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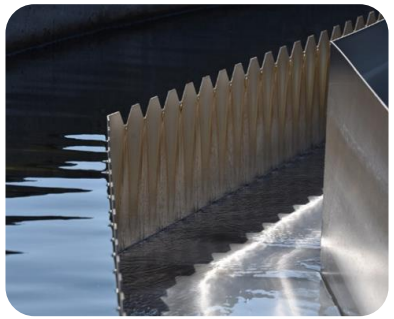
Heating and Cooling with Renewable Energy from Wastewater

A Large-Scale Case Study from Vienna

Flora Prenner, Rabmer Greentech GmbH



ISEC 2024

Why energy from wastewater?

- **Since 2018: Energy from wastewater classified as a renewable energy resource by the EU**
- Energy from wastewater = contribution to decarbonisation in building sector
  - Available 24/7 and all year round
  - Temperatures between 12-20°C in sewer (industry often higher)
  - Available in urban areas, where usually high heating and cooling demand
  - Verified and profitable technology: combination of heat exchangers and heat pumps
- Guidelines available, such as Austrian working tool ÖWAV-AB 65/2021 or German DWA Advisory leaflet M114

Possible applications

- **Inhouse solutions BEFORE entry into sewer**
  - Business, hospitals, hotels, etc.
  - Industry (process waters, wastewater, etc.)
- **Sewer solutions**
  - In-sewer heat exchanger
  - External heat exchanger with bypass
  - In public sewer or on/after treatment plant
  - Existing or new sewers
- **Possible supply of**
  - Heating and cooling of buildings, districts, etc.
  - District heating, local heating networks, etc.

Prerequisites for using energy from wastewater from sewer

- Suitable dimensions of the sewer with > DN 800 (except pressure pipes or new construction)
- Available wastewater discharge > 10 l/s
- Wastewater temperature > 8°C
- Heating/cooling demand
  - > 50 kW at heat exchanger
  - Proximity to potential users
- Coordination with and approval of sewer operator

Heat exchangers in sewer vs. external heat exchangers

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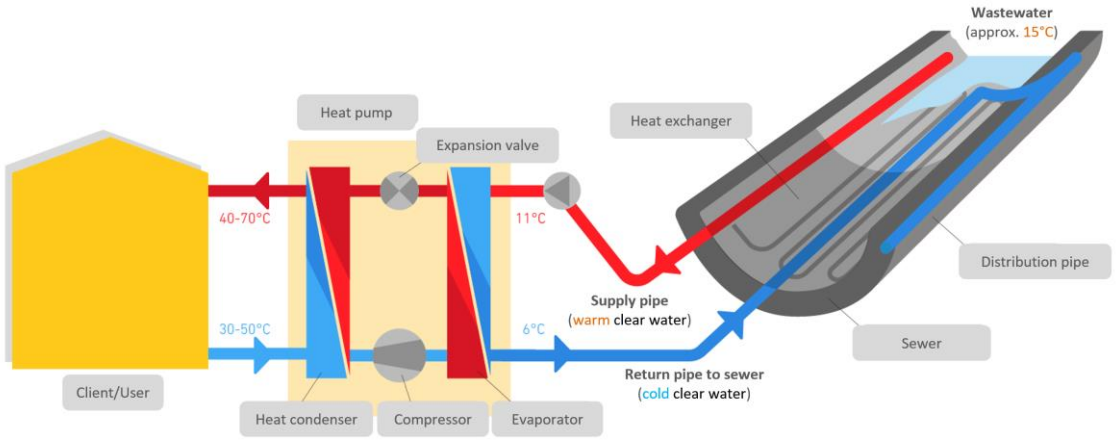
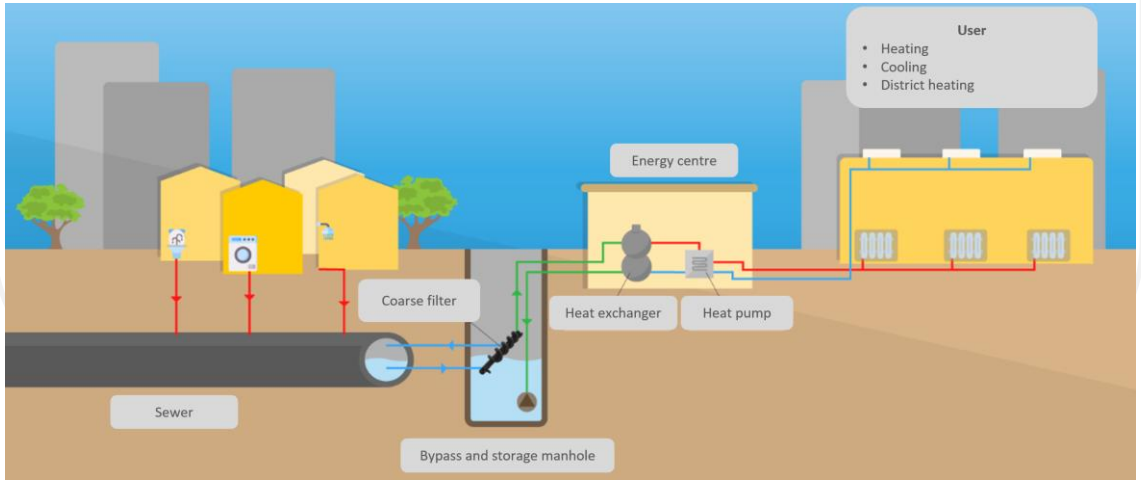
Selection criteria:

