



Decarbonizing the Pulp & Paper Industry with Industrial Heat Pumps

Unlocking Efficiency, Competitiveness and Climate Impact with HEATEN

15.04.2026



Why Heat Pumps Matter for Paper Mills



70%

*of all energy consumed in a paper mill goes into drying alone
— the single largest lever for decarbonization (IEA, [iea.org/energy-system/industry/paper](https://www.iea.org/energy-system/industry/paper))*

340 TWh

Annual energy demand
of the paper sector in Europe
(Eurostat 2021)

4% / year

Rate of energy efficiency improvement
needed by 2030 – COP28 target
(IEA Energy Efficiency 2025)

> 50%

Of process heat in European paper mills
could be supplied by heat pumps
using on-site waste heat
(IEA / CEPI–EHPA Working Group)

Agenda

- **HEATEN – Who we are**

Company background & strategic partnerships

- **Industry Challenges**

Energy cost pressure, decarbonization targets & waste heat potential

- **HeatBooster Technology**

Unique piston compressor, temperature range & competitive advantages

- **Application**

Paper mill use cases & real-world demo project

- **Way forward**

Step-by-step decarbonization & next steps

16 YEARS OF DEVELOPMENT



Concept Development

2011-2012

- › **Development of Single Cylinder ORC Heat Engines for up to 215°C**

2013-2015

- › Worldwide commercial deployment of demonstrators
- › Gaining operational experience with refrigerants and lubrication

Technology Development

2016 – 2017

- › Enhancement of technology

2018-2019

- › **Commercial installation of Heat pumps one-cylinder (now running for more than 50,000h each)**

2020

- › Acquisition of Viking IP, inventory and team by HEATEN

Product Development

2022-2023

- › Product specification for HBL4 and HBL16
- › Product development for HBL4

2024

- › **Acquisition of HEATEN by Advent & Strategic Partnership INNIO**

2024-2025

- › Testing on test bench and in field
- › Stabilization of HBL4
- › Concept study 2-stage conducted
- › Serialization of HBL4 incl. variants

Portfolio Development

2025

- › **Commercial roll out**
- › **Product development for HBL16**
- › **Invest in test infrastructure Jenbach for HBL4 & HBL16**

2026-2027

- › HBL16 testing on test bench and in field
- › Launch of HBL4 2-stage
- › Launch of HC's products

