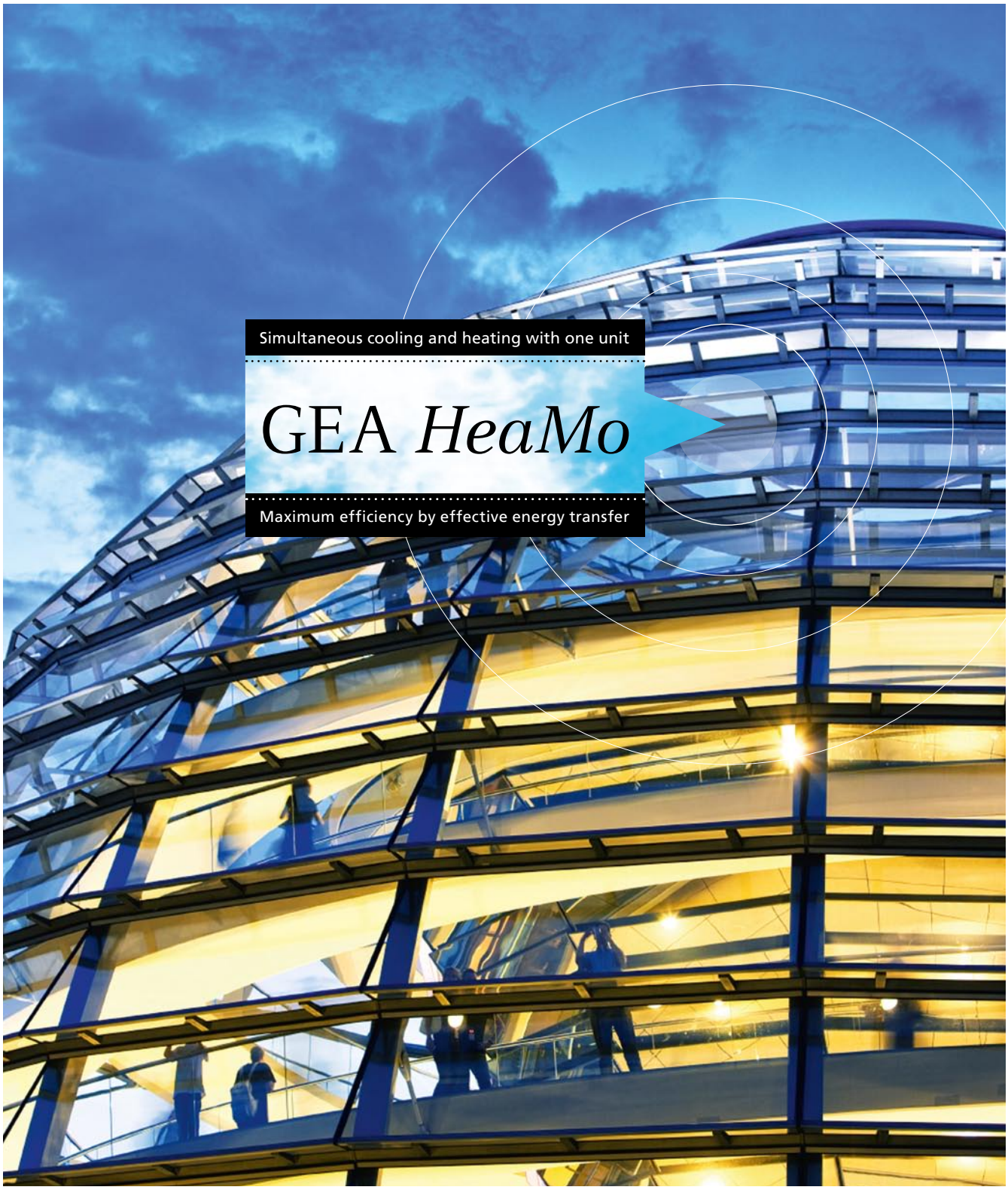
Air Eco$_2$nomy®



GEA Heat Exchangers / **HVAC Systems**

Air Eco$_2$nomy

Effective distribution of energy

We hear about energy efficiency from all sides – not only from lawmakers, but also from our demanding customers. And it is especially in building services that sustainability with respect to energy-reduced operations has become critical. Investors, planners, and architects accordingly demand resource-conserving energy management for building services.

