Heat Exchanger Solutions for Air-Source Heat Pump Applications in Medium and Large Scale

Franz Sperl – Güntner GmbH & Co. KG

eurammon Symposium, 8 July 2022

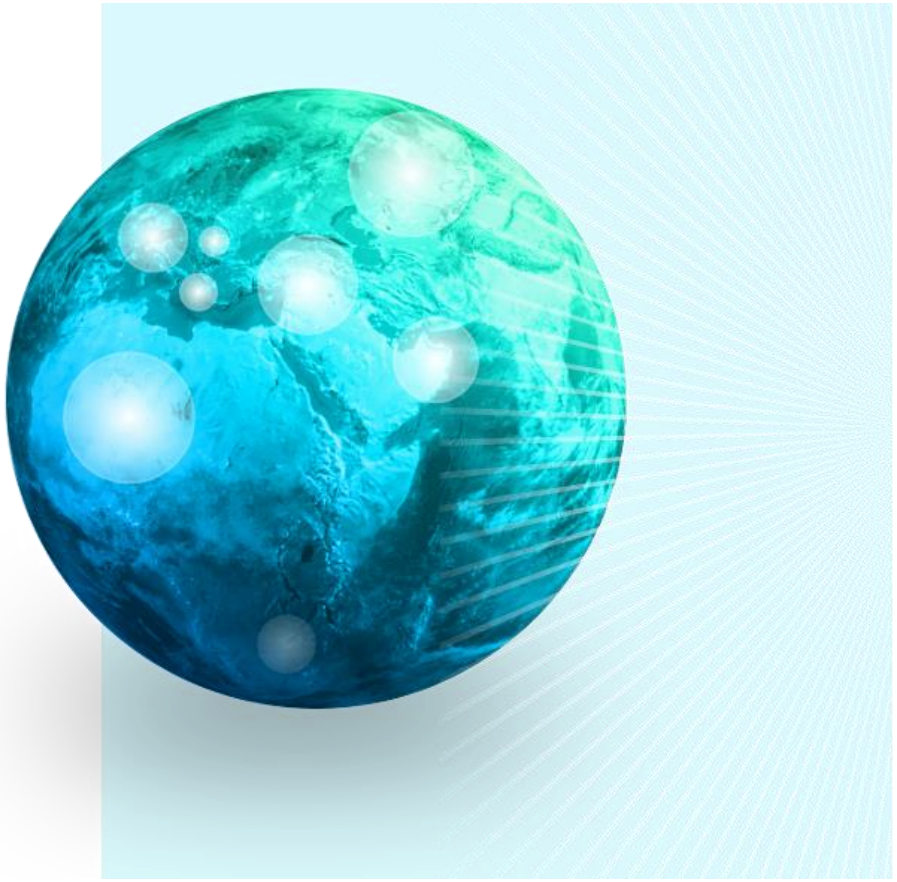
eurammon
refrigerants delivered by mother nature

AGENDA

- Güntner GmbH & Co. KG
- Market
- Best Practice Examples
- Multiple Heat Source Concept
- Technical Air-Side Details

Güntner GmbH & Co. KG

The power of progress



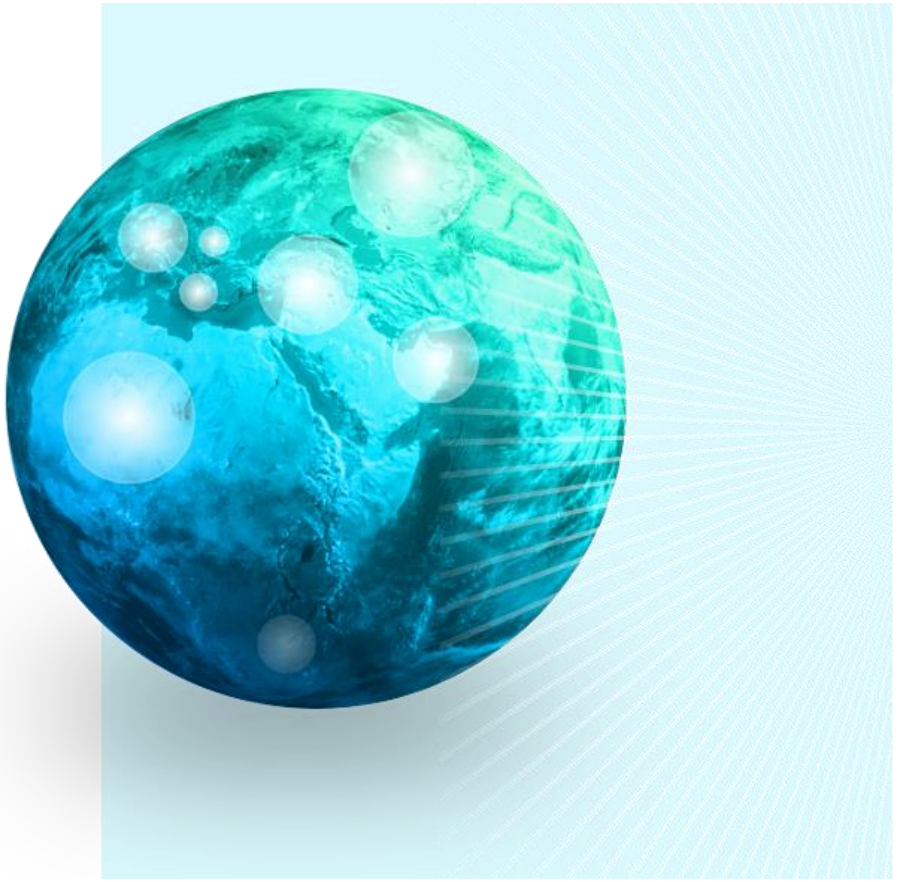
90 YEARS OF PROGRESS

I am Hans Güntner.
In the founding year 1931
I repair and build refrigeration equipment for the media

SO_2
CO_2
NH_3
and water

Güntner GmbH & Co. KG

The Power of Progress



- 90 YEARS OF PROGRESS

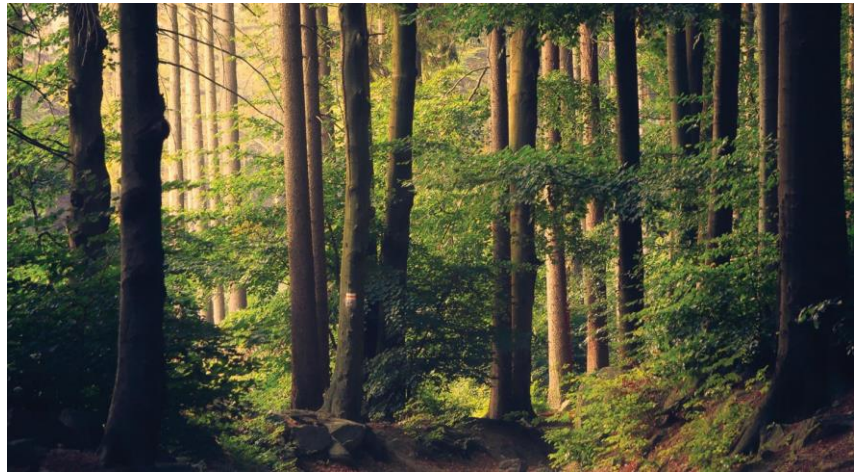
  Founded in 1931 in Munich as a refrigeration equipment manufacturer.

- We operate across more than 50 office locations and 6 manufacturing plants in Europe, Asia and the Americas.

- We are critical to a wide variety of industries: We power everything from
  - keeping food fresh to
  - providing comfortable indoor temperatures in office buildings,
  - enabling renewable energy production and
  - efficiently empowering heat pumps.

Güntner GmbH & Co. KG

Sustainability – At Our Heart



We are united in the desire to find ways to progress as a society – unified in our search for well-being, prosperity for future generations, and the protection and preservation of our shared home. And we believe it's part of our role to make our industry better – step by step.

