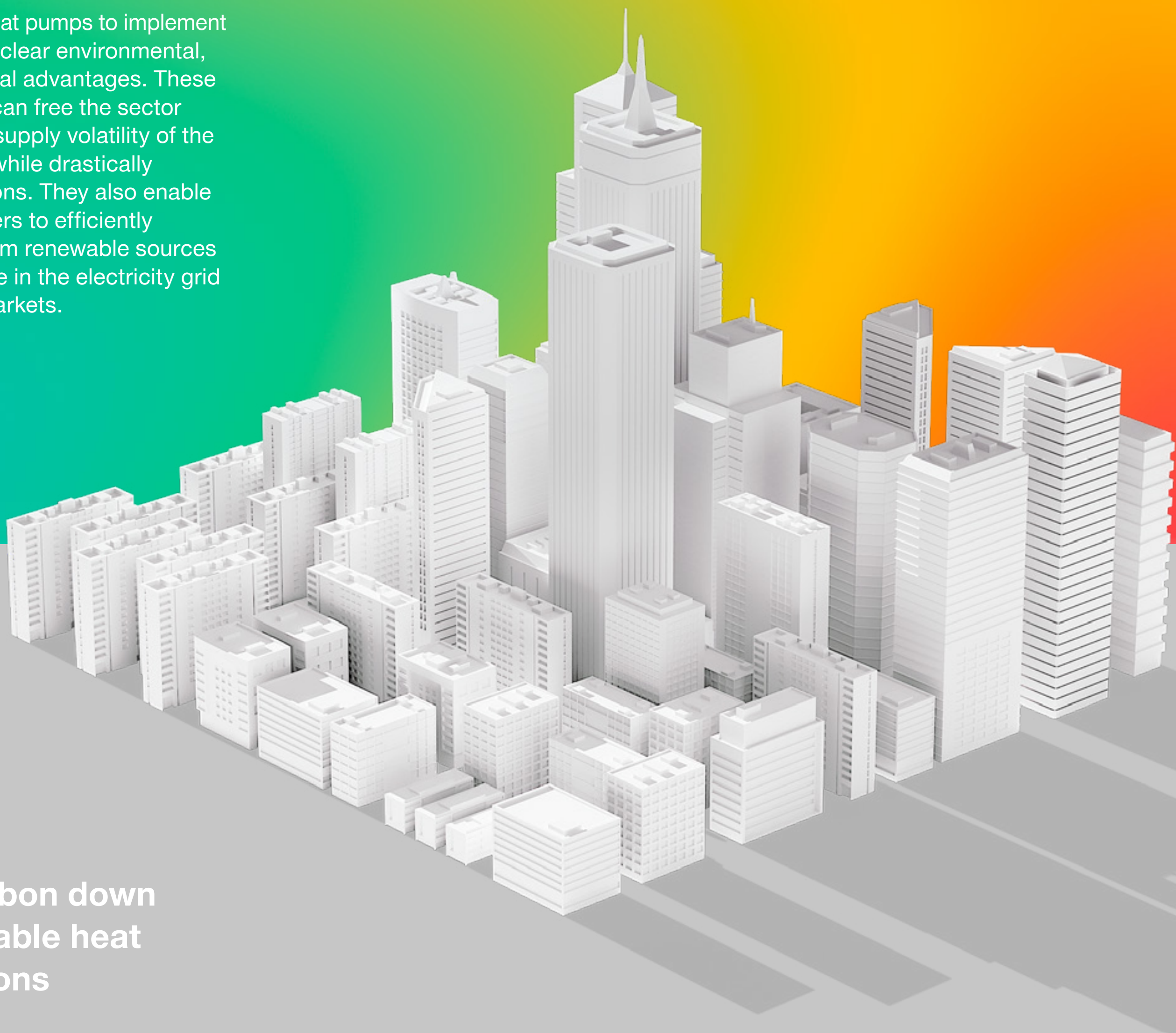
MAN Energy Solutions
Future in the making

Heat pumps for district heating

Using large-scale heat pumps to implement district heating has clear environmental, economic, and social advantages. These mega heat pumps can free the sector from the price and supply volatility of the fossil fuel markets while drastically cutting CO_2 emissions. They also enable district heat providers to efficiently integrate energy from renewable sources and even participate in the electricity grid power balancing markets.



Heat up, carbon down with our reliable heat pump solutions

The decarbonizing power of heat pumps

Low-carbon heating and cooling

The impacts of climate change and global warming are becoming ever more apparent. At the same time, cities' energy requirements for heating and cooling continue to increase. District heating already offers environmental advantages over individual heating systems, but there is a need to reduce its overall carbon footprint. Fortunately we have sustainable technologies that offer a clean, inexhaustible, and increasingly economical alternative to fossil fuels.

