New Perspectives for the Application of large-scale Heat Pumps

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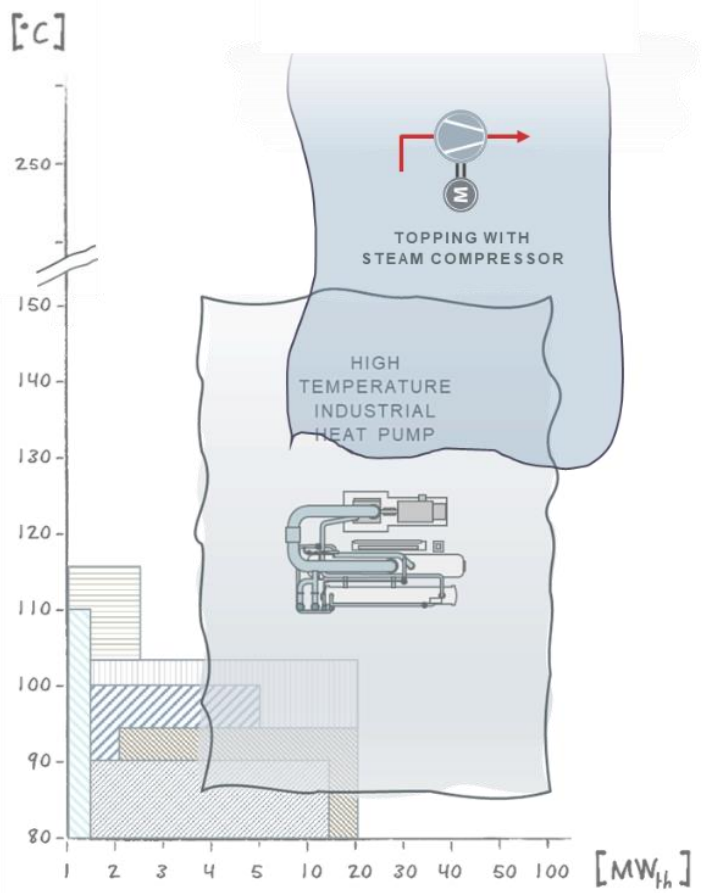
Large scale heat pumps open-up new perspectives for low carbon heat supply

Large scale heat pumps



Heat supply

~7 – 70 MW$_{th}$ per unit

Temperatures

up to **150°C** directly from heat pump

Various drive concepts

Electrical or **mechanical**

Combination with steam compression for **higher temperatures** and **pressures** for process steam production

Scope of supply

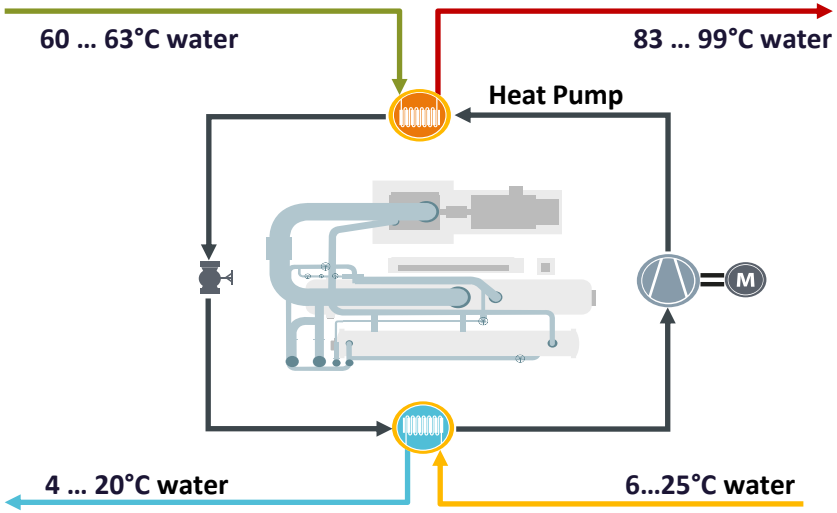
Component up to **turnkey supply**

Application perspectives – examples:

- **District heating systems**
- **Process industries**
- **Power-to-X plants**
- **CHP plants**
- **…**

Recent examples for large scale heat pumps in district heating systems

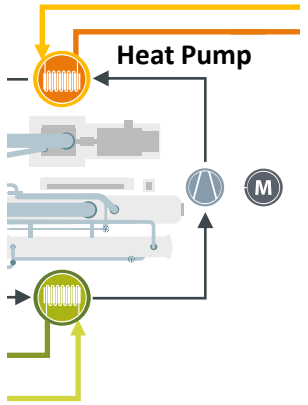
District heating system, Mannheim, local utility MVV, Germany



Thermal capacity	max. 20 MW_{th}	**COP** (overall)	2.7 (average)