- ✓ Sewer parameters (dimensions etc.)
- ✓ Wastewater discharge and temperature
- ✓ Hydraulic capacity
- ✓ Approval of sewer operator and given specifications
- ✓ Heating and cooling demand

Heat exchanger in sewer



External heat exchanger

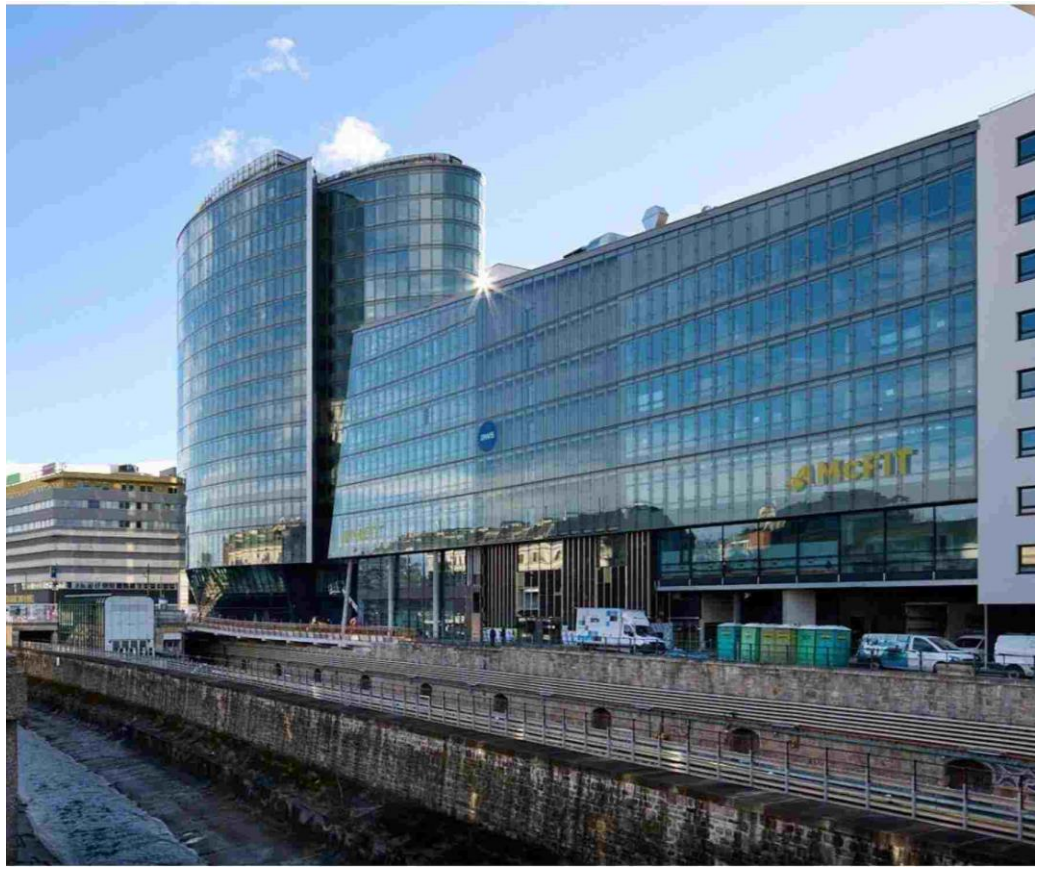


Source: Rabmer GreenTech GmbH

Case study Vio Plaza

- New building complex in Vienna, near U4 Meidlinger Hauptstraße
- Mixed use building for office spaces, retail, living, etc. (~3500 people)
  - about 22 000 m² office area
  - about 1 250 workplaces
