ROTATION HEAT PUMP

ecop

COP tests of a Rotation Heat Pump

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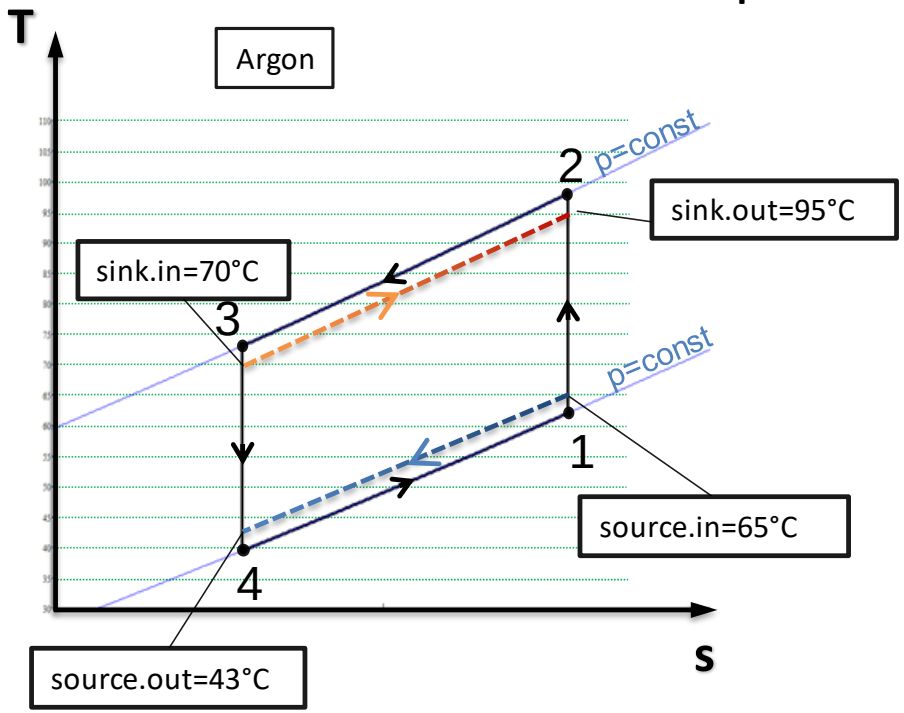
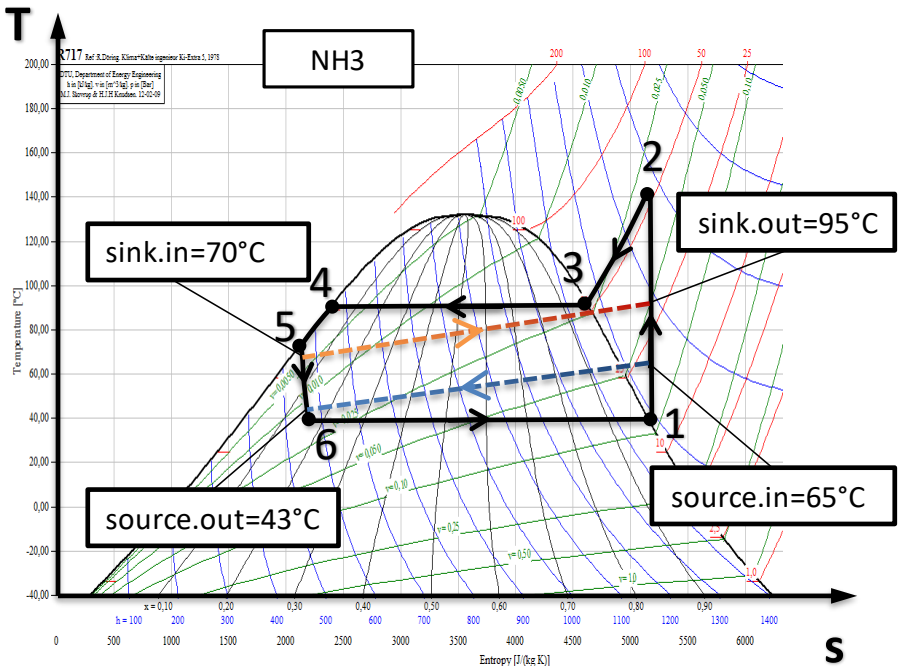
Agenda

- Technology Explanation
- Product
- results of COP Tests
- Applications
- Outlook
- About ecop

The joule process reach higher COP compared to 2-phase process

comparison of 1- and 2- phase process





$$COP = \frac{h2 - h3}{(h2 - h1) - (h3 - h4)} = 10.3$$

case 1

sink 70°C to 95°C

source 65° to 43°C

$$COP = \frac{h2 - h5}{(h2 - h1)} = 6.05$$

High efficient compression of RHP makes Joule-process economical

Case 1

- Sink 70/95 and Source 65/43

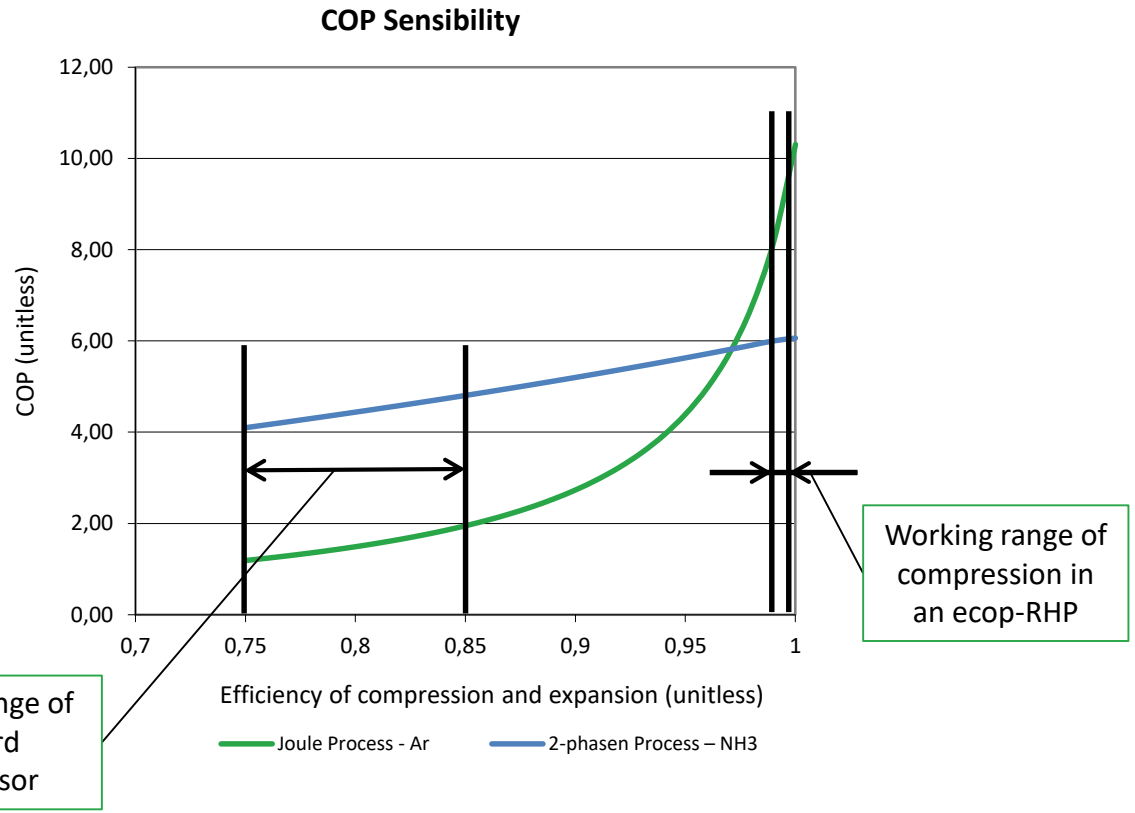
Compression with 100% efficiency @ 1MW heat transferred