Expected benefits	• District heat for 3500 households • CO2 savings: ~ 10000 t/a

District heating system, Berlin, Vattenfall, Germany



Thermal capacity	max. 8 MW_{th}	**COP** (overall)	3 (average)

Expected benefits	• District heat production: ~ 55 GWh/a • CO2 savings: ~ 6500 t/a • Cooling water savings:~ 120 000 m^3/a

Recent examples for large scale heat pumps in district heating systems

District heating system, Mannheim, local utility MVV / GKM, Germany

Thermal capacity	max. 20 MW_{th}
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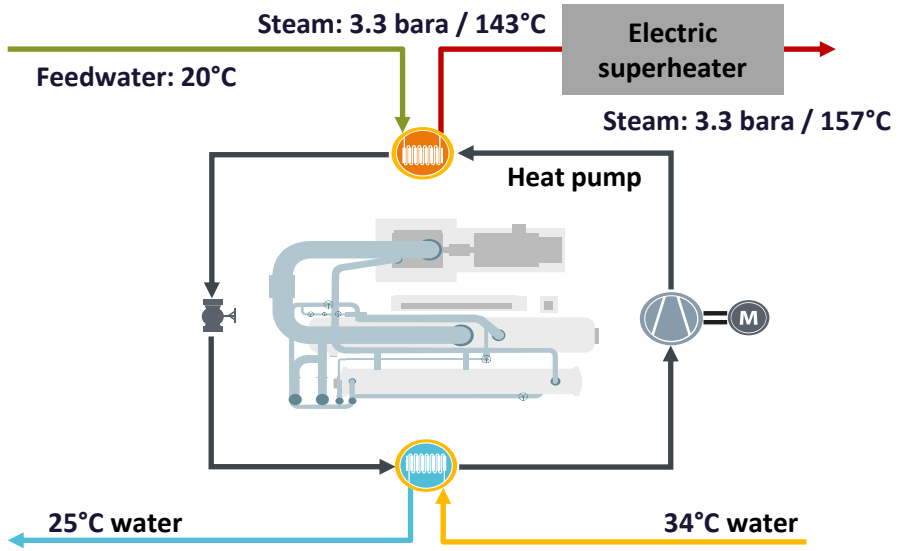
Recent examples for large scale heat pumps in process industries

Paper mill, Northern Europe

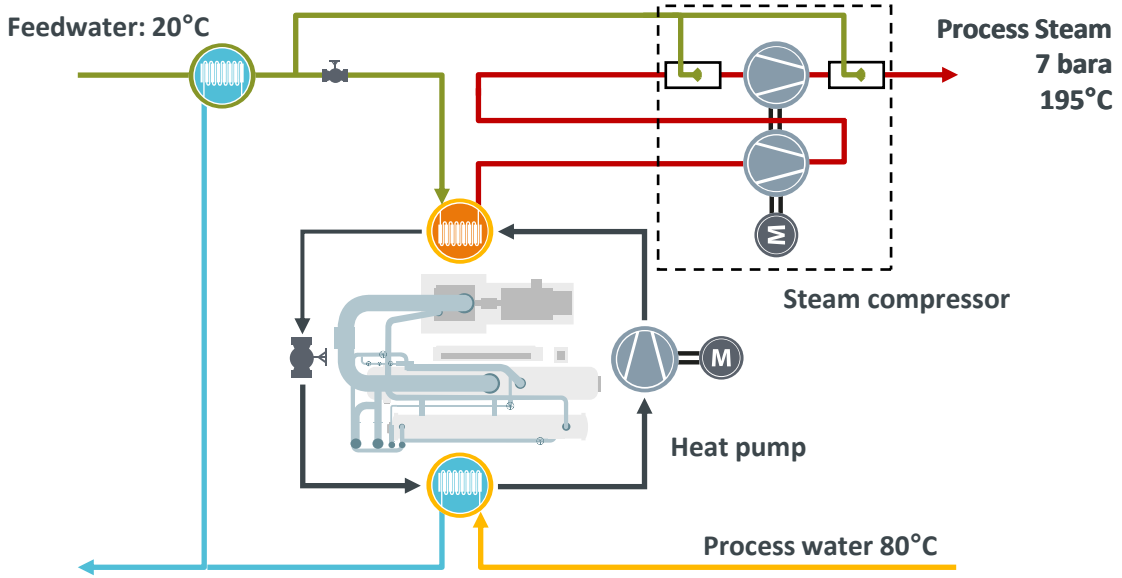


Thermal capacity	17 MW_{th} (incl. electric superheater)
COP (overall)	1.9 (incl. electric superheater)

Expected benefits

- Enhanced overall energy efficiency
- Low(er) carbon heat supply
- Reduced dependence on fossil fuels