  - about 10 000 m² retail area
  - 265 hotel rooms
  - 166 appartements
  - 456 underground parking spaces
  - 200 bicycle parking spaces

→ aim: thermal energy supply from renewable sources for heating and cooling



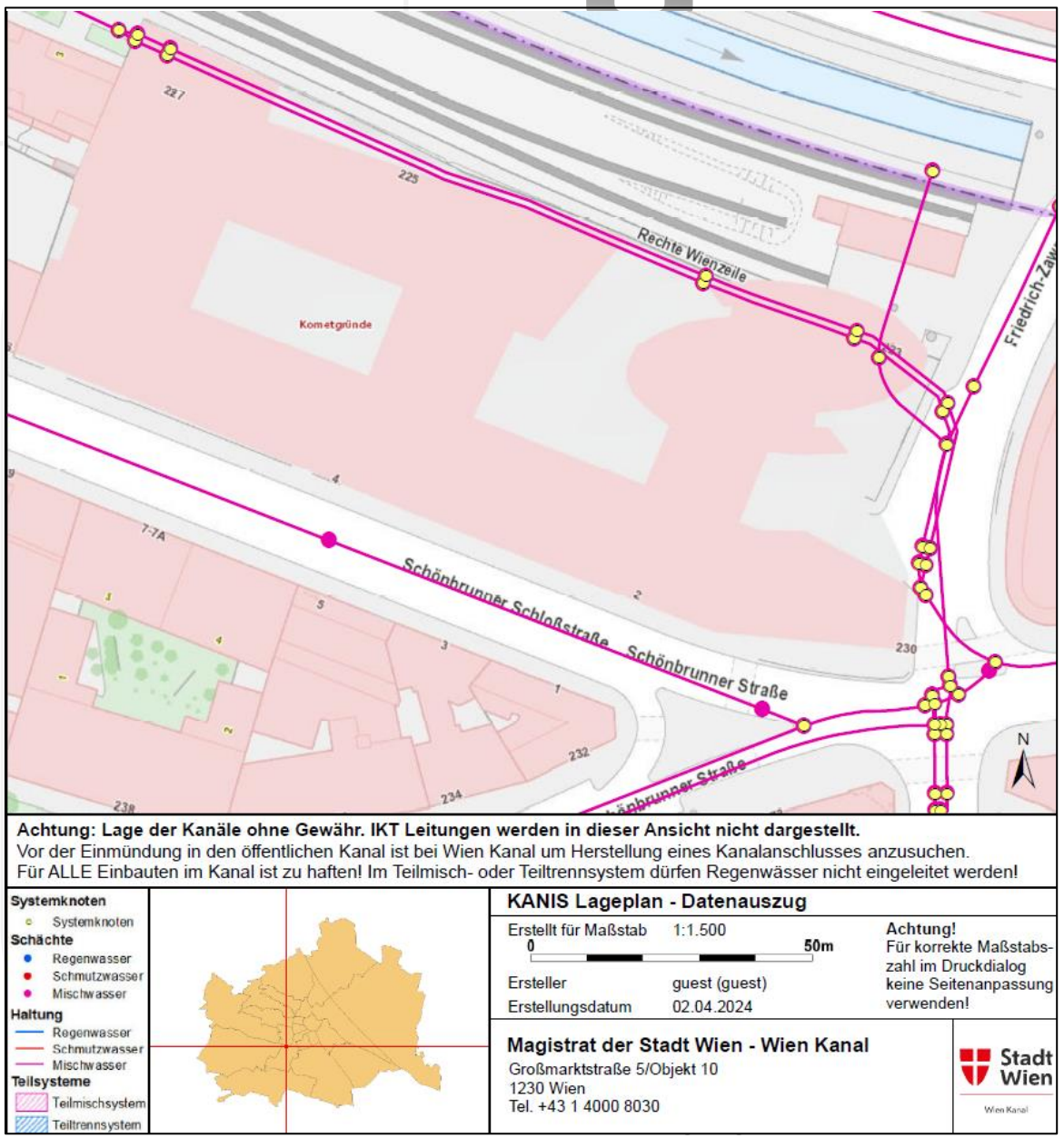
Source: Wiedemann/Rabmer GreenTech GmbH

Energy from wastewater for heating and cooling

- Use of wastewater for
  - Cooling: up to 6 MW (100%) at heat exchanger
  - Heating: base load of 1.2 MW at heat exchanger (30%), the peak load in winter is covered by district heating

