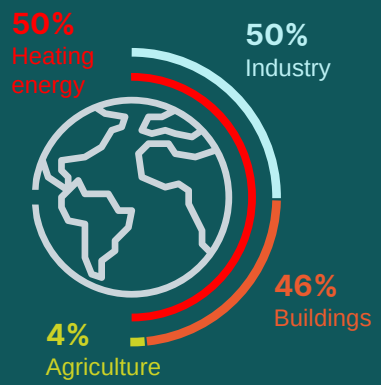
Valves, filters, and safety devices

Service equipment and spare parts

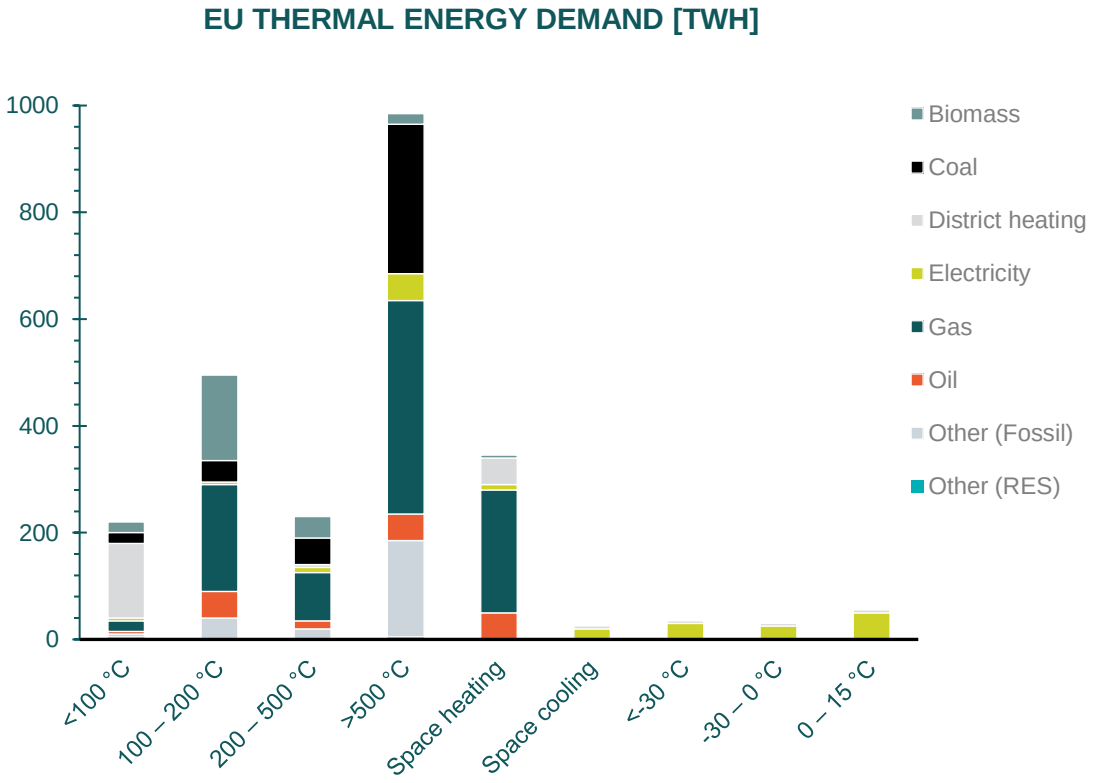
Heating today and in the future

Heating demands and decarbonization:

Accounting for approx. 50 % of the total global energy demand, heating takes the biggest share thereof. As most of the heating energy is still supplied with the help of fossil fuels (approx. 90 %), it is a key driver for CO_2 emissions with a contribution of approx. 40 % to the total global emissions.

