

# MAN heat pumps

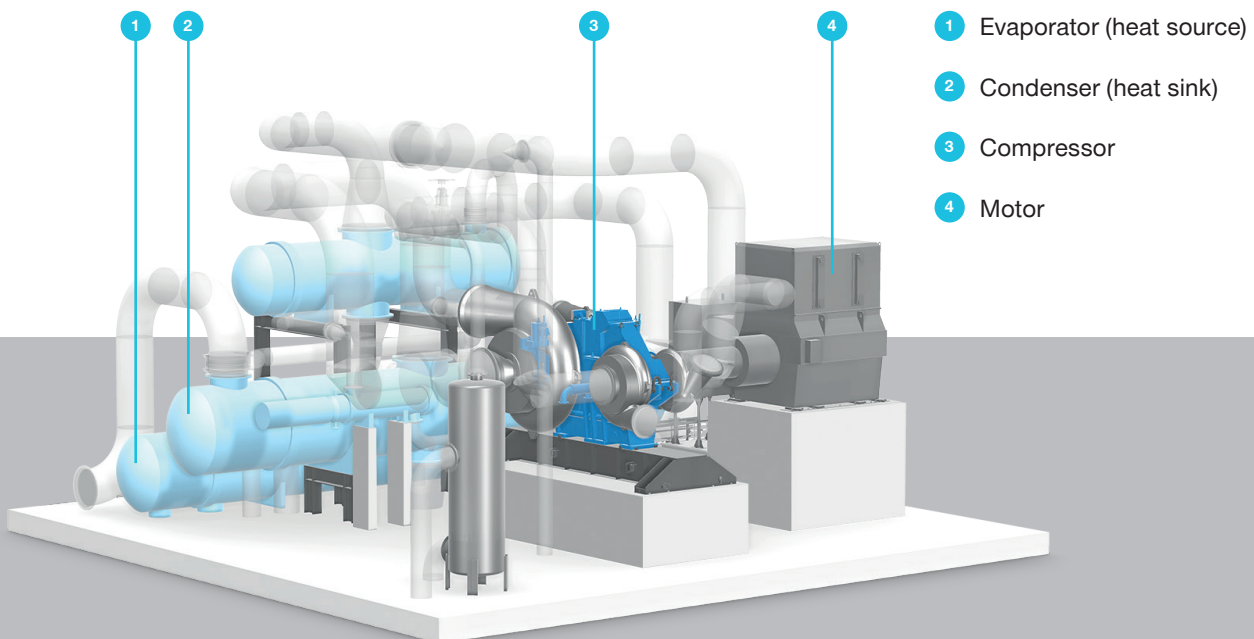
## Vapor compression cycle (VCC)

Industrial processes are responsible for using about 50 % of the global heat energy produced, while another 46 % is used for space and water heating. Decarbonization of the thermal energy segment is therefore key to achieving our climate goals.

Improved energy efficiency in industrial processes can lead to substantial primary energy savings and subsequent reduction of CO<sub>2</sub> emissions. Heat pumps will provide an important mechanism to convert low and high temperature waste heat to useful high-quality process heat.

### Benefits at a glance

- Reduced primary energy cost
- Eco-friendly heat production
- Reliable production of hot water up to 140 °C and steam up to 20 bar/280 °C
- Unit production capacity up to 90 MWth



# Eco-friendly, reliable and efficient heat generation

## Electrification of heat supply

Decarbonization of the heating sector and the growth in renewable electricity production lead to an electrification of the heat supply (power-to-heat) while fossil fuels are phasing out.

Re-electrification of industrial processes gains more importance and offers a high potential for waste heat utilization.

## System solution

MAN Energy Solutions high temperature heat pumps bring the economic and climate-friendly benefits of domestic heat pumps to large-scale industrial applications. To ensure a process steam supply, MAN Energy Solutions can offer a combined heat pump/vapor compressor or a separate vapor compressor skid that provides the required process conditions.

## General competence

Our many years of experience with turbomachinery and reactors in the petrochemical industry and the associated process engineering know-how will support our customers on the path to carbon neutral heat generation.