Ventilation with climate control is precision work in the temperature control and conditioning of room air. This, after all, is the only way of harmonizing optimal effects and maximum energy savings.

Buildings of all kinds account for 40 % of total world energy consumption, and are responsible for 21 % of global greenhouse emissions. There is great potential for energy savings here – both from ecological as well as economical standpoints. Simultaneous cooling and heating is no longer a rarity in advanced building services. This is because of a complex of appreciable benefits and current developments involved in applying this technology: the capability of reduction of heat-transmission losses, an increasing share of inner cooling loads, and the continuously growing share of façade glazing in modern architecture – to mention only a few factors. Certain types of building demand over long periods the simultaneous provision of heating and cooling. These include buildings with north and south orientation, facilities with requirements for all-year cooling of electronic switching and communications centers, and applications with great demand for hot water for sanitary facilities. The same especially applies to the spring and autumn of each year in hotels. The personal temperature sensitivity of guests often makes it essential to provide simultaneous heating and cooling in individual rooms.

The efficient solution for advanced building services

Simultaneous supply of heating and cooling with minimal enery consumption

Today, it is not seldom to find systems for provision of cold water for cooling, and systems to supply hot water, to be operated in parallel. But this means neglect of energy-saving potentials.

GEA *HeaMo* controls heat exchange within a building, whereby the cost effectiveness of the unit increases as simultaneous demand for heating and cooling becomes more frequent.

The GEA *HeaMo* unit exploits the heat produced by cooling to cover the hot-water requirements of a building (*HeaMo* means “heat in motion”). The output and the temperatures of the cold- and hot-water systems can be individually controlled in accordance with the cooling and heating loads prevailing in a building. Maximum effectiveness is achieved when cooling and heating energy are simultaneously required in balanced volumes. This assures that no cooling or heating energy must be wastefully emitted to the environment.

A GEA *HeaMo* system should be selected with respect to its capacity such that many operating hours are dedicated to simultaneous heating and cooling. A GEA *HeaMo* should not be expected to meet peak demands – such as for heating on cold winter days or cooling in high summer. These requirements, instead, should be met by supporting facilities. The integration of thermal storage units helps to achieve simultaneous heating and cooling as often as possible.

Areas of application

One system and many application possibilities

Office buildings:
Buildings oriented to the north and south require simultaneous heating and cooling for most of the year. Whereas rooms on the south side require cooling owing to solar radiation, rooms on the north side still require heating.

Hotels:
Hotels require great amounts of hot water the entire year: e.g., for sanitary facilities, kitchens, laundries, etc. in addition, the temperature sensitivity of each guest is different, with the result that both cold as well as hot water must be provided for comfort control of the rooms.

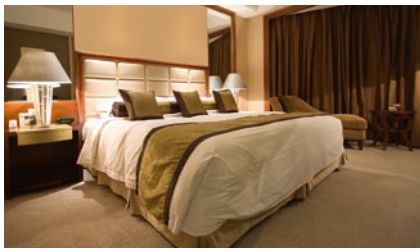
Buildings with glass façades:
During spring and autumn, buildings with large glazed facades require simultaneous heating and cooling. Rooms with a large share of window glazing must be cooled owing to incident solar radiation, while rooms with small glazed areas must be heated.

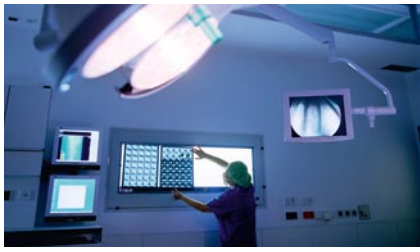
Fitness centers:
Cold water is required almost the entire year for climate control of fitness rooms. They also require hot water for washing and showering facilities.

