ThermBooster

SPH Sustainable Process Heat GmbH

Figure 1: ThermBooster LS1 – Water-Steam-Heat pump

Summary of technology

The ThermBooster is a closed-loop, compression-type heat pump. It operates with various low-GWP A1 HFO refrigerants such as R1233zd and R1336mzz-Z, achieving temperatures up to 165 °C, and with natural refrigerants like butane and pentane, reaching up to 180 °C. The thermal power output of a single-compressor system ranges from 300 to 800 kW. The single-stage system can be scaled up to 2.5 MW.
The compressor is a four-cylinder piston type, specifically designed for HFO and natural refrigerants in high-temperature applications. It is an open-type compressor with shaft sealing, driven by an IE4/IE5-class electric motor. The valve system is optimized for the working fluids and reduces pressure losses by up to 30% compared with standard piston compressors. The compressor includes integrated oil conditioning for both heating and cooling, with oil type depending on the refrigerant used. The hardware is designed for operating temperatures above 250 °C, achievable with natural hydrocarbon working fluids.
The system can be configured as a water-to-water, water-to-thermal-oil, or water-to-steam unit. The steam version uses a combined condenser/steam evaporator for direct steam production. The ThermBooster is available as a single-stage system for temperature lifts up to approximately 80 K, and as a two-stage system for lifts up to around 160 K. For low-temperature sources, a standard screw compressor may be used as the first stage. The stages are connected via a combined condenser/evaporator heat exchanger.
By combining multiple compressors in parallel, higher thermal power outputs can be achieved; multi-cycle configurations are also possible. The inverter-driven compressor allows very fast adjustment of thermal power within a range of approximately 33 % to 100 %. By selecting different working fluids and lubricants, the same hardware can be adapted to various temperature levels.
The ThermBooster is commercially available in Europe and marketed worldwide. In 2025, more than 10 units will be in operation, with additional systems expected to go online in 2026.

Table 1: Performance.

$T_{source,in}$ [°C]	$T_{source,out}$ [°C]	$T_{sink,in}$ [°C]	$T_{sink,out}$ [°C]	$COP_{heating}$ [-]
85	78	90	134 (3 bar sat. steam)	3.9 calculated
60	50	90	130 Hot water	2.9 calculated
95	90	95	159 (6 bar sat. steam)	3.0 calculated

All information were provided by the supplier without third-party validation. The information was provided as an indicative basis and may be different in final installations depending on application specific parameters.

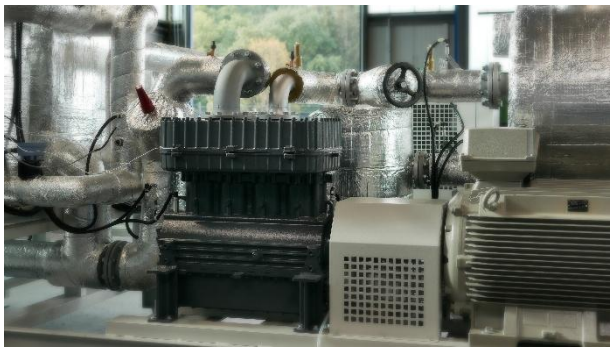

Figure 2: SPH's piston compressor

Project example

The AHEAD heat-pump system was integrated into one of Takeda's largest pharmaceutical production sites in Vienna in 2025. It uses hot water at 70 °C, provided by an existing heat pump, as its heat source. SPH Sustainable Process Heat's ThermBooster produces steam at 120 °C (approx. 1.9 bar(a)), and a steam compressor from Spilling further increases the steam temperature and pressure to 184 °C and approx. 11 bar(a).
The system can be expanded to reach temperatures between 200 °C and 260 °C without further technological development. The goal of the AHEAD system is to reduce CO_2 emissions by approximately 80 %.
The steam-generating heat pump in the AHEAD system provides a maximum heating capacity of 1.7 MW with a COP of approximately 4.4, using 180 kg of R600 (n-butane) as the refrigerant. The Spilling steam compressor in the same system has a steam capacity of 2.5 t/h.
Harald Erös, Refrigeration and Heat-Pump Engineering Lead at Takeda Manufacturing Austria AG: "Takeda is a patient-focused company dedicated to sustainability and innovation. With AHEAD, we are setting new standards for responsible and future-ready manufacturing — a true lighthouse project for the industry and society."

FACTS ABOUT THE TECHNOLOGY

Heat supply capacity: per unit 300 kW – 2.5 MW

Temperature range:
Heat source: 0 °C – 120 °C (up to 150 °C planned)
Heat sink: 80 °C to 180 °C (up to 200 °C planned)
Spread between 5 °C and up to 80 °C 1-stage or up to 160 °C 2-stage systems

Working fluid:
R515B, R1234ze, R1233zd, R1224yd, R1336mzz-Z
Propane, Isobutane, Butane, Isopentane, Pentane

Compressor technology: Piston

Specific investment cost for installed system without integration:
400 €/kW for low lift 1-stage systems to
1000 €/kW for high lift 2-stage systems

TRL level:
TRL 8-9

Expected lifetime: System service lifetime up to 20 years, compressor lifetime before major overhaul 40,000 – 60,000 h

Size: Single stage, one compressor water-water system: 3 x 2.5 m, 4 tons
2-stage, 2 x 2 compressors water-steam system: 8 x 2.5 m, 15 tons

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