**GEA CO₂ Heat Pump**

**GEA Heating and Refrigeration Technologies**

![Image of a GEA CO₂ heat pump](image)

**Figure 1: Transcritical chiller with BLUE compressors.**

**Summary of technology**

GEA’s high-temperature industrial CO₂ heat pump for combined heating and cooling applications can provide heating water at up to 130 °C.

The unique properties of supercritical CO₂ makes it a favorable choice of heat pumps for heating ‘once through’ water. It can also be used for heating process water with a low return temperature and high forward temperature. The hot water return temperature ideally should be between 10 °C – 45 °C. The lower the hot water return temperature, the higher the heat pump efficiency.

A GEA CO₂ heat pump for combined heating and cooling gives the largest benefit per kWh of electricity used. With a heating COP of 3 and a cooling COP of 2, it delivers 5 kWh of useful energy per kWh of electricity used. CO₂ is a non-flammable natural refrigerant, with low toxicity and GWP = 1.

The heat pump is constructed with multiple reciprocating transcritical CO₂ compressors (2 – 8) to deliver the required heating and cooling capacities. The heat pump is equipped with a flooded evaporator and separation vessel. The gas coolers can be 1 or 2 heat exchangers in series depending on the temperature lift. For very high temperature lift the intermediate temperature between the high temperature gas cooler (HTGC) and the low temperature gas cooler (LTGC) is optimized to give the best heat pump efficiency.

The heat pump is equipped with GEA Omni control panel which provides state-of-art control...
of the hot water outlet temperature and the optimal heat pump efficiency. During test the importance of good control of both the heat pump and water system is seen, and since the change of control system to a single controller for both systems a significant efficiency gain during variable operating conditions have been seen.

Table 1 shows the performance of the heat pump in four different operating conditions.

### Table 1: Estimated performance.

<table>
<thead>
<tr>
<th>T&lt;sub&gt;source&lt;/sub&gt;, in [°C]</th>
<th>T&lt;sub&gt;source&lt;/sub&gt;, out [°C]</th>
<th>T&lt;sub&gt;sink&lt;/sub&gt;, in [°C]</th>
<th>T&lt;sub&gt;sink&lt;/sub&gt;, out [°C]</th>
<th>COP&lt;sub&gt;heating&lt;/sub&gt; [-]</th>
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<tr>
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<td>4</td>
<td>20</td>
<td>130</td>
<td>3.13</td>
</tr>
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</table>

**Project Example**

A prototype of the GEA CO<sub>2</sub> transcritical heat pump has been running since 2019 at GEA’s test facilities. The heat pump is producing 130 °C hot water, which is operating in a closed loop returning at 35 °C. At the same time the heat pump is producing chilled water at 4 °C. The chilled water is used for dehumidification and is returning to the heat pump at 10 °C. The prototype heat pump produces 90 kW of hot water at a COP of 3.13.

**FACTS ABOUT THE TECHNOLOGY**

- **Heat supply capacity:** 0.1 MW - 1.2 MW
- **Temperature range:** Hot water supply temperature from 90 °C to 130 °C. Hot water return temperature from 10 °C to 45 °C. Chilled water/glycol outlet from -10 °C to 25 °C
- **Working fluid:** R-744 (CO<sub>2</sub>)
- **Compressor technology:** Semi-hermetic piston
- **Specific investment cost for system without integration:** 200-300 €/kW
- **TRL level:** 8
- **Expected lifetime:** 10 - 15 years
- **Size:** n/a

**Contact information**

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