



Industrial heat pump references in Switzerland – Examples (Task 1, first draft)

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- Examples of industrial heat pumps in Switzerland
- Data sources: heat pump manufacturers, installers, planers and contractors





HP manufacturer: CTA AG
 Contractor: Seiz AG
 Consultant: Carnotech AG

| | Cooling | Heating |
|-----------------------|----------|----------|
| Cooling capacity | 222.6 kW | 183.7 kW |
| Electrical power | 70.4 kW | 96.8 kW |
| EER | 3.16 | 1.9 |
| Heat source out | 11°C | 17°C |
| Heat source in | 5°C | 11°C |
| Heating capacity | 289.8 kW | 276.2 kW |
| COP | 4.12 | 2.85 |
| Hot water inlet | 35°C | 60°C |
| Hot water outlet | 45°C | 70°C |
| Refrigerant | R-1234ze | R-1234ze |
| Piston compressors | 4 | 4 |
| No. of cooling cycles | 2 | 2 |

Temperature range from 5 to 70 °C
 Space for 8 heat pumps à 220 kW
Application: Cooling and heating of
 chocolate conching machines
 Savings fossil fuels = 2'590 MWh
 Savings CO₂ emissions = 30% (510 t/a)



■ Maestrani chocolate factory

- Up to 8 machines (currently 2, modular design à 220 kW), with HFO
- Wide temperature range from 5 to 70 °C, depending on the process step in chocolate production
- 6 different operating points (further information [here](#))



■ District heating Champagne

- 2 groundwater heat pumps, custom-made, each 650 kW
- Heat source 11 / 7 °C, heat sink 63 / 48 °C
- Speed-controlled piston compressor

■ Biocenter Basel

- 3 NH₃ chillers à 1.6 MW each, total 4.8 MW cooling capacity
- Electric motor power 3 x 400 kW, total 1.2 MW
- Cold water temperatures 14 / 8 °C, waste heat temperatures 32 / 40 °C
- Use of waste heat (further information [here](#))



■ District heating Basel

- 2 internally installed air-to-water heat pumps
- Custom-made à 265 kW for A5/W65
- Cooler on the roof of the newly renovated St. Jakob Stadium

■ Gravel plant

- 1 Optipro standard heat pump à 168 kW with W10/W35
- Max. heat sink 63°C, COP 5.9, 2-stage 50% / 100%
- Heating of offices, production and workshop (www.cta.ch/2625)



