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RENEWABLE HEATING AND COOLING WITH ENERGY FROM WASTEWATER

Contribution to Decarbonization ISEC 2022

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Rabmer Group

We combine tradition with innovation



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- ➔ Rabmer is an internationally active group consisting of 8 companies with headquarters in Altenberg/Linz, Austria
- ➔ **Family business** in the 2nd generation - founded in 1963
- ➔ Managing partner: Mag. Ulrike Rabmer-Koller
- ➔ Fields of activity: **Building and civil engineering, real estate, municipal services, environmental technology and renewable energy**. Focus on water and wastewater as well as **energy efficiency** solutions in the field of environmental technology



Why energy from wastewater?



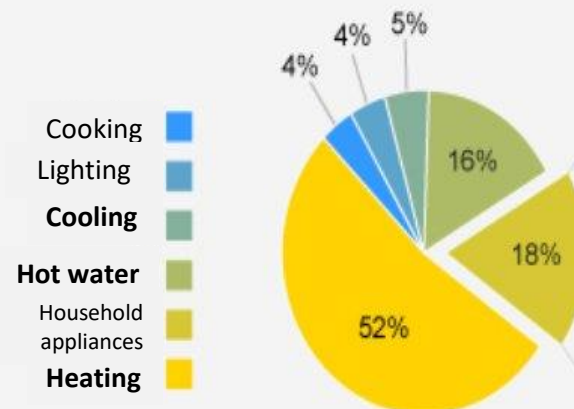
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- ➔ Around 50% of global energy demand is used for heating and cooling
- ➔ 73% of energy consumption in the residential sector (OECD) is used for heating and cooling, of which
 - 52% heating
 - 16% hot water and
 - 5% cooling

Energy consumption of OECD countries in the residential sector

Share of energy consumption



Source: IEA



Why energy from wastewater?



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- ➔ is available 24h hours, 365 days a year
- ➔ Output temperatures (channel 12°C - 20°C, industry 30°C and more) ideal for economic use
- ➔ Technologies tested and matured over many years available
- ➔ 10-14% of the heat demand in the building sector can be covered, BEFORE wastewater treatment plant
- ➔ Reduction of CO₂ emissions and operating costs
- ➔ Amortization periods of less than 10 years realistic



Why energy from wastewater?



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- ➔ **Wastewater heat recovery - since 12/2018 EU classification as renewable energy source**
- ➔ Consideration by the Austrian federal government in the upcoming climate protection program
- ➔ New ÖWAV-working aid 2021
- ➔ Additional subsidies of KLIMAFONDS AUSTRIA, the federal states, e.g. Upper Austria subsidizes conversion to large heat pumps, e.g. by using wastewater heat
- ➔ CO₂ targets only achievable if we switch from fossil fuels to renewable energies, decarbonization of urban areas ...
- ➔ **Energy from wastewater is a sustainable solution!**



Overview of technologies and framework conditions



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➔ Inhouse - Solutions

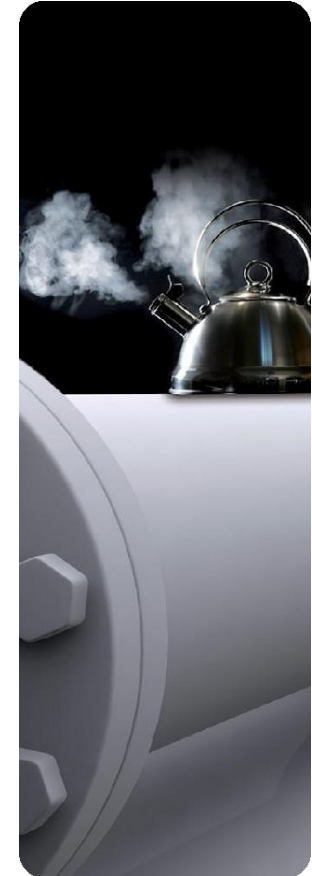
- Municipal, commercial, hospitals, hotels, etc.
- Industry (process water, waste water, etc.)

➔ Sewer waste heat: heating and cooling of buildings and quarters

- Sewer - heat exchanger in the sewer
- Sewer - external bypass solutions
- Wastewater treatment plant ("before" and "after")

➔ Cold Grids and District Heating Systems

- Transfer of wastewater heat from sewer into heat networks



What criteria must be fulfilled?