	Joule Process – Ar	2-phase Process – NH3
P.compression in kW	1.319	165
P.expansion in kW	1.222	-
Net-power	97	165
COP	10,3	6,1

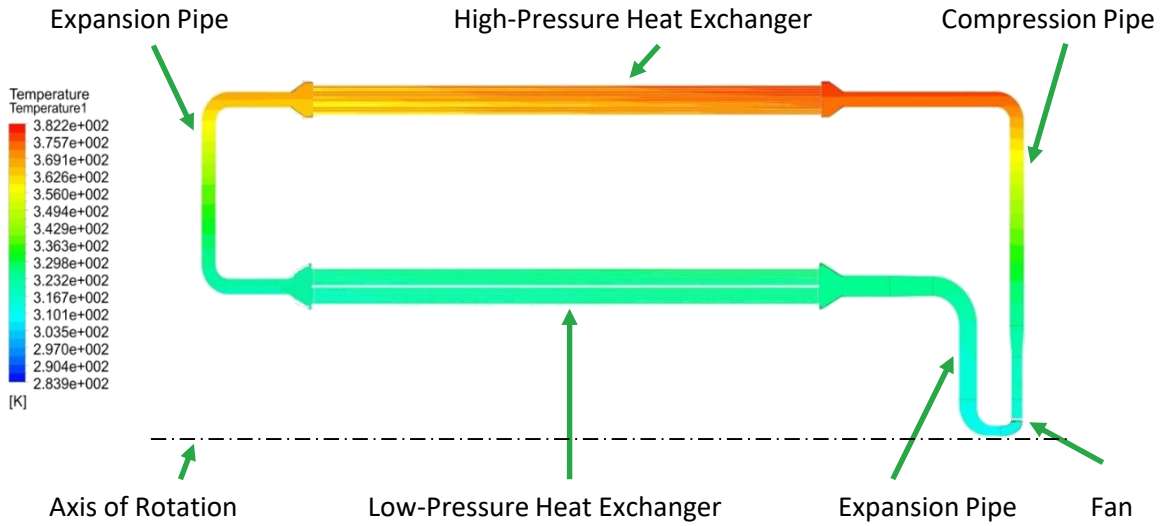
Compression with 80% efficiency @ 1MW heat transferred

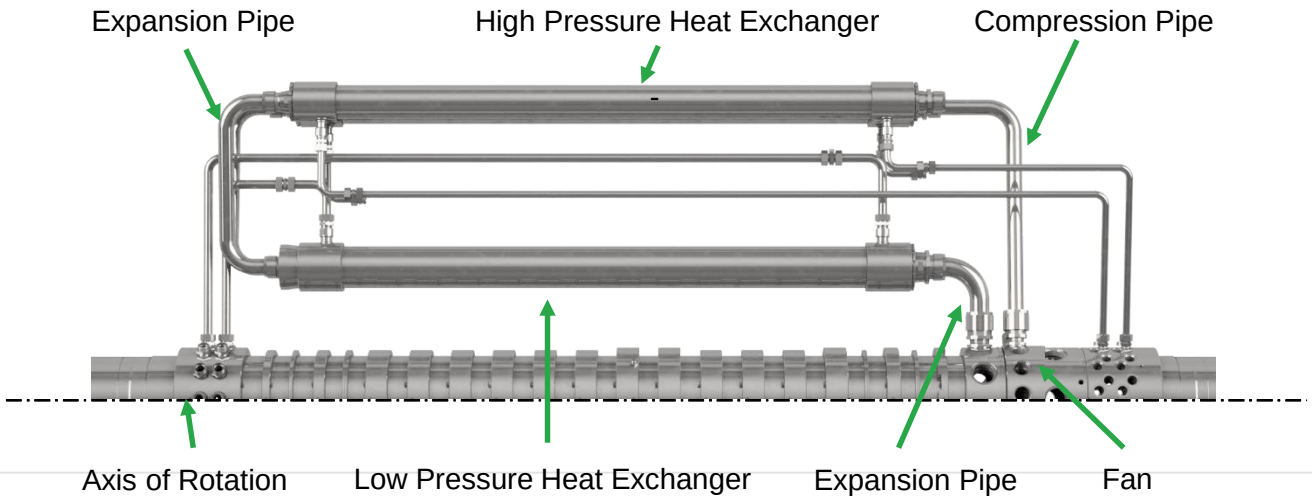
	Joule Process – Ar	2-phase Process – NH3
P.compression in kW	1.649	207
P.expansion in kW	1.222	-
Net-power	427	207
COP	2,3	4,8