Computer centers with adjacent office space:
In data-processing centers with adjacent office space – the same as production facilities with great cooling demand and with nearby offices – electronic systems must be cooled throughout the entire year. The offices nearby must be heated during spring and autumn, and during the winter.

Swimming pools:
Swimming pools require heating energy throughout the year to provide pleasant pool temperatures in the water, and to supply hot water for showers and the like. In addition, swimming pools must be dehumidified during the entire year – for which the available cold water is used.

Clinics and hospitals:
Facilities such as clinics and hospitals need cold water for climate control of patient rooms, and to cool machine rooms. Hot water is required the whole year for sanitary facilities, for kitchens, and for laundries. The hot water produced can also be used to heat the buildings.





Triply combinable – which means efficiency and environmental protection

GEA *HeaMo* AIR model

GEA *HeaMo* GEO model

Four different modes of operations are possible with only one unit.

Automatic mode:
This mode simultaneously produces hot and cold water and cuts in or switches off output depending on the desired temperatures. Surplus energy is automatically emitted to the environment, and energy shortfall is extracted from the environment.

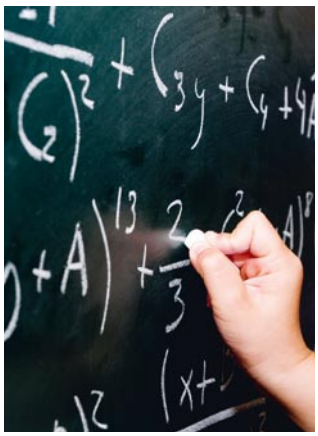
Only cooling mode:
If the GEA *HeaMo* is not required to produce hot water for longer periods, it is possible to switch to the "Only cooling" mode. The GEA *HeaMo* now operates only as a chiller, and the hot-water pump is shut down.

Only heating mode:
If there is no requirement for cold water in the building for a longer period of time, the "Only heating" mode is possible. The GEA *HeaMo* now operates the same as a heat pump. The cold-water pump is shut down.

Heat recuperation:
The GEA *HeaMo* covers hot-water requirements only if there is demand for cold water. If the required value for hot water is reached, the surplus heat energy is emitted to the environment.

Calculating and operating cost effectively

Energy indices in practice



For many years, the following energy-evaluation parameters have been used: EER (energy efficiency ratio) for chillers, and COP (coefficient of performance) for heat pump operation.

