Individual heat pumps combined with industrial NH_3-refrigeration systems

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refrigerants delivered by mother nature

Company and Lecturer

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Kreutzträger
Kältetechnik

Company and Lecturer

Kreutzträger Kältetechnik

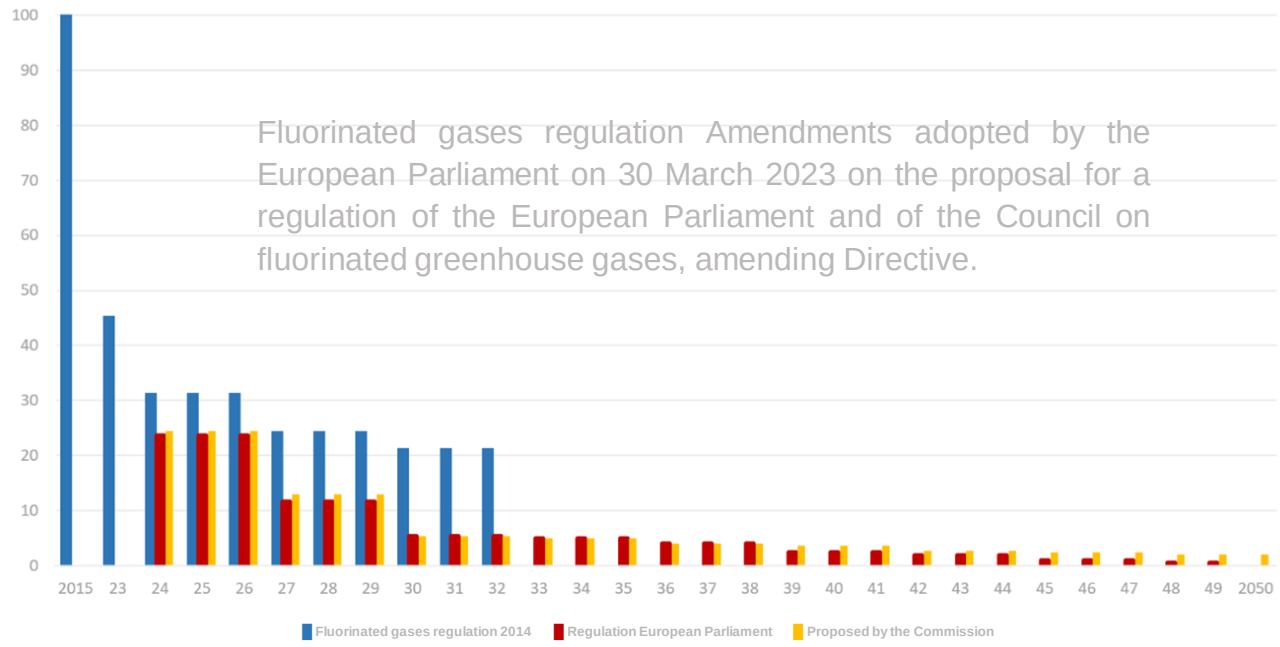
> Nationwide working family-owned company located in Bremen
> Serving the market for more than 60 years
> Approx. 170 employees, 50% of whom are fitters and service technicians
> Comprehensive Know-how enables developing refrigeration systems and heat pumps
> Industrial refrigeration plant construction and service
> Use of natural refrigerants, like ammonia, propane and carbon dioxide, is core competency

Agenda

- Motivation
- To remember!
- Examples of standardized solutions of the refrigeration industry
- Findings when upgrading a refrigerant plant by a heat pump
- Suggestions and Ideas
- Real-world example
- Summary
- Questions

Motivation

- Reduction of CO_2 emissions (greenhouse effect)
- Scarcity of fossil fuels
- Increasing costs of using fossil fuels
- Fluorinated gases regulation as an accelerator



Designed by brgfx / Freepik

To remember!

- Every refrigerant plant is also a heat pump!
- The waste heat from the refrigeration system is relevant in total.
- The temperature level of waste heat from a refrigeration system is too low.
- Waste heat must be tapped as needed.
- Waste heat from the refrigeration system is not always available.
- Heat source and heat sink are individually different.
- Heat consumption must be guaranteed and matched to the cooling capacity.

Examples of standardized solutions of the refrigeration industry

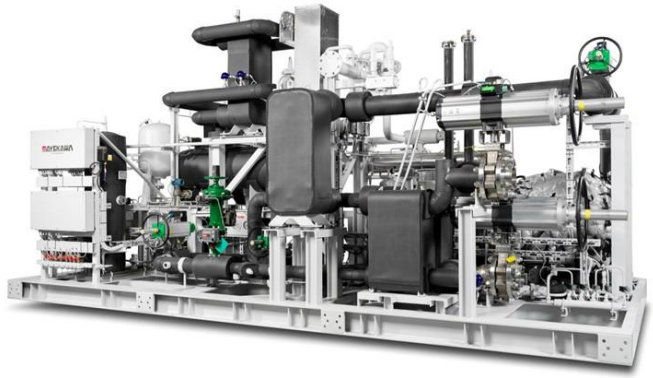
- Examples of standardized heat pumps

GEA-Heat-Pump, open Type

(literature source: Homepage GEA 12.06.2023)

SABROE HeatPAC

(literature source: Homepage Sabroe 12.06.2023)



Mayekawa Heat pump,

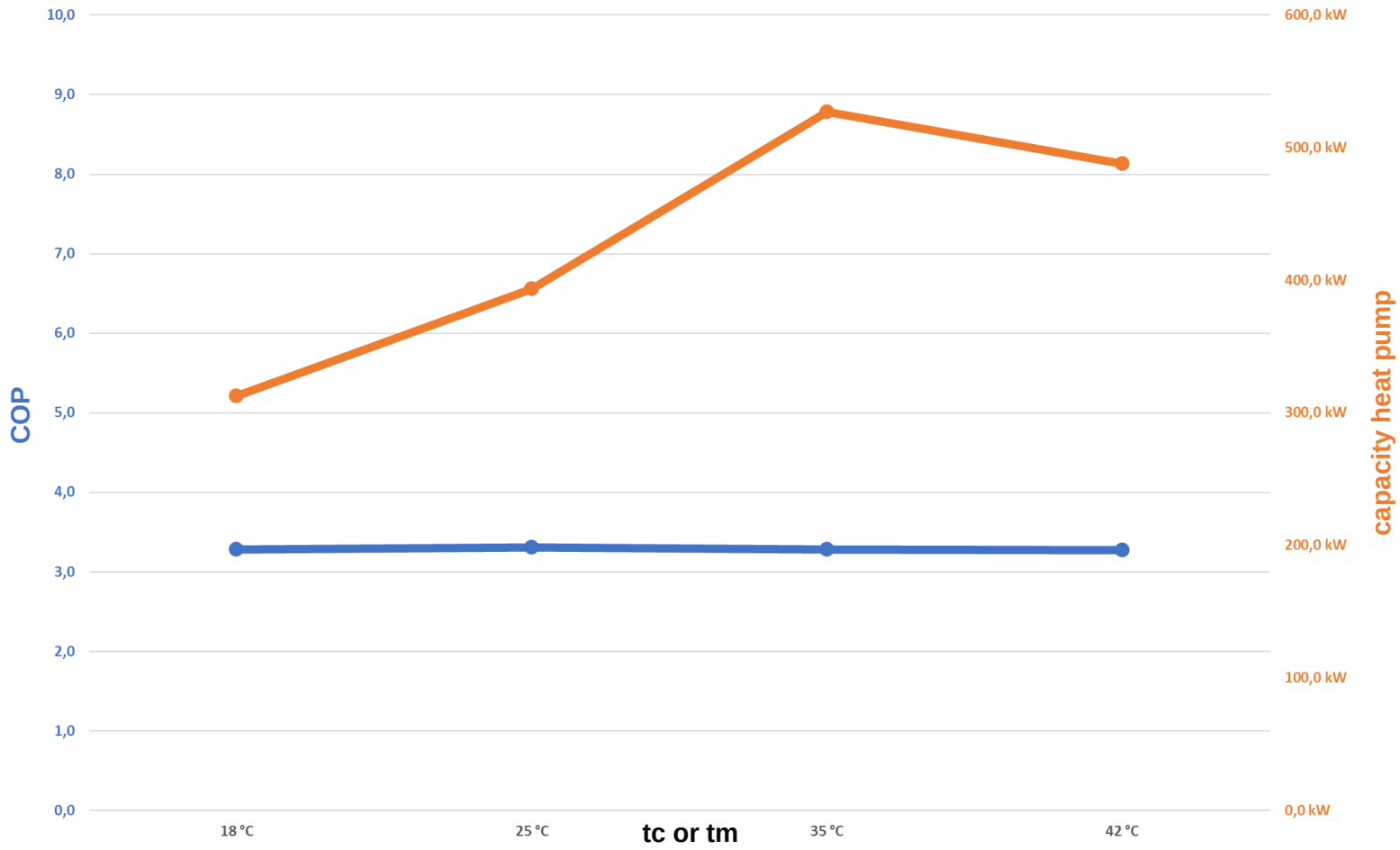
(literature source: Homepage Mayekawa 12.06.2023)