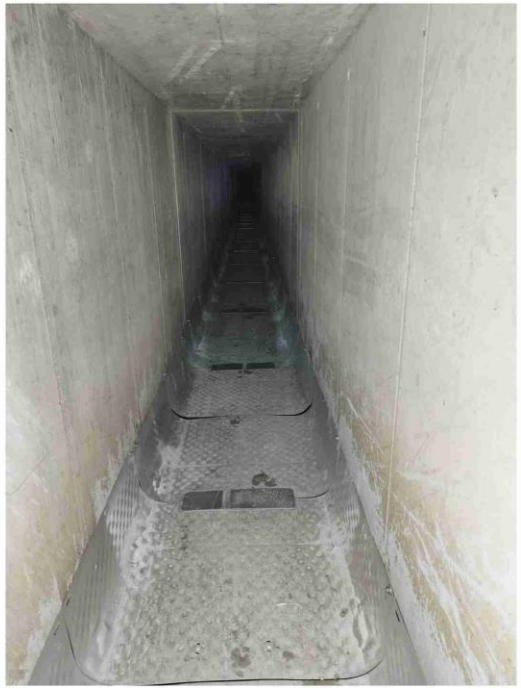
→ **Largest facility of its kind in Austria!**

- Milestones
  - Installation heat exchangers, monitoring system, connecting pipes, etc. 11/2023
  - Trial operation 12/2023-02/2024
  - Continuous monitoring 01/2024
  - Regular operation 02/2024



In-sewer heat exchangers

- 2 parallel sewer lines
  - Easier operation and maintenance
  - Increased yields
  - Dimensions: 1,0x2,25 m
- Heat exchangers
  - 185m per sewer line
  - Supply and return flow lines
  - Tichelmann pipe for equal pressure drop



Source: Rabmer GreenTech GmbH

Heat pumps

- 3x cooling units
  - 2x screw compressors with a sum of 2.3 MW cooling power
  - 1x turbo compressor with 2.4 MW cooling power
- 1x heat pump
  - Screw compressor with 2 MW heating power
- All machines by Trane
- Operated by Wien Energie

Source: Rabmer GreenTech GmbH

Monitoring system

- Monitoring system based on the results of the ThermaFLEX project (plant in Wien Blumental)
- Aim: Survey of energy production and impact on sewer operation
- Installed sensors in
  - Both sewer lines
  - Supply and return pipes to the heat pumps
- Direct connection to control system of the energy center
  - Monitoring of sewer parameters
  - Control of heating and cooling
  - Data continuously available for operator
  - Ensure optimal energy production
  - Estimation of energy production

	Sewer 1	Sewer 2	Supply Pipe	Return Pipe
Measured parameters				
Temperature	before and after heat exchanger	before and after heat exchanger	x	x
Flow velocity			x	
Water level	x	x		
Pressure			x	x
Calculated parameters				
ΔT	x	x	x	
ΔP			x	
Discharge			x	