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- ⇒ Suitable location
- ⇒ Sufficiently large channel, DN 400 or larger
- ⇒ Dry weather flow rate > 10 l/s
- ⇒ Temperature > 8°C
- ⇒ Distance of the consumer to the sewer max. distance 900 m for big solutions, 200 m for small projects
- ⇒ Requirement of heating-/cooling load > 50kW
- ⇒ Coordination with and approval of the sewage system operator



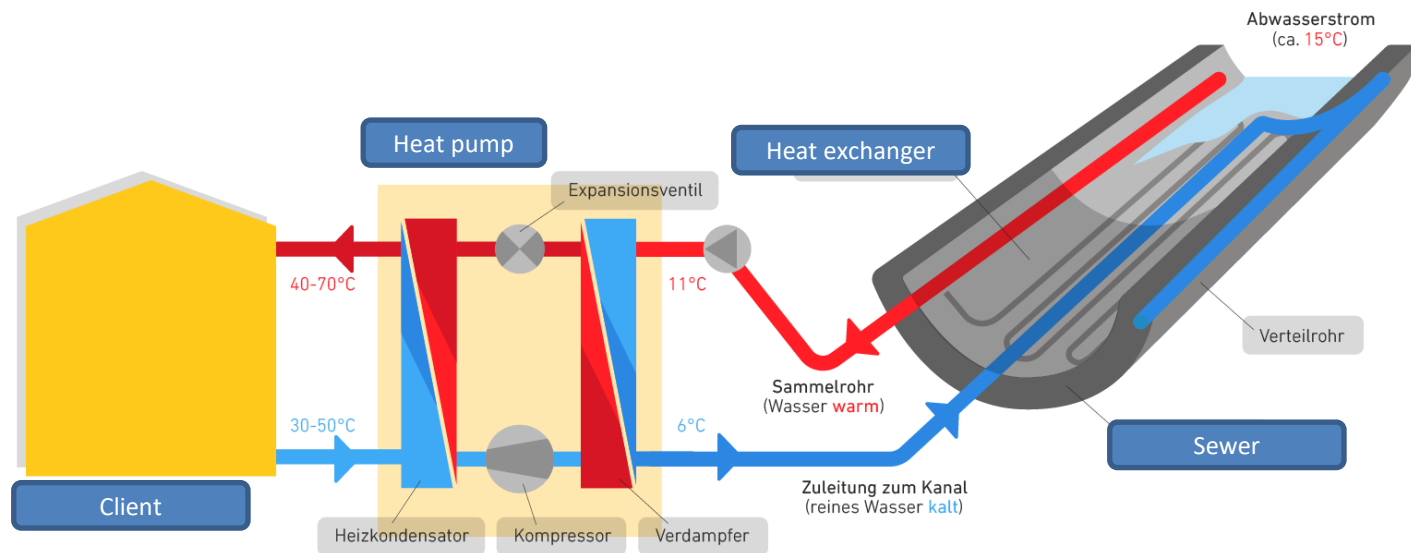
Heat exchanger inside the sewer



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➔ For applications till 1 MW power



Heat exchanger inside the sewer



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- ➔ Produced in special stainless steel
- ➔ Structured surface to reduce biofilm
- ➔ Lifetime till 50 years
- ➔ No negative implication on sewage operation, no additional cleaning
- ➔ Applicable for new sewers as well as for renovation
- ➔ Made to measure, fitting for each individual situation
- ➔ Cross sectional constriction < 10%
- ➔ At any time changeable