- A lot can be covered with standard solutions.
- But not everything!!!

Findings when upgrading a refrigerant plant by a heat pump

- Characteristics of Heat Pump with piston compressor

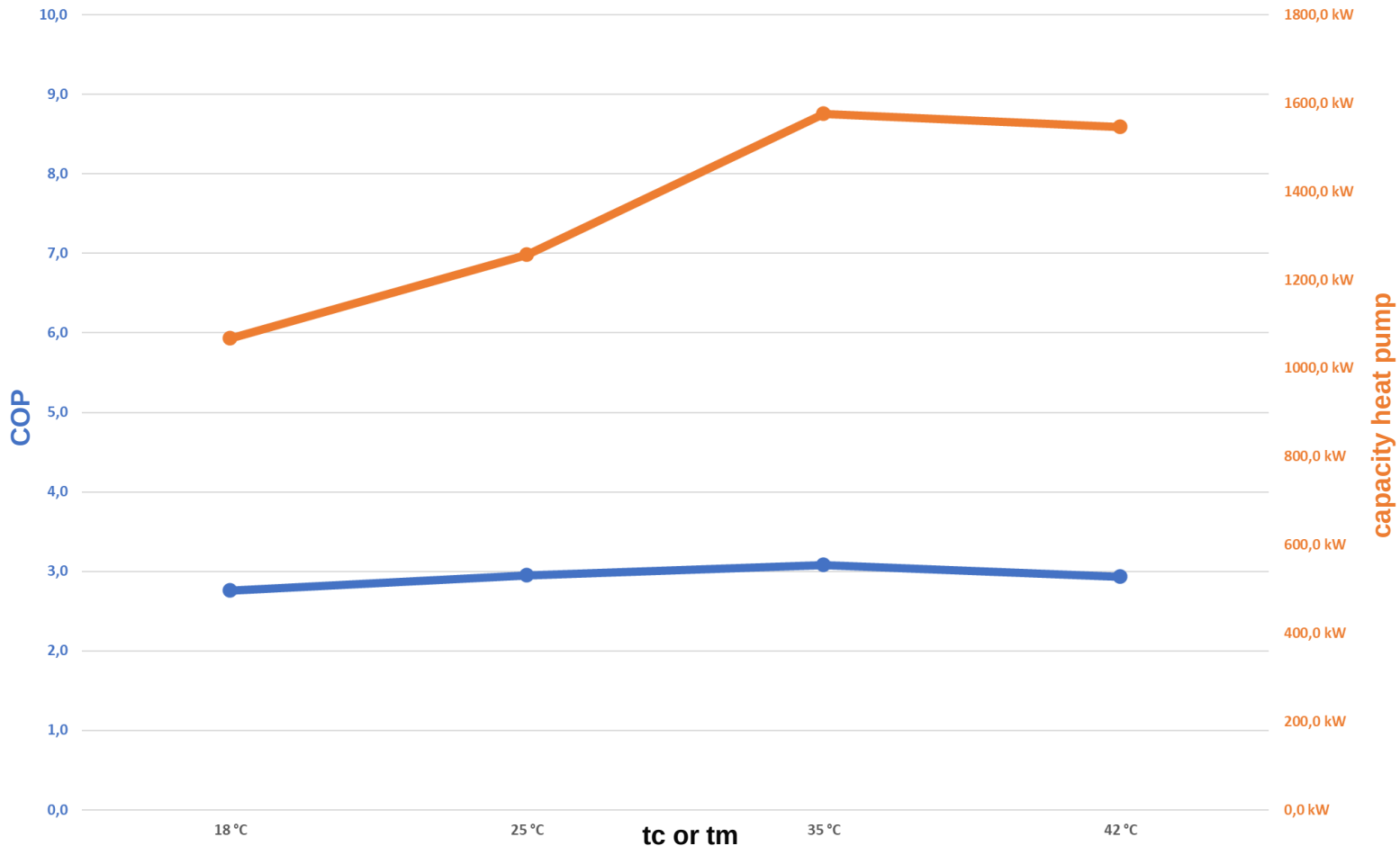
LP - Stage V700				
to	-10 °C	-10 °C	-10 °C	-10 °C
tc	18 °C	25 °C	35 °C	42 °C
Qo RE	217,1 kW	274,5 kW	366,6 kW	338,8 kW
Pe	30,3 kW	50,3 kW	92,1 kW	100,7 kW
Speed	604 min-1	810 min-1	1200 min-1	1200 min-1
EER	6,56	5,23	3,98	3,36
Qom	247,4	324,8	458,7	439,5
HP - Stage HP65				
to	16 °C	23 °C	33 °C	40 °C
tc	65 °C	65 °C	65 °C	65 °C
Qo HP	247,5 kW	324,8 kW	458,4 kW	439,4 kW
Pe	65,1 kW	68,8 kW	68,7 kW	48,6 kW
Speed	1500 min-1	1500 min-1	1495 min-1	1145 min-1
EER	3,8	4,72	6,67	9,04
COP	4,80	5,72	7,67	10,04
HP Total				
Qo	217,1 kW	274,5 kW	366,6 kW	338,8 kW
Pe RE + Pe HP	95,4 kW	119,1 kW	160,8 kW	149,3 kW
Qh total	312,6 kW	393,6 kW	527,1 kW	488,0 kW
Σ COP	3,3	3,3	3,3	3,3