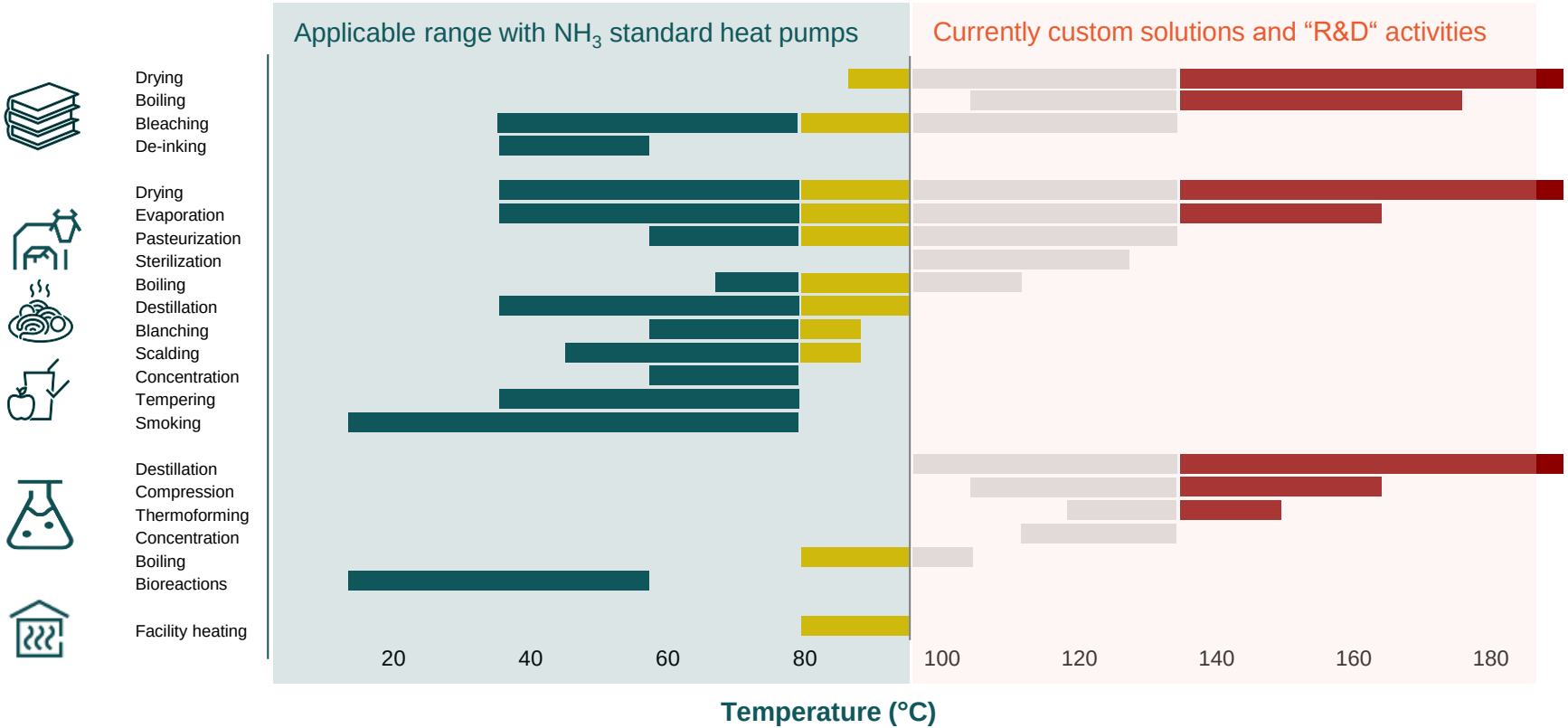


Source: IEA World energy outlook 2000



Heating applications

Industrial process examples and their temperature range:



Sustainable heating

Available technologies (key examples):

Clean combustion

“Clean“ combustion,
e.g. with hydrogen

Electric heating

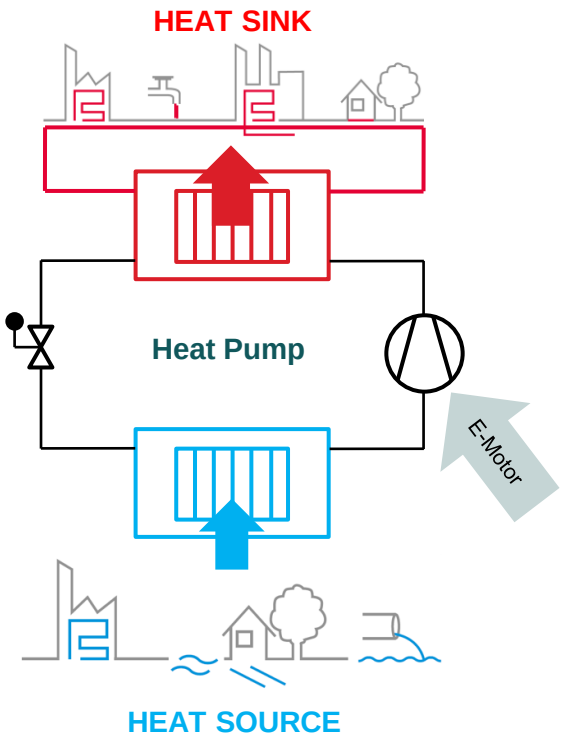
Direct electrical heating,
e.g. e-boiler

Solar heating

Heat generating with
solar panel technology

Biomass

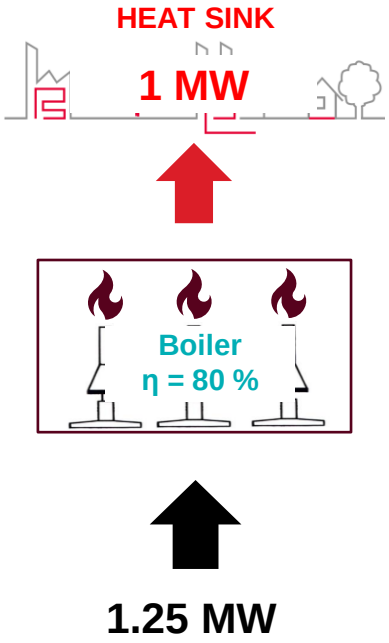
Heating energy
from biomass



Efficiency advantage of NH_3 compression heat pumps

Even with non-regenerative electricity an efficient heat pump is more sustainable:

1 MW heat demand realized with a boiler:



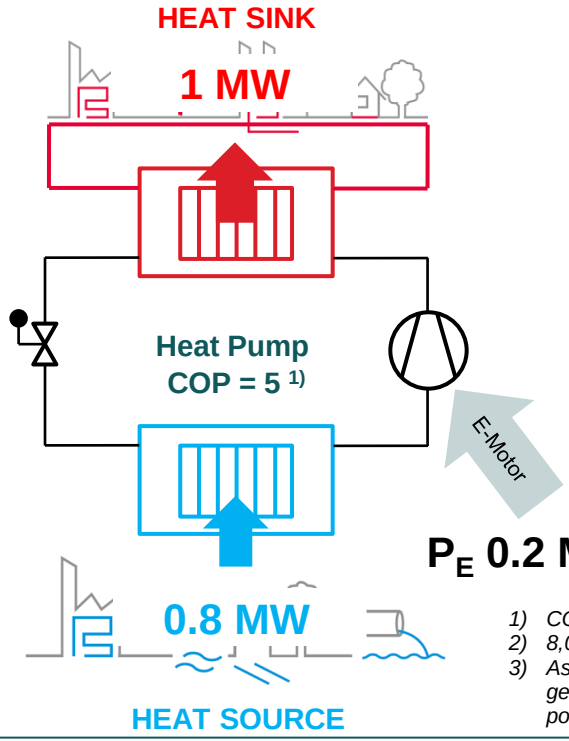
10,000 MWh
fos. energy demand 2),4)

10,000 MWh
el. energy demand 2),5)

low investment
low operational effort

2) *8,000 operating hrs. p.a.*
4) *Fossil fuelled boiler*
5) *E-boiler*

1 MW heat demand realized with an NH_3 Heat Pump:



1,600 MWh
el. energy demand 2)

3,200 MWh
fossil fuel demand 3)

high investment
high operational effort

1) *COP = heating rating/ P_E*
2) *8,000 operating hrs. p.a.*
3) *Assuming electricity is entirely generated via fossil based power plants at η = 50 %*

Total cost of ownership advantage of efficient heat pumps

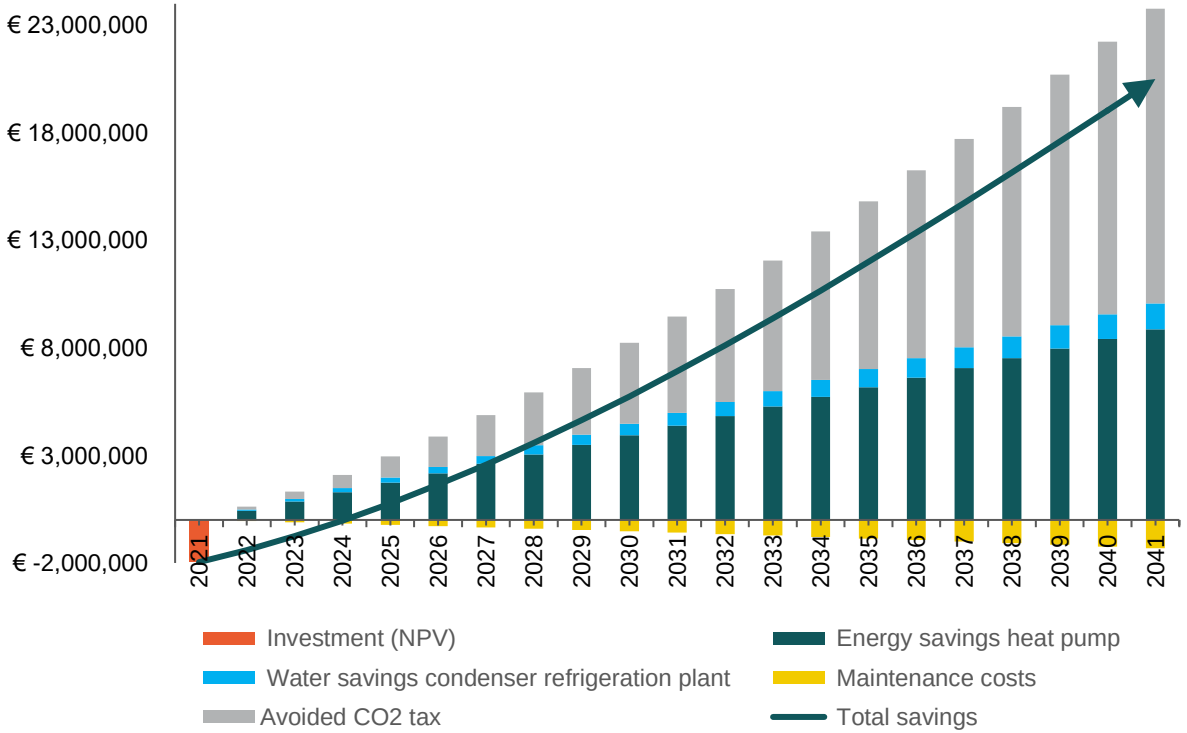
Economic sustainability heat pumps:

Real case example beverage production:

- 400 million bottles p.a.
- Approx. 8 MW cooling and refrigeration load
- Approx. 5 MW thermal load rejected at ambient temperature
- Approx. 7 MW heating load (hot water)
- 600 kg/h steam (covered yet by e-boiler)

Financials:

- Gas price EUR 0.207/Nm³
- Electricity price EUR 0.052/kWh
- Maintenance costs increase 2 % p.a.
- CO2 emission tax EUR 30/kg p.a. with polynominal increase



Providing higher temperatures and steam sustainably

High-temperature heat pump technologies:

Hybrid heat pumps

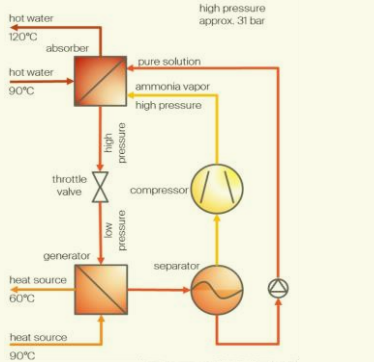
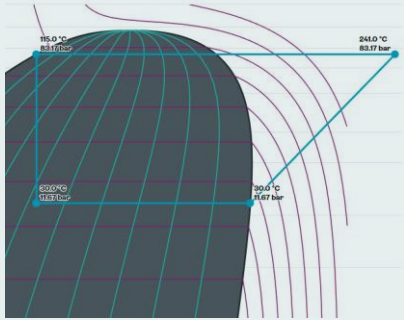


Image: AGO Calora heat pump

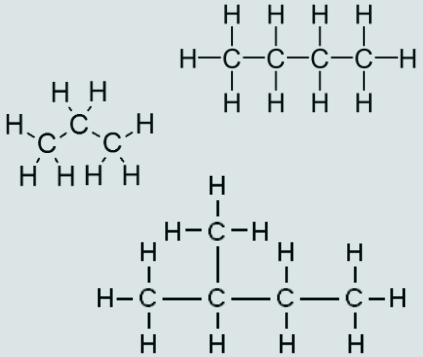
- Using a sorption cycle parallel to the mechanical compression
- Temperatures up to approx. +160 °C
- Higher CAPEX but very efficient (low OPEX)

NH_3 at higher pressures



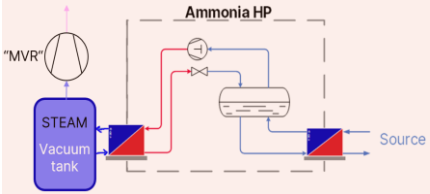
- R-717 at +115 °C relates to 83 bar → design PS100 bar
- Very high discharge temps.
- Limited availablity of suitable R-717 components
- Cost factor (CAPEX) increase est. 1.5 … 2.0

Alternative refrigerants



- Use of butane, pentane, iso-butane for example
- Less volumetric efficiency than natural refrigerants (R-717 1.75 kW/[m³/h] vs. R-600a 0.59 kW/[m³/h])
- High CAPEX (ATEX design)

Mech. vapor compression



- (NH_3) Heat Pump at the basis providing +85 … +95 °C, steam generated with a vacuum tank
- High CAPEX, medium efficiency

GEA compressor development

High-pressure equipment milestones:

2006

50 bar piston series 5 HP

4x types, R-717, R-744
101 – 202 m³/h (1500 rpm)
PS 50 bar

52 bar screw series

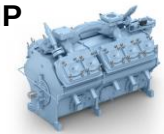
20x types, various refrigerants
231 – 870 m³/h (2940 rpm)
PS 52 bar

2018

39 bar piston series V HP

3x types, R-717
290 – 580 m³/h (1500 rpm)
PS 39 bar

2021



63 bar piston series V XHP

4x types, R-717
376 – 941 m³/h (1500 rpm)
PS 63 bar

2022

63 bar screw series L XHP

3x types, various refrigerants
1990 – 2748 m³/h (2940 rpm)
PS 63 bar

≥ 2024

Continuous development activities

Compressor & heat pump testing with alternative refrigerants, multi-stage systems

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