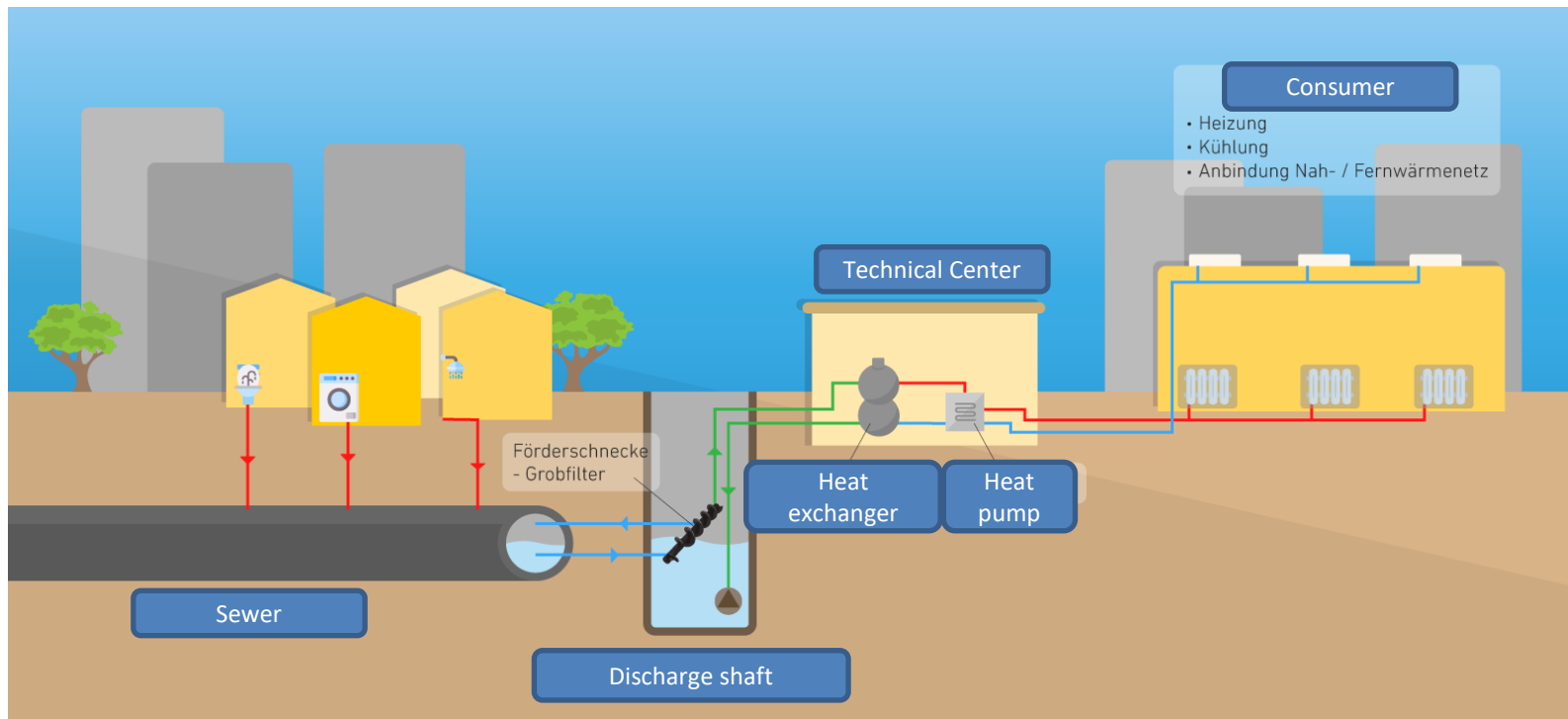
External Bypass Solution



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➔ For applications above 1 MW power



External Bypass Solution



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- ➔ Wastewater extraction from sewer, wastewater treatment plant effluent, pumping stations, etc.
- ➔ Innovative pre-cleaning in the discharge shaft
- ➔ Use of external heat exchangers with special heat pumps
- ➔ Range of performance 500 kW – 10 MW



Best practise examples of “Energy from wastewater”



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Heat exchangers in the sewer system:

- ➔ Stuttgart/DE 2019: 300 kW heating/484 kW cooling from heat exchanger
- ➔ Stuttgart/DE 2019: 2100 kW heating from heat exchanger
- ➔ Innsbruck/AT 2019: 150 kW heating from heat exchanger
- ➔ Wangen/DE 2019: 400 kW local heating

Bypass systems with external heat exchangers:

- ➔ Straubing/DE 2010: 210 kW heating
- ➔ Budapest/HU 2014: 3.9 MW heating/ 3.3 MW cooling
- ➔ Uni Szeged/HU 2017: 1.6 MW heating/ 1.5 MW heating



Best practice example

“Wien Kanal” headquarter



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- ➔ Use of wastewater energy for heating and cooling of the new headquarters of Wien Kanal in Vienna – Blumental
- ➔ 76 m heat exchanger Therm-Liner in 1500x2000 mm sewer
 - Heating 215 kW (max. 450 kW) on heat pumps
 - Cooling 400 kW (max. 500 kW) on heat pumps
 - Innovative monitoring system included
- ➔ Heat pumps: 2 pc., each of them with
 - 215 kW heat power, COP 3,6-4,0
 - 400 kW cooling power, EER 4,1-5
- ➔ Trial operating and commissioning: Oct – Nov 2021
- ➔ Regular operation beginning from Dec 2021
- ➔ Continuous monitoring, beginning 10/2021
- ➔ 100 % heating and cooling with energy from wastewater
- ➔ **Project part of the research initiative ThermaFLEX**