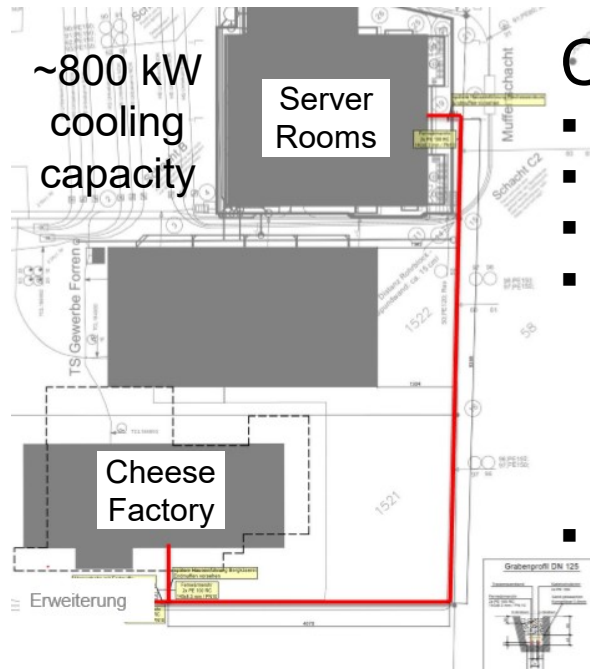
Cheese Factory in Gais Appenzell



Rechenzentrum Ost



Waste heat from server
rooms 16 to 20 °C

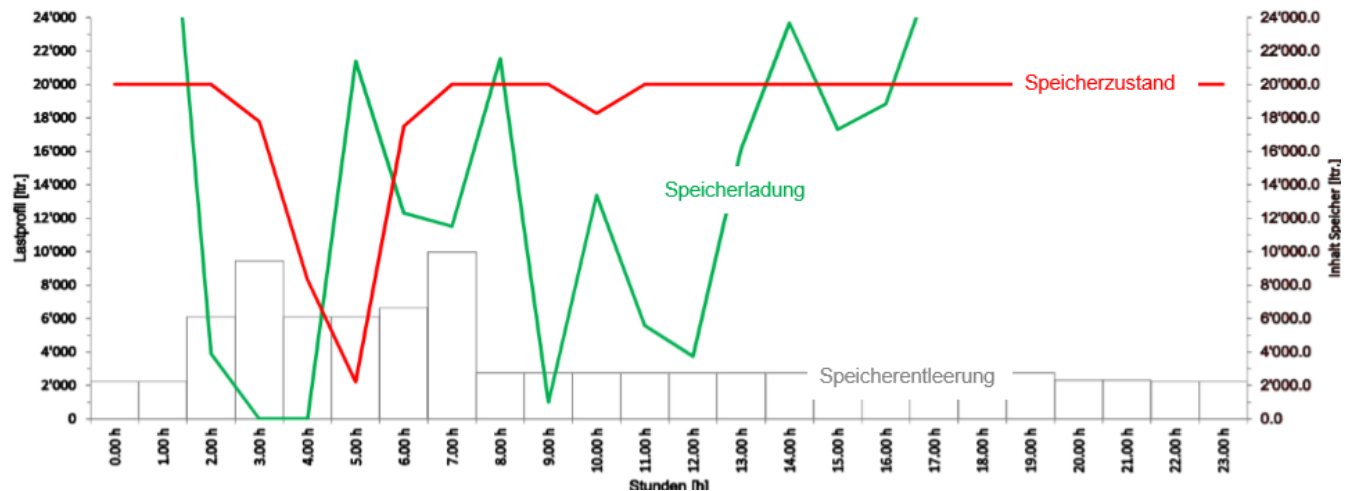
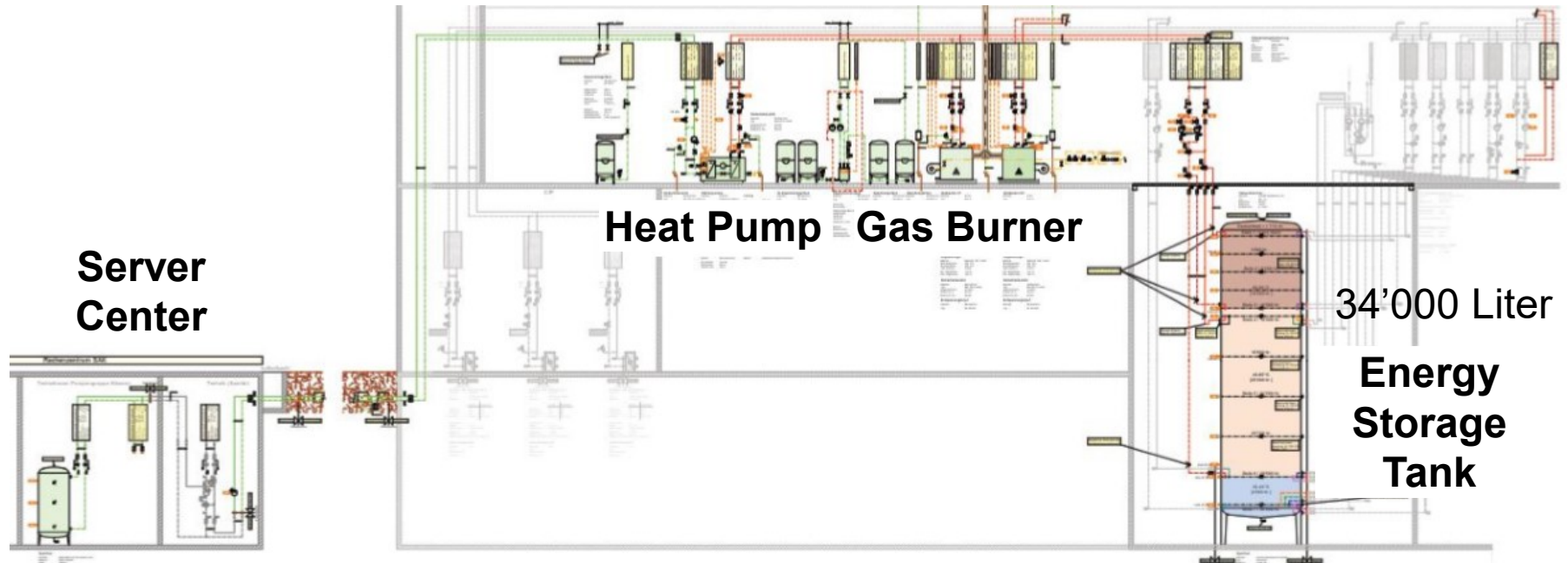


Cheese Factory

- Energy demand ~1'800 MWh/a
- ~10 Mio. Liter milk per year
- ~300 t cheese per year
- Temperature levels:
WRG GWK: <42°C
Space heating/hot water: 65°C
Process Niveau 1: 92 °C
Process Niveau 2: 105°C
- Redundancy Process 100%

Source: Amstein +Walthert

Cheese Factory in Gais Appenzell



Cheese Factory in Gais Appenzell

Heat pump

- **OCHSNER**
ENERGIE TECHNIK
- **IWWHS 570 ER6c2**
92°C, ~520kW
R1234ze (A2L)
- **Part-load operation**
for capacity control

| Betriebspunkte: | | Hochtemperatur HT (W18-14/W92) | | |
|-------------------------------|--|----------------------------------|------|------|
| | | 100 | 75 | 50 |
| Leistungsstufe [%] | | 100 | 75 | 50 |
| Verflüssigerleistung [kW] | | 520 | 419 | 321 |
| eff. Leistungsstufe [%] | | 100 | 81 | 62 |
| Verflüssigerdurchfluss [m³/h] | | 44.7 | 36.0 | 27.6 |
| Temperaturdifferenz [K] | | 10.0 | 10.0 | 10.0 |
| Verdampferleistung [kW] | | 338 | 264 | 195 |
| Verdampferdurchfluss [m³/h] | | 82.7 | 82.7 | 82.7 |
| Temperaturdifferenz [K] | | 3.5 | 2.7 | 2.0 |
| el. Leistungsaufnahm [kW] | | 182 | 155 | 126 |
| COP | | 2.85 | 2.70 | 2.55 |
| Betriebspunkte: | | Niedertemperatur NT (W18-14/W65) | | |
| | | 100 | 75 | 50 |
| Leistungsstufe [%] | | 100 | 75 | 50 |
| Verflüssigerleistung [kW] | | 505 | 390 | 279 |
| eff. Leistungsstufe [%] | | 97 | 75 | 54 |
| Verflüssigerdurchfluss [m³/h] | | 43.4 | 33.5 | 24.0 |
| Temperaturdifferenz [K] | | 10.0 | 10.0 | 10.0 |
| Verdampferleistung [kW] | | 385 | 293 | 205 |
| Verdampferdurchfluss [m³/h] | | 82.7 | 82.7 | 82.7 |
| Temperaturdifferenz [K] | | 4.0 | 3.0 | 2.1 |
| el. Leistungsaufnahm [kW] | | 120 | 98 | 74 |
| COP | | 4.20 | 4.00 | 3.75 |



