SPH Sustainable Process Heat

Highly efficient
Industrial heat pumps
for up to 165°C

Let‘s make the world a little bit greener!

Valuable Process Heat From Waste Heat

Your Advantages

- **Energy Cost Reductions**
  Become independent from increasing fossil fuel prices and CO2 taxes
- **CO2 Reduction**
  100% CO2-free process heat when using renewable electricity
- **Improve your energy efficiency**
  use your waste heat and keep it in the process
- **Easy installation**
  4 pipes plus one wire - and the systems runs
- **Flexible operations**
  automatic adaptation to your heat demand

Industrial Heat Pumps for Temperatures up to 165°C

SPH Sustainable Process Heat GmbH is your partner for industrial high temperature heat pumps for process heat. With our unique system it is possible to generate temperatures up to 165°C with the highest efficiency.

The system uses your waste heat from production equipment or processes, which is today dumped in the environment or expensively cooled away. With the use of 15-40% of electrical energy, our system can produce valuable process heat from your waste heat.

It doesn't matter if you need it as hot water, thermal oil or steam, everything is possible with our unique system.

Easy system integration as monovalent installation or bivalent with your existing heat source make the usage simple and safe.

The use of novel refrigeration agents, which have both a low global warming potential and are nonflammable and nontoxic, ensures a sustainable system which is fit and ready for a future with continually stricter requirements for greener production methods.

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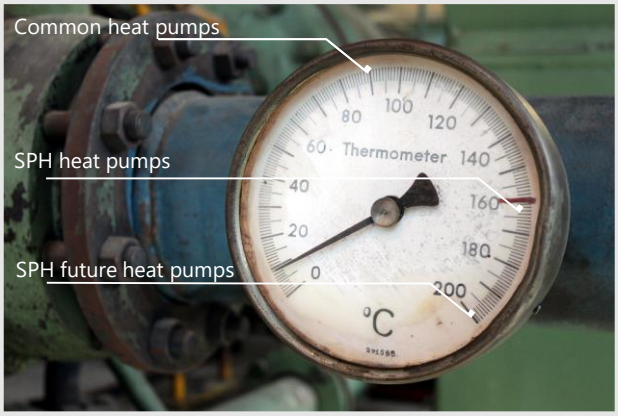
Higher Temperatures

Hotter and more efficient than other heat pumps

The global demand for industrial heat between 100 and 200 °C is presently about 6,500 TWh per year (4% of all global energy demand), and the demand in this temperature range is expected to further increase by 20% within 2030*.
Currently more than 80% of this heat is produced by burning fossil fuels, which emits millions of tons of CO2 into the atmosphere.
Industrial heat pumps have historically been restricted to a maximum output temperature of 80-90 °C while the large portion of the demand is in the 100-200 °C range. SPH Sustainable Process Heat GmbH has cracked the case and develops a series of very high temperature heat pumps with output temperatures up to 165 °C , which will increase to above 200 °C in the future.
The heart of our system is a piston compressor, which has been especially developed for this application, combined with innovative process technology.

*Source: IEA: "World Energy Outlook 2017"



Facts

Industrial Heat Pumps

Heat source media	Water, Water-Glycol, Thermal Oil, Steam
Heat sink media	Water, Thermal oil, Steam
Temperature range heat source	20°C – 150°C
Temperature range heat sink	80°C-165°C (200°C)
Temperature lift per stage	up to 80K (100K)
Thermal power per compressor	400 kW- 1000 kW depending on operation point
setup	1-stage, 2-stage, serial, parallel
Power control	30%-100% continuously
Working media	Enviromentally friendly refrigerants with low GWP (<20)

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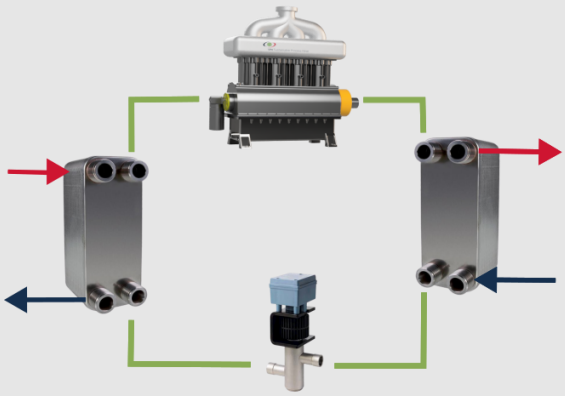
How does it work?