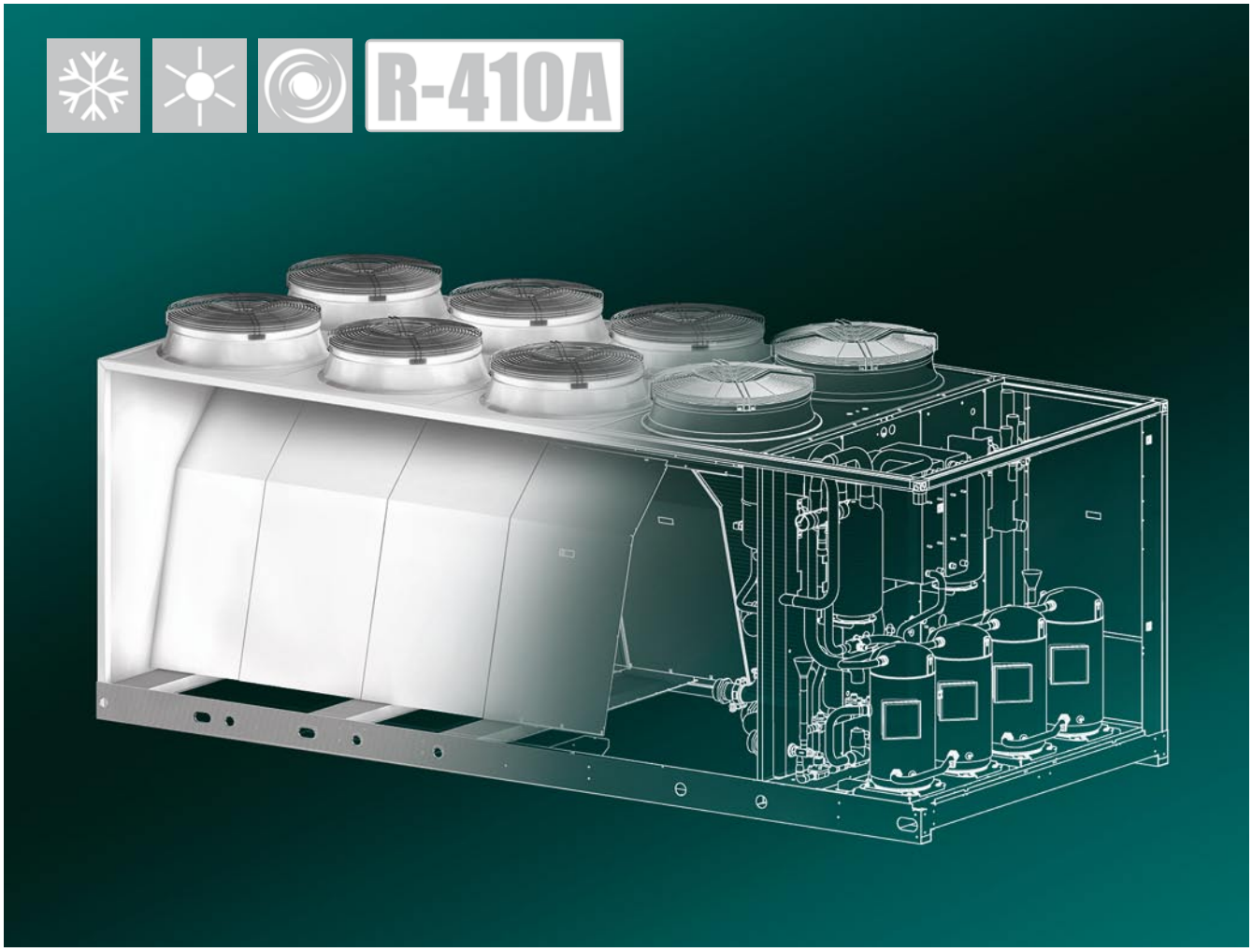
$$\text{EER} = \frac{\text{Cooling duty}}{\text{Power consumption}} \qquad \text{COP} = \frac{\text{Heating duty}}{\text{Power consumption}}$$

Satisfactory realistic values for air-cooled equipment are as follows: approx. 2.8 for EER and approx. 3.1 for COP. Since the GEA *HeaMo* System for cooling and heating uses only one unit to simultaneously produce heat and cold, a new energy index is called for:

$$\text{ITEE} = \text{index of total energy efficiency} = \frac{\text{Cooling duty + Heating duty}}{\text{Power consumption}}$$

The optimized operation of a GEA *HeaMo* enables more than 7 kW of heating and cooling output with only 1 kW of electrical operational power.