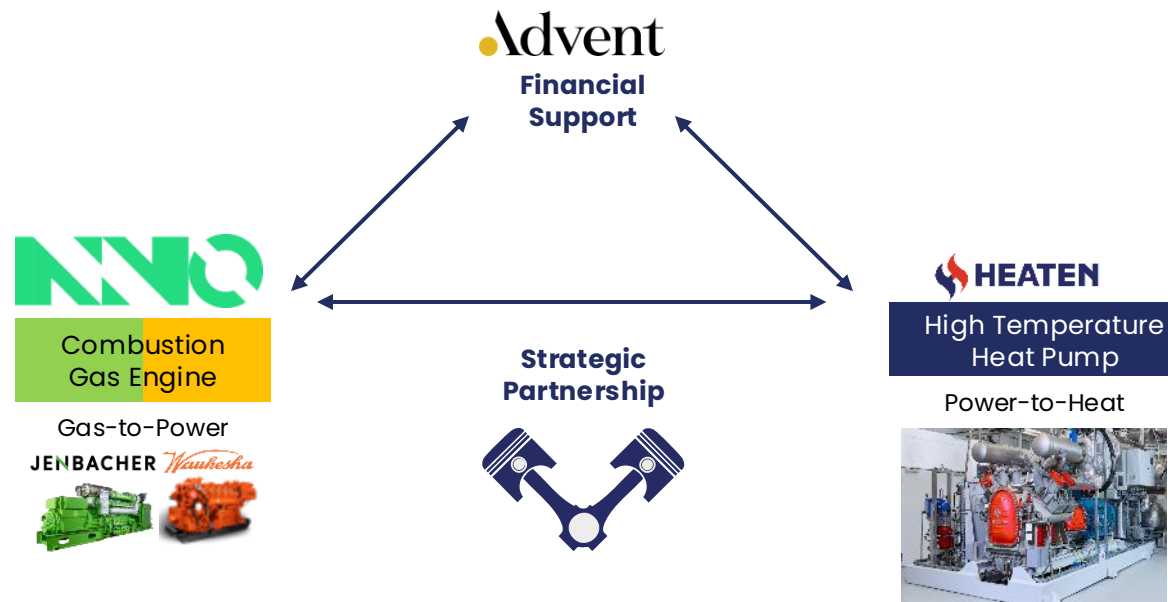
2028-2029

- › Launch of HBL16 2-stage
- › Standardization



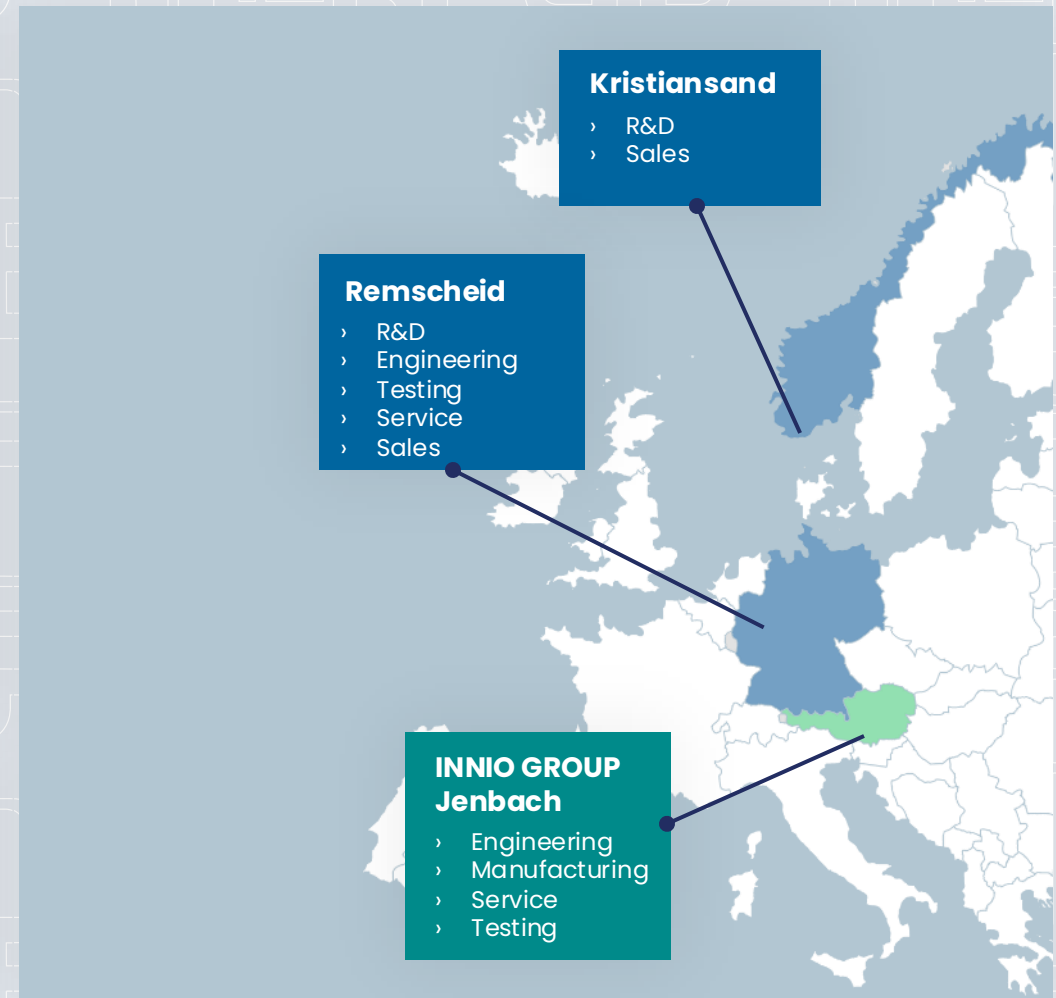
STRATEGIC PARTNERSHIP

between INNIO and HEATEN



INNIO has delivered more than 59,000 engines globally

- › Through a team of more than 4,500 experts
- › And a service network in more than 100 countries