Heat pump working principle

Almost everybody owns a heat pump without knowing it. The most widely used heat pump in the world is actually in your refrigerator and keeps your food cold and fresh.
A heat pump extracts heat from a thermal system (the inside of your fridge) and introduces it into another thermal system (here the ambient) on a higher temperature.
We use this same principle and extract thermal energy from your waste heat, by cooling it down, and introduce the energy into your process heat system on a higher temperature level. Technically it works as shown below:

2. Compression of the working medium vapor to a higher pressure -> the temperature increases

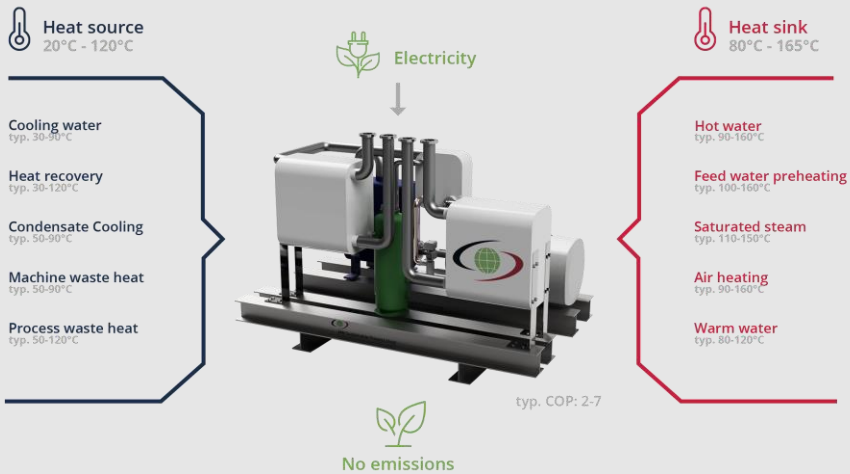
1. Evaporation of a liquid working medium by assimilation of heat from the heat source



3. Liquefaction of the hot working medium vapor by transfer of heat into the heat sink

4. Expansion of the liquid working medium to a lower pressure level -> the temperature decreases

Overview of our system



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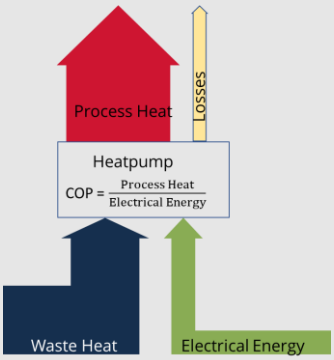
Very high efficiency

The economy of the heat pump installation depends to a large extent on the efficiency of the applied solution. This efficiency is given by the coefficient of performance (COP), which is the ratio between the thermal energy output against the electrical energy input. The COP indicates how many kilowatts of heat you get for one kilowatt of electricity. This depends on both **external** factors such as the temperature lift and on **internal** factors such as the efficiency of the compressor.



Performance-determining factors

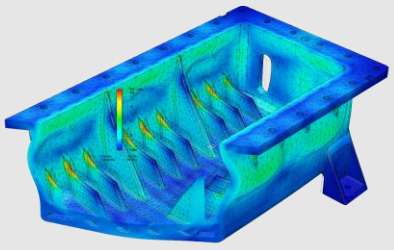
Decisive external factors which determine the performance of the heat pump are:

- Temperatures of the heat source
- Temperatures of the heat sink

It is the temperature lift which is the most important factor, i.e. the greater the difference between the highest temperature (flow heat sink) and the lowest temperature (return heat source), the lower the COP and also the power output.
Furthermore, the temperatures also determine the selection of the suitable working medium and thus also decisively the achievable power. With given external factors, which are normally determined by the application and are not changeable, the system structure of the heat pump will then give the attainable COP.
SPH Sustainable Process Heat GmbH has incorporated more than 50 years of experience in the development of reciprocating engines into the compressor. By combining innovative concepts and proven automotive technology, SPH Sustainable Process Heat GmbH has made the core of the system extremely efficient and at the same time durable. Highlights are:

- Friction-optimized with innovative lubricant concept
- Low dead volume with very low internal pressure loss

All this leads to groundbreaking high isentropic and volumetric efficiencies in the target temperature range. The design of the rest of the system guarantees low thermal and fluidic losses at maximum energy yield of the thermal process.
All this leads to an industrial heat pump system with the ability to generate very high temperatures at very high efficiency