WE ALWAYS KEEP THIS COMMITMENT IN MIND

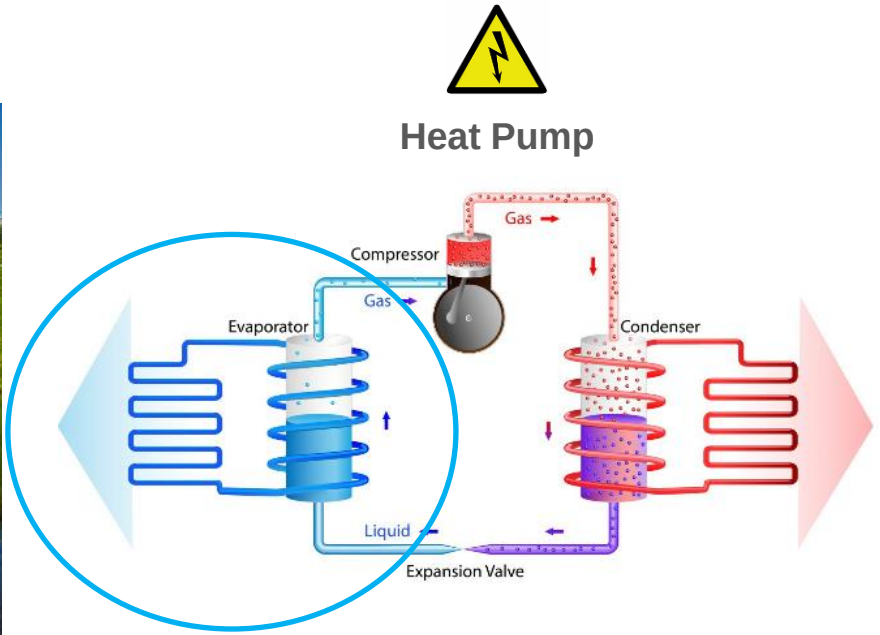
Our manufacturing plants are designed with respect for our nature:

- We use green energy
- We have implemented sustainable water treatments
- Our unique 'planted plant' concept in Sibiu (Romania) is a breakthrough in healthy work environments

Also, all our units operate with the lowest water and energy consumption possible, protecting the world's valuable resources.

Market

Heat Pump



Market

Influence Factors

decarbonization

CO2 Prize

Supply chain

Independent

Energy Transition

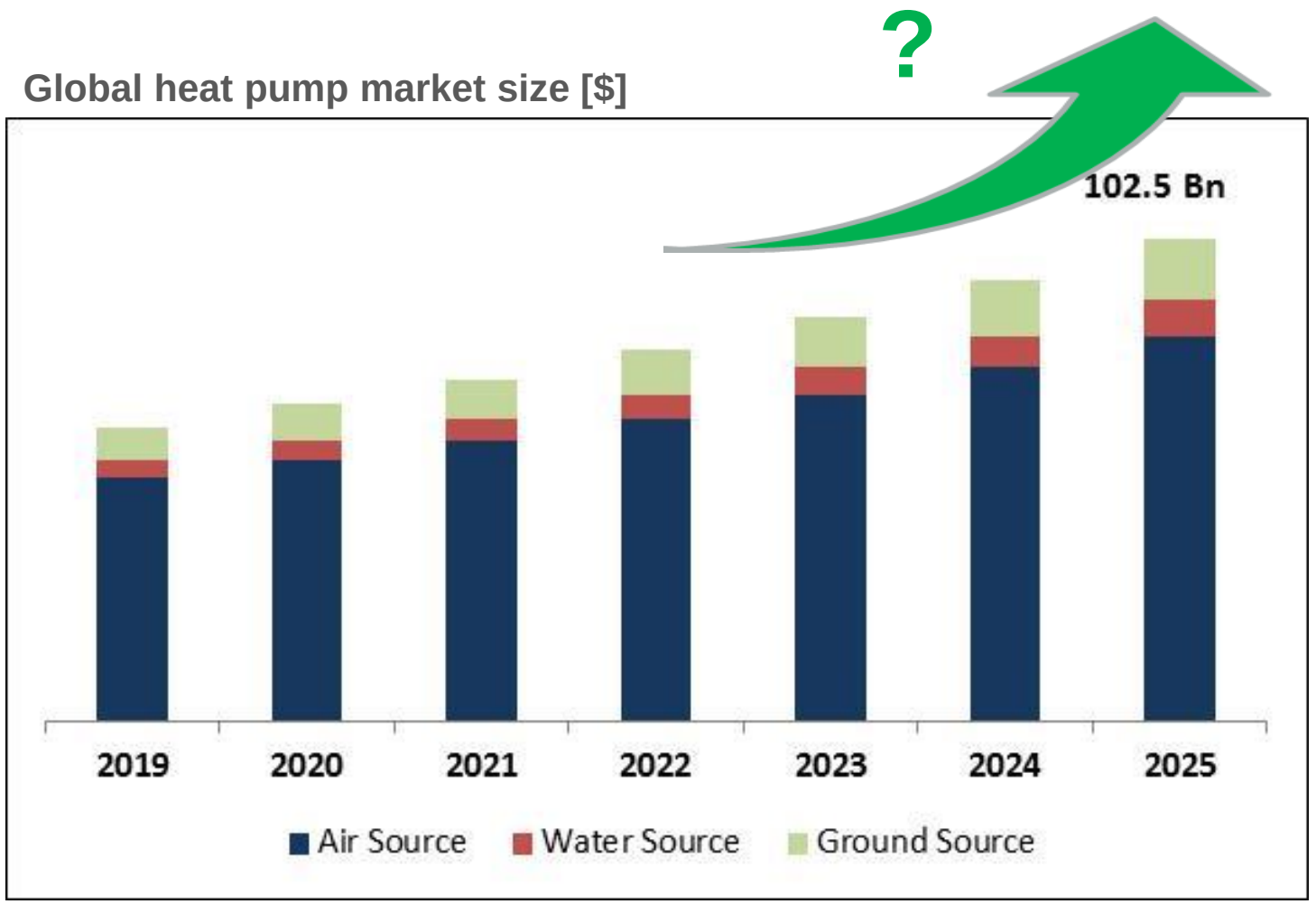
Commissione europea

REPowerEU

Market

Trend

Global heat pump market size [$]



https://www.kbvresearch.com/heat-pump-market/ ; Year 2019

Market

Trend

Global: IEA “Net Zero by 2050”

	2020	2030	2050
Worldwide stock – million units	180	600	1,800
Heat pumps (electr.) covering heat supply	7%	20%	55%

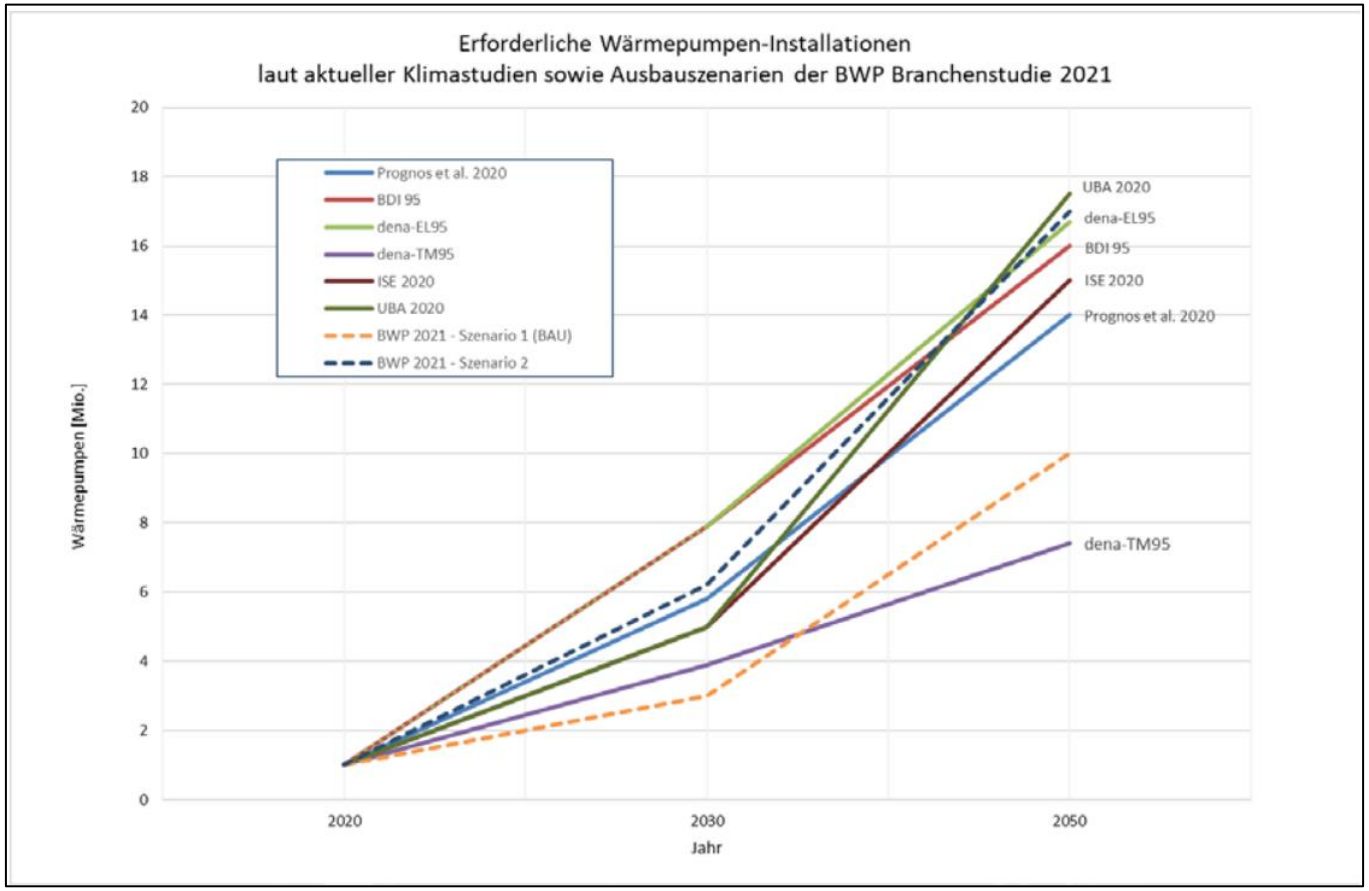
EU: REPowerEU proposal (2021):