Environmentally and economically sustainable

Heat pumps are one of the most practical ways for utilities to lower heating/cooling costs and CO_2 emissions. Powered by renewable electricity, a large-scale heat pump is an economical way to fully decarbonize your heating and cooling supply system. Heat pumps also enable sector coupling and can help to balance renewable energy surpluses. The technology is well known, extremely reliable, robust, and efficient.

Benefits at a glance

- Reduce CO_2 emissions of district heating to net zero
- Most efficient use of renewable energies
- Access opportunities for ancillary services and revenues
- Long-term cost savings
- Provide heating and cooling
- Reduce complexity of centralized heat generation
- Enhanced use of waste heat/ heat sources
- Average COP of 3 – 5

Approx.

50,000

tons CO_2 savings per heat pump unit per year

Efficient thermal technologies

Amplifying and transferring thermal energy

A heat pump extracts heat from a low temperature source such as water, air, or waste heat from machinery, amplifies it to a useful high temperature, and transfers it to where it is needed. The principle is based on a closed-loop refrigerant cycle with compression and expansion of the refrigerant fluid and can be operated in both directions to deliver heating or cooling. Electricity is needed to power the compressor. Efficiency is measured as a ratio of the heat output to the power input. This is called the coefficient of performance (COP). When powered by renewable electricity, a heat pump can supply carbon neutral heating or cooling.

Heating and cooling

Large-scale MAN heat pumps can supply the heating and cooling needed for local residential and industrial or commercial needs. Just like the domestic versions, mega heat pumps need a heat source. In large-scale systems, water from the sea, rivers or lakes can be used. So can sewage and effluent from power plants. Industrial waste heat and geothermal energy can make the process even more efficient and environmentally friendly.

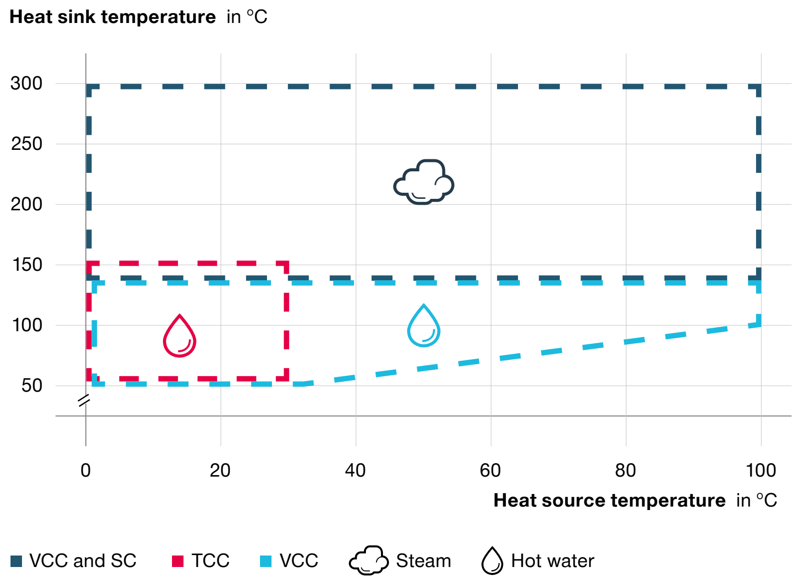
Stabilizing the grid

Mega heat pumps can contribute to grid stability by providing balancing power. This is important because the transition to renewable energy sources is challenging the grid's stability in two ways: firstly because renewable energy sources are sometimes volatile and thus raise the demand for balancing power, and secondly because the fossil fuel power stations that traditionally supplied balancing power are being switched off.

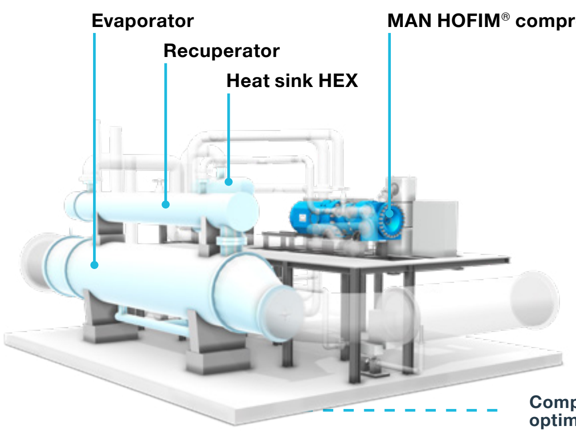
Steam and liquid heat carriers

District networks around the world are at different stages of modernization. Many still use steam and hot water as heat carriers. We scale our heat pump solutions to the temperature and power needs of our customers. For warm water we use our transcritical compression cycle (TCC) and our vapor compression cycle (VCC) technologies. For steam we use VCC with an optional steam compressor (SC). The power output ranges from 10 to 100 MWth per heat pump unit.

