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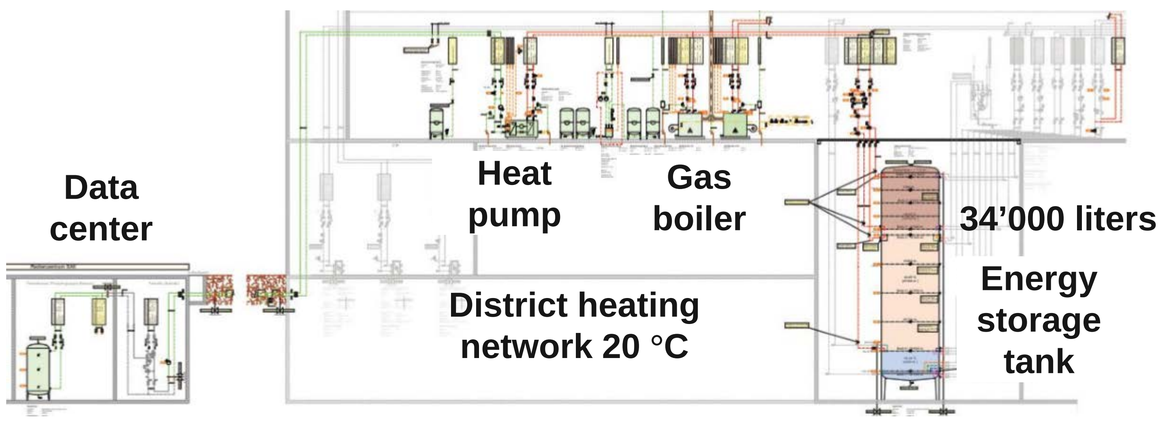
High Temperature Heat Pump in a Swiss Cheese Factory

From Waste Heat to Cheese

Application

The **mountain cheese factory in Gais Appenzell** transforms **waste heat at 20 °C from the neighboring data center** into **process heat of up to 100 °C** using a **high temperature heat pump** in order to heat and process the milk for cheese production.
This **saves** the mountain cheese factory around **1.5 million kWh of natural gas per year**.



Cheese factory in Gais Appenzell

- Energy demand approx. 1'800 MWh per year
- Approx. 10 mio. liters of milk per year (60 milk suppliers)
- **Approx. 300 tons of cheese per year**

Temperature levels:

- **Waste heat recovery** (washing, ventilation heating): **<42 °C**
- **Space heating and hot water** (cheese storage house): **65 °C**
- **Process heat 1** (cheese vats, cleaning water): **92 °C**
- **Process heat 2** (multi-purpose heater, pasteurisation): **105 °C**

Contacts

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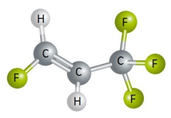
Technical data of the HTHP

Heat pump type	IWWHS 570 ER6c2
HFO  R1234ze(E) (GWP of 6)	I: Industrial heat pump W: Water as heat source W: Water as heat sink H: High temperature heat pump S: Screw compressor 570: Heating capacity range in kW E: Economizer cycle R: Shell and tube heat exchanger 6: Refrigerant HFO R1234ze(E) c2: 2-stage compressor
Heating capacity	approx. 520 kW
Heat source	18/14 °C (in/out)
Heat sink	82/92 °C or 55/65 °C (in/out)
Heat source	Cooling water (waste heat) from the neighboring data center (16 to 20 °C)
Compressor type	2-stage screw with vapor injection
Refrigerant	R1234ze(E) (130 kg, safety group: A2L, mildly flammable)
First operation	2020/21 (using waste heat from the data center)

- The **mildly flammable** (A2L) HFO refrigerant R1234ze(E) demands special measures for **fire protection (e.g. gas sensors, ventilation)** and **escape routes**.

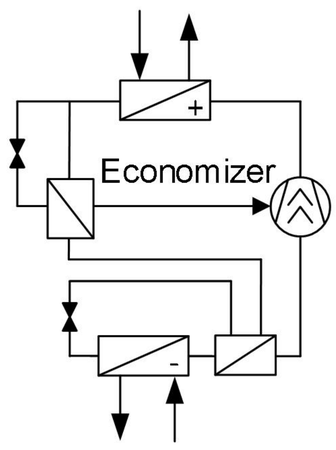
Performance data of the heat pump

	High temperature (W18-14/W82-92)			Low temperature (W18-14/W55-65)		
Part load (%) (by slide valve control)	**100***	75**	50**	**100***	75**	50**
Effective part load (%)	**100**	81	62	**97**	75	54
Condenser capacity (kW)	**520**	419	321	**505**	390	279
Condenser water flow rate (m^3/h)	**44.7**	36.0	27.6	**43.4**	33.5	24.0
Temperature difference condenser (K)	**10.0**	10.0	10.0	**10.0**	10.0	10.0
Evaporator capacity (kW)	**338**	264	195	**385**	293	205
Evaporator water flow rate (m^3/h)	**82.7**	82.7	82.7	**82.7**	82.7	82.7
Temperature difference evaporator (K)	**3.5**	2.7	2.0	**4.0**	3.0	2.1
Compressor power (kW)	**182**	155	126	**120**	98	74
COP_H (-)	**2.85**	2.70	2.55	**4.20**	4.00	3.75

(from data sheet of Ochsner Energie Technik GmbH, * experimentally tested data, ** extrapolated)

Economizer cycle with vapor injection

- **Efficient solution for high temperature lifts**
- **Higher refrigerant mass flow** ↑ at compressor outlet results in **higher heating capacity** ↑
- **Reduced compressor discharge temperature** ↓ is positive with regard to the compressor temperature limits
- **Stronger subcooling** ↑ of condensate increases the COP ↑



References

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[4] Amstein+Walthert, 2018. "Bergkäserei Gais: Mitarbeiter Remo Niederöst im Interview". August 28, 2018, available online: https://www.blog-amstein-walthert.ch/2018/08/28