Consequence of losses for simplified approach

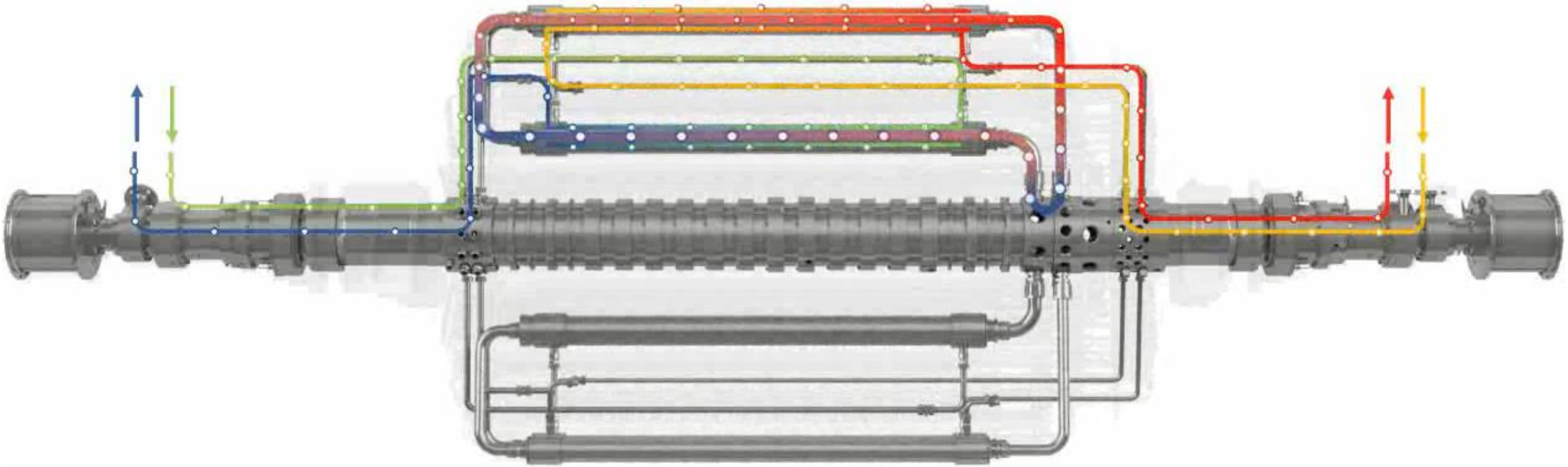


Function of patented ecop-technology

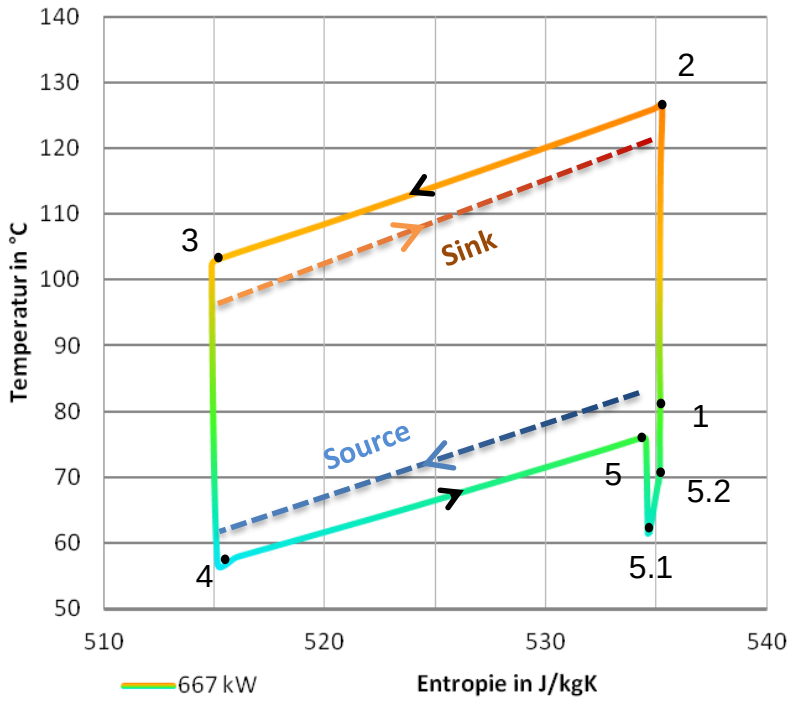


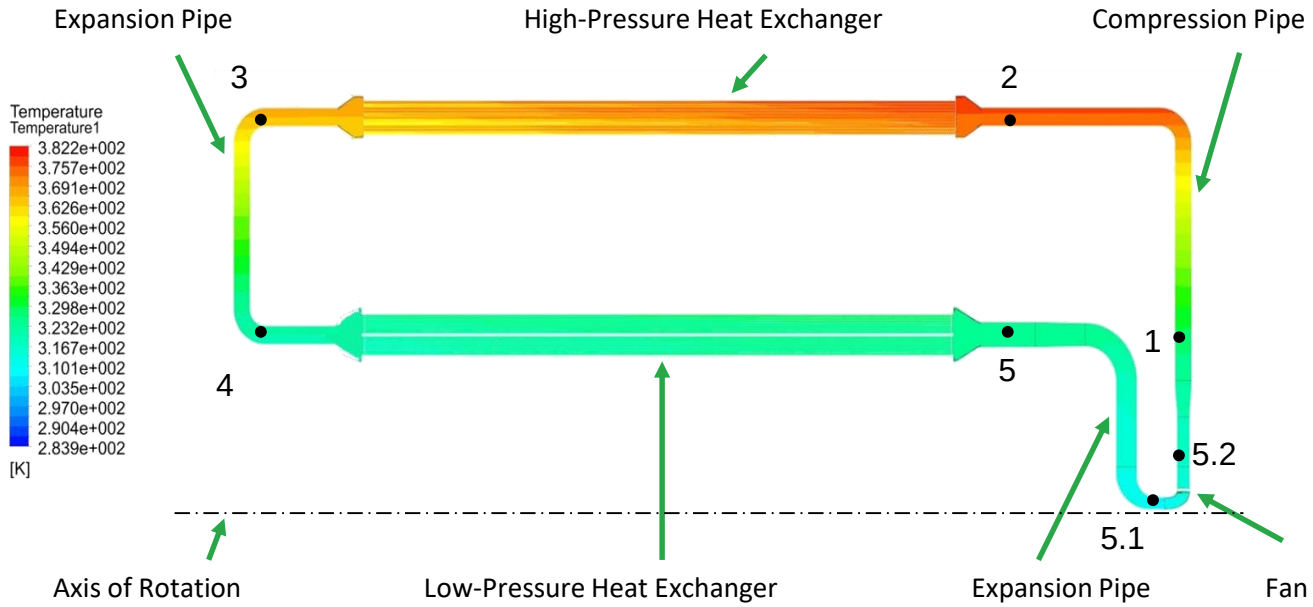


Function of patented ecop-technology



The Joule process within the Rotation Heat Pump





Recent product – The ROTATION HEAT PUMP K7 (RHP K7) in numbers

- Net power: 700 kW_{th} (400-800 kW)
- Max. ΔT between Source in and Sink out: 40°C
- Flexible In- and Outlet temperature
  (Source -20°C to +110°C, Sink 0°C to +150°C)
  → Temperature range -20°C to 150°C
- Temperature spread up to 70°C (Source out to Sink out)
- Flow rate: 21 m^3/h / 0,5 bar pressure drop

Reference system @ customer

- Operation of a biomass power plant which supplies surrounding municipalities with district heating
- Source: waste heat from CHP system
- Summer operation: Direct supply to district heating at 95°C
- Winter operation: preheating for boiler