Heat source: 37 °C

- waste heat from refrigeration (cooling of storage rooms)

Heat sink: 80 – 95 °C

- process water for disinfection of beverage filling plants and wine tanks
- space heating of storage rooms
- district heating of production site

Heat pump type: ISWHS 60 ER3

Heating capacity: 63 kW

Cooling capacity: 48 kW

Compressor: Screw, ÖKO 1

COP Heating: 4,2

EER Cooling: 3,2

Year of installation: 2017

Examples of industrial heat pumps in Switzerland

Nutrex – Vinegar fermentation and pasteurization



Applications:

Cooling: Vinegar fermentation process over 10 days at 30°C

Heating: Vinegar pasteurization above 70°C to obtain a non-perishable food.

Cooling capacity 136 kW

Heating capacity 194 kW, COP 3,4

Savings CO₂ emissions ~310 t/a

Savings fuel up to 65'000 L/a

Technical details of the application

Heating capacity: 194 kW

COP: 3,4

Refrigerant: R134a

Heating source: Water

Supplied temperature: > 70°C

By **VIESSMANN**
climate of innovation

Left: Production of the vinegar/fermentation

Right: Heat pump in machine room

Source: Viessmann/Nutrex

Meat production – Slaughterhouse Zurich

- Meat production: 30'000 t/a (with 500 employees)
 - Location: in the middle of the city (in a historical building)
- Heat sink:
 - Hot water for cleaning processes up to 90°C and space heating
- Heat source:
 - Waste heat from refrigeration processes (closed water loop with storage tank) and waste heat from compressed air generation
- Heating capacity = 800 kW at 90/30°C
- COP 3.4, refrigerant CO₂
(Gas burner as back-up heater)
- Percentage of substituted fossil energy: 30%

Source: EnergieSchweiz (2018): Erneuerbare Energien in der Industrie – Fallanalysen, Hochrechnung und Empfehlungen

Härterei Gerster AG

- Heat treatment of metal parts to increase wear and corrosion resistance
 - 50 oven systems and 50 inductive hardening systems
 - Heat source: Recovery of waste heat from cooling water
- Energy savings by heat pump:
 - Gas consumption of 80% (800 MWh/a) and 160 t/a CO₂



Seit 1970 befindet sich der Sitz der Härterei Gerster AG im solothurnischen Egerkingen.



Die neue Wärmepumpe hat den Energiebedarf für Heizungen um 80 Prozent reduziert.

The Lausanne heat pump plant – district heating



Technical details of the application

Heating capacity: 4,5 MW

COP: 4,8

Refrigerant: NH₃

Heating source: Water

Supplied temperature: 65°C


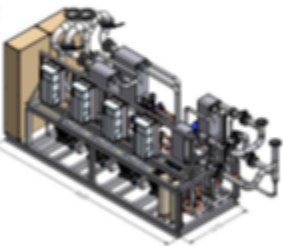




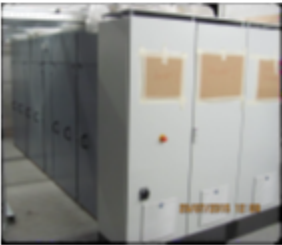

Application: District heating networks with storage tank
2 x 4,5 MW heat pumps
Water flow rate approx. 260 L/s (water from lake Lemane)
Heat source 6 to 7 °C
Heat sink 28 to 65°C and 26 to 50°C
Storage tank to limit start-ups and mechanical wear

By **SULZER**

Examples of industrial heat pumps in Switzerland

Engie – Heat pumps installed in 2014 to 2016 References producing hot water



| Identification | No | Engie_01 | Engie_02 | Engie_03 | Engie_04 |
|-------------------|---|---|--|---|---|
| Installation | Name of project | CO2 heat pump, Küsnacht/Zürich | R134a HT heat pump | R134a HT heat pump with sound insulation housing | R134a heat pump Geistlich Wolhusen |
| | Location | Küsnacht / Zürich | Kerns | Kerns | Geistlich Wolhusen |
| Technology System | Year of installation | 2014 | 2014 | 2015 | 2016 |
| | HP manufacturer | ENGIE Kältetechnik GmbH | ENGIE Kältetechnik GmbH | ENGIE Kältetechnik GmbH | ENGIE Kältetechnik GmbH |
| | HP technology | Heat pump with CO2 | Heat pump with R134a | Heat pump with R134a | Heat pump with R134a |
| | Working fluid | CO2 | R134a | R134a | R134a |
| | Heating/cooling capacity (kW) | 101 | 800 | 500 | 606 |
| | Heat source | Brine | | | |
| | Heat source temperature (°C) IN | 5 | 20 | 3 | 2 |
| | Heat source temperature (°C) OUT | 1 | 15 | -1 | -1 |
| | Heat sink | Hot water | | | |
| | COP | 3.57 | 3.68 | 2.82 | 2.94 |
| Fotos, Figures | Fotos (e.g. heat pump, installed at site) |  |  |  |  |
| | Schematics (e.g. process scheme, figure) |  |  |  |  |