Findings when upgrading a refrigerant plant by a heat pump

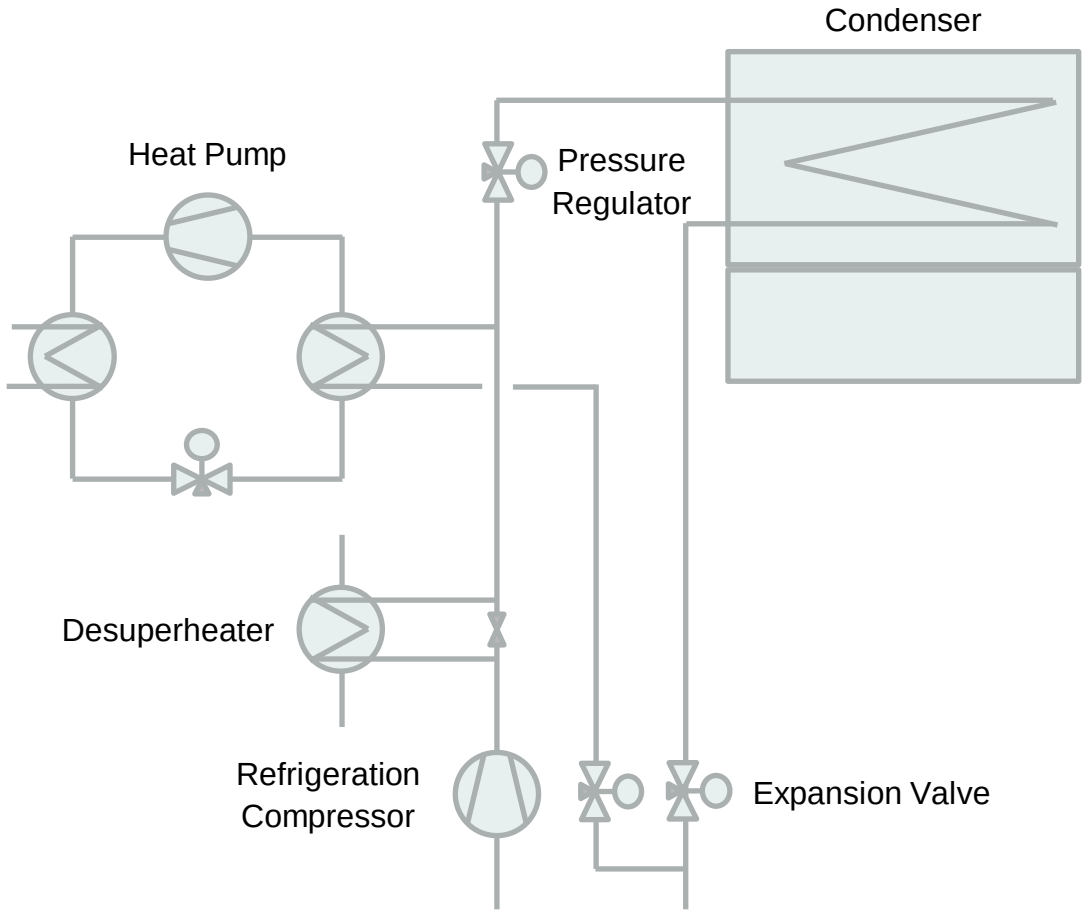
- Characteristics of Heat Pump with screw compressor

LP - Stage SP1 RB-5B				
to	-10 °C	-10 °C	-10 °C	-10 °C
tc	18 °C	25 °C	35 °C	42 °C
Qo RE	681,3 kW	830,4 kW	1064,3 kW	1017,8 kW
Pe	103,5 kW	158,4 kW	278,6 kW	329,6 kW
Speed	2672 min-1	3369 min-1	4500 min-1	4500 min-1
EER	6,58	5,24	3,82	3,09
Qom	784,8	988,8	1342,9	1347,4
HP - Stage SP1 HP MB-7A				
to	16 °C	23 °C	33 °C	40 °C
tc	65 °C	65 °C	65 °C	65 °C
Qo HP	784,0 kW	989,0 kW	1342,9 kW	1347,4 kW
Pe	283,0 kW	268,0 kW	233,5 kW	198,1 kW
Speed	3600 min-1	3600 min-1	3570 min-1	2925 min-1
EER	2,77	3,69	5,75	6,80
COP	3,8	4,7	6,8	7,8
HP - Total				
Qo	681,3 kW	830,4 kW	1064,3 kW	1017,8 kW
Pe RE + Pe HP	386,5 kW	426,4 kW	512,1 kW	527,7 kW
Qh total	1067,0 kW	1257,0 kW	1576,4 kW	1545,5 kW
Σ COP	2,8	2,9	3,1	2,9



Suggestions and Ideas

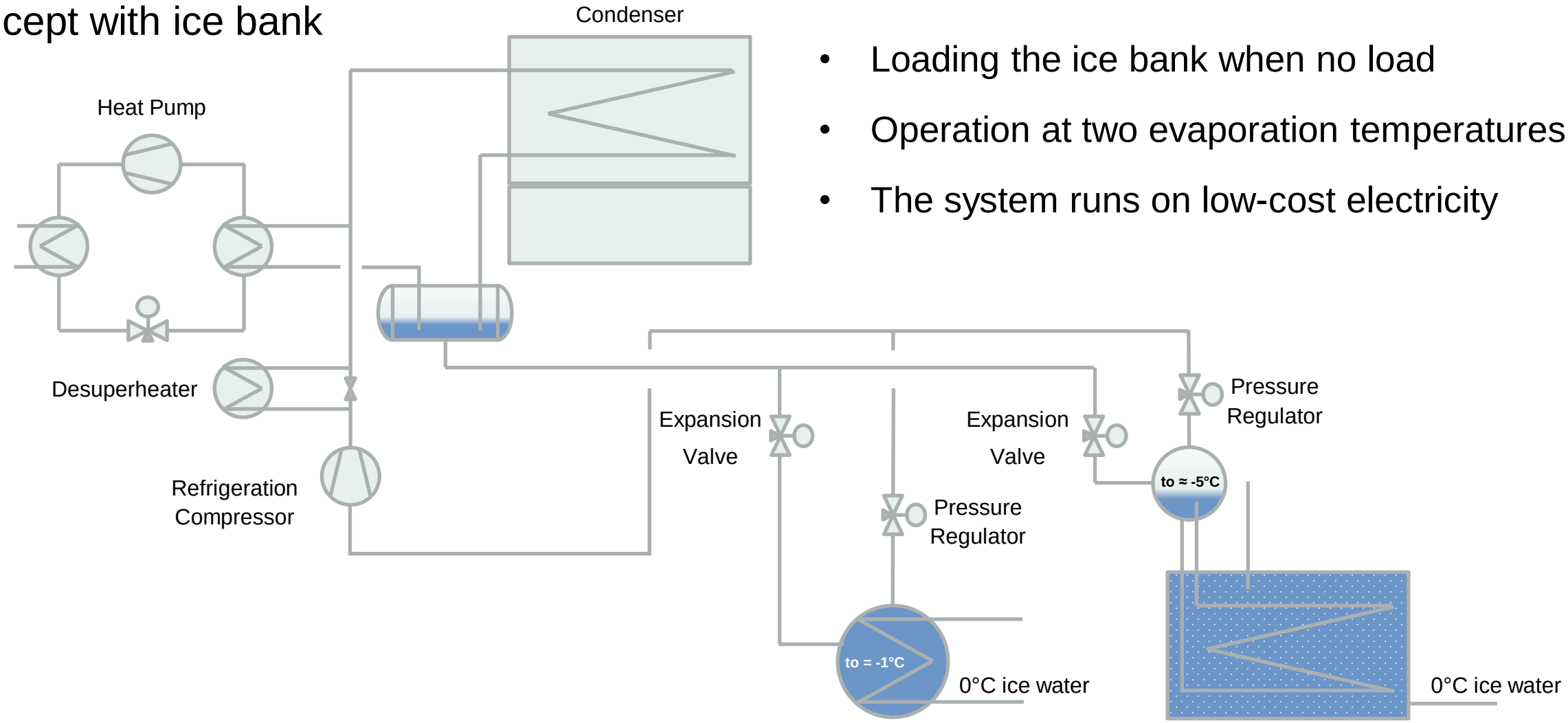
- How simple it is to integrate a Heat Pump in an existing NH_3-Circuit.