Advantages & strengths of RHP

Disruptive rotation technology (61 patents) for up to 100% more efficiency

Flexible input and output temperature (source -20°C to +110°C, sink 0°C to +150°C)

High temperature output (up to +150° Celsius)

Nontoxic, non-flammable working-fluid with zero global warming potential

Product from the shelf – easy to operate

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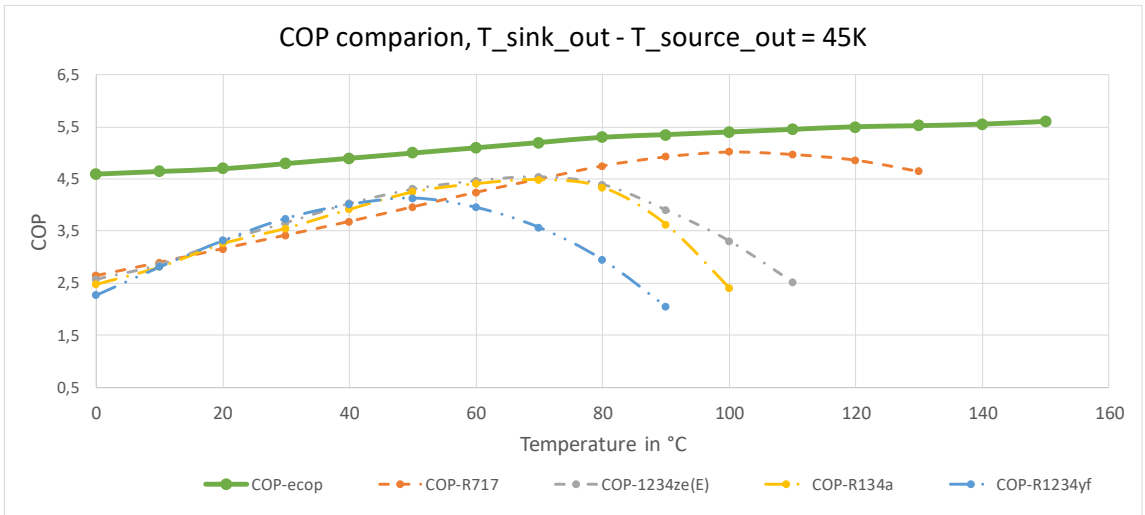
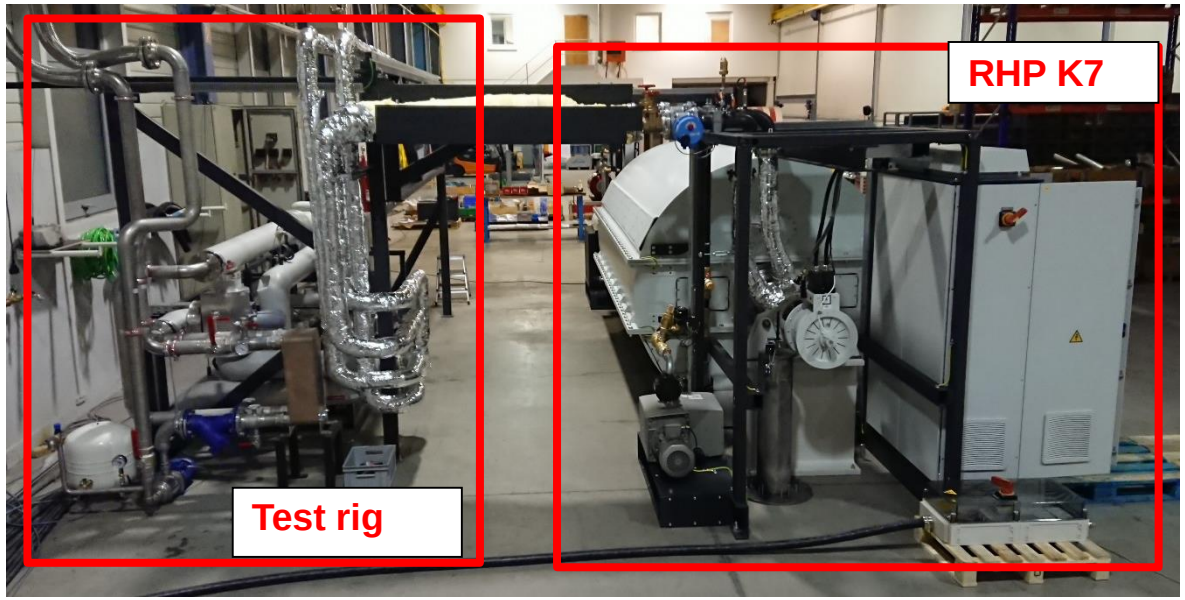
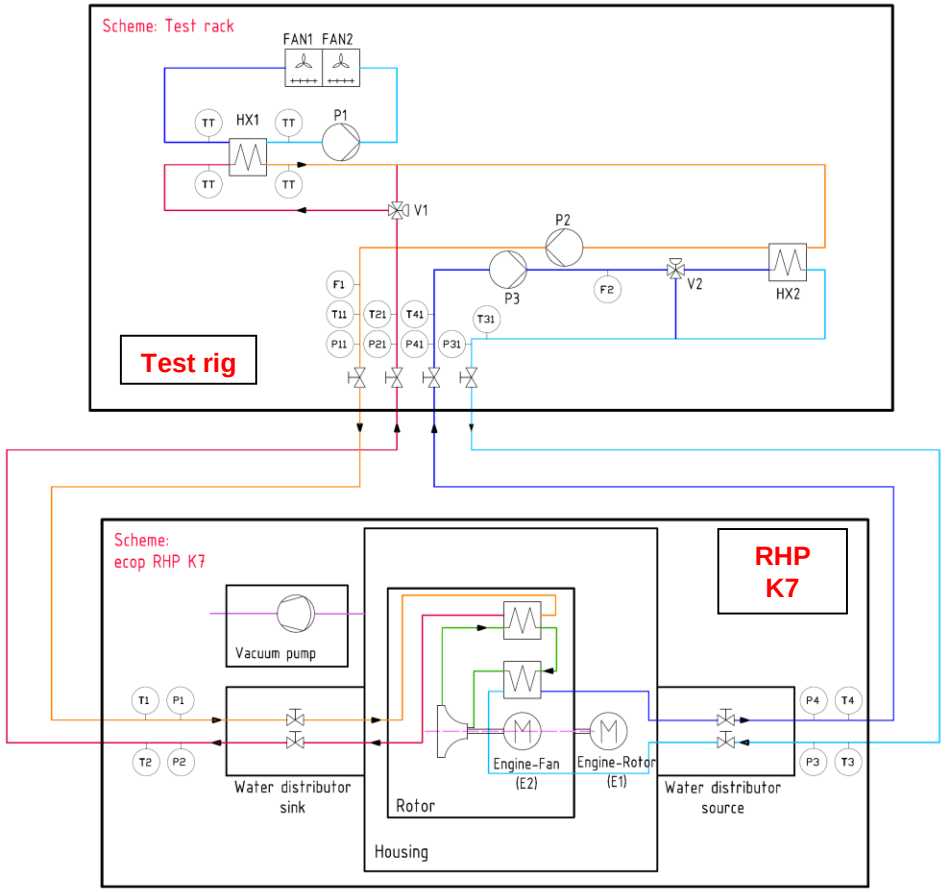