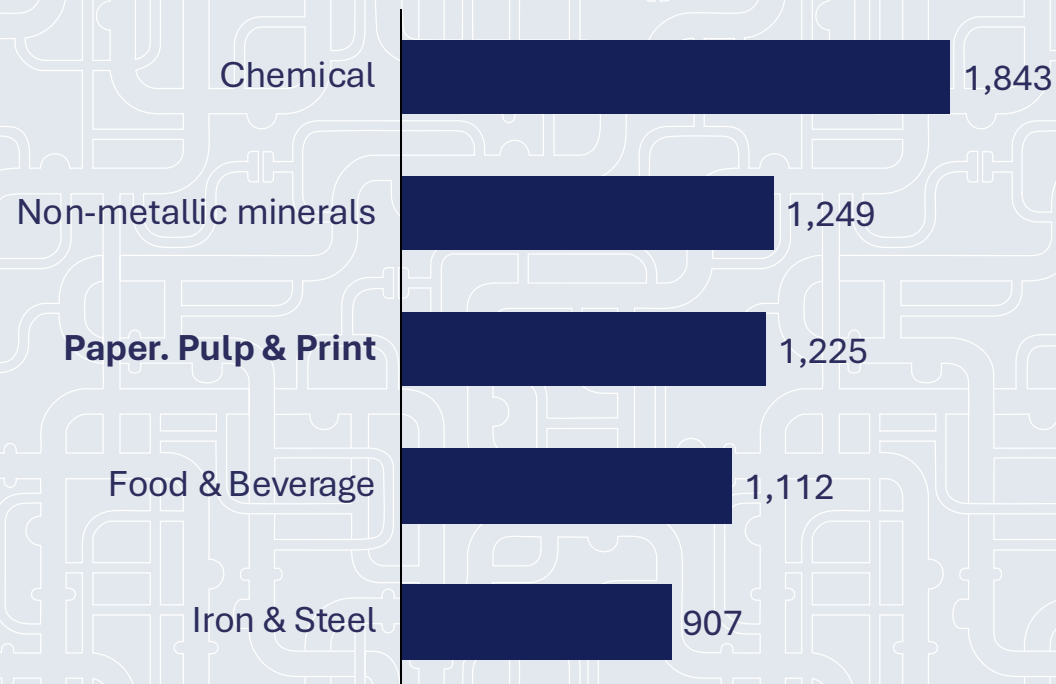


Energy Challenge in the Paper Industry



The sector with the highest electrification potential faces mounting cost pressure

Final Energy Use by EU Industry Sector, 2023 [PJ]



Eurostat, „Final energy consumption in industry – detailed statistics“, Daten extrahiert Juli 2025

Highest Electrification Potential

Pulp & Paper is among the top EU industrial energy consumers — paper, pulp & printing rank in the top 3 alongside chemicals (Eurostat 2022 / JRC 2024)

Energy = 20–30% of Production Costs

Energy reached up to 30% of operating costs for selected European mills in 2008; thermal energy is the dominant component (CEPI 2008 / Springer Energy Efficiency 2012)

COP28 Target: 4%/year Efficiency by 2030

Nearly 200 countries agreed to double the global efficiency improvement rate from ~2% to 4%/year by 2030 — industry is currently off track (IEA Energy Efficiency 2025)

70% of Mill Energy = Drying

Paper production is heat-intensive: drying alone accounts for 70% of energy use in the sector — the single biggest lever for efficiency gains (IEA, [iea.org/energy-system/industry/paper](https://www.iea.org/energy-system/industry/paper))

Paper Mills Already Generate Large Amounts of Waste Heat

PROCESS HEAT DEMAND · 100 – 165°C · Steam (0–8 bar) — 70% below 5 bar (CEPI/EHPA 2023)