Monitoring system

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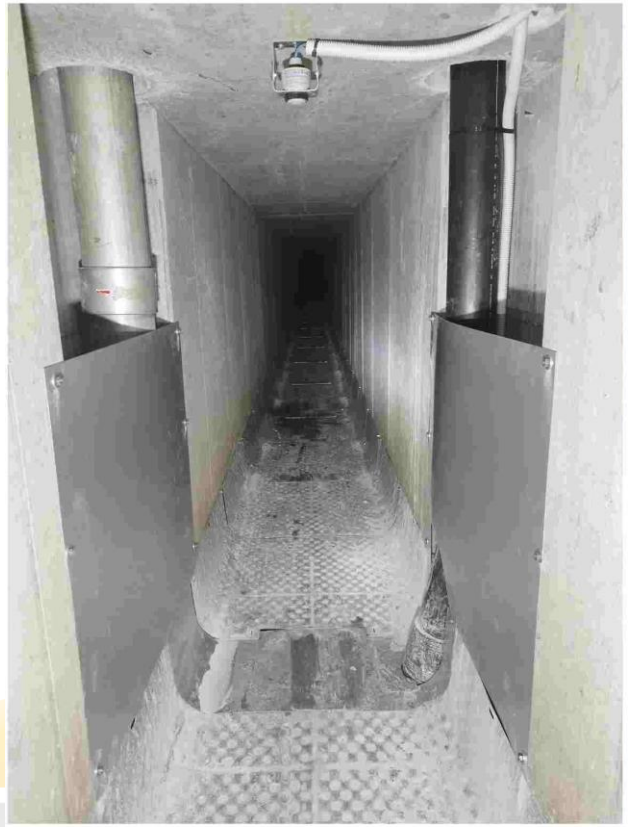
Water level sensor in sewer



Supply and return pipes

Sensors in supply and return pipes

Control cabinet

Source: Rabmer GreenTech GmbH

Example of continuous monitoring data

14th-26th of February 2024

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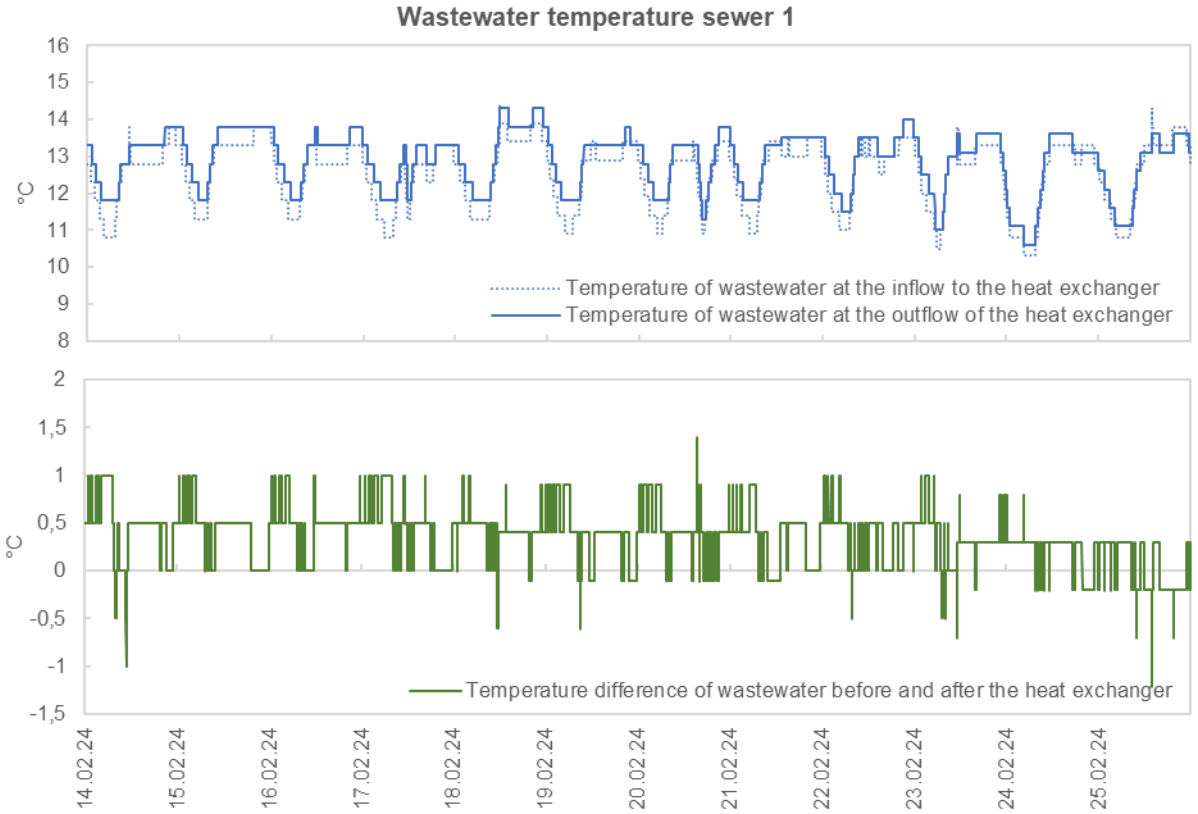