Cumulative sum over the next 5 years:

10 million units

Update May 2022:

30 million units until 2030



Germany: Industry survey BWP 2021

https://www.waermepumpe.de/fileadmin/user_upload/waermepumpe/07_Publikationen/Sonstige/2021-04-29_BWP_Roadmap_final.pdf; Year 2021

Market

Sectors

Supermarket and Commercial Refrigeration

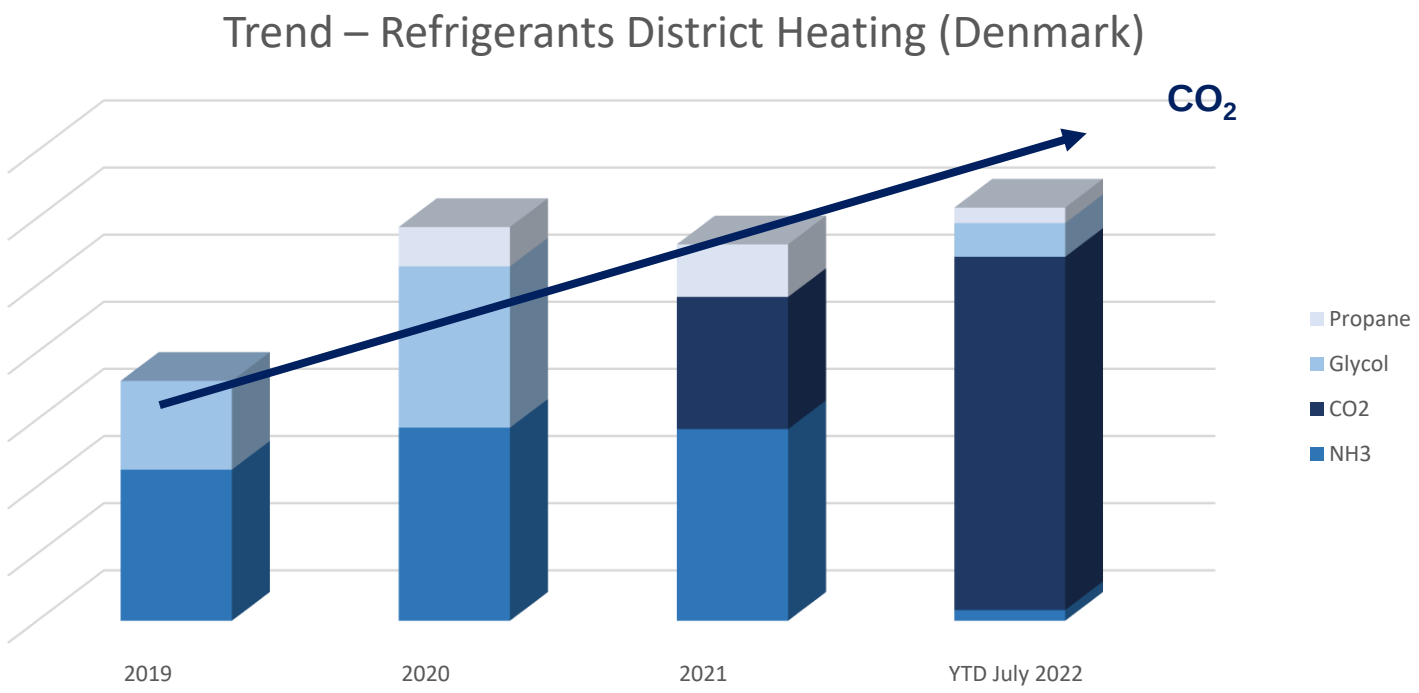
Industries

Buildings

District Heating

Market

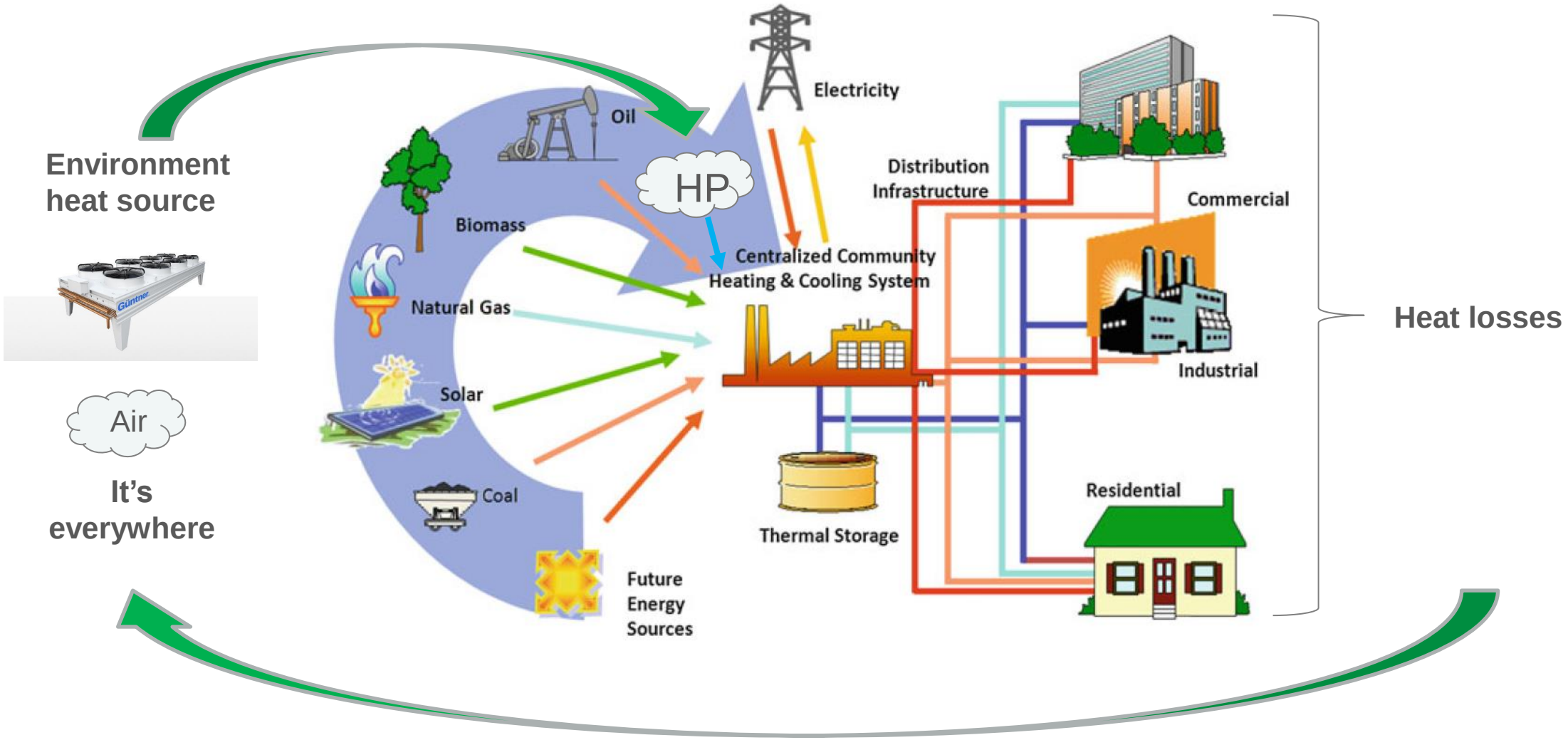
Trend – Refrigerants District Heating



Güntner GmbH & Co. KG

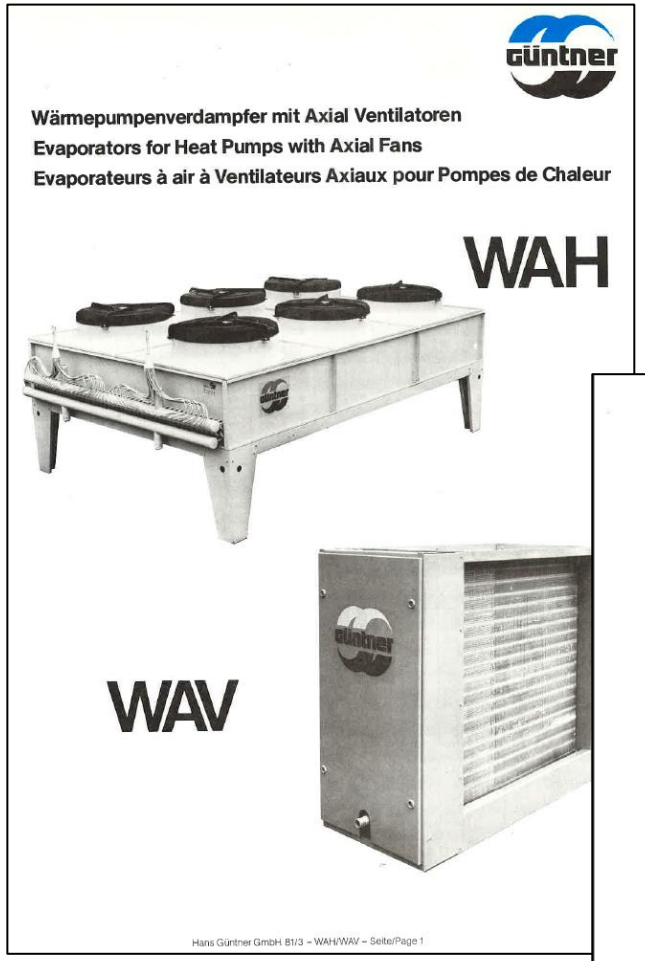
Market