Scheco – Heat Recovery of (cleaned) Waste Water



Screw compressor with integrated inverter

| | |
|----------------------------------|---------------------------------------|
| No | <i>Scheco_01</i> |
| Name of project | <i>Kläranlage Zürich</i> |
| Industry | <i>waste water</i> |
| Application | <i>district heating</i> |
| Process applied | <i>heat recovery</i> |
| Location | <i>Zurich, Switzerland</i> |
| Year of installation | <i>2014</i> |
| HP manufacturer | <i>Scheco AG</i> |
| HP technology | <i>inverter for part-load control</i> |
| HP system | <i>waste water/water</i> |
| Working fluid | <i>R134a</i> |
| Number of units | <i>1</i> |
| Compressor | <i>screw with integrated inverter</i> |
| Heating/cooling capacity (kW) | <i>410</i> |
| Supply temperature (°C) | <i>50</i> |
| Heat source | <i>waste water (cleaned)</i> |
| Heat source temperature (°C) IN | <i>7</i> |
| Heat source temperature (°C) OUT | <i>2</i> |
| Heat sink | <i>hot water</i> |
| Heat sink temperature (°C) IN | <i>44</i> |
| Heat sink temperature (°C) OUT | <i>50</i> |
| Heat source/ heat sink | <i>heating</i> |
| Thermal storage | <i>hot water</i> |

Scheco – Heat Recovery of Waste Thermal Water



Heat pump for heat recovery of waste water from thermal bath

| | |
|----------------------------------|--------------------------------------|
| No | <i>Scheco_02</i> |
| Name of project | <i>Thermalbad</i> |
| Industry | <i>thermal bath</i> |
| Application | <i>hot water</i> |
| Process applied | <i>heat recovery</i> |
| Location | <i>Nordwest Switzerland</i> |
| Year of installation | <i>2008</i> |
| HP manufacturer | <i>Scheco AG</i> |
| HP technology | <i>n.a.</i> |
| HP system | <i>waste water/water</i> |
| Working fluid | <i>R134a</i> |
| Number of units | <i>1</i> |
| Compressor | <i>screw</i> |
| Heating/cooling capacity (kW) | <i>550</i> |
| Supply temperature (°C) | <i>55</i> |
| Heat source | <i>waste water from thermal bath</i> |
| Heat source temperature (°C) IN | <i>29</i> |
| Heat source temperature (°C) OUT | <i>5</i> |
| Heat sink | <i>hot thermal water</i> |
| Heat sink temperature (°C) IN | <i>47</i> |
| Heat sink temperature (°C) OUT | <i>55</i> |
| Heat source/ heat sink | <i>heating of thermal bath</i> |
| Thermal storage | <i>hot water</i> |

Conclusions

- 18 examples summarized
- Heat pump manufacturers providing > 100 kW heating capacity: CTA, Viessmann, Engie, Ochsner, Scheco, Friotherm, Sulzer, Kibernetica
- Max. identified heat sink temperature: 92 °C (cheese factory) (so far not higher !)
- Food industry: Chocolate (heating, cooling), Vinegar (fermentation, pasteurization), Cheese (process heating), Meat (cleaning processes)
- Metal industry: Heat treatment of metal parts (hardening processes)
- District heating networks: Lausanne, Champagne, Basel, Les Vergers (Meyrin), Laurana (Thônex), etc.
- Waste water treatment: thermal bath water, waste water
- Heat sources: industrial waste heat, waste water, lake water
- Refrigerants: R134a, R1234ze, R717 (NH₃), R744 (CO₂)
- Savings: 30 to 40% reduction of CO₂ emissions and large amounts of fossil fuels

Thank

Financial Support



Bundesamt für Energie (BFE)

Vertragsnummer: SI/501782-01

Project: HTWP-Annex 48 – Beitrag über
HTWP zum IEA TCP HPT Annex 48



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Thank you for your attention