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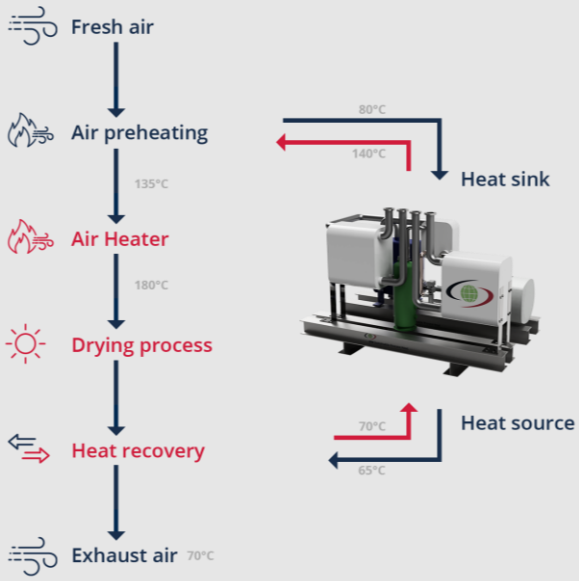
Application Example

Drying Process

This application example shows a typical industrial drying process, e.g. used in powder production or brick drying.
All values are for illustration purposes only.



Simplified operation schematics for heat pumps in drying processes.

	Without heat pump	With heat pump	Without heat pump Year 2025	With heat pump Year 2025
Thermal power [kW]	765	765	765	765
Fuel power air heater [kW]	900	265	900	265
Thermal power, heat pump [kW]	0	550	0	550
Electrical power, heat pump [kW]	0	125	0	125
COP heat pump	-	4,4	-	4,4
Yearly running time [h]	6000	6000	6000	6000
Gas consumption [GWh]	5,4	1,59	5,4	1,59
Electrical consumption [MWh]	0	750	0	750
Gas price [€/MWh]	35	35	51	51
Electricity price [€/MWh]	85	85	110	110
Yearly gas costs	189.000 €	55.650 €	275.400 €	81.090 €
Yearly electricity costs	0 €	63.750 €	0 €	82.500 €
Consumption costs	189.000 €	119.400 €	275.400 €	163.590 €
Yearly savings	0€	69.600 €	0€	111.810 €

The heat pump will save up to 1000 tons of CO2 per year compared to natural gas - and 1600 tons per year against oil. This equals the yearly emissions from 800–1300 compact cars.

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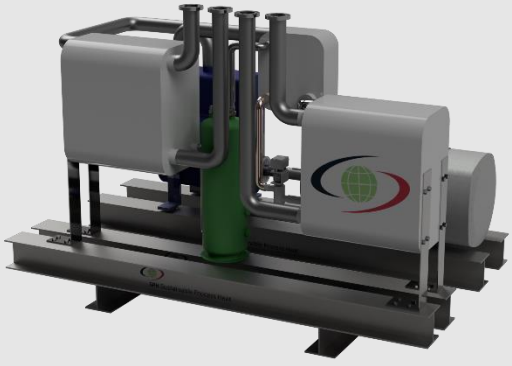
Standard System

SPH offers custom made heat pump systems, individually designed for your application. All systems are however based on our piston compressor, which has been specifically designed for high temperature heat pumps.
In order to avoid unnecessary engineering and development costs we have defined a standard system with some common options, which will cover most applications, and which can be multiplied in a variety of configurations for higher power needs.

System configuration

- Hydraulic module and electrical cabinet are delivered separately, for flexible installation
- Liquid-liquid heat pump
- One stage with one compressor
- PLC based control with 10" touchscreen
- Various A1 HFO refrigerants available, depending on temperature
- Up to 165°C heat sink temperature
- Up to 1000 kW thermal output, depending on operating point
- 30%-100% continuous power control
- Heat source temperature spread 3°C – 30°C
- Heat Sink temperature spread 5°C – 50°C
- Available options:
    - Direct steam production
    - Additional sub cooler for power improvements on high sink spread