- Consider partial load on the cold side
- Cool weather influences condensing pressure
- Ensure uniform heat dissipation at Heat Pump

Suggestions and Ideas

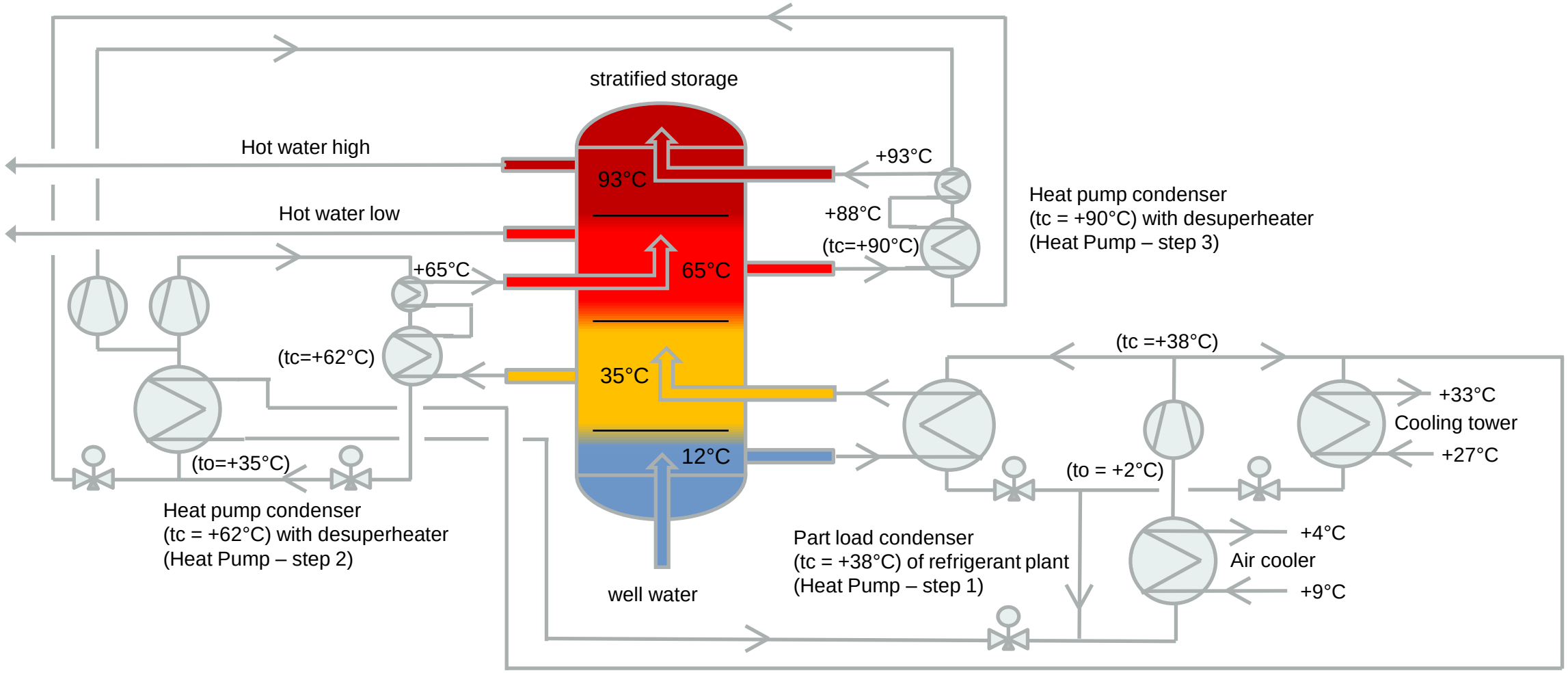
- Concept with ice bank



- Loading the ice bank when no load
- Operation at two evaporation temperatures
- The system runs on low-cost electricity

