High Temperature Heat Pump

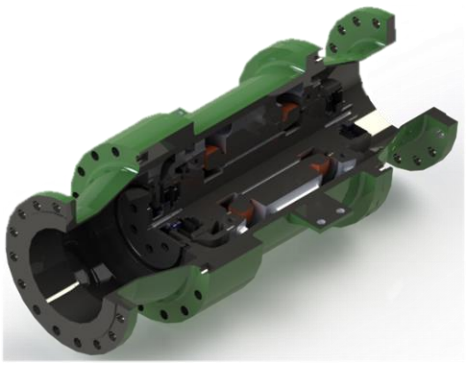


Figure 1: 3.7 MW Enertime Heat Pump on Low-Pressure Steam

Summary of technology

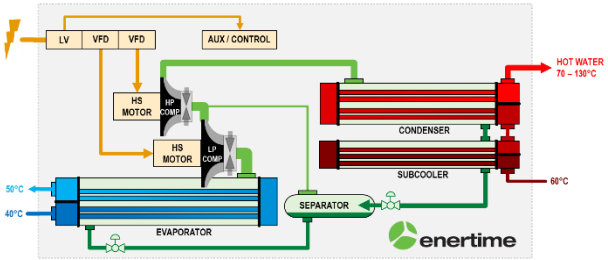
Originating from the design, manufacturing and commercialisation of Organic Rankine Cycle (ORC) machines, ENERTIME proposes High Temperature Heat pumps for large-scale industrial applications (>2 MWth) generating steam, superheated or hot water or direct process heating (process fluid, hot air, ...).

Large-scale machines are tailor-made and designed to recover heat from industrial waste heat (cooling loops, process cooling, fumes condensation) and low-temperature resources (greywater, freshwater, seawater, DC networks, ...).

The proposed concepts are illustrated in the simplified diagrams below:

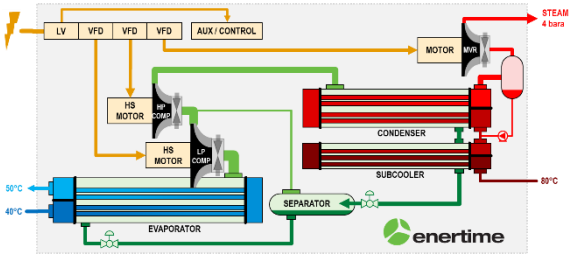
CONCEPT 1 – Superheated / hot water production

For temperatures up to 140°C and lifts up to 80°C.



CONCEPT 2 – Steam generation heat pump

Direct steam generation (max 3 bara & 80°C lifts) or in combination with steam compressor (max 8 bara) from low and medium-temperature resources



CONCEPT 3 – Process heat pump

Tailor-made systems aiming at direct process heating (hot air, process fluid) using medium and low temperature resources (liquid, moist air, process fluid).

MAIN FEATURES

ENERTIME High-temperature heat pumps (HTHP) and steam generators heat pumps (SGHP) provide custom-made solutions adapted to industrial constraints and project needs.

Proposed Heat Pumps are using new-generation non-flammable HFO fluids and custom-made centrifugal compressors adapted to the characteristics of every project with rotation speeds up to 20 000 rpm and compression ratios up to 3.2.

Enertime compressors are using 1 or 2 high speed hermetic motors and magnetic bearing to reach the highest possible performances while ensuring an oil-free, wear-free operation, low vibration rates and low noise emission (<78 dB(A) at 1m) allowing its installation in sensitive areas. Large-scale applications use conventional motors with oil lubricated bearings.

Motocompressors are controlled by AIGV (Automatic Inlet Guide Valves) and VFD (Variable Frequency Drive) to reach the maximal COP, including on non-nominal and partial load operation.

Steam generating heat pumps are coupled with separator tanks and standard steam compressors to generate medium-pressure steam for higher temperature/pressure demand.

COP and performances

Enertime High-Temperature heat pumps are adapted to customer source and sink characteristics while always offering optimal thermodynamic design.

COP generally range between 2.5 to 5 with temperature lifts from 40 to 120°C.

$T_{source,out}$ (°C)	$T_{sink,out}$ (°C)	COP
35	100	3.6
55	120	3.6
60	140	3.3

WORKING FLUIDS

Enertime uses new-generation refrigerants as the working medium for the HTHP. The properties of the refrigerant are optimally adapted to the process requirements in order to achieve high efficiency:

- Chemical stability
- Non-flammable and non-toxic for an easy integration in urban and industrial areas
- Low GWP and ODP
- High critical temperature and low critical pressure
- High volumetric cooling & heating capacity

Selected suitable refrigerants for High Temperature Heat Pumps are listed in the table below:

Type	Refrigerant	T_{crit} (°C)	P_{crit} (bar)	GWP	ODP
HFO	R1336mzzz(Z)	171.3	29.0	2	0
HCFO	R1224yd(Z)	166.5	36.2	1	0
HCFO	R1233zd(E)	155.5	36.3	<1	0

FACTS ABOUT THE TECHNOLOGY

Heat supply capacity: 2 MW to 10 MW

Temperature range: 90°C to 160°C (Steam generation)]

Working fluid: R1336mzzz(Z), R1224yd(Z), R1233zd(E)

Compressor technology: 1 or 2 stage centrifugal hermetic compressor

Specific investment cost for installed system without integration:

- 400€/kW of heat up to 4MW heat production
- 300€/kW of heat from 5MW heat production

TRL level:

- 7-8 concept 1
- 5-6 concept 2
- 4-5 concept 3

Expected lifetime: 20 years

Size: Custom-made depending on project characteristics

Contact information

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