Test setting – schematic

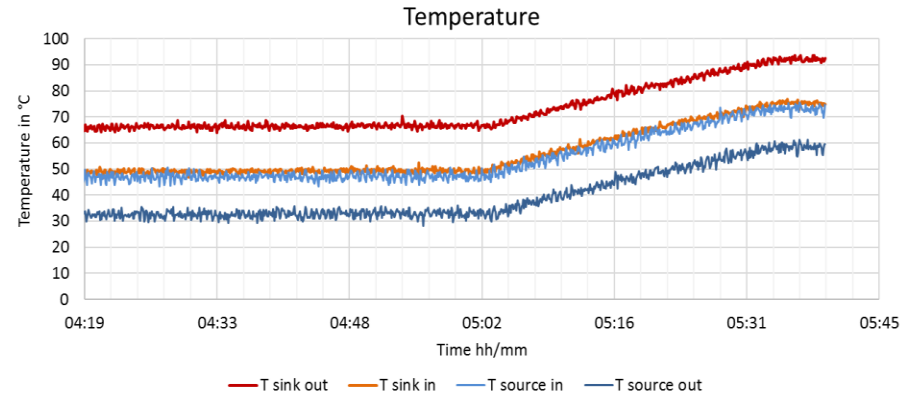


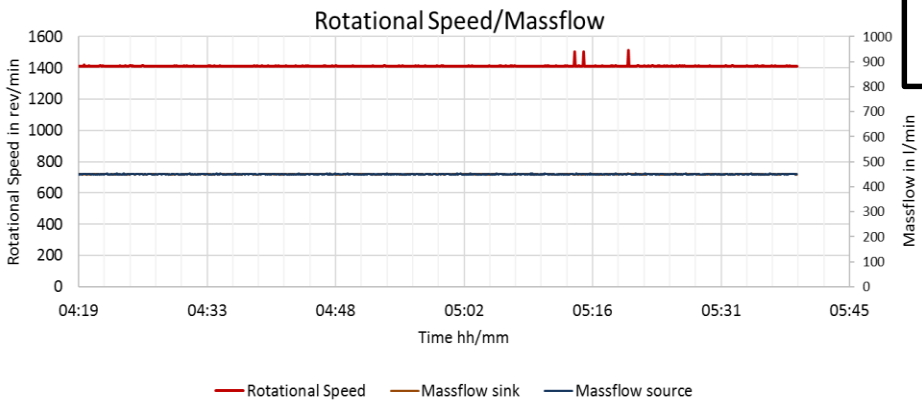


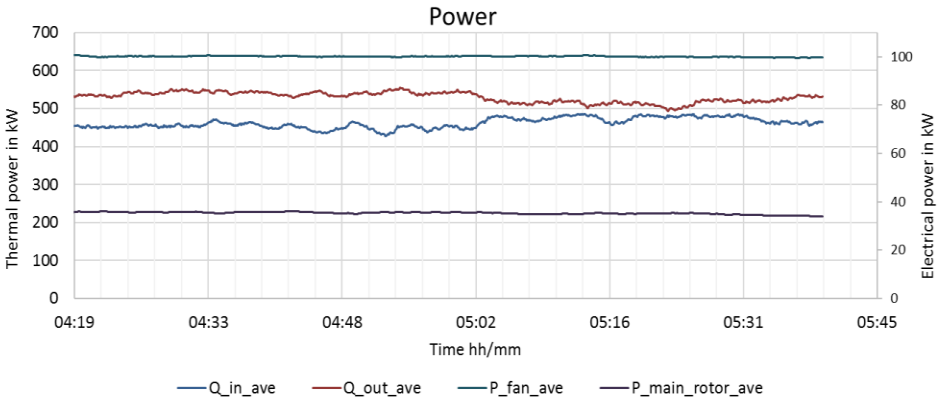
Test results – constant COP at rising temperature