Chemical plant, Western Europe



Thermal capacity	44 MW_{th} (incl. steam compressor)
COP (overall)	2.8 (incl. steam compressor)

Expected benefits

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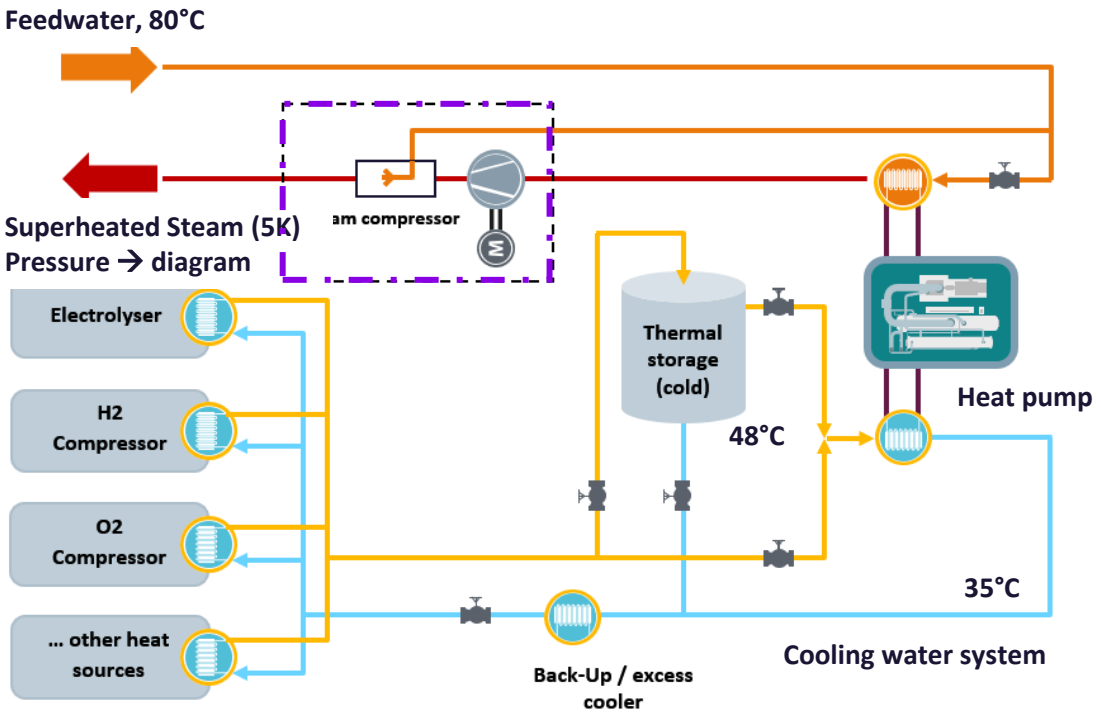
- Low(er) carbon heat supply
- Reduced dependence on fossil fuels

Large scale heat pumps in climate neutral energy supply systems – actual concepts (1/2)

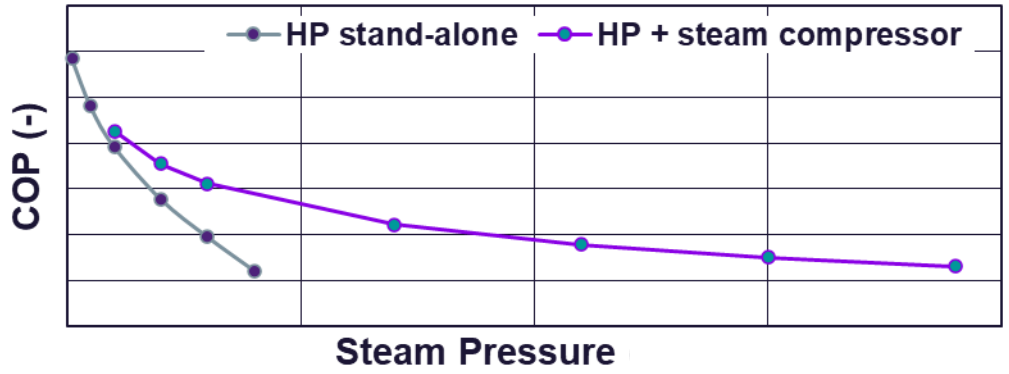
Waste heat recovery from electrolyzer plant



Thermal capacity (order of magnitude)

- 20 % of electrical power draw as waste heat i.e., heat source
- 30 MW_{th} heat pump output per 100 MW_{el} electrolyzer input assuming a COP between 3.