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Examples from CTA AG



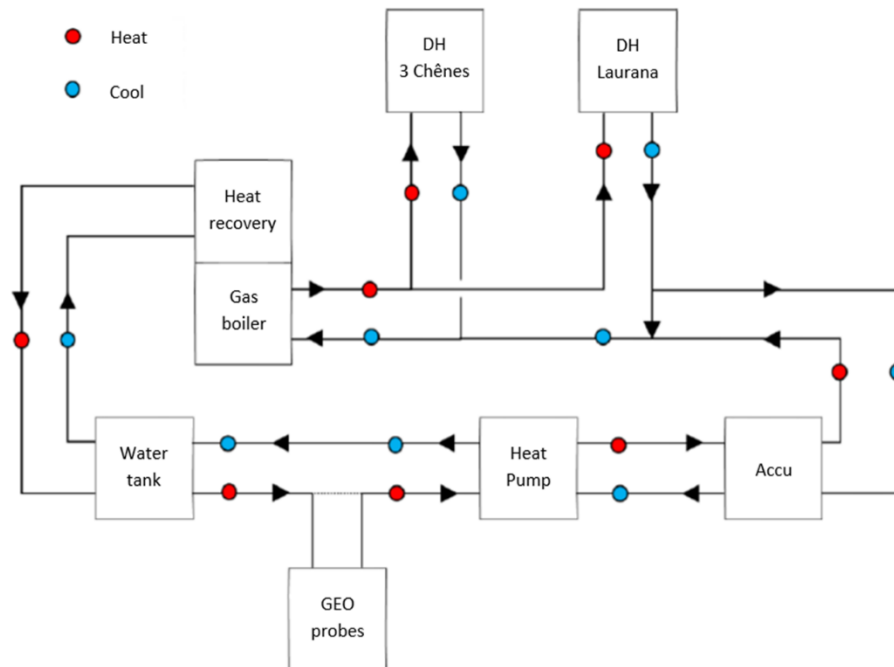
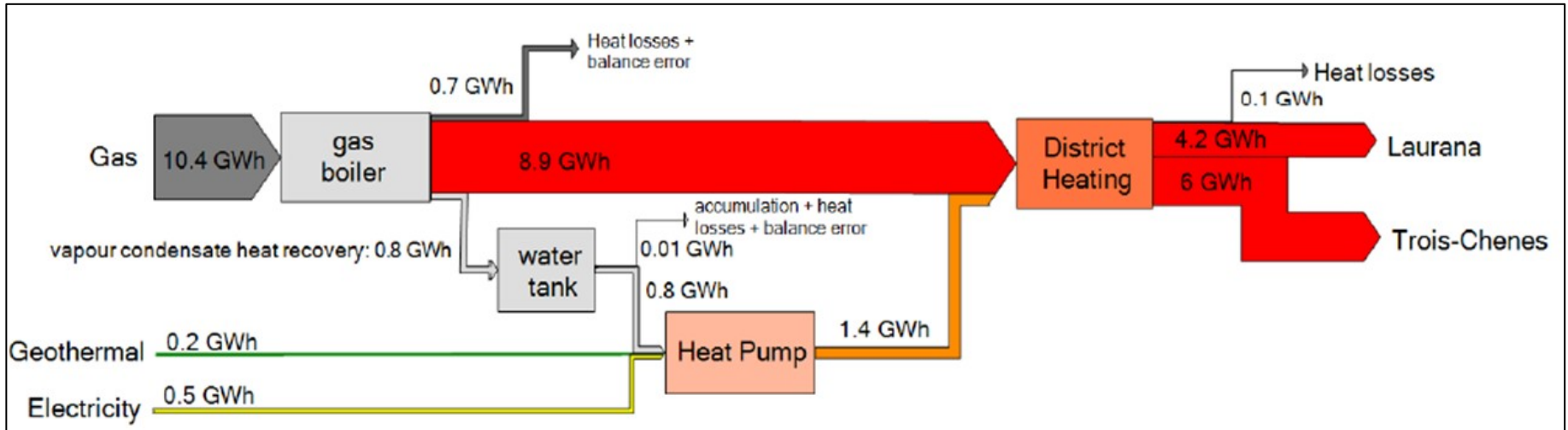
| | No | CTA 01 | CTA 02 | CTA 03 |
|----------------------------------|--|---|---|------------------------|
| Identification | HPT Annex.# | | | A-5 / W55 |
| | Name of project | Schokoladenfabrik Maestrani, Flawil | Fernwärmeverbund Champagne, Biel | Wärmeverbund Basel |
| | Reference (URL / source of literature) | http://www.maestrani-schokolade.ch/ | https://www.esb.ch/ | |
| | Industry | Food | Heizzentrale/ BKW / AEK Contracting | |
| Installation | Application | Chocolate Factory | Fernwärmeverbund Champagne, Biel | Heizzentrale |
| | Process applied | cooling/ cold water supply | heating/hot water supply | Heizen Warmwasser |
| | Location | Flawil, Switzerland | Biel, Switzerland | Basel, Switzerland |
| | Year of installation | 2016 / 2017 / 2019 | 2017 | 2018 |
| | End User (company) | Chocolate Factory, Flawil | Heizungsnutzer / Endnutzer Wohnblöcke | IFB Basel |
| | HP manufacturer | CTA AG | CTA AG | CTA AG |
| | Contractor | Seiz AG | Energie Service Biel (ESB) | IFB Basel |
| | Consultant | Carnotech AG | BKW / AEK Contracting | IFB Basel |
| | Technology System | HP technology | Water Cooler (WCC) | MHP |
| HP system | | water cooled chiller | water cooled chiller | Luft-Wasser-Wärmepumpe |
| Working fluid | | R-1234ze | R-1234ze | R-134a |
| Number of units | | 2 | 2 | 4 |
| Compressor | | Piston Compressor | Piston Compressor | Hubkolbenverdichter |
| Heating/cooling capacity (kW) | | 290/225 | 650/474 | 181/ 111 |
| Supply temperature (°C) | | 5 | 63 | 65 |
| Heat source | | water | water | Luft |
| Heat source temperature (°C) IN | | 11 | 11 | n.a. |
| Heat source temperature (°C) OUT | | 5 | 7 | n.a. |
| Evap. temperature (°C) | | 1 | 3 | n.a. |
| Heat sink | | water | water | Ethylenglykol 40% |
| Heat sink temperature (°C) IN | | 35 | 48 | 55 |
| Heat sink temperature (°C) OUT | | 45 | 63 | 65 |
| Cond. temperature (°C) | | 46 | 65 | n.a. |
| Heat source/ heat sink | | cooling only | heating only | Wasser |
| Thermal storage | cold water | hot water | Warmwasserspeicher | |
| Cost | Heat Pump | n.a. | n.a. | n.a. |
| | Installation | n.a. | n.a. | n.a. |
| | Annual Operation | n.a. | n.a. | n.a. |
| | Annual Maintenance | n.a. | n.a. | n.a. |
| Effects | Savings energy (%) | n.a. | n.a. | n.a. |
| | Savings CO2 emissions (%) | 30 (510 t/a) | 30 (510 t/a) | |
| | Savings energy cost (%) | n.a. | n.a. | |
| | Others: additional effects | Saving of 2,590 MWh fossil | Saving of 2,590 MWh fossil fuels | |
| | Remarks | no | no | |