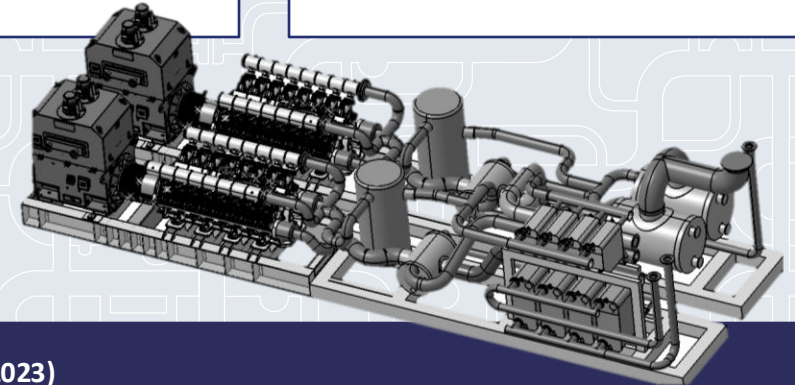
Pulping & Cooking

Washing & Bleaching

Drying & Coating

Paper Machine Section

↑ HEAT PUMP UPGRADES ↑



AVAILABLE WASTE HEAT · 20 – 60°C · Wet Air / Water (CEPI/EHPA 2023)

Dryer Hood Exhaust Air

Dewpoint 50–60°C · Latent + sensible heat

Warm Process Water

46–55°C · Continuous stream

Condensate Streams

60–90°C · Dryer cylinder condensate

Cooling Systems

20–40°C · Vacuum pumps, seal water

High-Temperature Heat Pumps by HEATEN

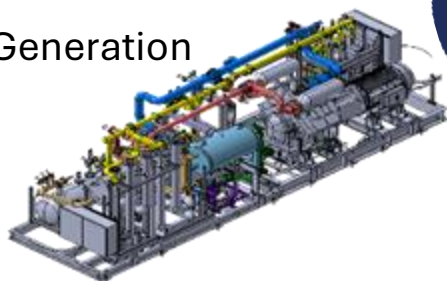


HEATEN heat pumps are specifically designed to convert industrial waste heat into valuable process energy

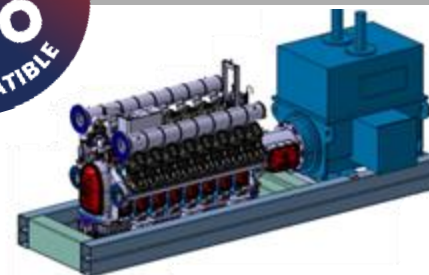
HBL4 (V4 → 1500 m³/h)
(4-cylinders)



2nd Generation



HBL16 (V16 → 6000 m³/h)
(16-cylinders)



Operating range

Temperature heat source	10-150°C
Temperature heat sink	90-200°C (HC), 90-165°C (HFO)
Thermal power range	0.8-2.5 MW _{th}

Dimensions

Length	mm	9,000
Width	mm	2,400
Hight	mm	2,500



Datasheets

Operating range

Temperature heat source	10-150 °C
Temperature heat sink	90-200 °C
Thermal power	3.2-10 MW _{th}

Dimensions

Length	mm	11,000 (2 skids)
Width	mm	2,400
Hight	mm	2,500

HeatBooster TECHNOLOGY



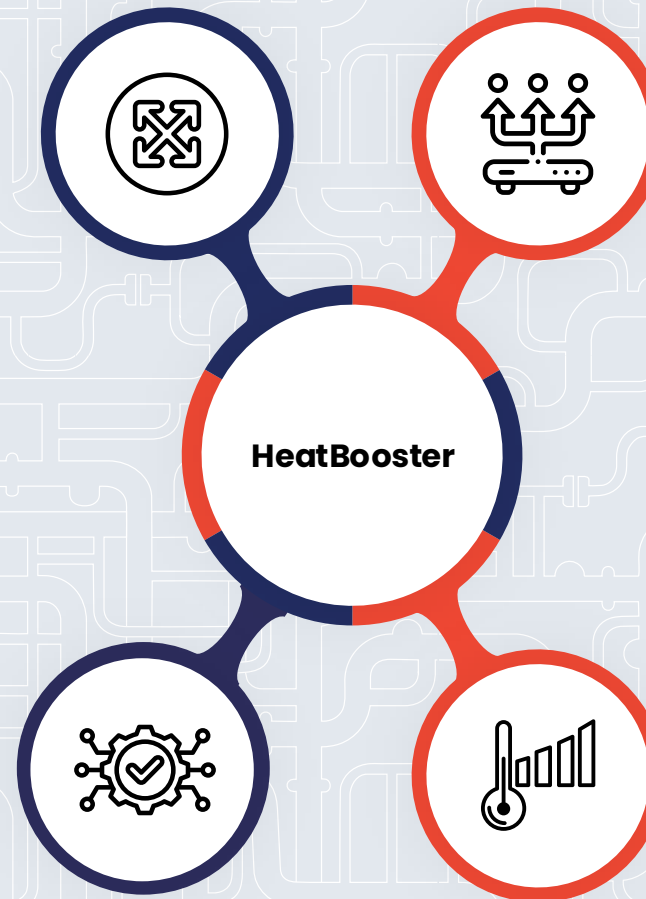
Unique Large Scale Piston Compressor – Bringing flexibility in the high MW_{th} range