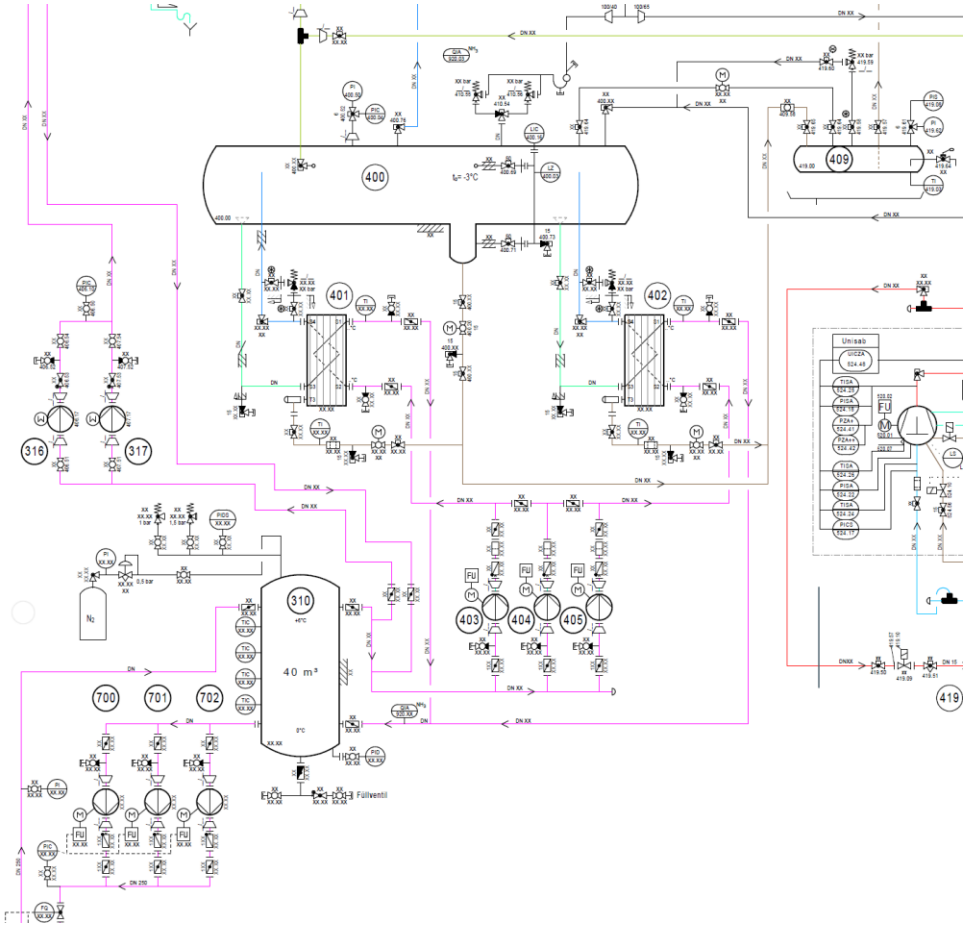
Suggestions and Ideas

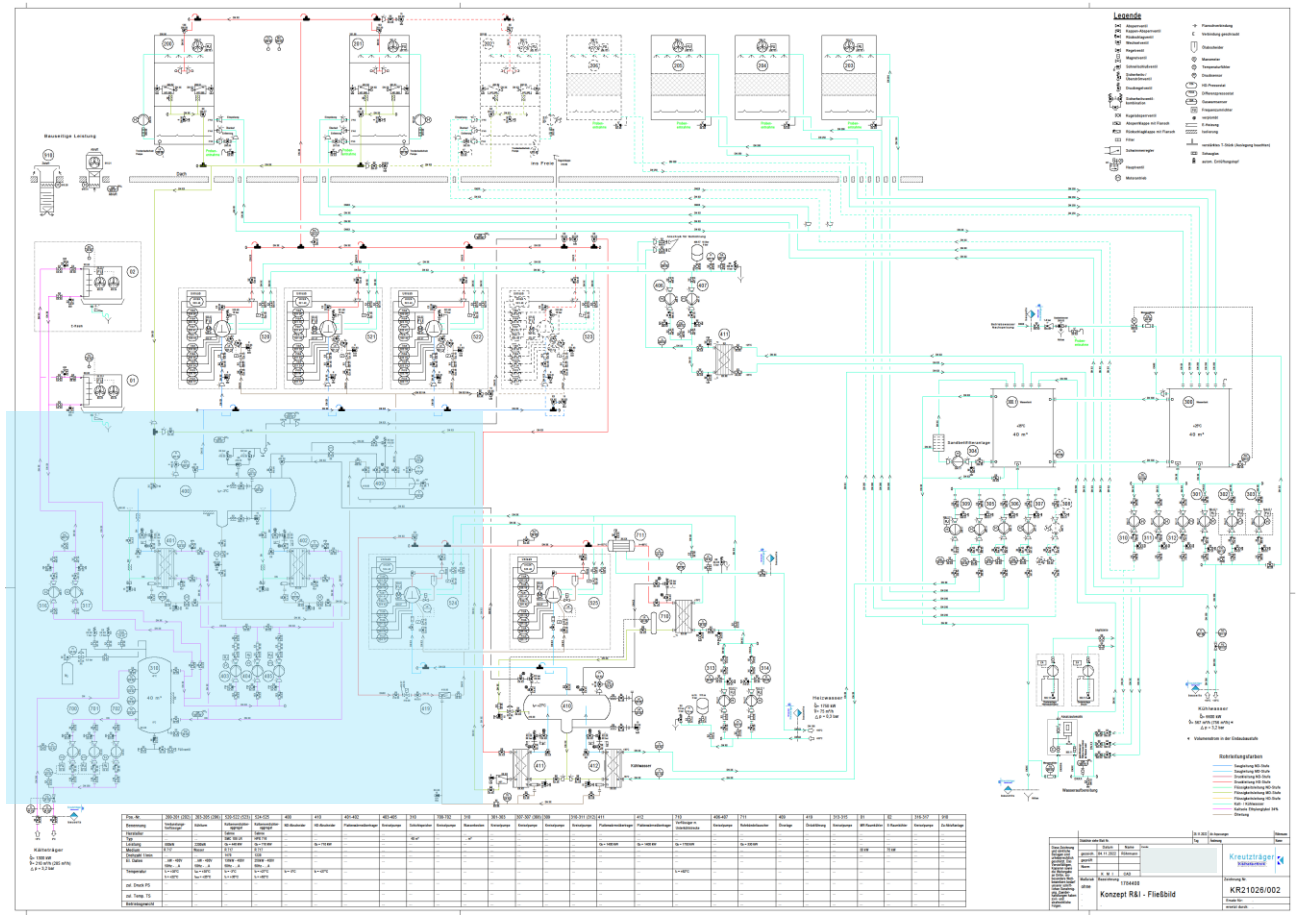
- Concept of a 3-stage heat pump



Real-world example

- A complex integration of Heat Pump in a NH_3-Circuit





Real-world examples

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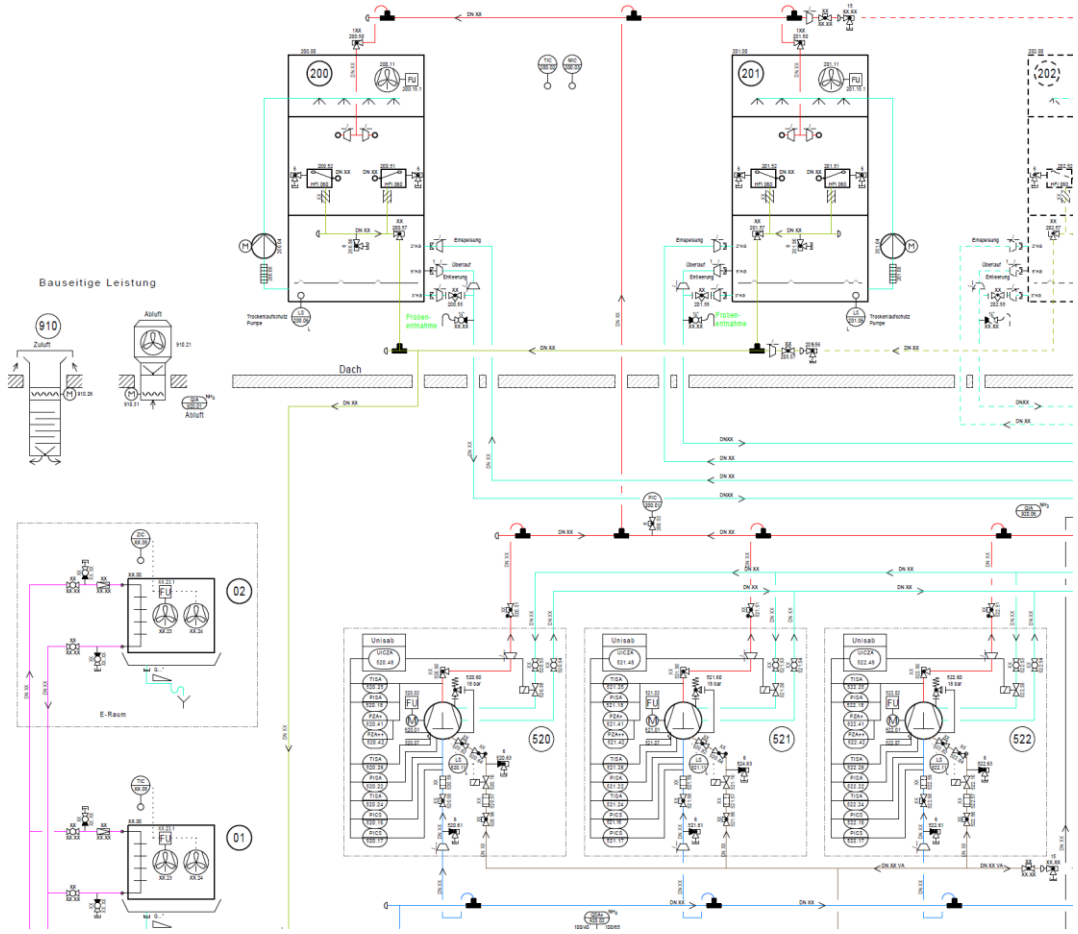