Examples of industrial heat pumps in Switzerland

SIG – District heating networks

| | No | SIG_01 | SIG_02 |
|-------------------|---|---|---------------------------------|
| Identification | HPT Annex-# | <i>n.a.</i> | <i>n.a.</i> |
| | Name of project | <i>Laurana, Thônex</i> | <i>Les Vergers, Meyrin</i> |
| | Reference (URL / source of literature) | https://archive-ouverte.unige.ch/unige:93169 | |
| Installation | Industry | <i>District heating</i> | <i>District heating</i> |
| | Application | <i>residential buildings</i> | <i>residential buildings</i> |
| | Process applied | <i>heating/hot water supply</i> | <i>heating/hot water supply</i> |
| | Location | <i>Thônex, Switzerland</i> | <i>Meyrin, Switzerland</i> |
| | Year of installation | <i>2012</i> | <i>2018</i> |
| | End User (company) | <i>SIG</i> | <i>SIG</i> |
| | HP manufacturer | <i>Carrier</i> | <i>Friotherm Unitop</i> |
| | Contractor | <i>SIG</i> | <i>SIG</i> |
| | Consultant | <i>Conti & Associés Ingénieurs SA</i> | <i>Riedweg & Gendre SA</i> |
| Technology System | HP technology | <i>MHP</i> | <i>MHP</i> |
| | HP system | <i>water cooled chiller</i> | <i>water cooled chiller</i> |
| | Working fluid | <i>R134a</i> | <i>R1234ze</i> |
| | Number of units | <i>1</i> | <i>1</i> |
| | Compressor | <i>Screw</i> | <i>Turbo</i> |
| | Heating/cooling capacity (kW) | <i>338</i> | <i>5'000/3'910</i> |
| | Supply temperature (°C) | <i>63</i> | <i>50</i> |
| | Heat source | <i>waste heat recovery, water (geothermal)</i> | <i>groundwater</i> |
| | Heat source temperature (°C) IN | <i>14-16</i> | <i>12.5</i> |
| | Heat source temperature (°C) OUT | <i>8</i> | <i>7.5</i> |
| | Evap. temperature (°C) | | |
| | Heat sink | <i>water</i> | <i>water</i> |
| | Heat sink temperature (°C) IN | <i>58</i> | <i>50</i> |
| | Heat sink temperature (°C) OUT | <i>63</i> | <i>35</i> |
| | Cond. temperature (°C) | | |
| | Heat source/ heat sink | <i>heating</i> | <i>heating only</i> |
| | Thermal storage | <i>hot water</i> | <i>no</i> |
| Cost | Heat Pump | <i>confidential</i> | <i>confidential</i> |
| | Installation | <i>n.a.</i> | <i>n.a.</i> |
| | Annual Operation | <i>mean value for operation & maintenance</i> | <i>n.a.</i> |
| | Annual Maintenance | <i>1'000 CHF</i> | <i>n.a.</i> |
| Effects | Savings energy (%) | <i>15</i> | <i>0</i> |
| | Savings CO2 emissions (%) | <i>42 (1'746 t/a) (DH total)</i> | <i>0</i> |
| | Savings energy cost (%) | <i>n.a.</i> | <i>n.a.</i> |
| | Others: additional effects | <i>HP saves 1'435 MWh fossil fuels</i> | <i>n.a.</i> |
| | Remarks | <i>Fuel oil replaced</i> | <i>new neighborhood since</i> |
| Fotos, Figures | Fotos (e.g. heat pump, installed at site) | | |
| | Schematics (e.g. process scheme, figure) | Laurana | Vergers |