Integration flexibility and modularization

- System scalability from **1 to 50 MW_{th}** + through parallel or cascaded installation
- Starting with a pilot and roll it out step by step
- HeatBooster systems can always adapt to customer needs, especially in brownfield applications

Scalability

- Standardization will be the key to reduce cost and speed-up the roll out
- Production scalability is proven by our partner INNIO
- We will leverage from service and maintenance network of INNIO



Operational flexibility (Load)

- Flexible load handling & high part-load efficiency, **even at 20% load**
- Super-fast load changes
- **Grid-balancing capability incl. in the intraday market**

Operational flexibility (Temp. range)

- The compressor is designed for 215°C
- Variable compression ratio allows
 - Different working fluids with the same Hardware
 - Operation across different temperature levels with same working fluid

Continuous progress – Status update

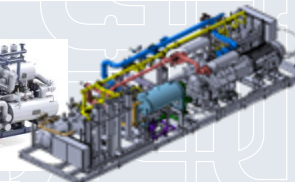
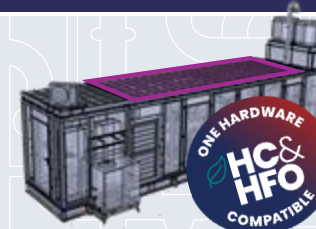
Commercial roll out started



	Testing Remscheid HBL4-W/W & Beneo	Testing Remscheid HBL4-S/S 130°C Steam	Südzucker 2x HBL4-S/S 130°C Steam	Südzucker 2x HBL4-S/S 100°C Steam	Testing Jenbach 1x HBL4-W/W 150°C Water	Plasterboard 2x HBL4-W/W Incl. Container	Dornoch HBL4-W/W 120°C	Felix Schoeller HBL4-W/S 120°C Steam
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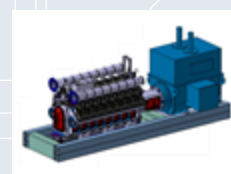
Rain