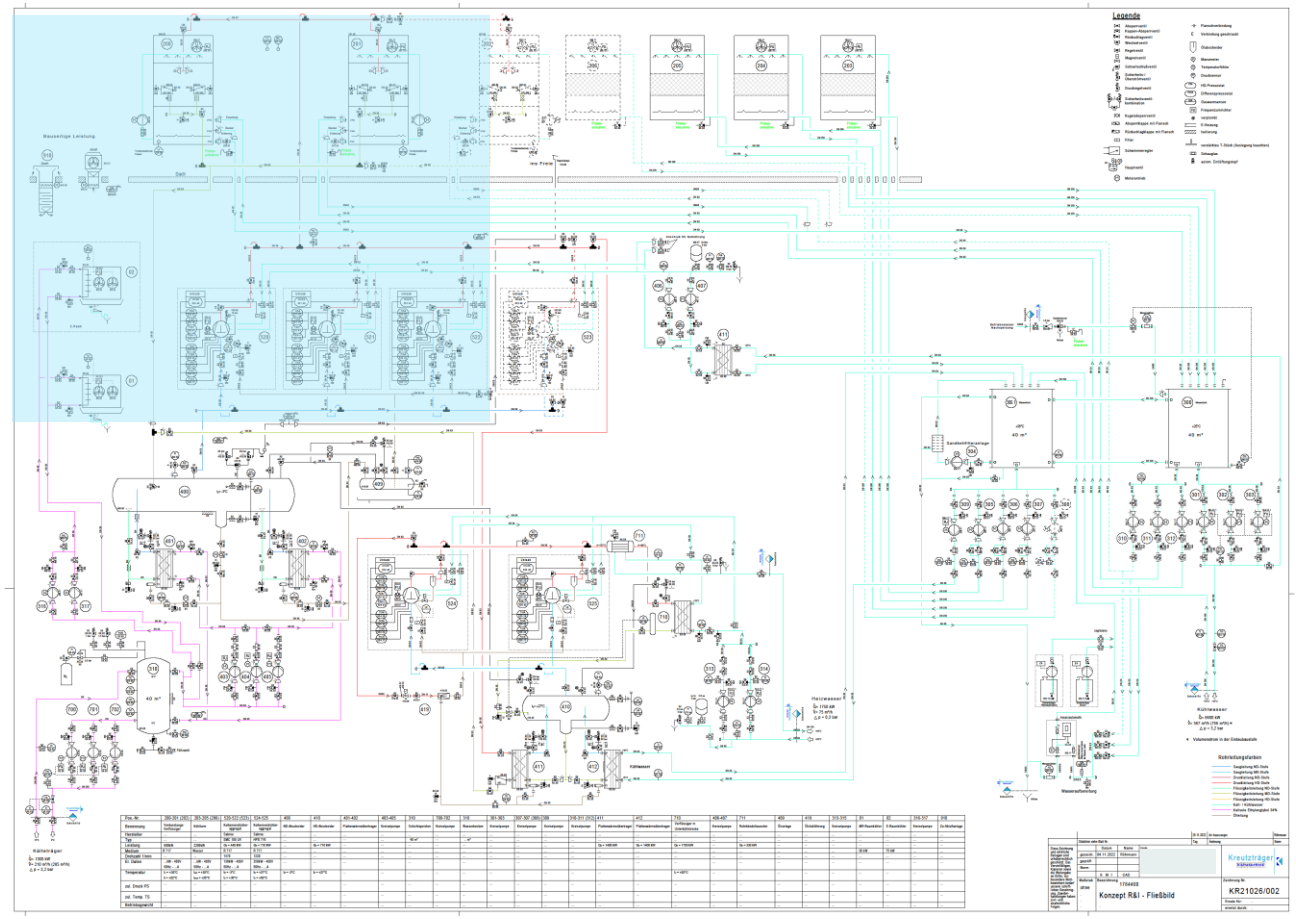

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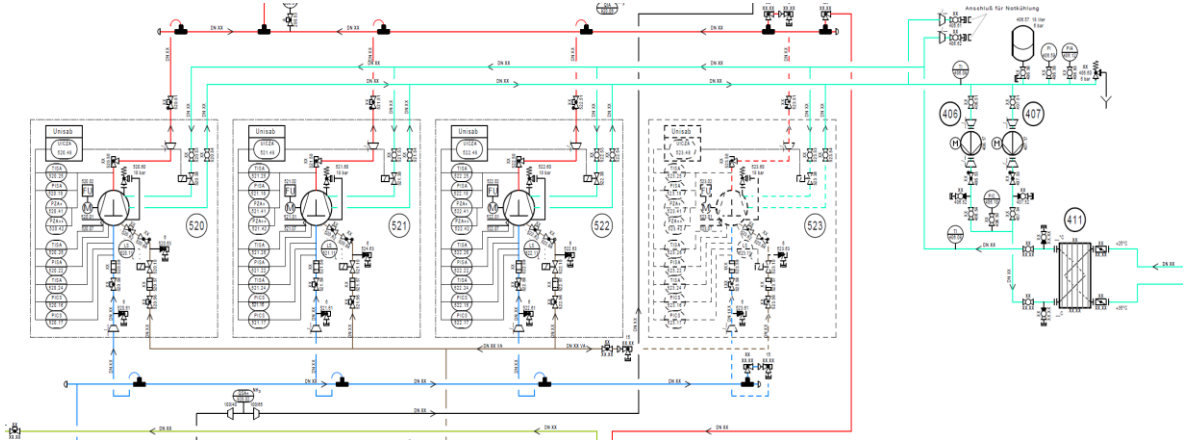