SIG – Laurana, Thônex – District heating network

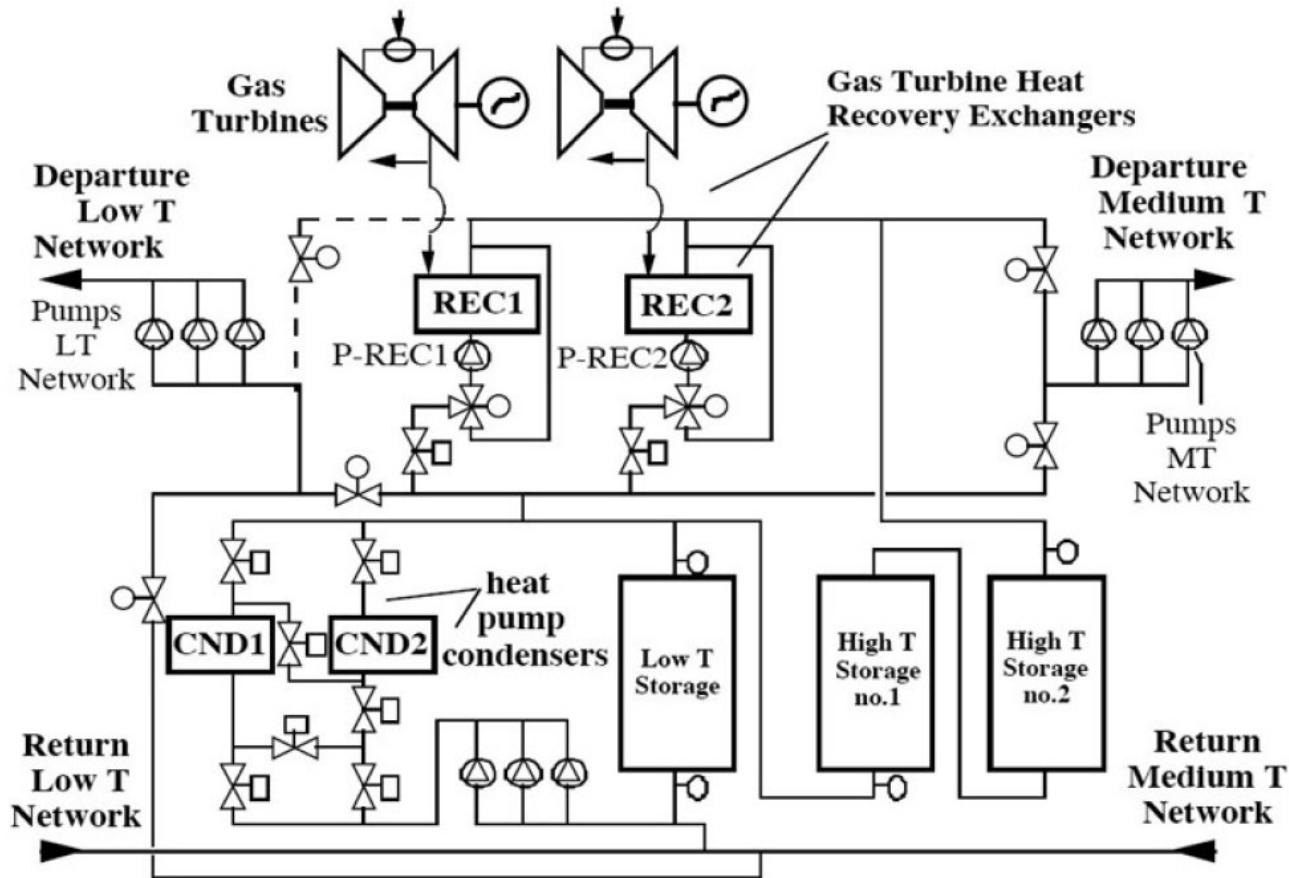


SIG – Les Vergers, Meyrin – District heating network



| | |
|----------------------------------|------------------------------------|
| Name of project | <i>Les Vergers, Meyrin</i> |
| Reference (URL / source of | |
| Industry | <i>District heating</i> |
| Application | <i>residential buildings</i> |
| Process applied | <i>heating/hot water supply</i> |
| Location | <i>Meyrin, Switzerland</i> |
| Year of installation | <i>2018</i> |
| End User (company) | <i>SIG</i> |
| HP manufacturer | <i>Friotherm Unitop</i> |
| Contractor | <i>SIG</i> |
| Consultant | <i>Riedweg & Gendre SA</i> |
| HP technology | <i>MHP</i> |
| HP system | <i>water cooled chiller</i> |
| Working fluid | <i>R1234ze</i> |
| Number of units | <i>1</i> |
| Compressor | <i>Turbo</i> |
| Heating/cooling capacity (kW) | <i>5'000/3'910</i> |
| Supply temperature (°C) | <i>50</i> |
| Heat source | <i>groundwater</i> |
| Heat source temperature (°C) IN | <i>12.5</i> |
| Heat source temperature (°C) OUT | <i>7.5</i> |
| Evap. temperature (°C) | |
| Heat sink | <i>water</i> |
| Heat sink temperature (°C) IN | <i>50</i> |
| Heat sink temperature (°C) OUT | <i>35</i> |
| Cond. temperature (°C) | |
| Heat source/ heat sink | <i>heating only</i> |
| Thermal storage | <i>no</i> |
| Heat Pump | <i>confidential</i> |
| Installation | <i>n.a.</i> |
| Annual Operation | <i>n.a.</i> |
| Annual Maintenance | <i>n.a.</i> |
| Savings energy (%) | <i>0</i> |
| Savings CO2 emissions (%) | <i>0</i> |
| Savings energy cost (%) | <i>n.a.</i> |
| Others: additional effects | <i>n.a.</i> |
| Remarks | <i>new neighborhood since 2018</i> |