GEA *HeaMo* AIR



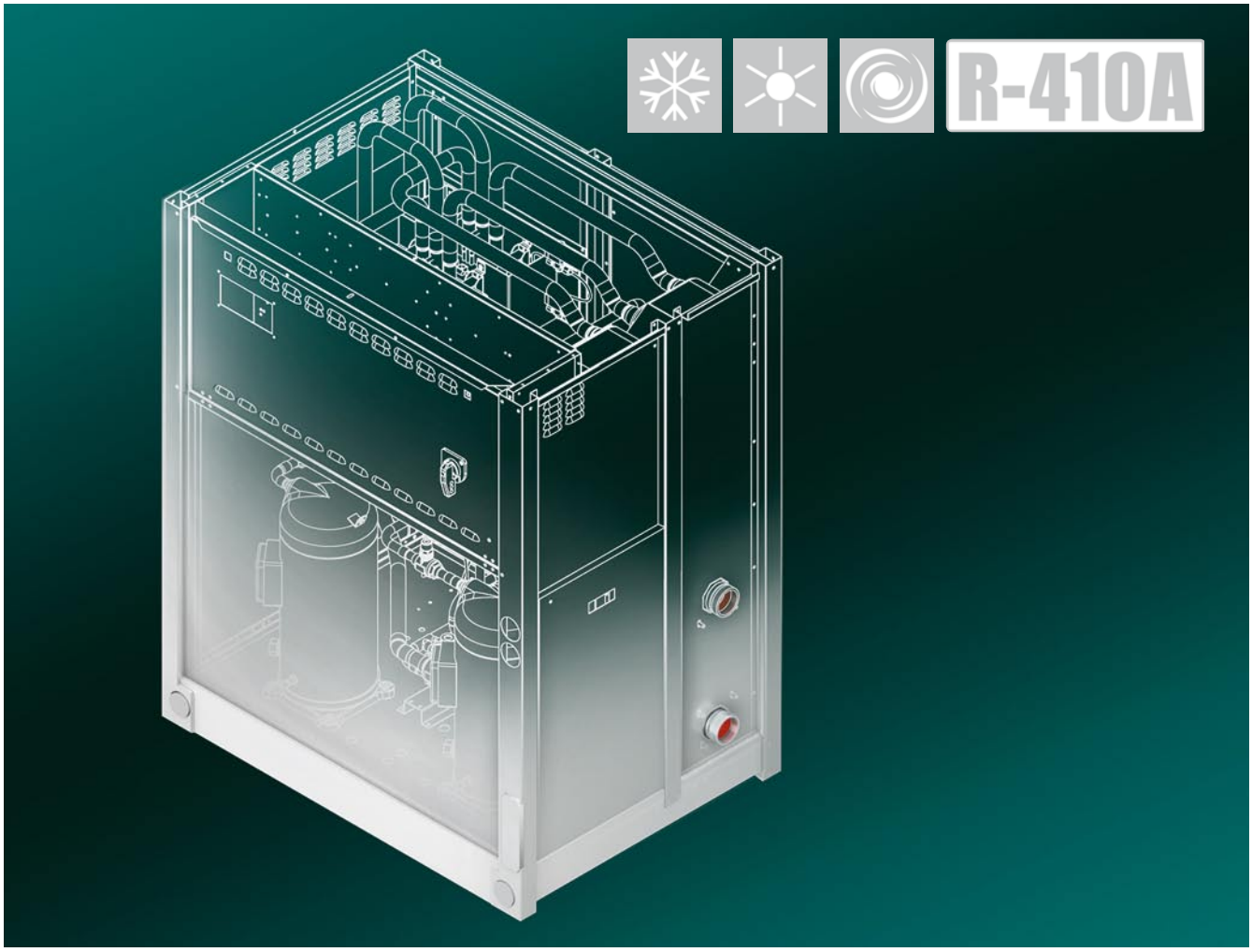
Pictured above is an air-cooled model for outdoor installation, for exploitation of outdoor air as energy source for pure cold- or hot-water operations. In cold-water operation alone, the air-cooled Cu-Al heat exchanger is used as a condenser, and in hot-water operation alone, the heat exchanger operates as an evaporator.