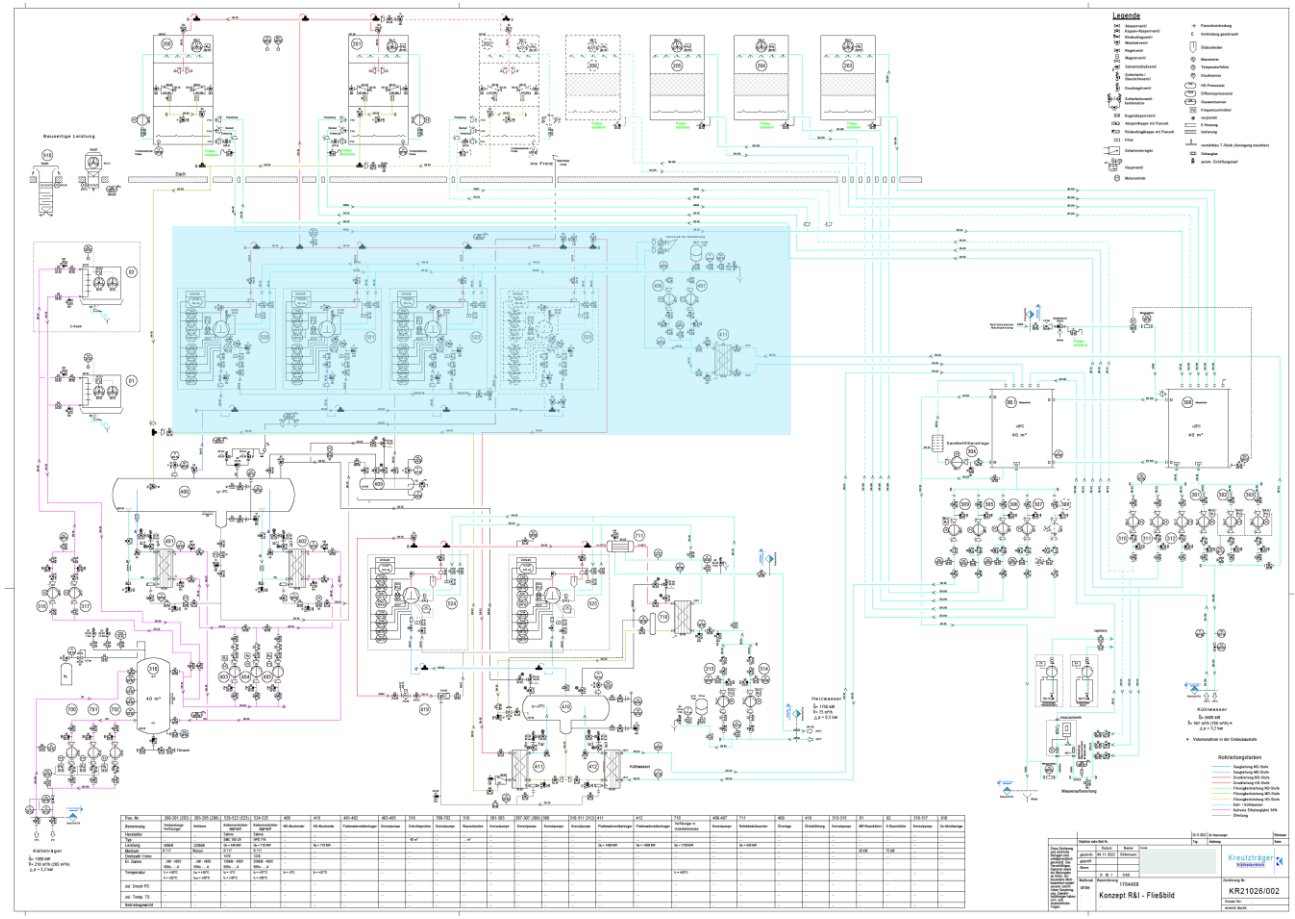

Real-world examples

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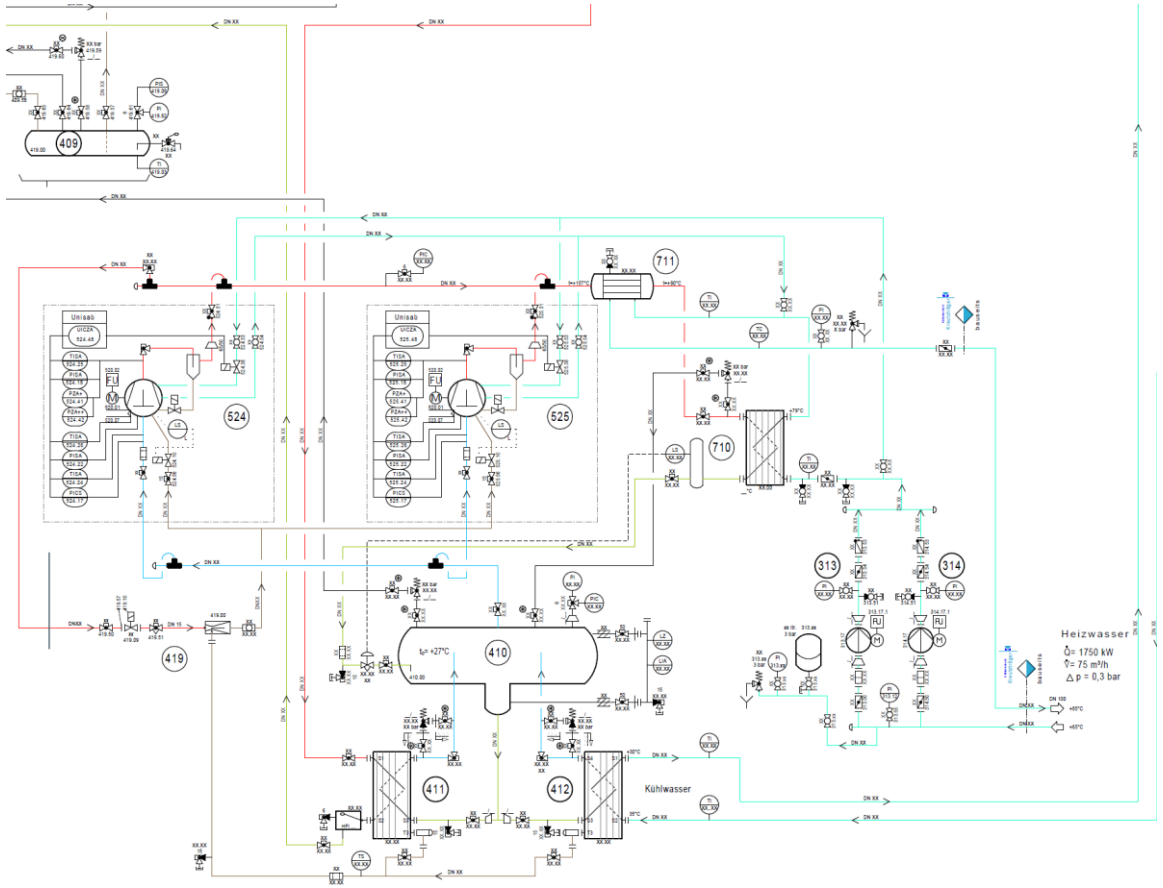