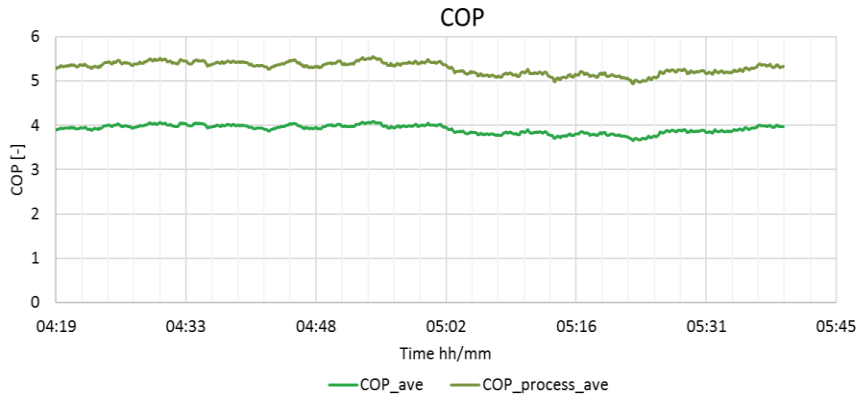
Confirmed by

Fraunhofer ISE



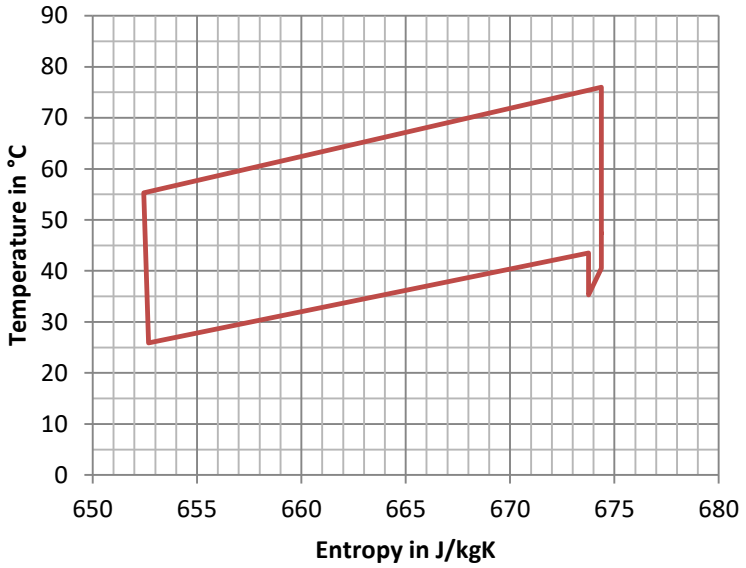






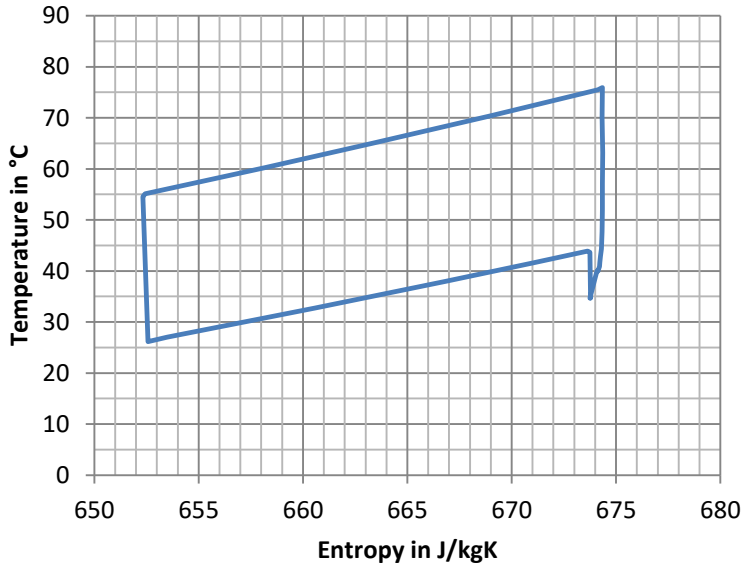
Heat transferred at sink: **540 kW**

1D-Analyses



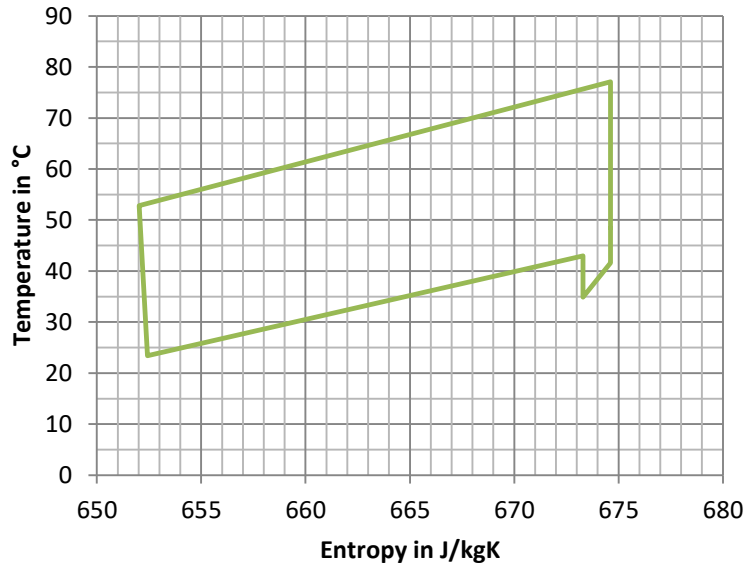
COP-Process = 7,2
COP-RHP = 5

CFD



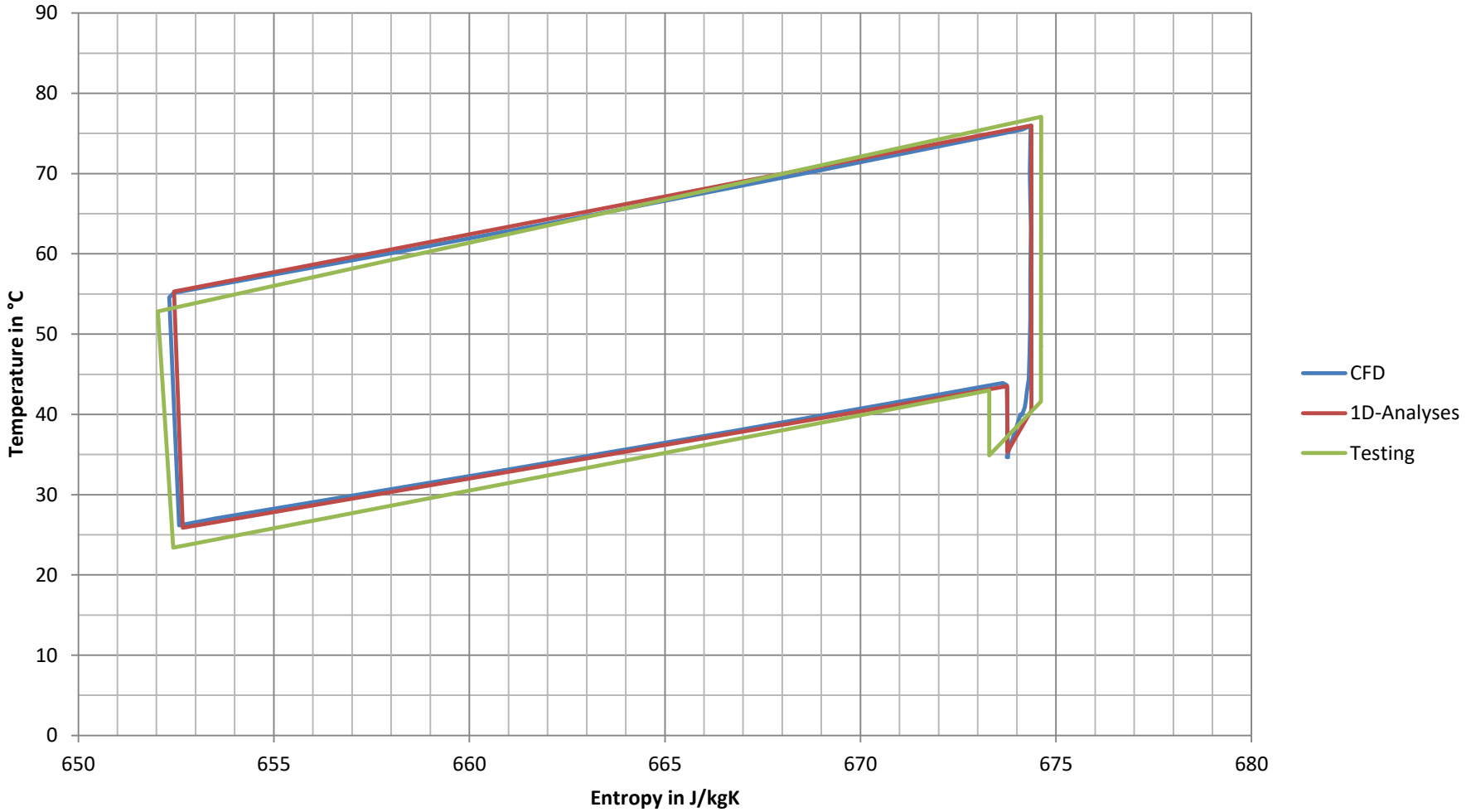
COP-Process = 7,4
COP-RHP = 5,1

Test



COP-Process = 5,4
COP-RHP = 4

Heat transferred at sink: **540 kW**



RHP fullfills requirements of most branches and processes

Use cases, where the product properties fits best and generates the greatest advantage for the customer:

- *Branches*
  - Pulp & Paper
  - Building materials
  - Food industry
  - Chemical industry
  - District heating
  - District cooling
  - Centralised air-conditioning
- *Processes*
  - Drying (bricks, wood, etc.)
  - Pasteurisation
  - Distillation
  - Air-conditioning

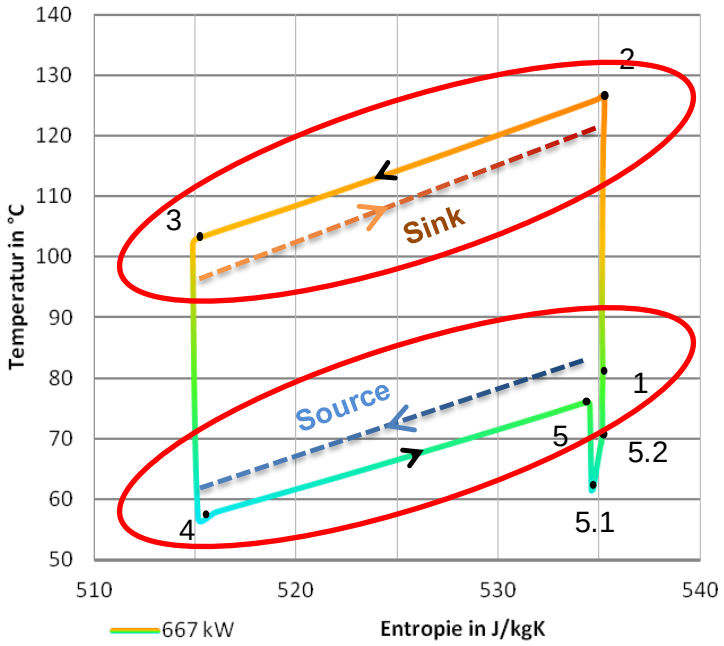
Special requirements of customer:

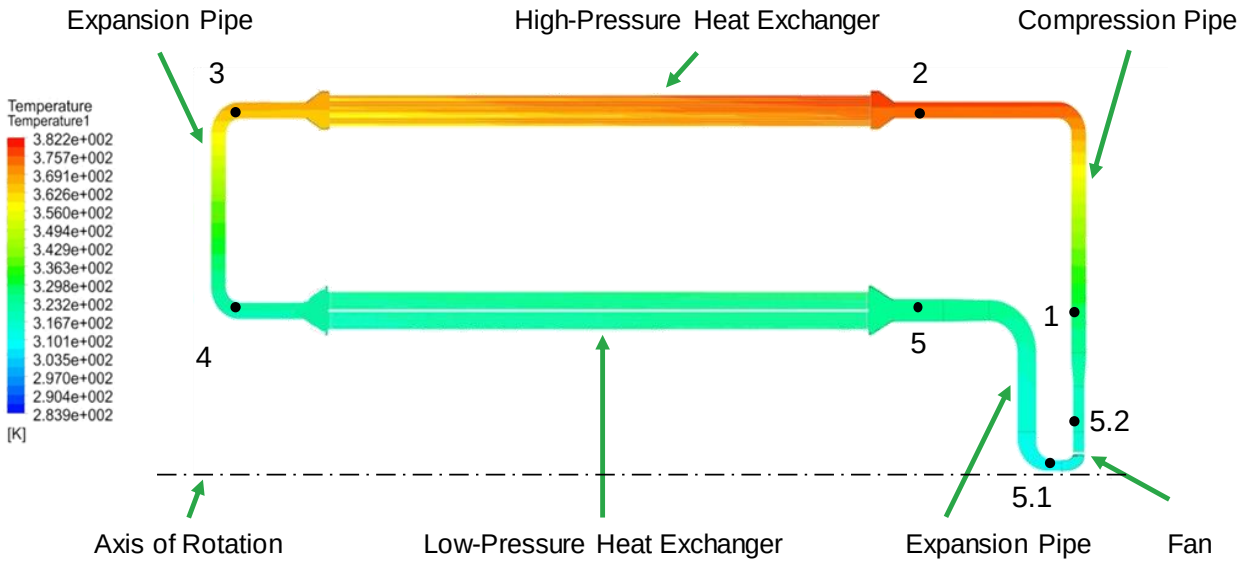
- High temperatures (up to 100-150°C)
- Use of waste heat
- Fluctuating Inlet- and Outlet-Temperature
- At consistent high COP

RHP fulfils all those requirements!

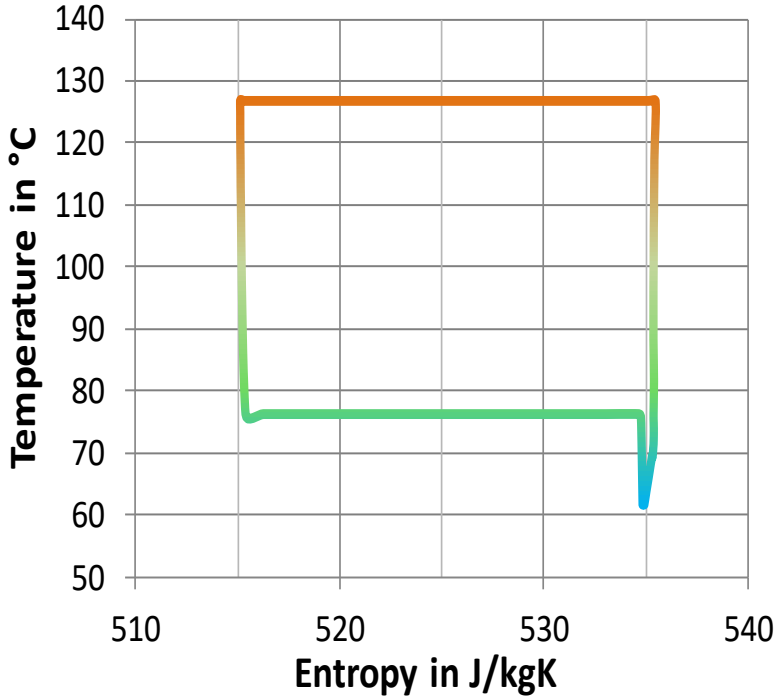
Is the Rotation Heat Pump possible for every application?