- 16 model sizes with output ranges of 35 to 350 kW (cooling/heating output)
- 2 independent refrigerant cycles
- 1 or 2 compressors per refrigerant cycle, depending on model rating
- Available models:
  - Standard model
  - ST model for quiet operation and with extended appplication limits
- Optional: 1 or 2 pumps for cold- and hot-water cycles, integrated in the unit enclosure
- Areas of application:
  Water:
  - Cold water: +2 °C to +15 °C water outlet temperature
  - Hot water: 25 °C to 52 °C water outlet temperature

  Outdoor-air temperature:
  - Only cooling: -10 °C to +44 °C
  - Only heating: -5 °C to 25 °C for standard model, and -10 °C to 25 °C for the ST model
- Copeland Scroll Compressors
- Brazed plate heat exchangers for the cold- and hot-water side, made of AISI 316
- Extensive accessoires

Cooling Heating Refrigerant Scroll Compressor

GEA *HeaMo* GEO



This image shows a water-cooled model for indoor installation, for exploitation of geothermal sources of energy for pure cold- or hot-water operation. In cold-water operation alone, the geothermal heat exchanger is used as a condenser, and in hot-water operation alone, the heat exchanger operates as an evaporator.

- 18 model sizes with output ranges of 50 to 550 kW (cooling/heating output)
- 2 independent refrigerant cycles
- 1 or 2 compressors per refrigerant cycle, depending on model rating
- Areas of application:
  - Cold water: +2 °C to +15 °C water outlet temperature
  - Hot water: 26 °C to 55 °C water outlet temperature
- Copeland Scroll Compressors
- Brazed plate heat exchangers for geothermal energy; cold- and hot-water side made of AISI 316
- As option, the sound power level can be reduced by 4 dB(A) for models with 2 scroll compressors, and by 10 dB(A) for models with 4 scroll compressors
- Compact equipment dimensions
- Extensive accessoires

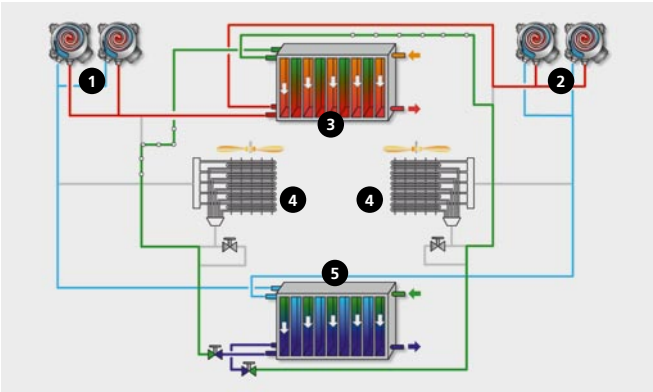
The controllers used in GEA *HeaMo* AIR and GEA *HeaMo* GEO satisfy all advanced requirements such as the following:

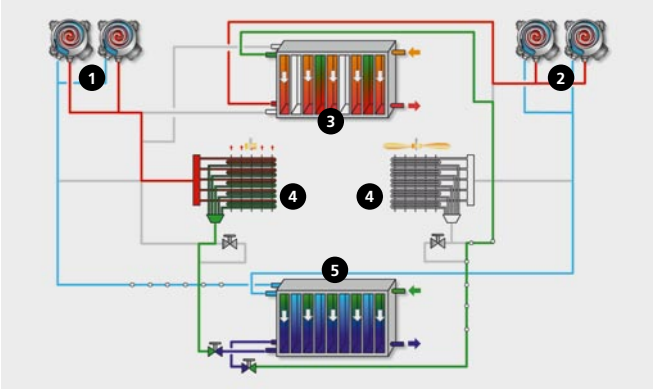
- Alphanumeric displays
- Intuitive-use menu assistance
- Automatic operating-hour compensation for the compressors
- Control system for the cold- and hot-water pump and of the geothermal pump (GEA *HeaMo* GEO)
- Integration into building services
- Retrieval of system information possible by LAN and Internet