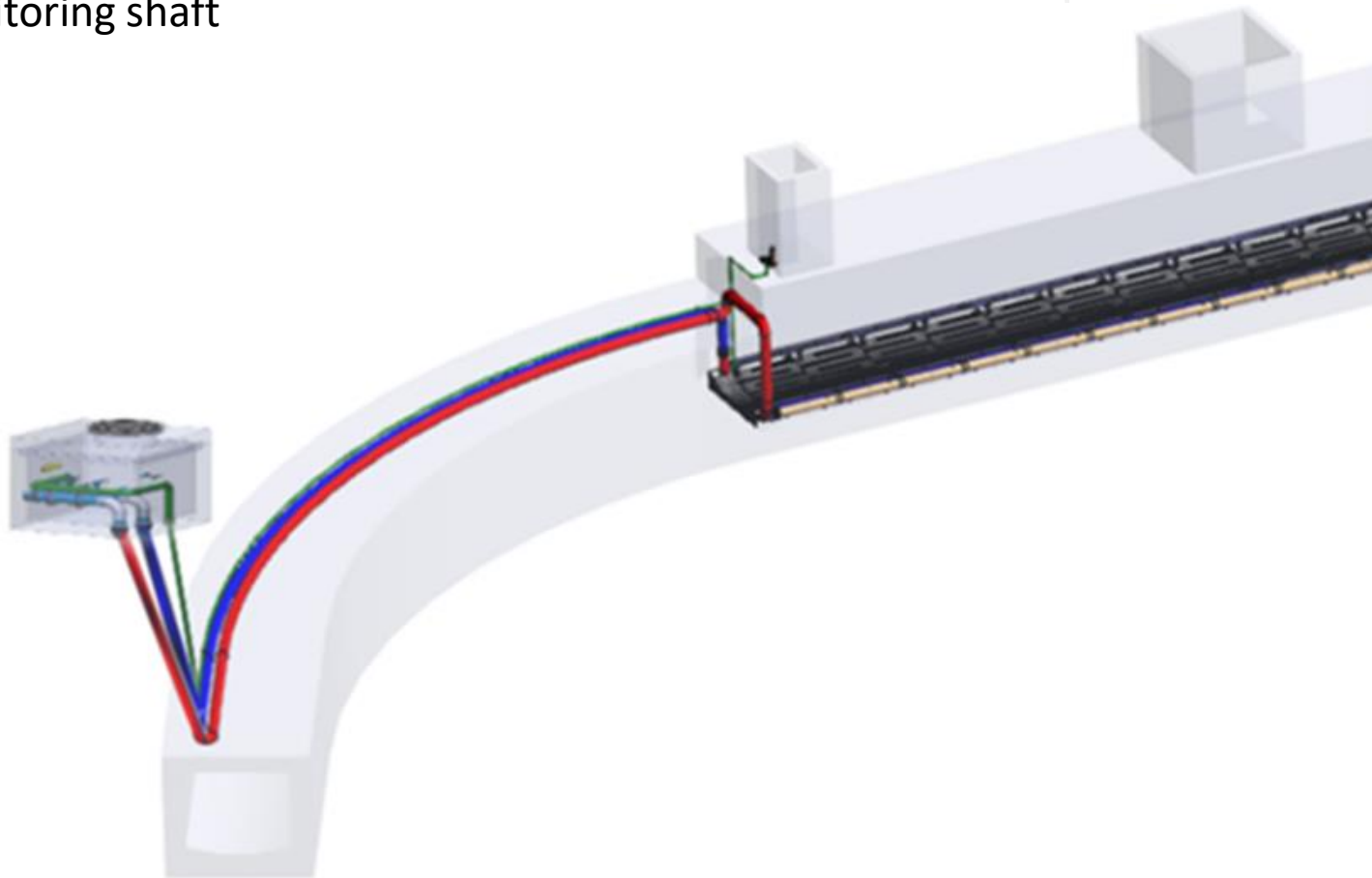
Heat exchanger and monitoring



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- ➔ Diagram of heat exchanger, cable routing sewer monitoring shaft