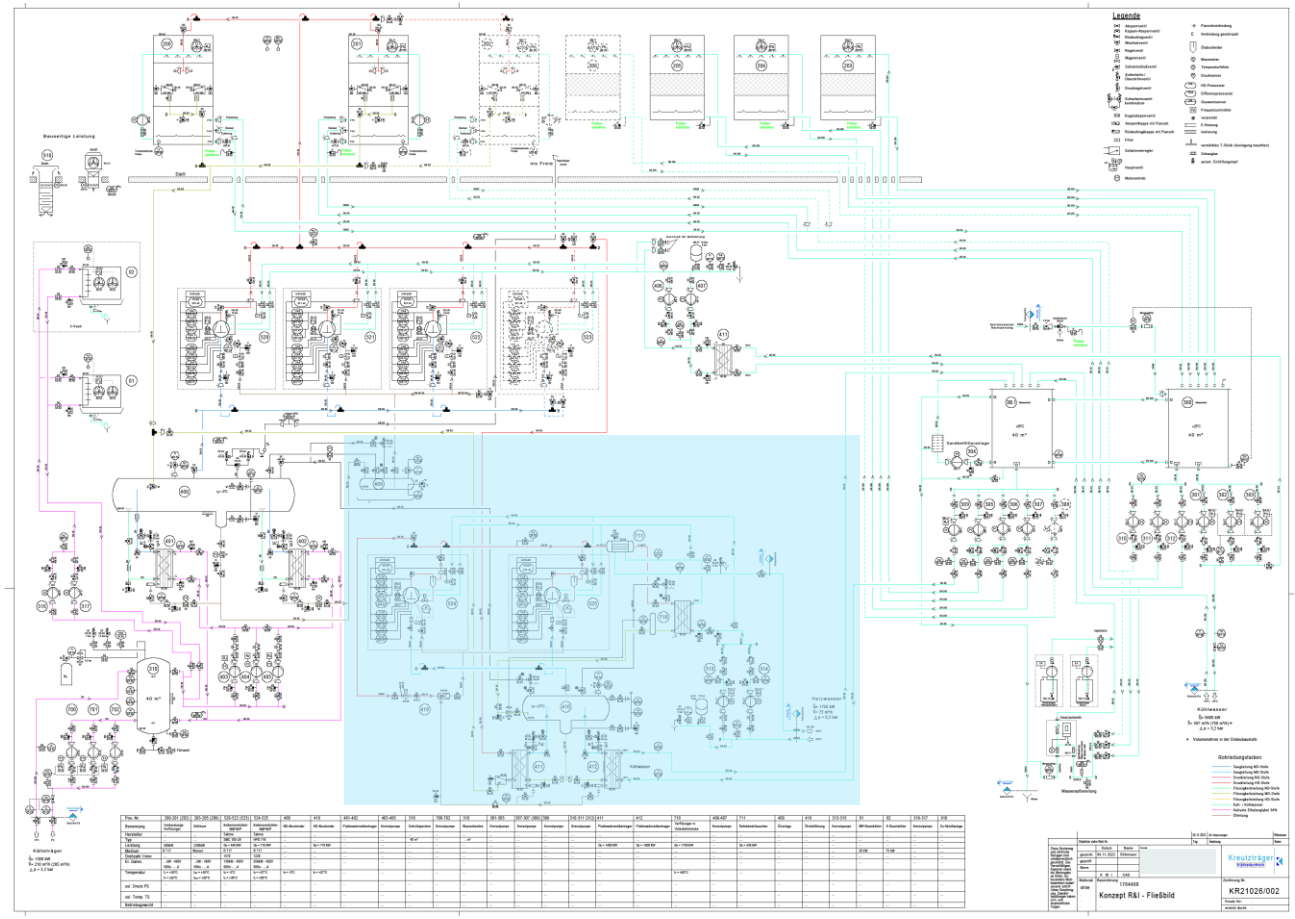

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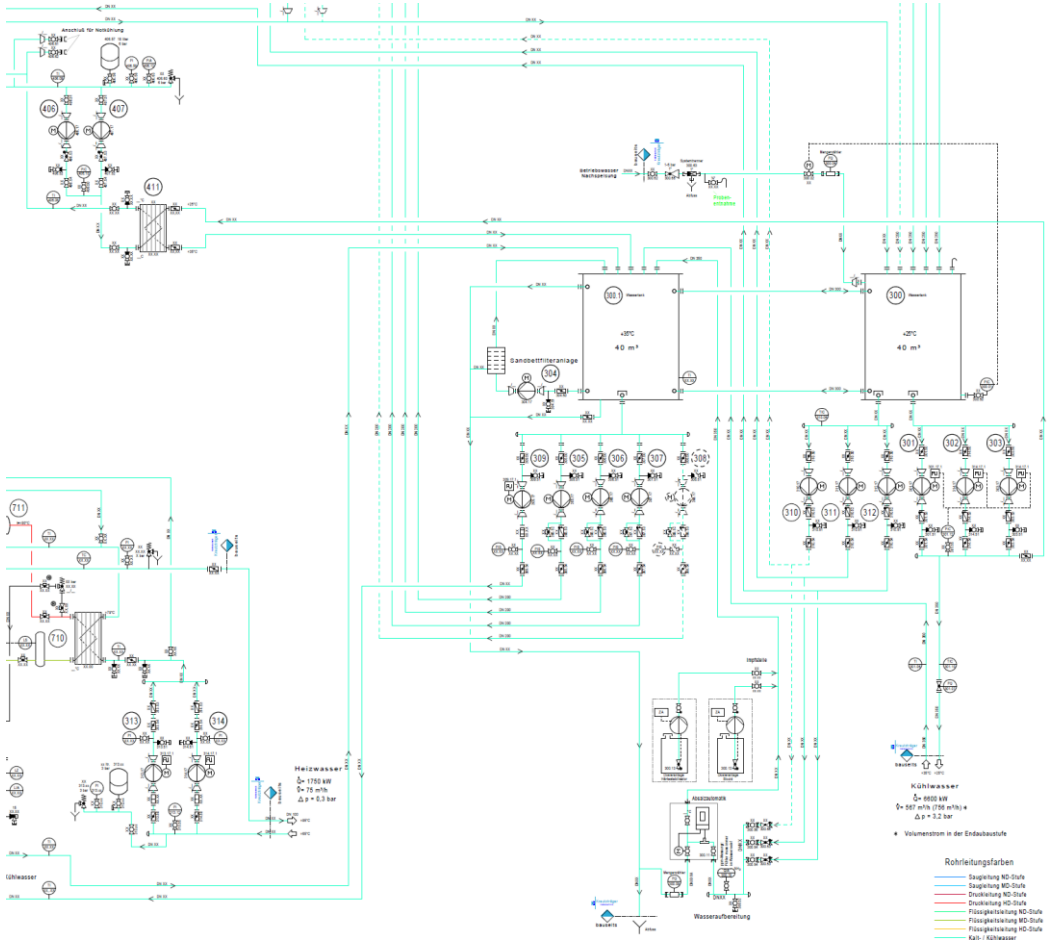

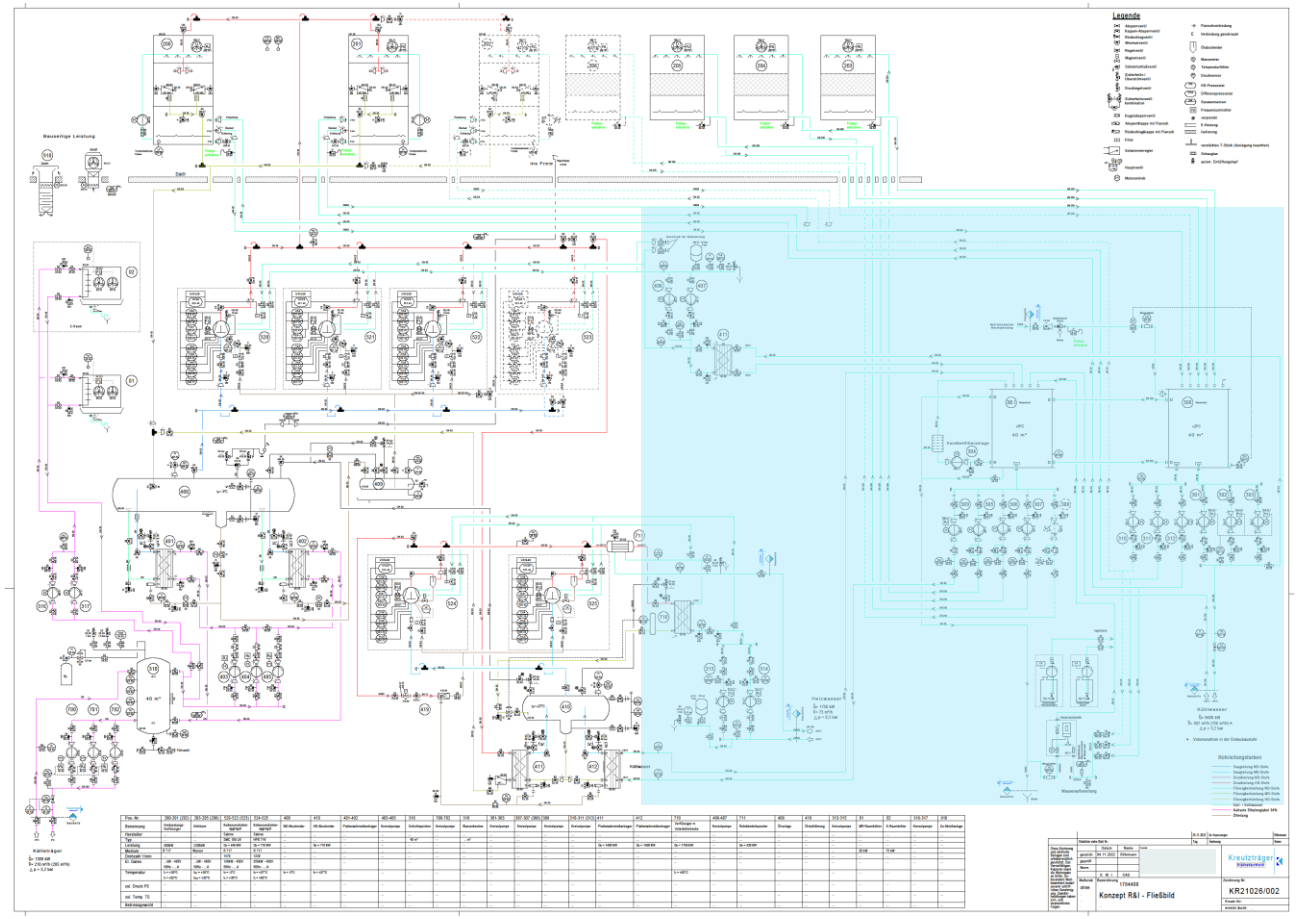

Summary

- Simple Heat-Pump concepts by using standardized chiller and heat pumps of suppliers.
- Individual concept require know-how by design, realizing and operation.
- For standard requirements are existing optimized solution on the market.
- The Efficiency of a full load heat pump is independent of the interstage temperature.
- Be careful by selection of tm when the heat pump is designed for a part of the waste heat.
- It is simple to integrate a desuperheater and a heat pump in an existing refrigeration plant.
- Energy storage on cold and warm side reduces electricity costs and increase flexibility.
- Individual heat pump concepts allow optimal adaptation to the requirements.
- NH_3 heat pumps offer a wide range of applications up to currently approx. 95°C hot water.

Questions

- Are any points unclear to you?
- Any more questions?

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

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