District Heating

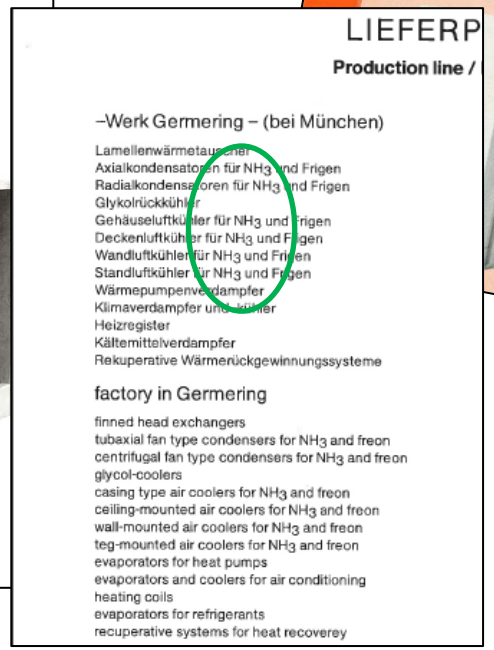


History of Experience

>40 Years Heat Exchangers for Heat Pumps



1981



1990

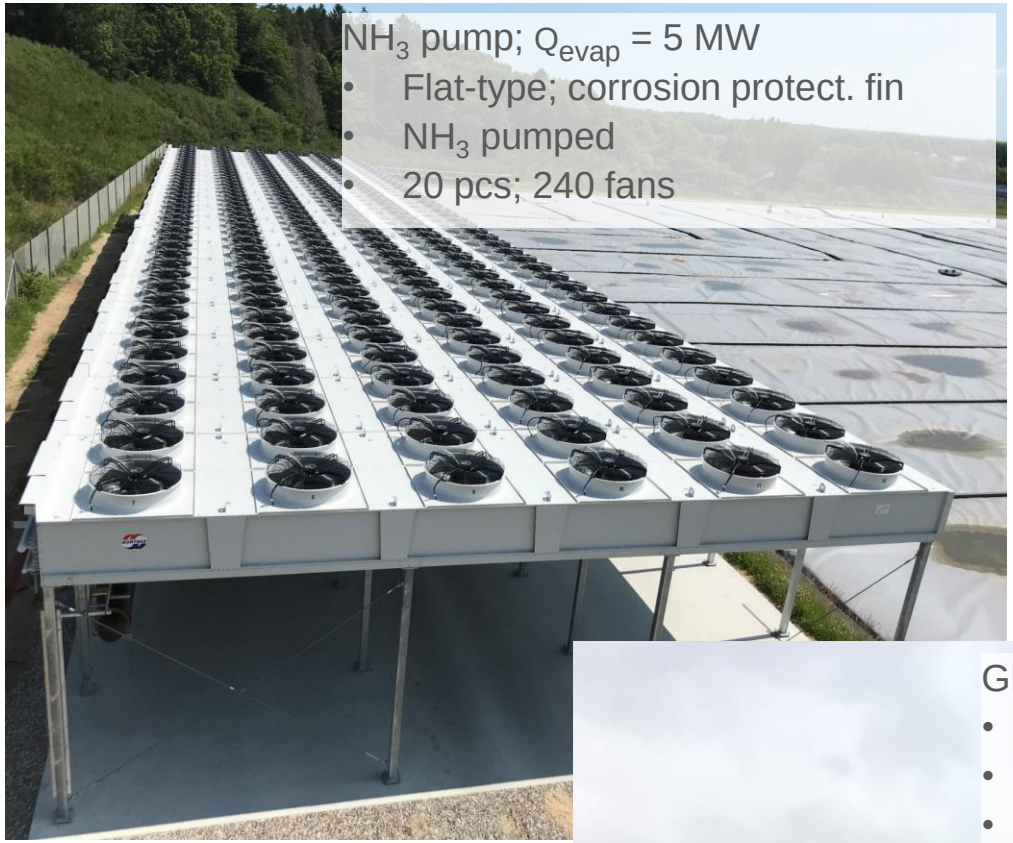
1994

Best Practice Examples

NH_3 – Pump Industrial

NH_3 pump; Q_{evap} = 8.2 MW
- Flat-type; corrosion protect. fin
- NH_3 pumped
- 32 pcs; 320 fans

NH_3 pump; Q_{evap} = 5 MW
- Flat-type; corrosion protect. fin
- NH_3 pumped
- 20 pcs; 240 fans



Johnson Controls

Glycol; $Q_{absorber}$ = 5.5 MW
- V-shape; corrosion protect. fin
- Sec.: Ethylene Glycol / Pri.: NH_3
- 16 pcs; 288 fans