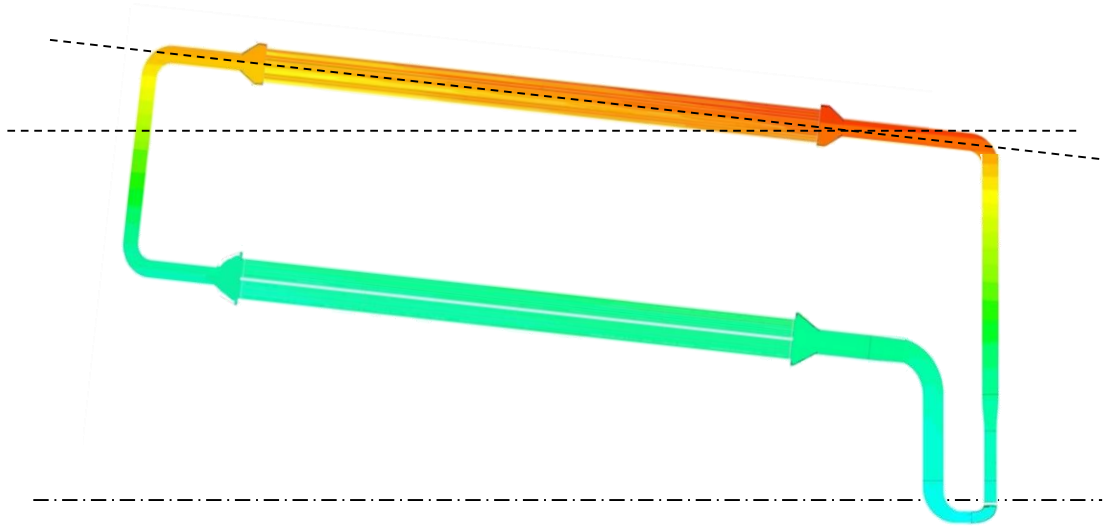
– Problem: sensible heat transfer is a barrier for applications where latent heat is needed





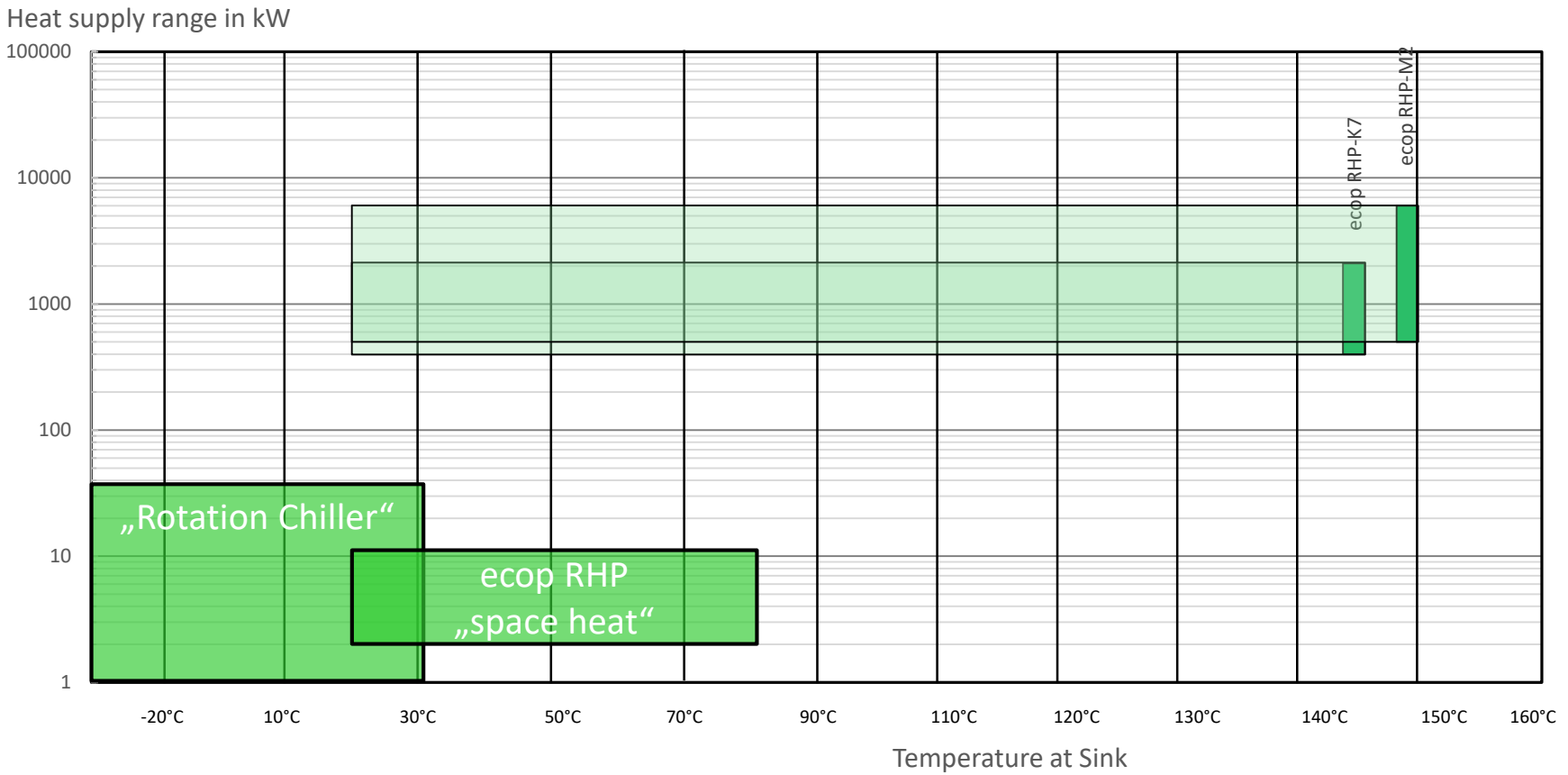
Maximum physical possible COP for every application due to additional DOF! (by tilting the heat exchanger to compress and expand during the heat exchange)





Process similar to Carnot

Is the Rotation Heat Pump possible for every application?



Technical feasibility is confirmed

- Venture Capital backed company
- Founded: 2011
- Located: Vienna (F&E)
  Neuhofen (Production)
- Employees: 16
- Patents: 4 patent families including 66 international granted patents

Prizes & Awards

- State award Energy and Environment 2018
- European Business Award for the Environment (EBAE) 2018
- Finalist state award of innovation (VERENA)
- Daphne, Mercur (innovation award), ÖGUT, ..

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Network & Partners

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