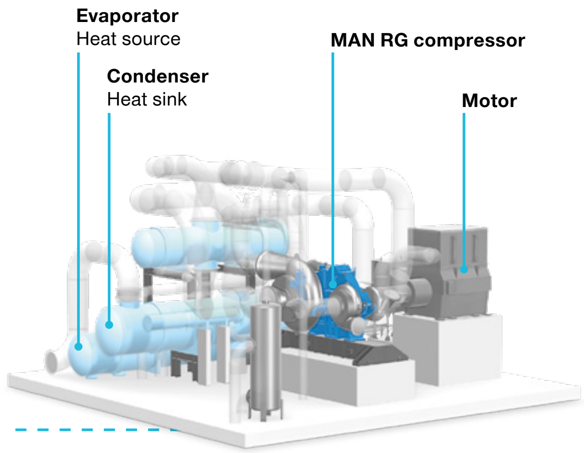
Working principles for different temperature grids



Transcritical compression cycle (TCC)



Vapor compression cycle (VCC)



Transcritical compression cycles (TCC)

Operating with TCC, our heat pumps have a perfect range for district heating and cooling requirements: from 0 °C to 150 °C and up to 50 MW of thermal heat and 30 MW of thermal cold.

Download our TCC factsheet >

Vapor compression cycles (VCC)

For district heating networks using water and steam as heat carriers, we offer the VCC solution for our heat pumps with industrial or ambient heat source and a radial gear type compressor with an additional steam compressor (separate or integrated). The system ensures reliable hot water production up to 140 °C and steam production up to 20 bar/280 °C.

Download our VCC factsheet >

Choosing the right refrigerant

There is no ideal refrigerant for all applications. The different types have various advantages and disadvantages in terms of environmental impact, safety and technological suitability. Our VCC heat pumps can use a range of different refrigerants. Our TCC systems benefit from the use of CO_2.

Refrigerants and their advantages
CO_2 (R744): Non-toxic, non-flammable, non-fluorinated refrigerant

Ammonia (R717): High-performance natural refrigerant

Hydrocarbons (e.g., Butane): High-performance, non toxic natural refrigerant (no fluorine)

Synthetic refrigerants (e.g., R1234ze): High-performance and safe refrigerant

MAN scope of supply

We scale our heat pumps to the temperature and power needs of our customers.

We supply complete systems and also provide:

- Consulting
- System efficiency design
- Planning of components such as compressor, pipework, etc.
- Testing and installation
- Digital solutions such as MAN dynamic simulation
- Maintenance

Mega heat pump for Aalborg

Climate-neutral district heating in Aalborg

With the installation of four MAN heat pumps, the Danish city of Aalborg is set to reduce CO_2 emissions by 210,000 tons annually compared to the city's current, coal-fired power plant, which is scheduled for closure in 2028. The new seawater heat pump plant in Aalborg will be one of the largest of its kind in the world, with a total heat output of 177 MW. Using renewable electricity produced by the utility plant operator Aalborg Forsyning, the heat pumps will raise the seawater's temperature from a range of 1 – 15 °C to 98 °C.

At the core of the heat pump system are the four oil-free, hermetically sealed MAN HOFIM® motor-compressor units. The MAN HOFIM® compressor unit uses a high-speed motor and active magnetic bearings, enabling it to operate without requiring a dry gas seal system or lube oil system.

Key facts

- **End customer:** Aalborg Forsyning (Denmark)
- **Scope of delivery:** MAN heat pump system with four heat pump units
- **Task:** heat production for 120,000 people
- **Function:** transfer energy from the seawater to the district heating water using renewable energy from the grid
- **Heat output:** 177 MW
- **Heat sink:** up to 98 °C
- **Heat source:** seawater at 1 – 15 °C
- **Replaced heat source:** coal-fired power plant
- **COP:** 3

210,000

tons of CO_2 saved per year

MAN Energy Solutions
86224 Augsburg, Germany
P + 49 821 322 - 0
F + 49 821 322 - 3382
info@man-es.com
www.man-es.com

D2366743 | GKM-AUG-24070