Johnson Controls

Multikol A/S

Best Practice Examples

CO_2 – DX Industrial

Mejlby Q_{heat} = 1,200 kW

Q_{heat} = 600 kW

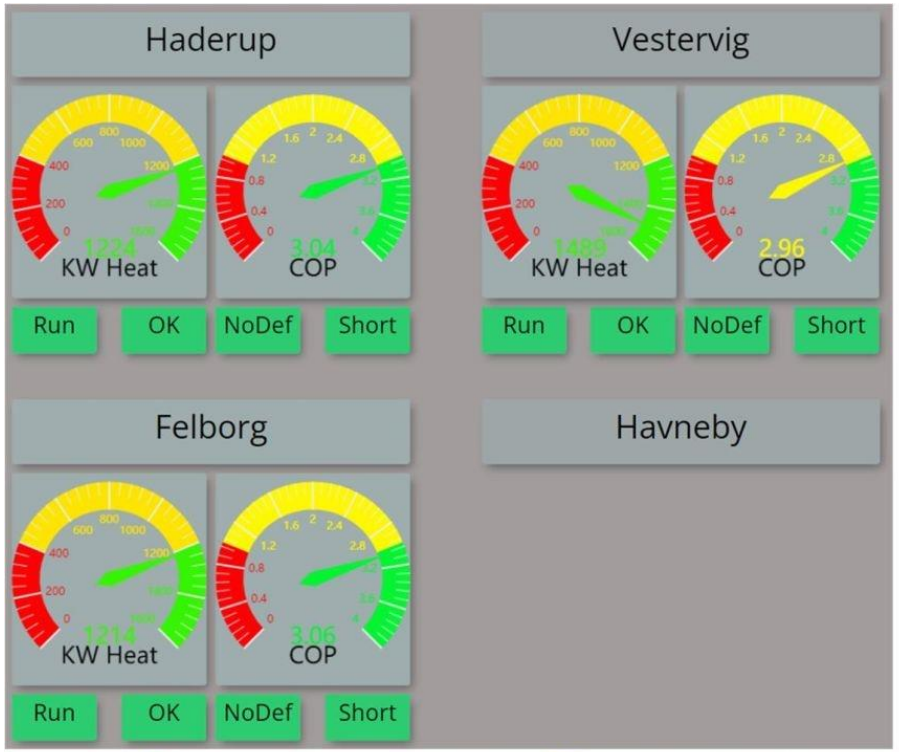
https://www.linkedin.com/company/fenagy/posts/?feedView=all

CO_2 – DX; Q_{evap} = 0.4 MW / 0.8 MW
@dT = 7 K; COP = 3.3

- 4x Flat-type, each; corrosion protect. fin
- Fast installation (extra long feet)
- $T_{W;\ supply}$ = 40 °C → 70 °C

Best Practice Examples

CO_2 – DX Industrial



Haderup Q_{heat} = 1,200 kW

Vestervig Q_{heat} = 1,400 kW

https://www.fenagy.dk/da/fenagy-varmepumper

Best Practice Examples

CO_2 – DX Commercial

Supermarket Germany; CO_2
Q_{GC} = 153 kW @dT = 2 K
Q_{evap} = 26 kW @dT = 7 K

Sandwich-Design: Gas cooler + heat pump evaporator on top

- Operation of GC and evap. at same time (while reusing heat)
- Independent circuits
- Independent fin spacings

Supermarket Germany; CO_2
Q_{GC} = 43 kW @dT = 2 K
Q_{evap} = 25 kW @dT = 7 K

One-Coil-Design: Gas cooler + heat pump evaporator using same coil

- Highest efficiency + cost effectiveness using the whole HX surface for both operations
- Defrost via effective HG integrated
- 120/130 bar design

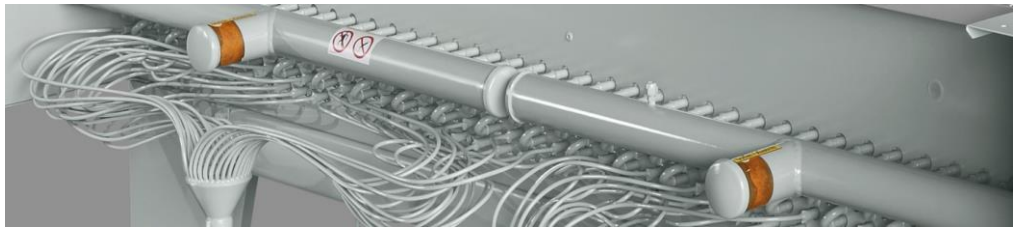
Hotel Norway; Glycol; $Q_{abs.}$ = 180 kW @dT = 8 K

Cubic

- Perfect for cold ambient air
- Highest defrost efficiency and
- Long operating periods
- Wind-, snow-, rain-proof

Best Practice Examples

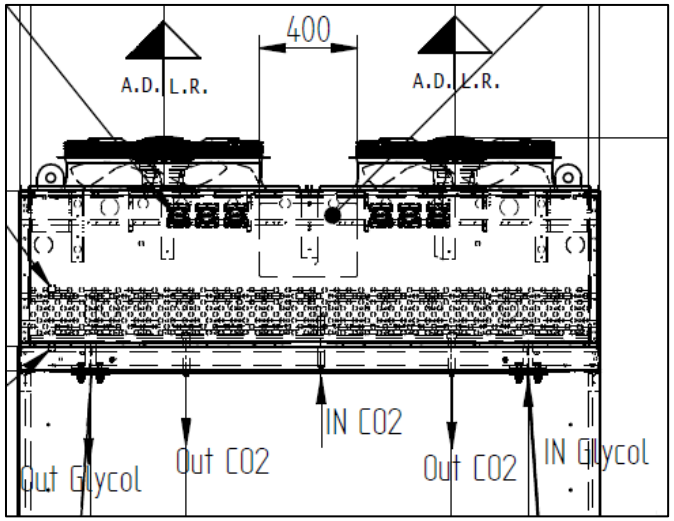
Flat – Flexible in Every Dimension



Condenser and evaporator (reverse)

Advantages

- Almost every coil configuration
- High corrosion protection class
- Special circuitry and capillary design for heat pump for max performance
- Very good defrost behaviour and efficiency



(CO_2 -) DX with 1 distributor for 2.2 m width; (optional) Glycol defrost

Japan;
Q_{Cond} = 412 kW @dT = 13 K
Q_{evap} = 276 kW @dT = 8 K

DX with high mass flow density

Denmark; Q_{evap} = 260 kW @dT = 7 K

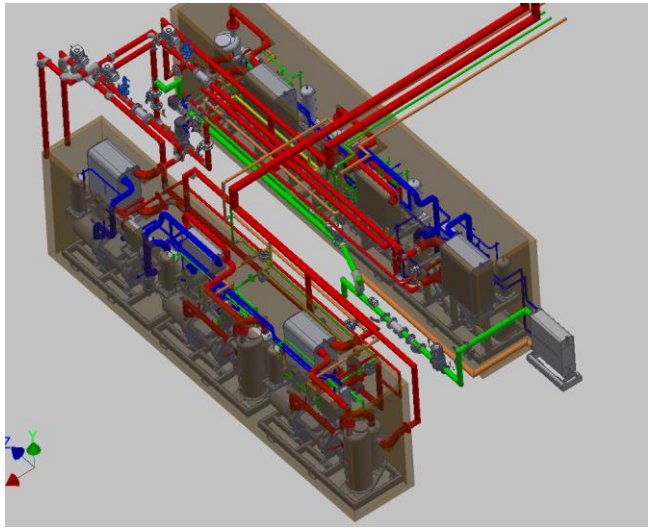
NH_3 with low recirc rates; HG defrost

Best Practice Examples

Propane – DX Industrial

Løgstrup District Heating – 2.5 MW

- $SCOP_{HP}$ = 3.14 @ TW = 36 °C/70 °C
- Heat production = 11,716 MWh
- Natural gas savings* = 795,516 €
- ROI** = 4 years



Propane DX;

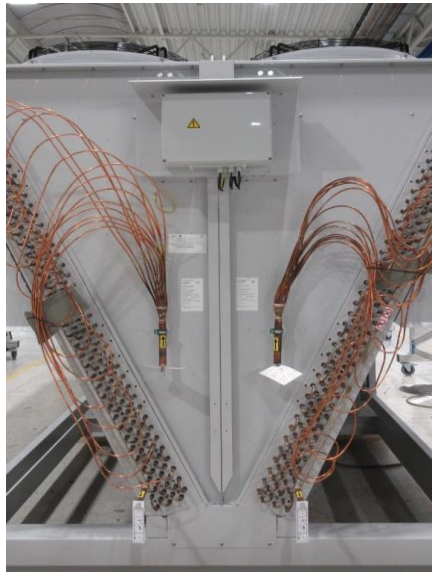
- V-shape
- Corrosion protected fins
- HG defrost

https://www.hp-summit.de/de/events/vortrag/air-source-heat-pump-for-district-heating-with-hc-case-study-by-frascold-27-/768167#top; Solid Energy