Heat exchanger and monitoring



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- ➔ Ready – assembled heat exchangers adapted to the configuration of the existing sewer



Heat exchanger and monitoring



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- ➔ Installation of the supply and return lines as well as the monitoring system in the sewer, view of the level sensor



Heat pumps (heating/cooling)



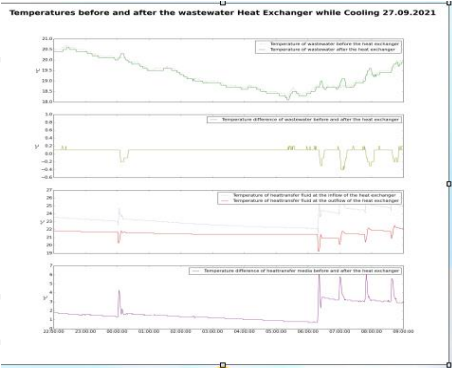
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➔ Heat pumps with connected Heat and Cold storage units



Schematic diagram



Energy from waste water Wien Kanal Zentrale Heating/ Cooling + Monitoring Cooling case

Monitoring data portal



switch cabinet

Data concerning Heat exchanger fluid and wastewater

Waste water: temperature and level
Heat exchanger fluid: temperature, flow and pressure

Wastewater heat exchanger with monitoring shaft

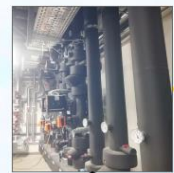
Total volume flow rate primary circuit: 91,1 m³/h

Inlet-Temperature 33,8 °C
Outlet temperature 28,8 °C

Basic dimensioning cooling case:
Dimensioning waste water temperature: 22 °C
Design thermal power of heat exchanger: -530 kW
Overflow heat exchanger area: 116 m²
Waste water heat exchanger total length: 76 m

emitted heat
sewer

heating manifold



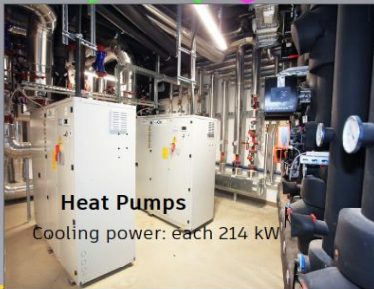
control technology

Cold distributor



Utilized cooling

Air conditioners and servers



Heat Pumps
Cooling power: each 214 kW

electrical energy, EER of the heat pumps=4,09

Heating buffer tank

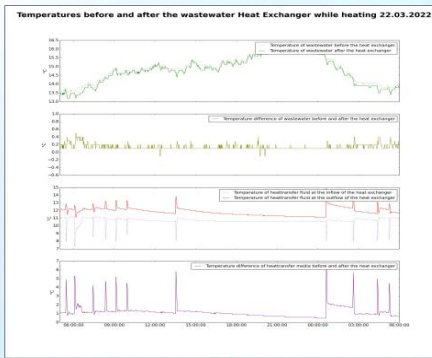


Cold buffer storage



Schematic diagram

Energy from waste water Wien Kanal Zentrale Heating/ Cooling + Monitoring Heating case



Monitoring Datenportal Website



Schaltschrank

Data concerning Heat exchanger fluid and wastewater

Waste water: temperature and level
Heat exchanger fluid: temperature, flow and pressure

Heater and ventilation system

utilitized heat

heating manifold



control technology

Wastewater heat exchanger with monitoring shaft

Total volume flow rate primary circuit: 36,8 m³/h

Inlet-Temperature 6 °C

Outlet-Temperature 9,8 °C

Basic dimensioning cooling case:

Dimensioning waste water temperature: 11 °C

Design thermal power of heat exchanger: 161 kW

Overflow heat exchanger area: 116 m²

Waste water heat exchanger total length: 76 m

emitted heat

sewer

Cold distributor

Utilitized cooling

Air conditioner and servers

Heat Pumps

Heating power: each 229 kW

electrical energy, EER of the heat pumps=3,6 - 4

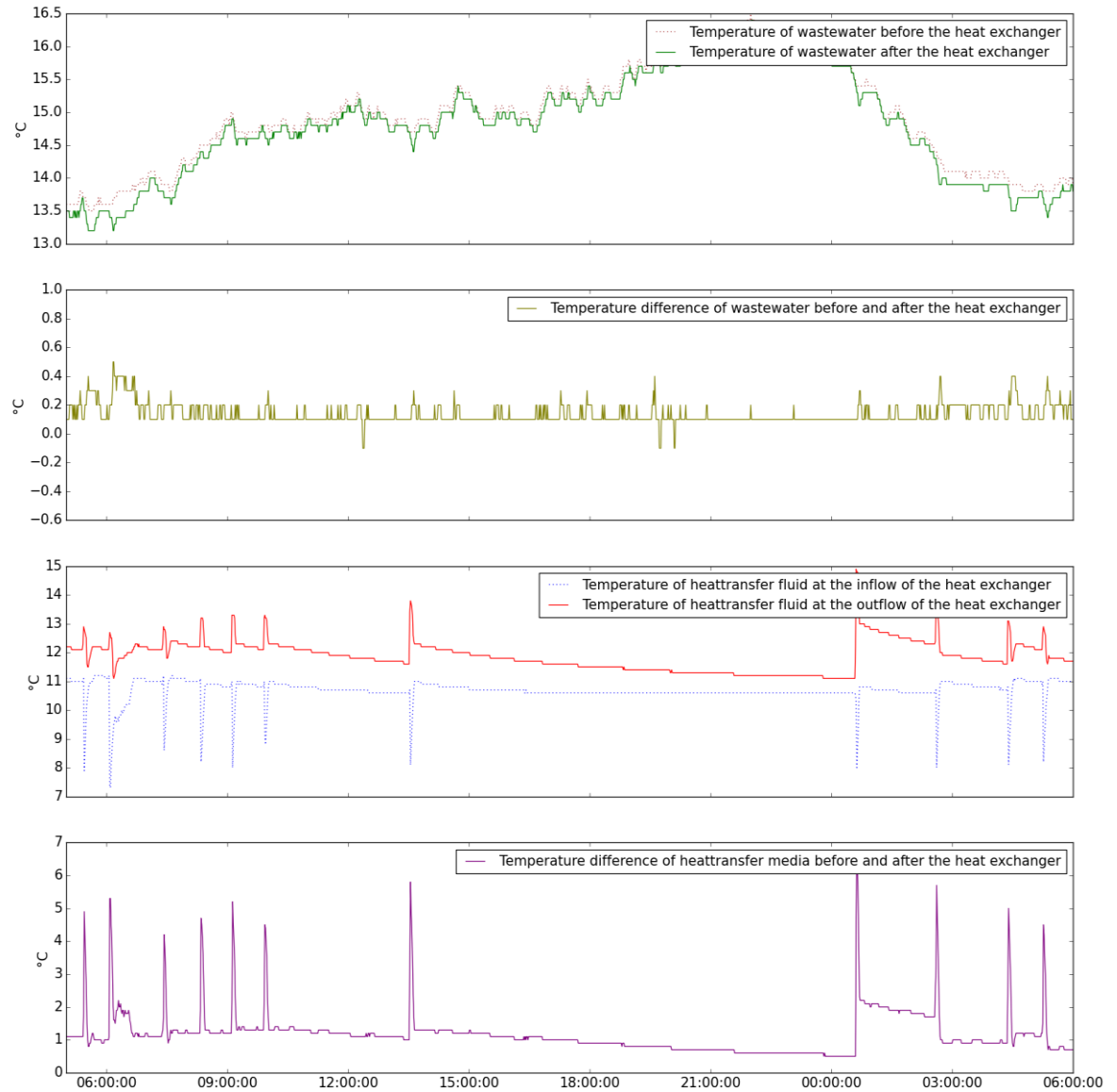
Heating buffer tank

Cold buffer storage



Example of continuous monitoring

Temperatures before and after the wastewater Heat Exchanger while heating 22.03.2022



Conclusions



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- ➔ Wastewater is a year-around, 365-day energy source and can be used with modern heat exchangers and heat pumps
- ➔ Framework conditions must be carefully checked beforehand
- ➔ Renewable heating and cooling from wastewater – valuable contribution to the energy transition and to decarbonisation
- ➔ Innovative monitoring ensures the optimal operation of the sewer system, influence on waste water treatment plant and the energetic use
- ➔ Heating and cooling can be provided sustainably
- ➔ More flexibility in district heating and cooling – with energy from wastewater
- ➔ Important for energy planning and circular economy





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THANK YOU FOR YOUR ATTENTION!

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