## Refrigerants

Different types of heat transfer fluids with focus on natural refrigerants can be offered for special applications under consideration of:

- Environmental aspects
- Very low global warming potential (GWP)
- Zero ozone depletion potential (ODP)
- Safety concepts

## Heat sources

### Natural:

- Sea/river water
- Air
- Geothermal energy

### Industrial:

- Process waste heat streams
- Process liquid waste streams
- Cooling water
- Sewage water
- Data centers

## Applications

### Hot water or steam supply for industries:

- Chemicals
- Petrochemicals
- Refineries
- Pulp & paper
- Food & beverage

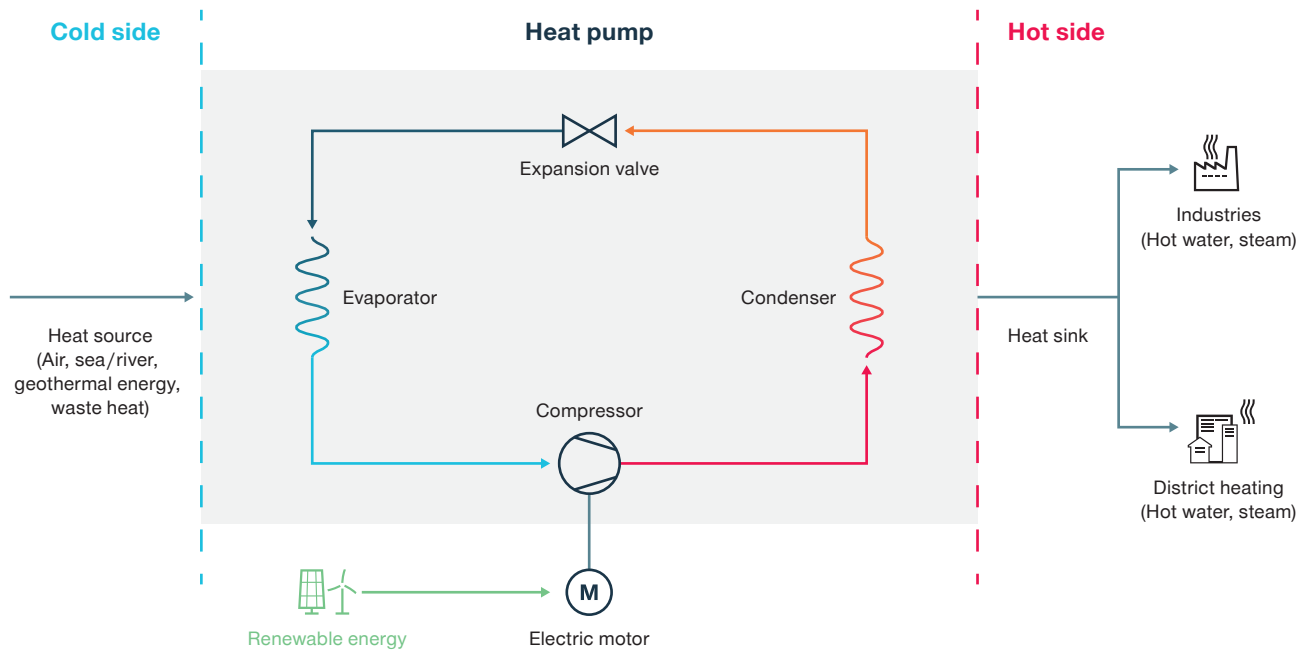
### District heating:

- Municipals
- Utilities
- Public or private facilities (e.g. hospitals, universities, industrial areas)

## Technical data (per single heat pump unit)

	Unit	MHP
Thermal heat capacity per module	MWth	10 – 90
	MMBtu/h	34 – 307
Heat sink temperature range (hot water/steam*)	°C	60 – 280
	°F	140 – 536
Steam pressure	bar	Standard up to 20*, higher pressure on request

\* Steam production above 2 bar with additional steam compressor



## Key components

### Compressor system

- Radial geared or inline compressor
- Multi-stage design
- Single casing multi-service design
- Separate steam compression system for higher steam pressures
- IGV or speed control
- Base frame mounted
- Fully packaged and tested

### Control system

- Process control system for control and operation of the complete heat pump unit
- Interface to plant DCS
- Anti-surge control of compressor unit
- Advanced digital services for remote operation, real time monitoring and predictive maintenance

### Driver

- Electrical motor
- Frequency converter for starting and control purpose

### Condenser stage

- Shell & tube heat exchangers
- Condenser
- Condenser subcooler

### Evaporator stage

- Shell & tube heat exchangers
- Evaporator
- Superheater

### Piping

- Of the complete heat pump loop
- Interconnecting piping
- Process valves and instruments

### Auxiliaries

- Separate lube oil unit
- Flash box/economizer

### Services

- Site services
- Long-term service agreements
- Training

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