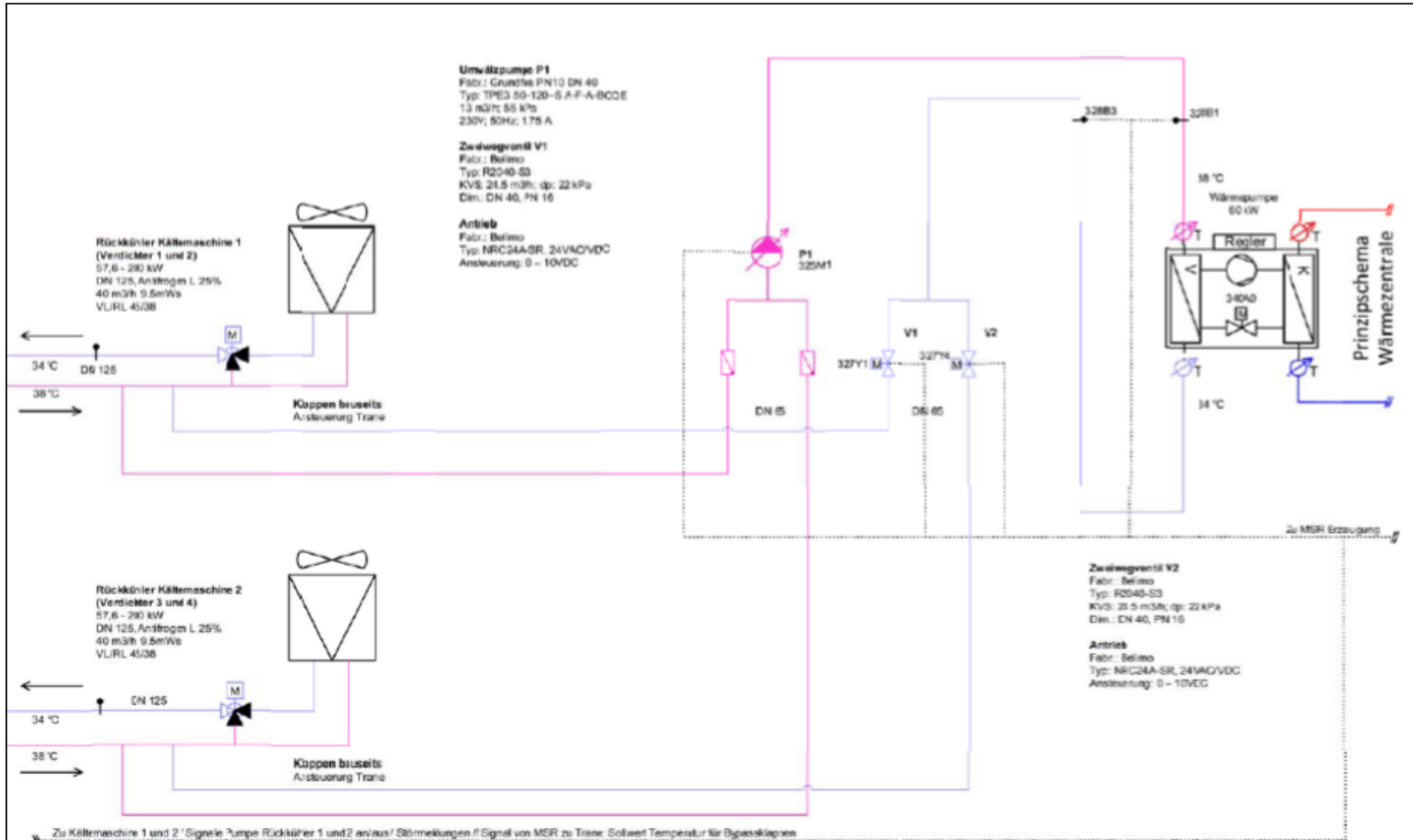
The Lausanne heat pump plant – district heating



The sea water is taken from a depth of 65 m at a distance of 700 m from the beach. The water cooled down by 3 K and is returned to a nearby river. Depending on the heating conditions, the two heat pumps with separate ammonia circuits can be operated either in series (two-stage heat pump) or in parallel (in this case one heat pump is usually in stand-by mode).

Examples of industrial heat pumps in Switzerland

GVS Landi, Schaffhausen – Beverages



Prinzipschema hydraulische Einbindung Kälte
 Schachenmangebäude EG
 Sanierung, Heizzentrale GVS Landi AG

| Gez. / Dat. | DCh / 2016-12-06 | Index | Datum | Beschreibung |
|--------------|------------------|-------|-------|--------------|
| Rev. / Dat. | - | | | |
| Gepr. / Dat. | - | | | |
| Plannummer | 12140012PS1.0 | | | |
| Format | A1 | | | |

Examples

| | | | | |
|---|--|---|---|---|
| identification | # of the project | | | |
| | Name of the project | | | |
| | Member country | | | |
| | Description, see page | Annex35/13 | Annex 48 | |
| | More information | URL/Source of literature/presentation | | |
| installation | Industry, application | | | |
| | Process applied | HVAC Hot water supply | Heating/cooling Heat recovery | Drying/dehumidification Concentration/evaporation/distillation |
| | Location (country/site) | | | |
| | User (company) | | | |
| | HP manufacturer | | | |
| | Year of installation | | | |
| technology - system | System cycle | Closed-cycle CC; open-cycle OC; | Mechanical compression; thermal compression; | |
| | Refrigerant/... | R-134a, R-717,... | | |
| | Compressor type | Scroll-screw-reciprocating-... | | |
| | Heating/cooling capacity | | | |
| | Heat source/heat sink | | | |
| | Supply temperatures/ranges | | | |
| | Operation hours per year | | | |
| | COP | | | |
| | Storage (volume/capacity) | | | |
| | evaluation | Arguments to overcome barriers for HP application | | |
| Experience with satisfaction, performance and operation | | | | |
| effects | Installation cost | | | |
| | Subsidies | | | |
| | Energy cost €/kWh electricity/gas/oil | | | |
| | Primary energy factor | | | |
| | Factor CO ₂ /kWh electricity produced | | | |
| | Annual energy cost | | | |
| | Annual maintenance cost | | | |
| | Annual operation cost | | | |
| | Savings energy cost | | | |
| | Savings primary energy | | | |
| Savings CO ₂ emissions | | | | |
| Payback period | | | | |

Locations of industrial heat pump examples