* 67.9 €/MWh gas
"Socio-economic calculation assumptions" – 2020.ens.dk
** list prizes

Best Practice Examples

CO_2 – DX Industrial/Commercial



Denmark; Office building

CO_2 – DX; Q_{evap} = 0.21 MW

@dT = 7 K; COP = 3.1

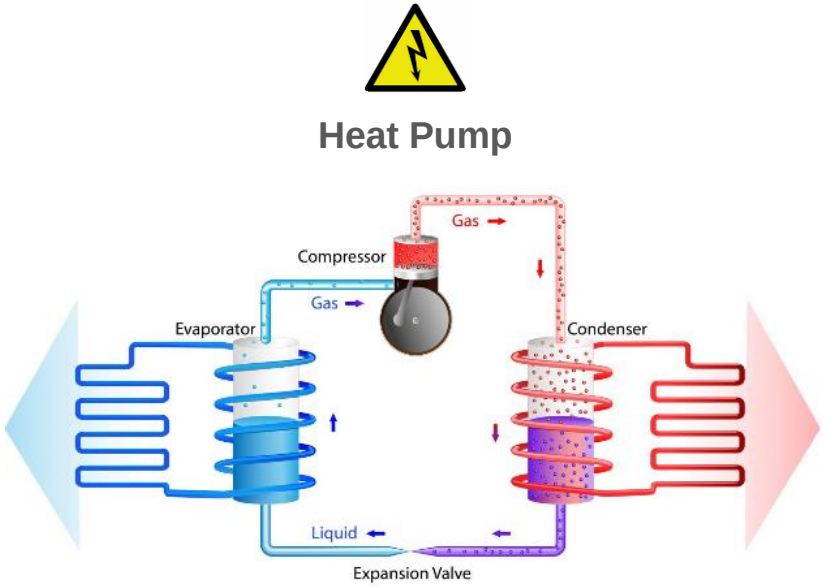
- V-shape with empty housing
- $T_{W;\ supply}$ = 40 °C → 70 °C

Advantages

- Small footprint for max. capacity
- Corrosion protected fins
- Accessories for heat pump
  - Only one exp. Valve/Control each coil necessary
  - Optimized for defrost efficiency
- Heat Pump Pack: 2 units + empty housing mounted on base frame
  → 4 separate coils for sectional defrost

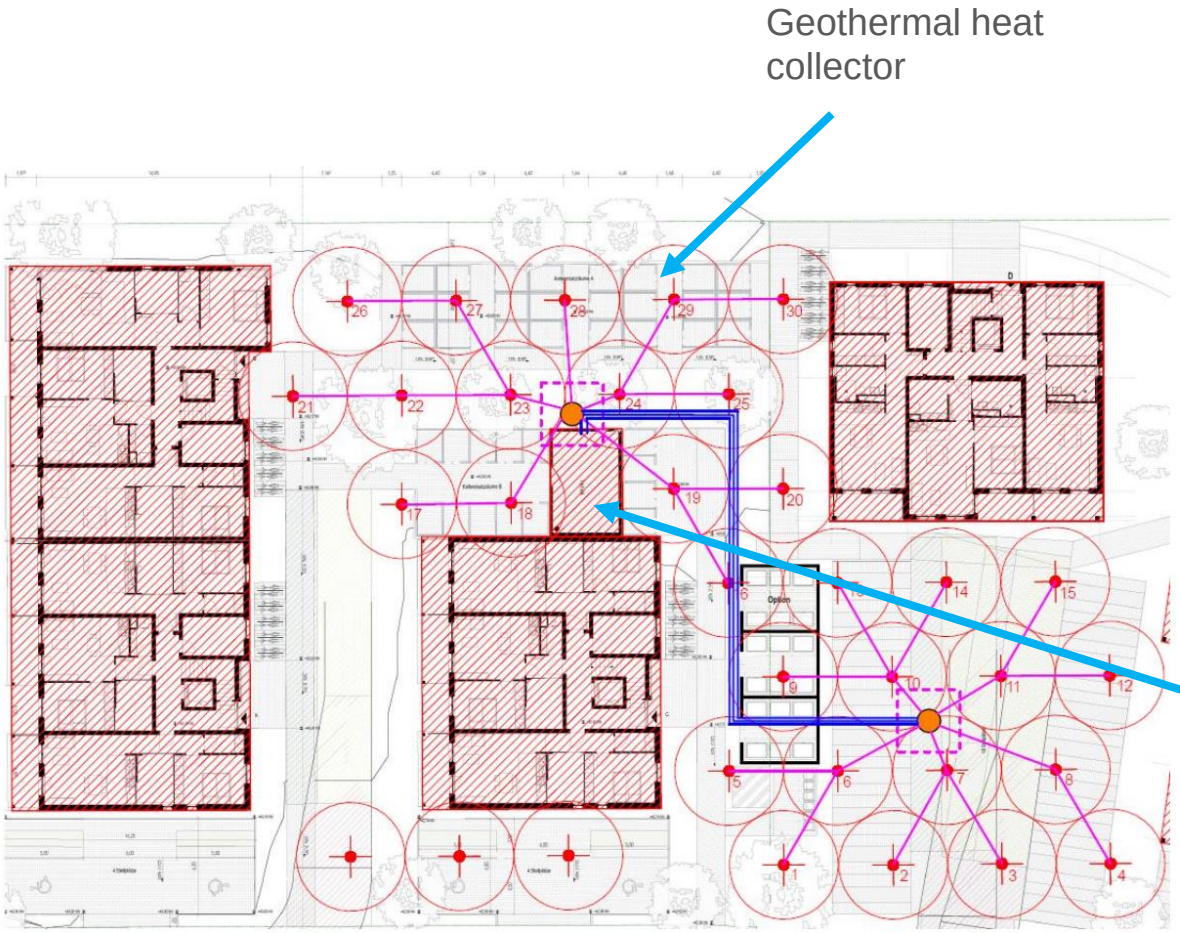
Best Practice Examples

Heat Source with Nat. Ref.



Multiple Heat Source Concept

Space Heating



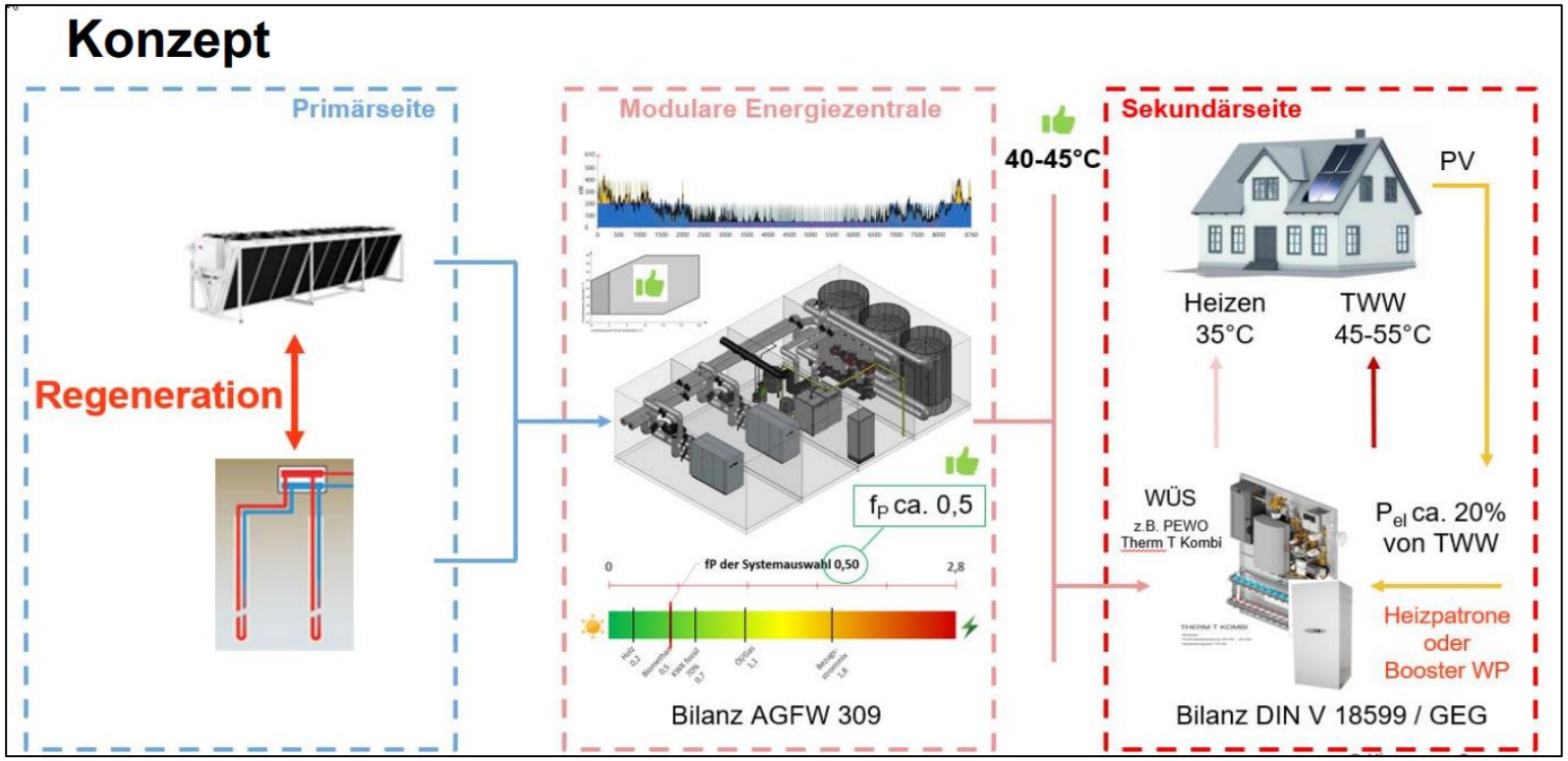
https://grosswaermepumpen-kongress.com/wp-content/uploads/2022/06/03_W%C3%96RDEMANN.pdf