Offenau



Publish
soon



V16 Design
finalized

Testing Jenbach
HBL16

HBL16-W/W
130°C

2023

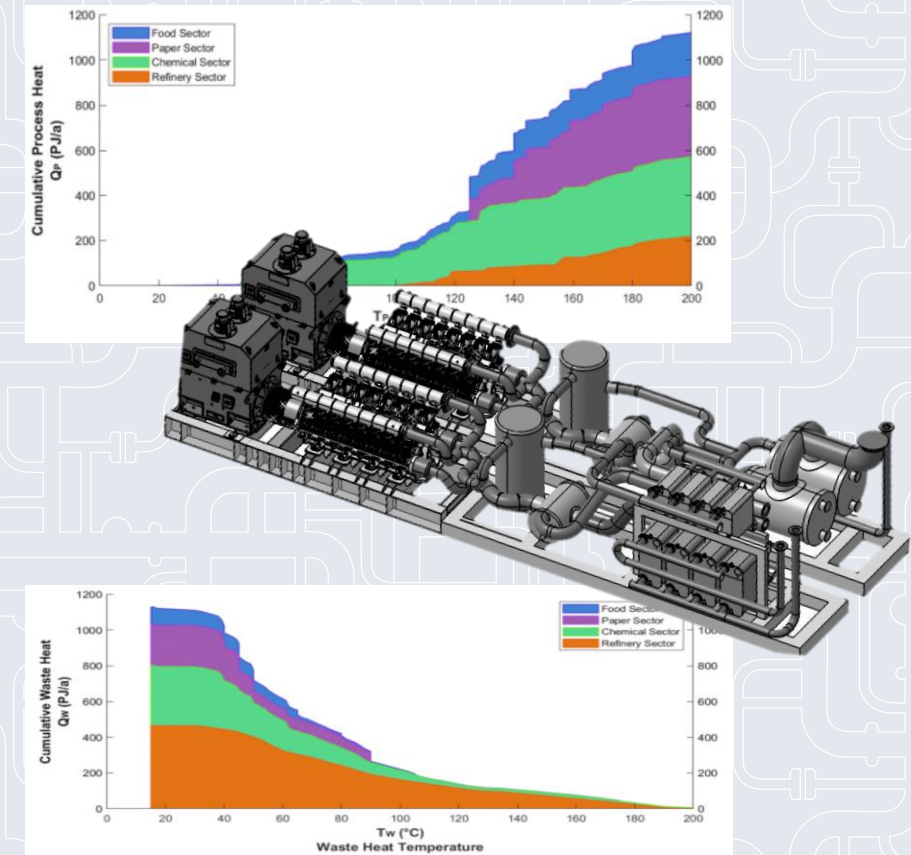
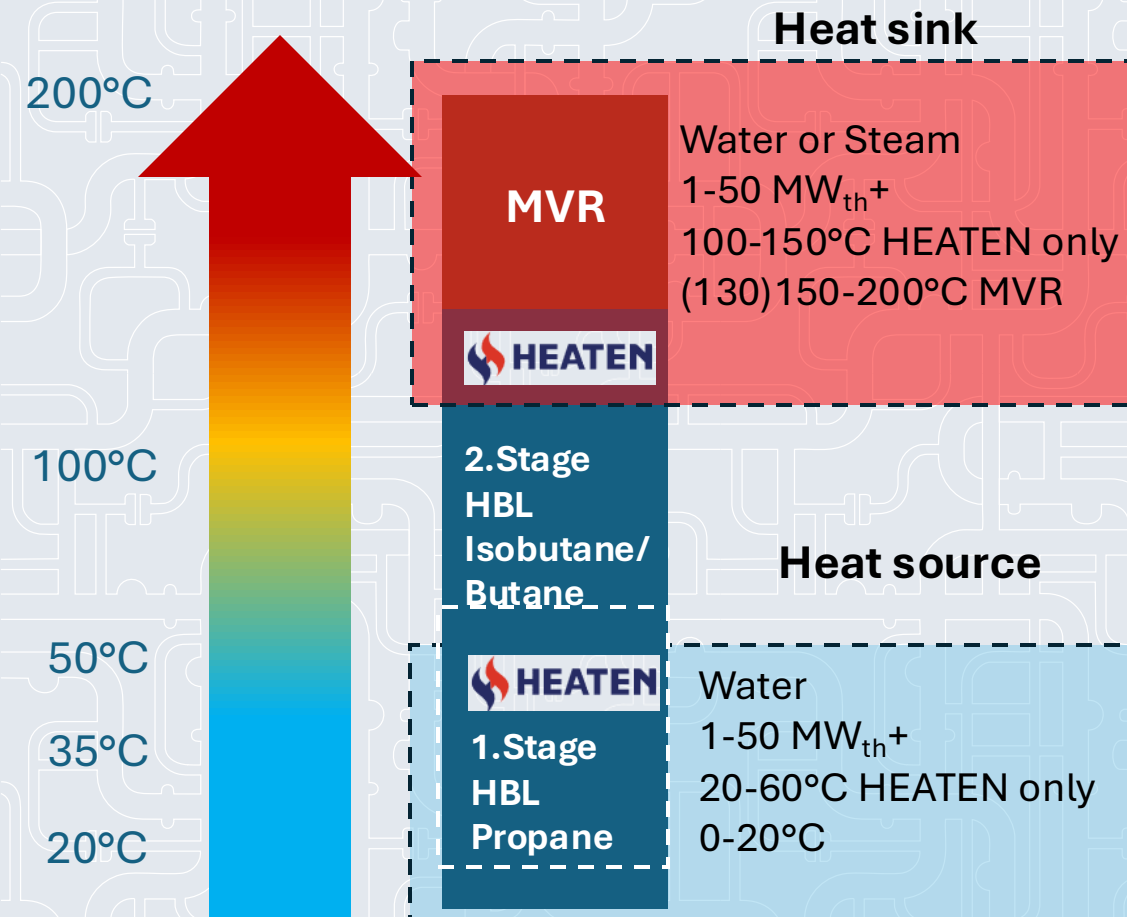
2024