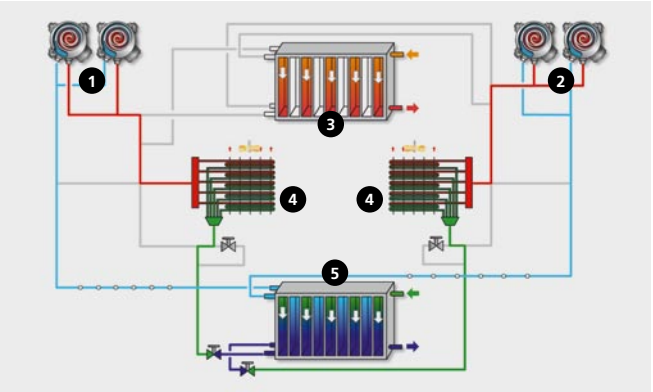
Cooling Heating Refrigerant Scroll Compressor

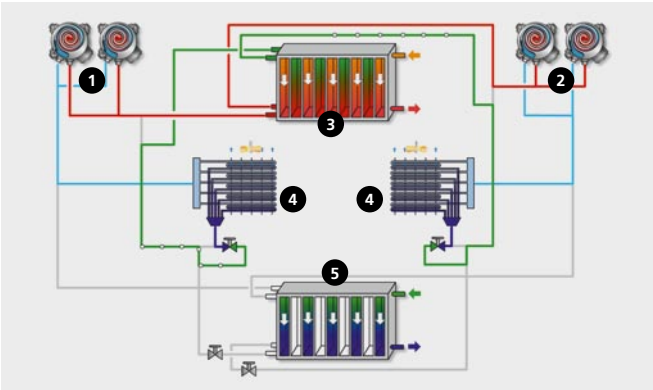
Modes of operation

One application – various operational modes









1 Circuit 1 with compressor 1 + 2
2 Circuit 2 with compressor 3 + 4
3 Condenser
4 Auxiliary exchanger
5 Evaporator

100 % cooling demand – 100 % heating demand

Under these conditions, the GEA *HeaMo* operates under an optimal energetic mode. The energy removed from the cold water is added to the hot water. GEA *HeaMo* can supply the building in this way with cold water for cooling and hot water for various heating purposes, without energy waste. Energy is re-distributed where it is momentarily needed throughout the building. The operation of this unit corresponds to that of a water-cooled chiller – whereby the output of the hot-water side can also be individually controlled, and not only the cold-water side. The air-cooled third heat exchanger is not in operation.

100 % cooling demand – 50 % heating demand

All compressors are in operation, in order to meet cooling demand. Both of the refrigerant cycles remove energy from the cold-water heat exchanger, which cools the cold water. Since, however, only 50 % of the heating capacity is required, only one refrigerant cycle to the hot-water heat exchanger is in operation. The second refrigerant cycle uses the air-cooled Cu-Al heat exchanger as a condenser to give off surplus heat to the outside air.

100 % cooling demand – 0 % heating demand

The system functions as a chiller. Energy is removed from the cold-water heat exchanger and is given off to the outside air via the air-cooled Cu-Al heat exchanger. The compressors switch on and off, according to the cooling demand, in order to assure constant cold-water temperatures. If hot water becomes necessary again during this mode, one refrigerant cycle switches from the air-cooled heat exchanger to the hot-water heat exchanger.

0 % cooling demand – 100 % heating demand

In this mode, the GEA *HeaMo* uses the outdoor air as free energy source, in order to again provide the energy removed from the air to the building in the form of hot water. During this operational mode, refrigerant is not pumped to the cold-water heat exchanger. If changes occur in the heating load, compressors will switch on and off accordingly. If the demand for cold water increases, one cold-water cycle will switch over from the air-cooled heat exchanger (which is used as an evaporator in this mode) to the cold-water heat exchanger.

The operation of the GEA *HeaMo* GEO is analogous to the modes of operation shown here for the GEA *HeaMo* AIR. The GEA *HeaMo* GEO system, however, uses geothermal energy sources for pure cold- or hot-water operation, and in cases of asymmetrical load distribution.

Air Eco$_2$nomy®

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