Multiple Heat Source

Space Heating

- Heated living space: 5,348 m²
- $Q_{heat,\ max}$ = 240 kW
- Heating energy 320,070 kWh/a
- Boreholes reduction
- ~45 pcs → 30 pcs
- Reduction invest for heat source
- 380 k€ → 225 k€

-40 %



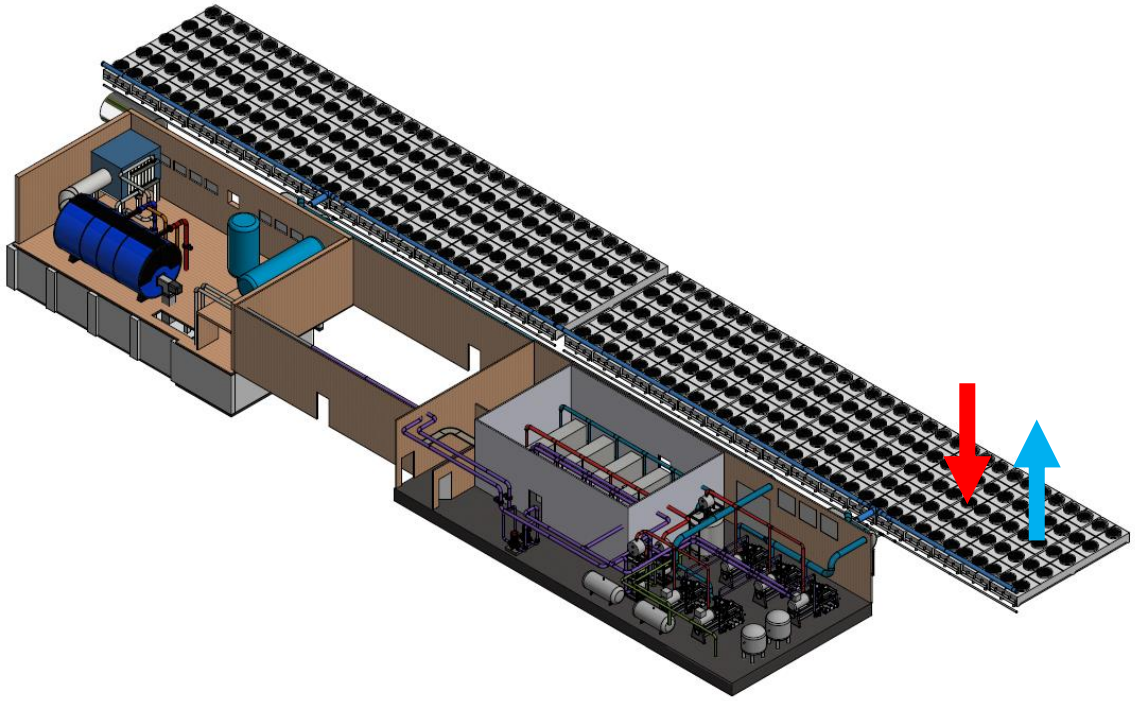
https://grosswaermepumpen-kongress.com/wp-content/uploads/2022/06/03_W%C3%96RDEMANN.pdf

V-shape; Glycol; $Q_{collector}$ = 111 kW @ dT = 8 K

- Aluminium fin
- Operation at T_A > 5 °C
- Summer: Regeneration of geothermal probes

Technical Air-Side Details

Air Circulation – Layout



The layout has an impact on the efficiency of the heat exchangers.

The air flow must be ensured by proper installation considering:

- Distance among the units
- Height from the ground
- Buildings and walls near the heat exchangers

CFD modelling for

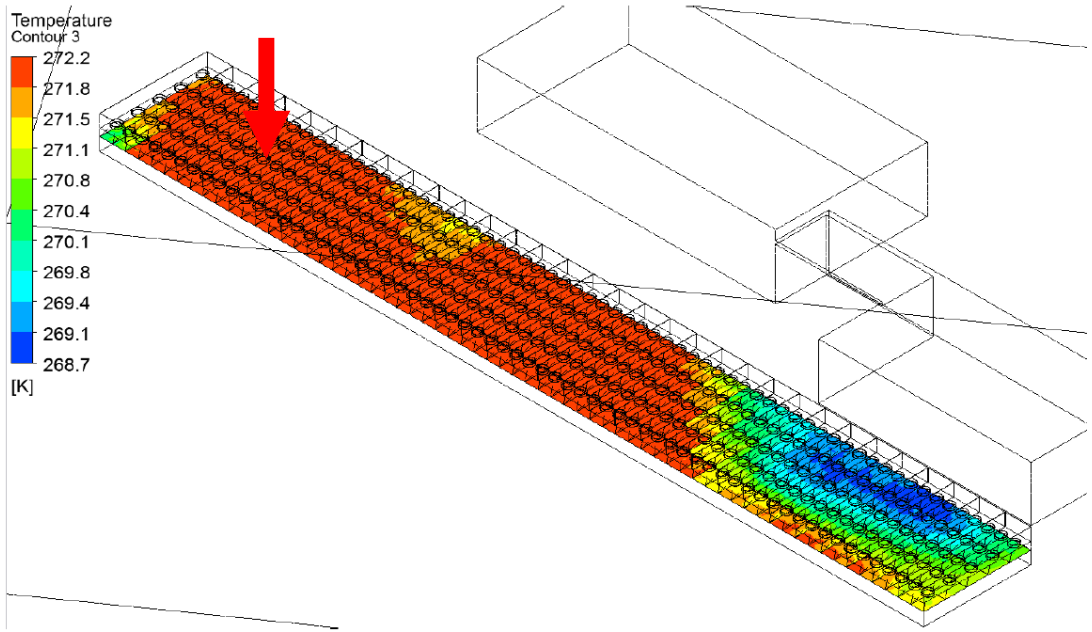
- blow-through (forced draft)
- draw-through (Induced draft)