2025

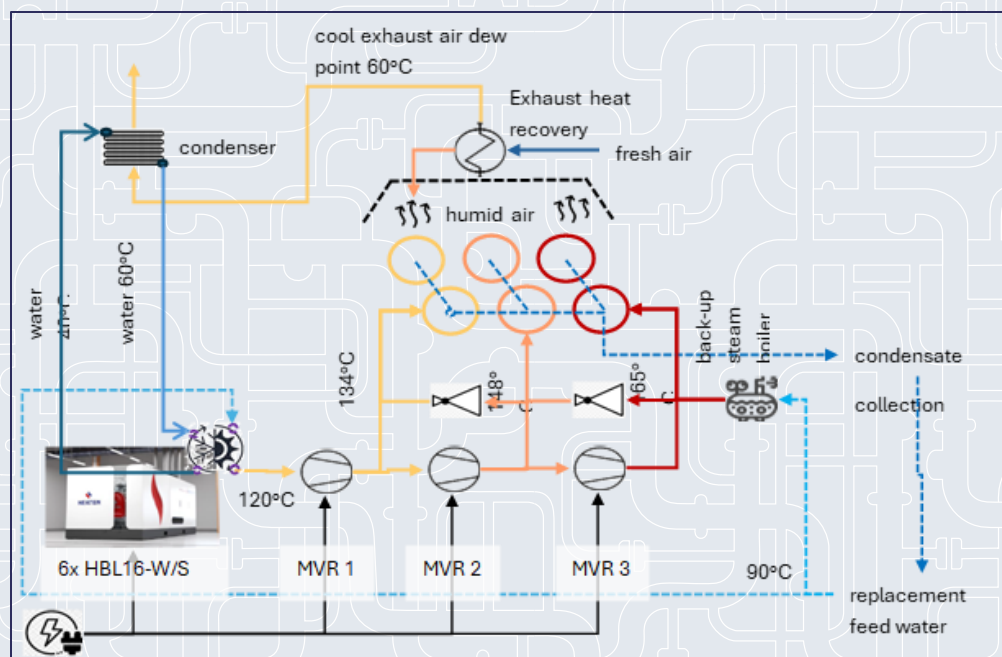
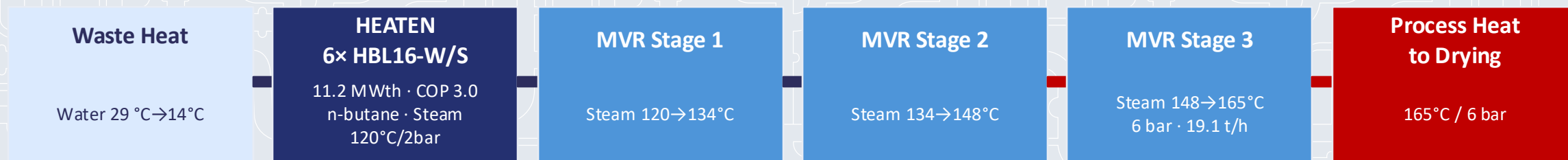
2026

2027

2-Stage HeatBooster to cover most processes which require temperature lifts beyond 80 K