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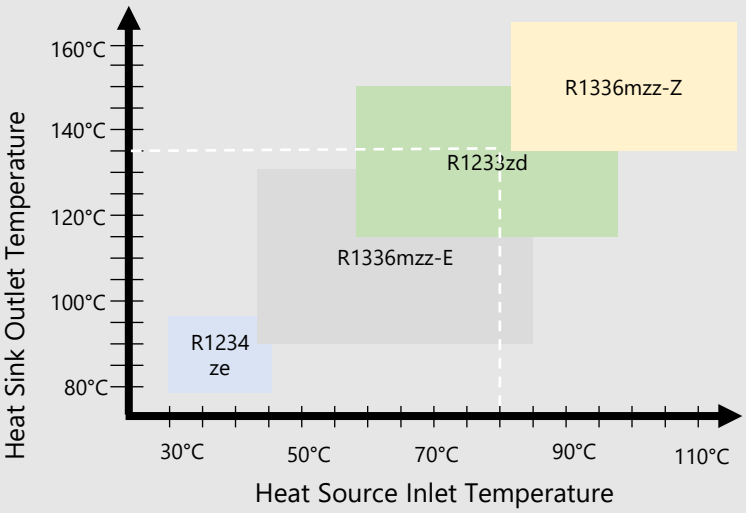
Performance data

The following charts are for a first approximation of the standard system performance. For a detailed case specific calculation please contact us. All values are valid for a 5K spread on the source side and a 10K spread on the sink side. All data is for the water-water type heat pump.

1. Step: Find out which working fluid is the best for your application.



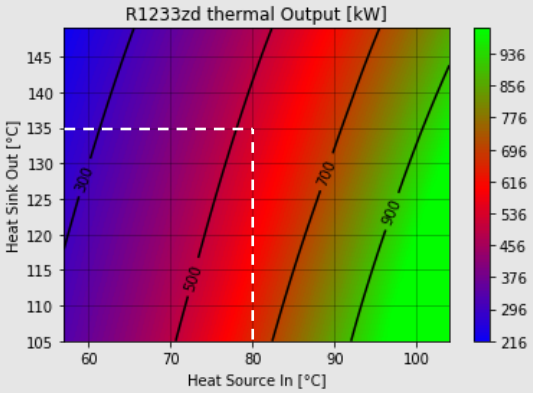
Example

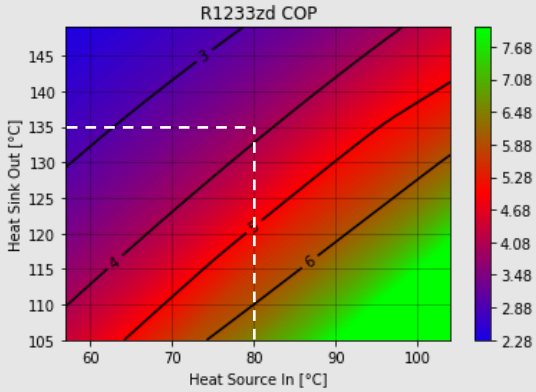
Your data:
Inlet Source: 80°C
Outlet Sink: 135°C

The charts are valid for:
Outlet Source: 75°C
Inlet Sink: 125°C

The best working fluid is R1233zd.

2. Step: Determine the approximate value for thermal output and COP from the charts on the following pages.





The reading gives approx. 530 kW thermal output with a calculated COP of 3,8.

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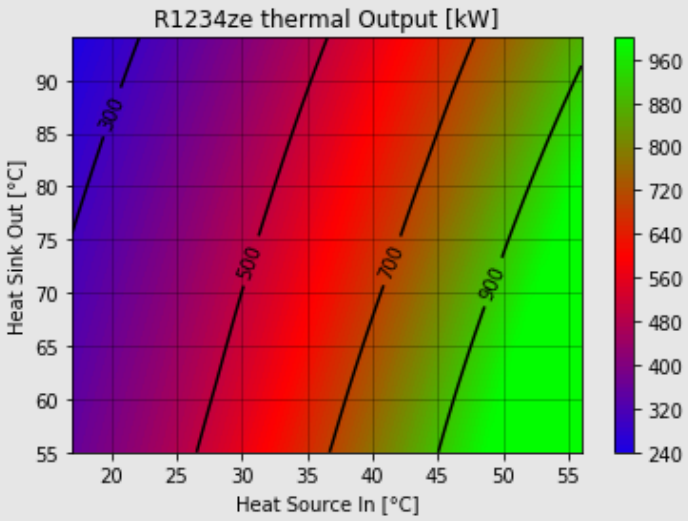
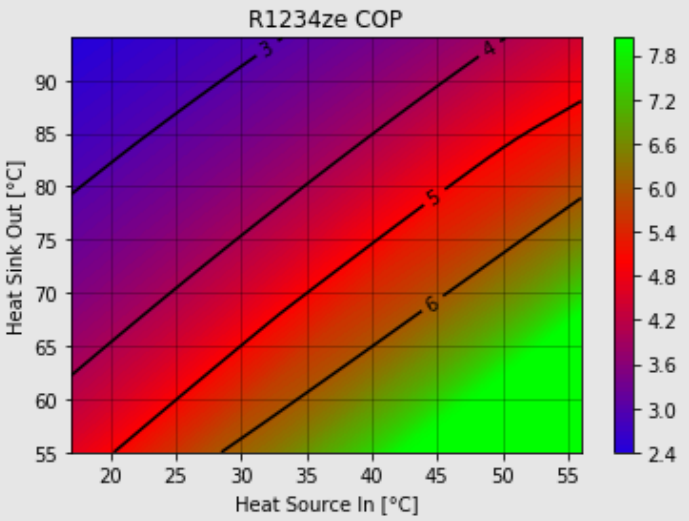
Working Media R1234ze