Technical Air-Side Details

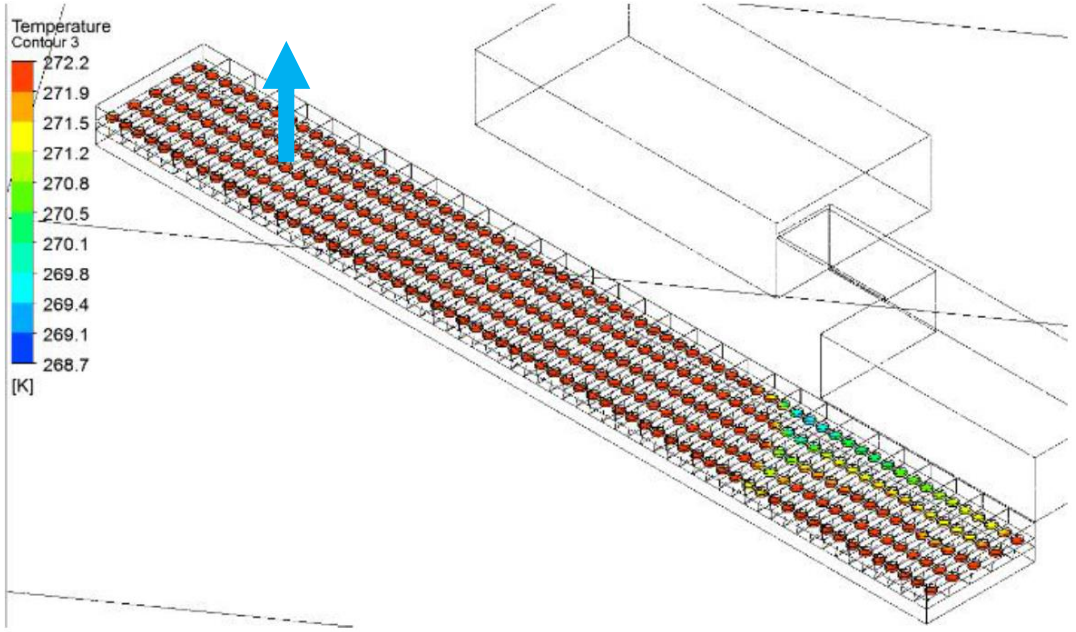
Air Circulation – Layout

The impact of wind on the performance depends on the solution you choose:

blow-through (forced draft)



draw-through (Induced draft)



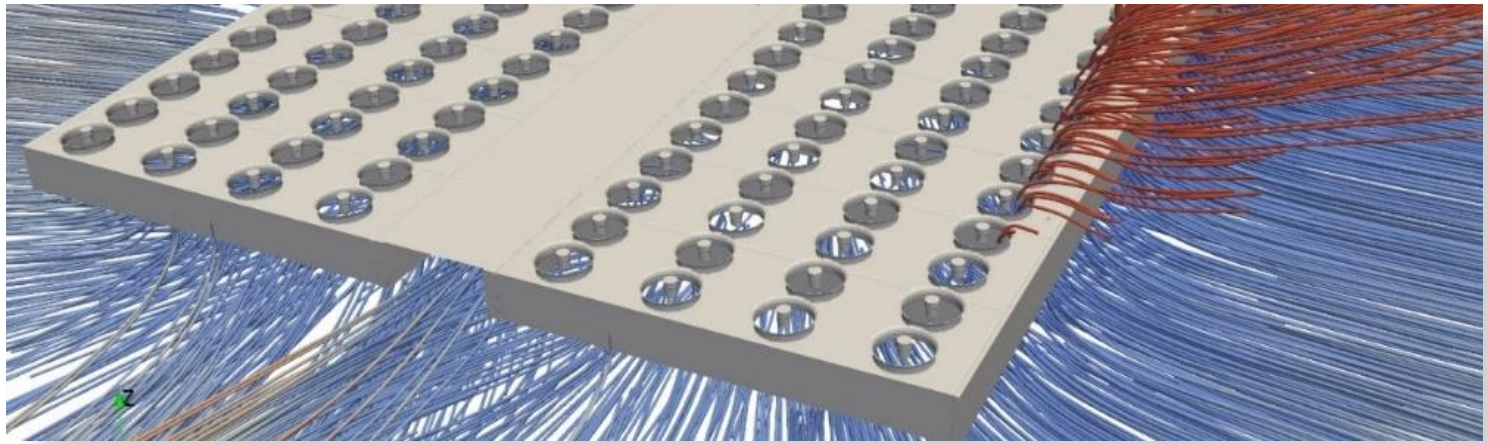
Draw-through fans, in most cases, operate more efficiently and reduce air circulation.

Technical Air-Side Details

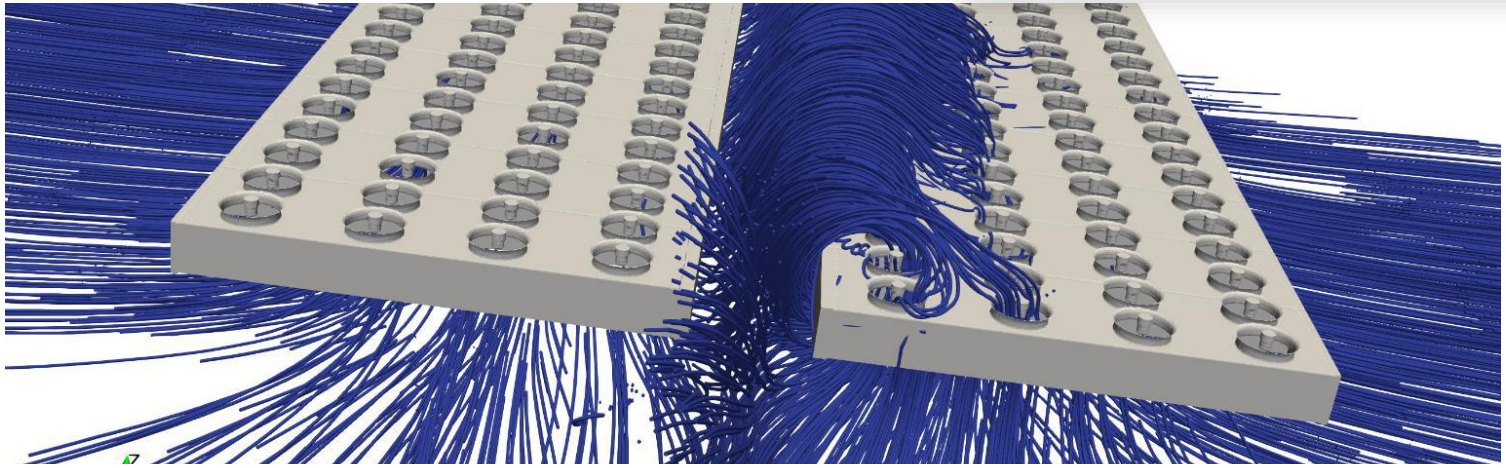
Air Circulation – Open/Closed Gap

CFD analysis demonstrates that, in most cases, closing the gap between the units helps avoiding air circulation between out- and inlet. This ensures the proper operation of the units.

Closed gap



Open gap



Challenges for Air-Side Heat Pumps

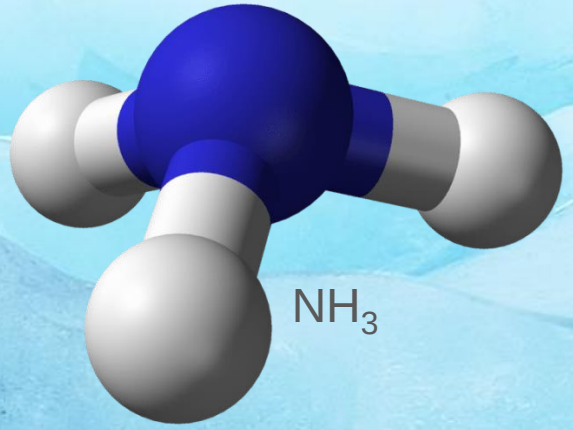
- Defrost / Icing optimization
- air recirculation reduction
- Wind factor
- Footprint reduction
- Sound emission reduction

COP

Always a Solution Ahead

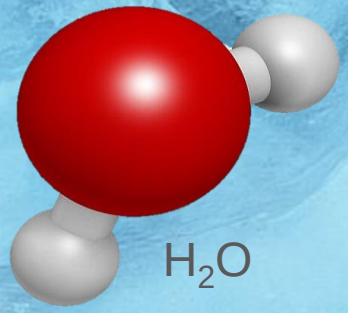
For a Sustainable Future

Ammonia



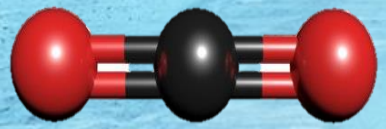
NH_3

Water



H_2O

Carbon Dioxide



CO_2

Propane

C_3H_8

eurammon e. V. is always available as a sparring partner for questions on refrigeration with natural refrigerants.

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eurammon

refrigerants delivered by mother nature