Coefficient of performance (COP)

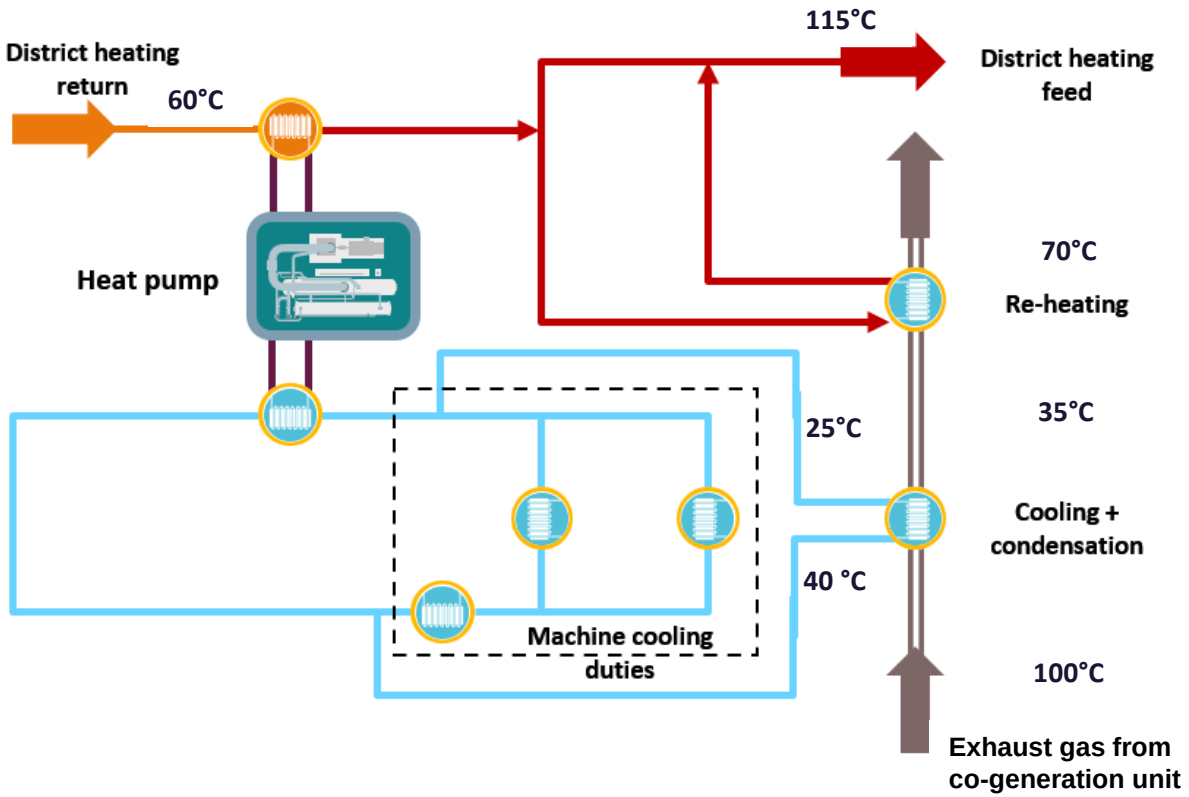


Expected benefits

- Reduced re-cooling loads
- Low carbon heat supply for adjacent processes
- No process heat requirement → heat "export" to district heating

Large scale heat pumps in climate neutral energy supply systems – actual concepts (2/2)

Exhaust gas condensation from natural gas or hydrogen fired boilers or gas turbines



Thermal capacity (order of magnitude)	
Natural gas:	
• Co-generation unit (SGT800):	76 MW_{th}
• Co-generation unit (SGT800) + HTHP:	76 MW_{th} + 23.5 MW_{th}
Hydrogen:	
• 23.5 MW_{th} + (Increased potential due to increase in p_{H2O})	

Coefficient of performance (COP)	
Natural gas:	2.5
Hydrogen:	2.5 (const. exhaust gas temp: of 35°C)
	2.5 + (const. thermal capacity of HP)

Expected Benefits

- Increased thermal power of boiler or gas turbine
- Enhanced fuel utilization
- Recovery of water

Summary

- The electrification of the heating sector is key to meeting global emissions targets. Heat pumps allow for energy efficient electrification of the heating sector.
- Large scale heat pumps
  - allow for heat supply to up to 150°C. Subsequent steam compression facilitates steam supply to up to 55 bara and 270°C.
  - facilitate low carbon heat supply to district heating systems and process industries.
  - can boost energy efficiency in climate neutral energy supply systems, such as electrolyzers and hydrogen-fired gas turbines.
- Siemens Energy has a track record as heat pump supplier at temperatures of up to 99°C and advanced products to facilitate heat supply at higher temperature levels.
- Siemens Energy can be your One-Stop-Shop for decarbonization – from the initial assessment and technical analysis to a heat pump ready for low carbon operation.

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