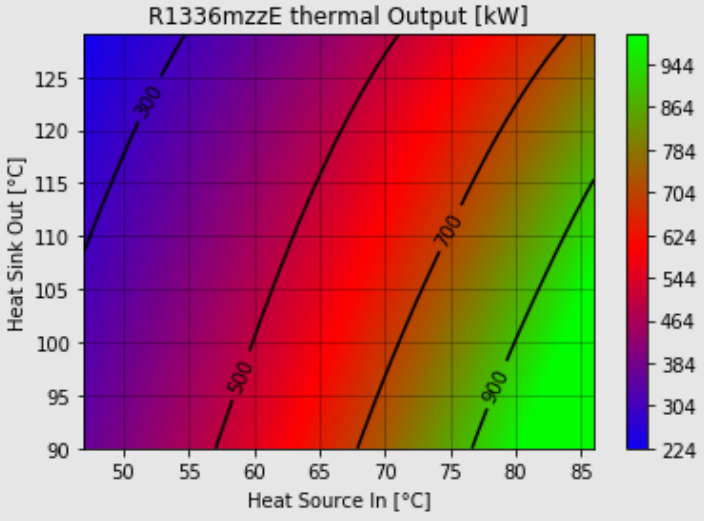
A2L refrigerant, low flammability, nontoxic, GWP* < 1