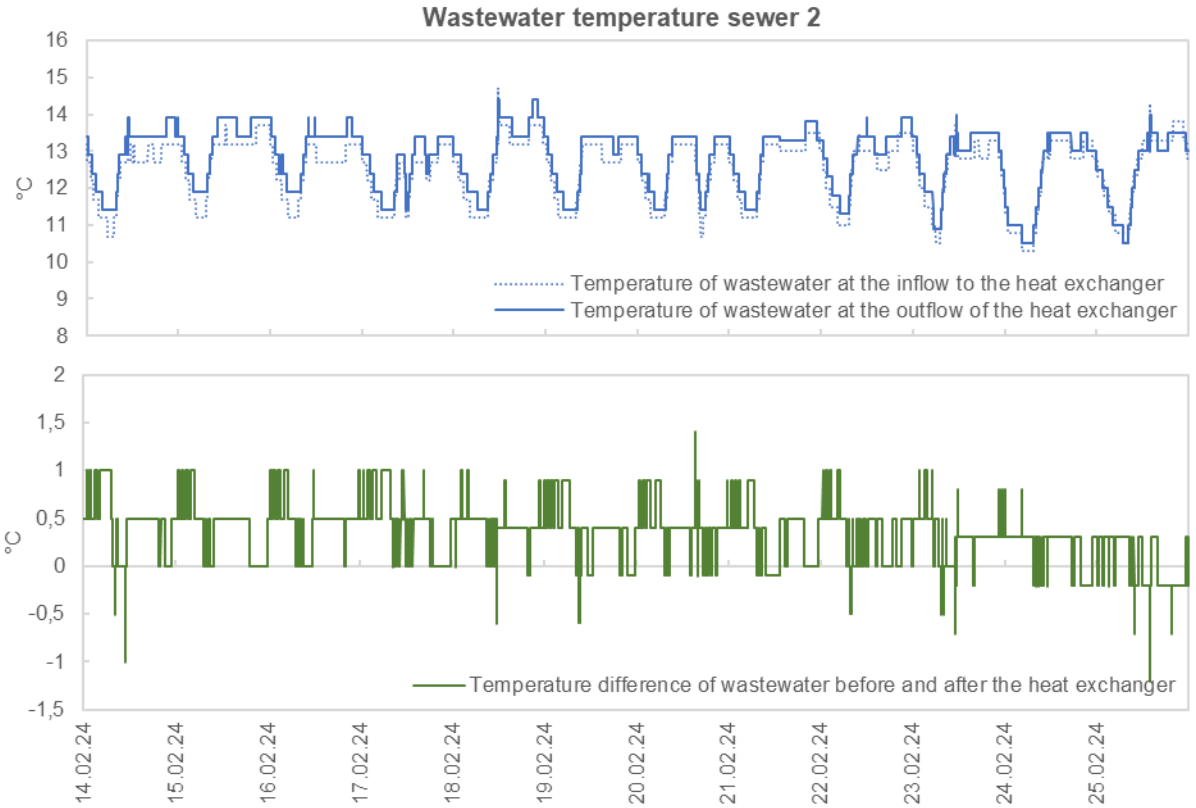

Example of continuous monitoring data

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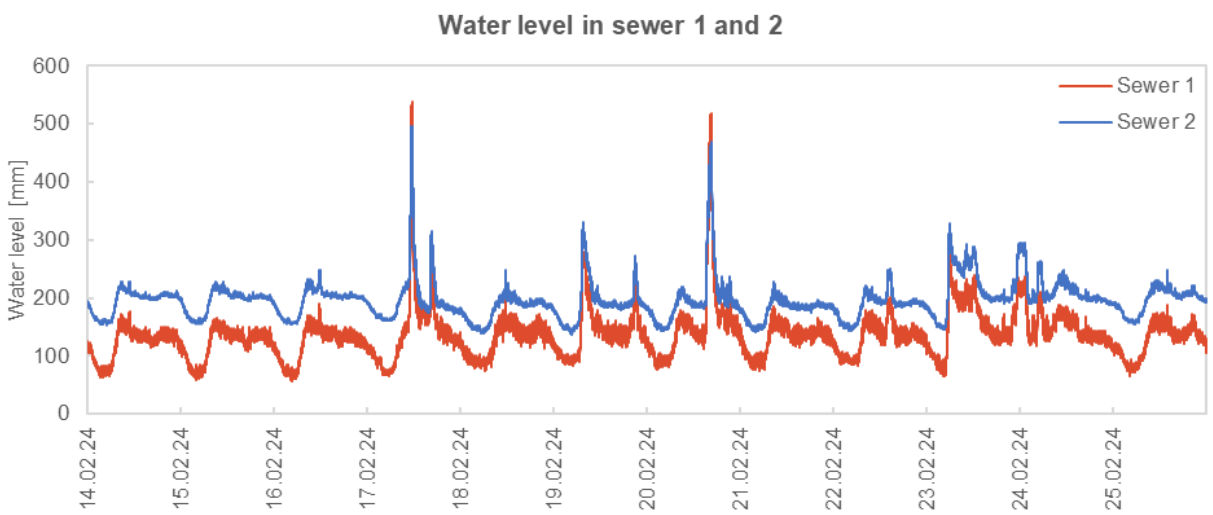
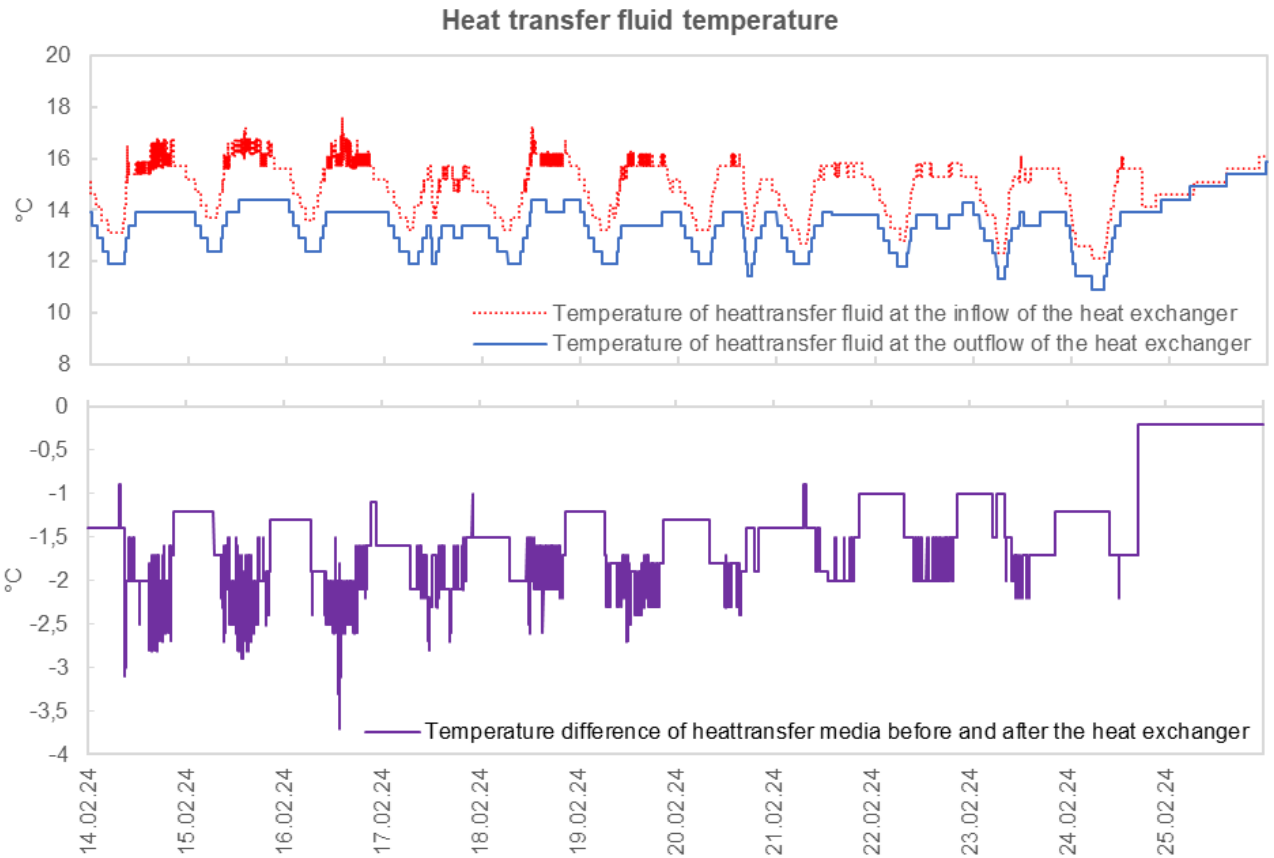
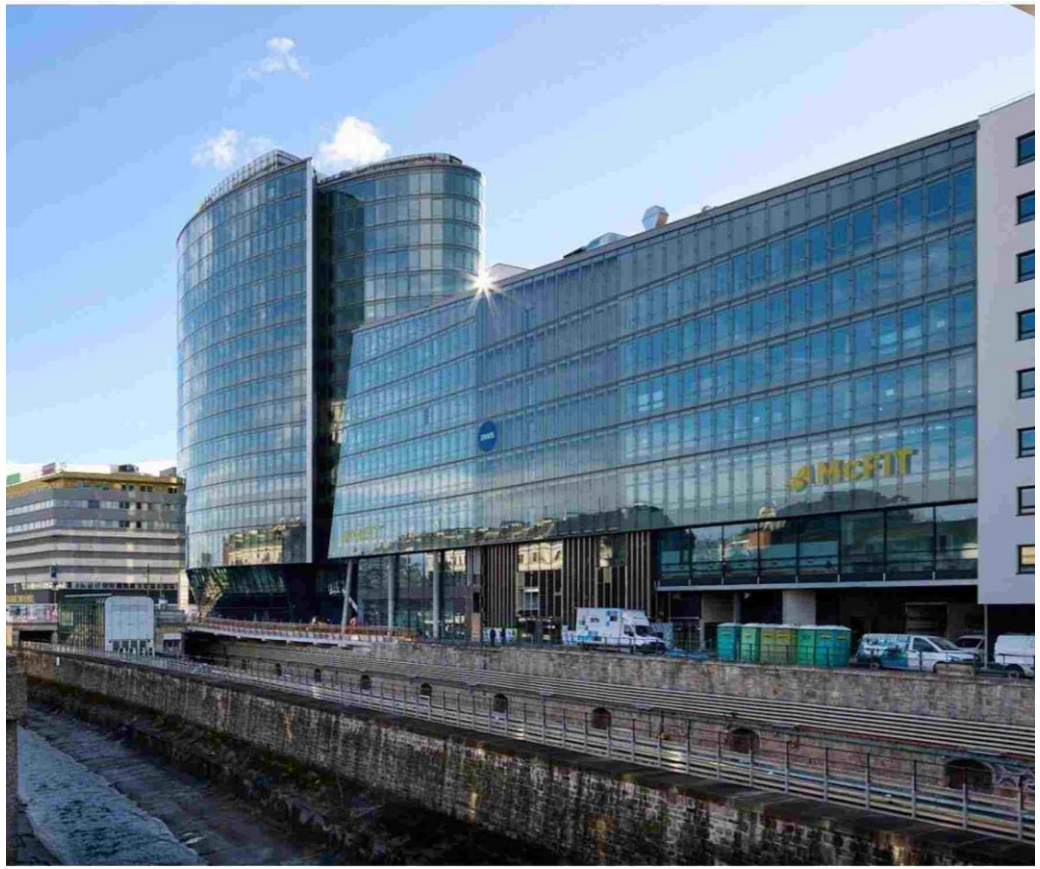




Results and experiences from Vio Plaza

- Successful cooling (100%) and heating (30%) of Vio Plaza Center based on wastewater
- Currently the largest facility of its kind in Austria
- Lighthouse function for technology and region
- Monitoring data shows
  - Smooth operation
  - Precise control to avoid exceeding threshold values
  - Operated according to the Austrian working tool ÖWAV-AB 65



Source: Rabmer GreenTech GmbH

Conclusions

- Wastewater is a renewable energy resource available year-around
- Combination of modern heat exchangers and heat pumps

  → heating and cooling possible
- Contribution to decarbonization of urban areas
- Framework conditions must be carefully checked beforehand, especially with sewer operators
- Innovative monitoring

  → optimal operation of sewer system, influence on wastewater and energetic use
- More flexibility in heating and cooling of buildings and districts – with energy from wastewater

Source: Rabmer GreenTech GmbH

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Thank you for your attention!

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