Application: HTHP + MVR – Maximum Steam Efficiency

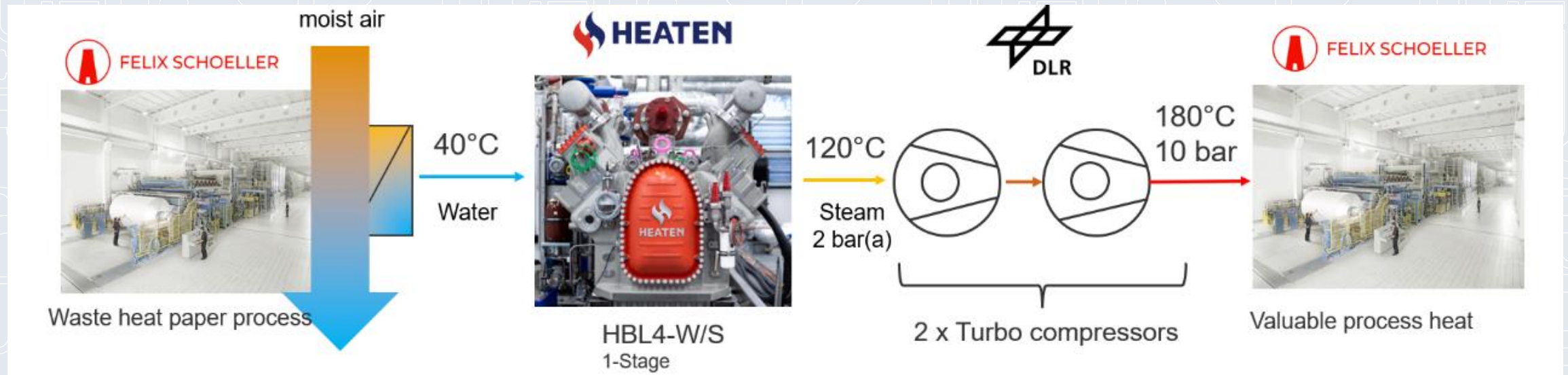


Benefits:

- Steam generation of 165
- Delivery of 19.1 t/h saturated steam
- Total system COP ~ 2.5
- CO₂ Savings ~ 26.900 t/y
- Standard machine in a modular arrangement
- Excellent part load capability
- Up to 50 MWth steam power provided to MVR system

EEETHOS – Demo III HTHP for Pulp & Paper

Heat supply for one individual process step



CASE HIGHLIGHTS	VALUES
Application	Pulp & Paper
Exp. Thermal power Output	> 1 MW _{th}
Working fluid	Isobutane
Exp. Steam supply	> 1.6 t/h
Steam temperature	180°C

Benefits:

- reduction in fossil fuel consumption
- lower energy costs
- improved energy efficiency
- reduced CO₂ emissions

Decarbonization of Industrial Processes – Step by Step

Feasibility & Pilot Unit

0.8–2.5 MWth
proven on site

01.



Deploy 1 HBL4 on the highest-value waste heat source. Collect experience, validate performance, measure savings, build the business case.

Scale Up to Full Zone

3–10 MWth
per zone

02.



Add parallel HBL4/HBL16 units to cover full drying zone demand. No production shutdown needed.

Full Mill Integration

20–50 MWth+
full mill

03.



Multi-zone or multi-stage systems to replace the main boiler load.

Optimize & Monetize

Revenue +
CO₂ credits

04.



Leverage grid balancing in intraday market. Optimize across zones. Prove and report CO₂ reductions.

A large, thick, dark blue arrow pointing from left to right, spanning across the bottom of the four steps.

Collecting experience, scale up infrastructure

Summary – Three reasons to act now



1

The Raw Material Exists

Paper mills produce massive waste heat from dryer exhaust, condensates, and cooling water at 10–80°C. The IEA and CEPI/EHPA estimate 65% of process heat could be supplied by heat pumps using on-site waste heat alone.

**65% of process
heat coverable
(IEA/CEPI-EHPA)**

2

The Technology Is Ready

HEATEN HeatBooster is commercially available, HC/HFO compatible, and backed by INNIO's global manufacturing and service network.

**HBL4 available
now, HBL 16 in
preperation**

3

EU Policy Creates a Clear Tailwind

The EU Emissions Trading System (ETS) covers paper mills directly. CO₂ certificates traded above €60/t in 2024. The Carbon Border Adjustment Mechanism (CBAM) and tightening Industrial Emissions Directive mean fossil heat costs will only increase. Mills that electrify heat now lock in compliance — mills that wait will pay more, for longer.

**EU ETS
>€60/t CO₂
2024 · rising
(EU ETS price)**

Let's talk.

Your next step towards mill
decarbonization starts here.



Visit Our Test Bed

Remscheid, Germany · Dedicated days every month ·
Register now

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