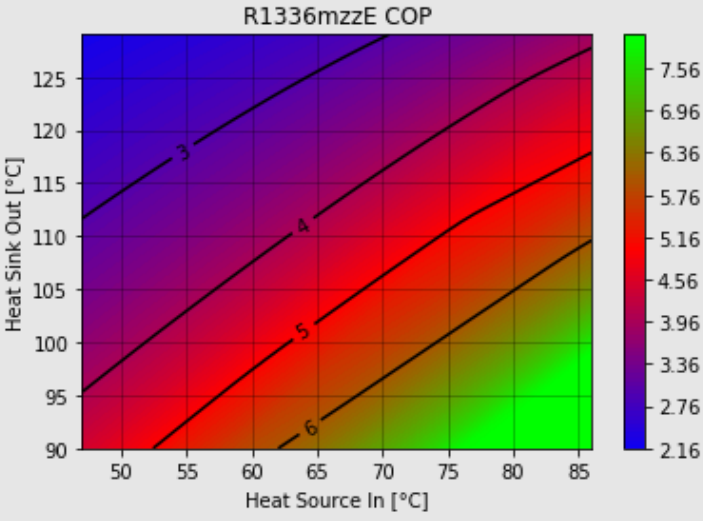




Working media R1336mzz-E

A1 refrigerant, nonflammable, nontoxic, GWP* = 18





*GWP: Global Warming Potential, in relation to CO_2

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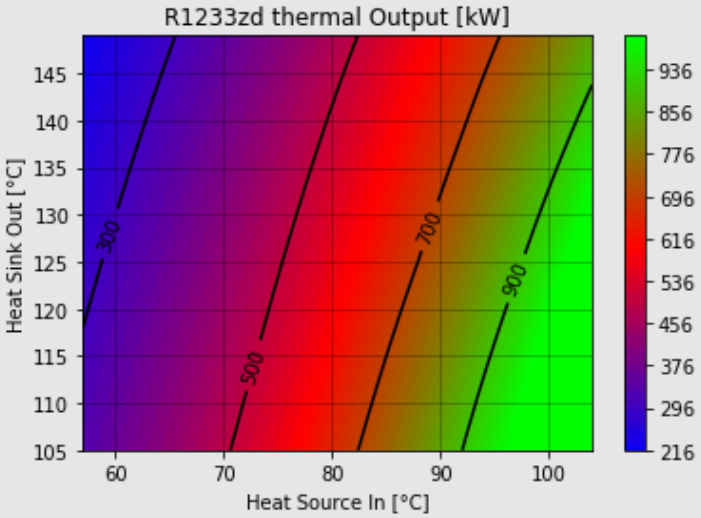
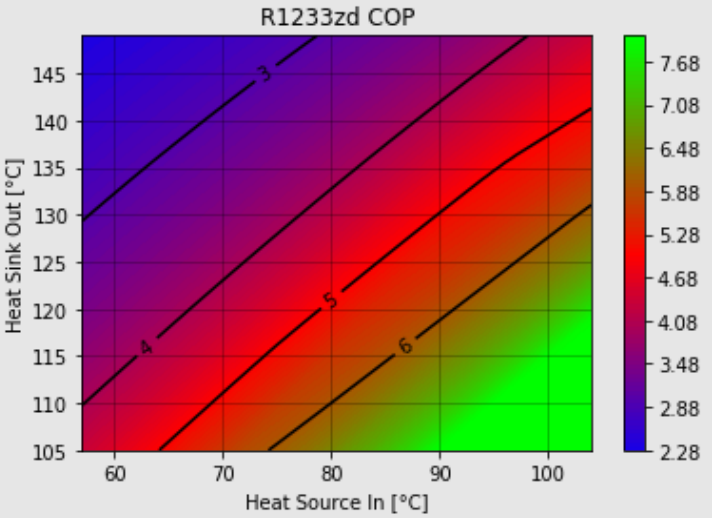
Working media R1233zd

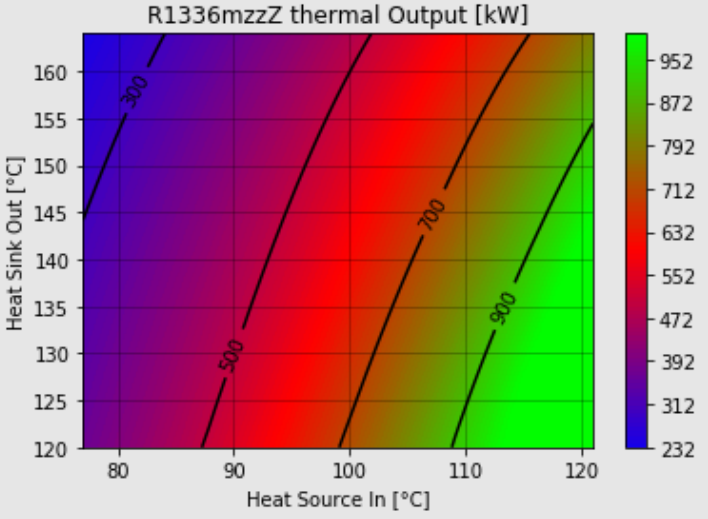
A1 refrigerant, nonflammable, nontoxic, GWP* = 1

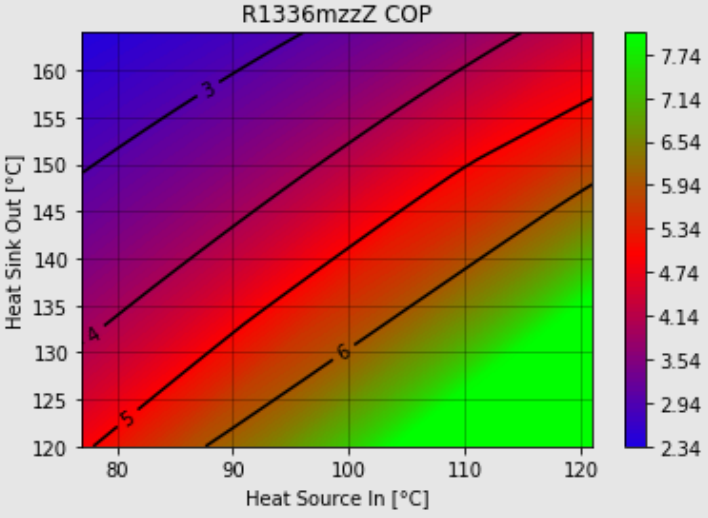




Working media R1336mzz-Z

A1 refrigerant, nonflammable, nontoxic, GWP* = 2





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