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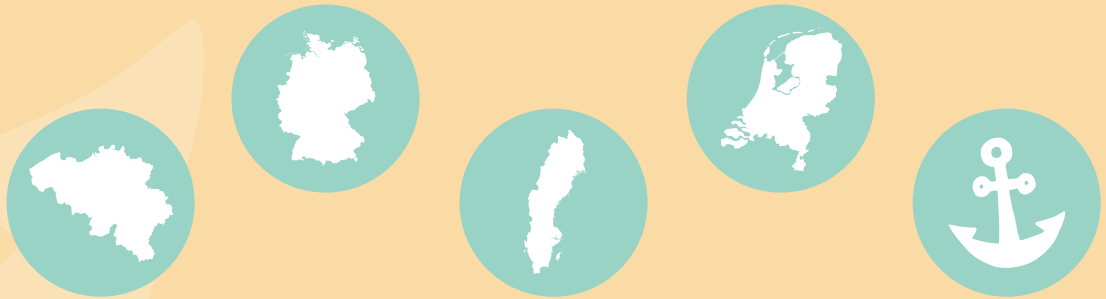
Heat Recovery



7th Anchor Lunch Talk

September 25th 2025

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Let’s fuel ”
the transition towards
water wise
neighbourhoods

HOW?

- By gathering experiences from a **unique EU demo network** in Belgium, the Netherlands, Germany and Sweden with **source separation technology**, and expanding it with **new pilots**
- By mapping the impacts of **decentralized water systems** in urban areas
- By closely **engaging with stakeholders**
- By delivering **practical tools and transition knowledge**

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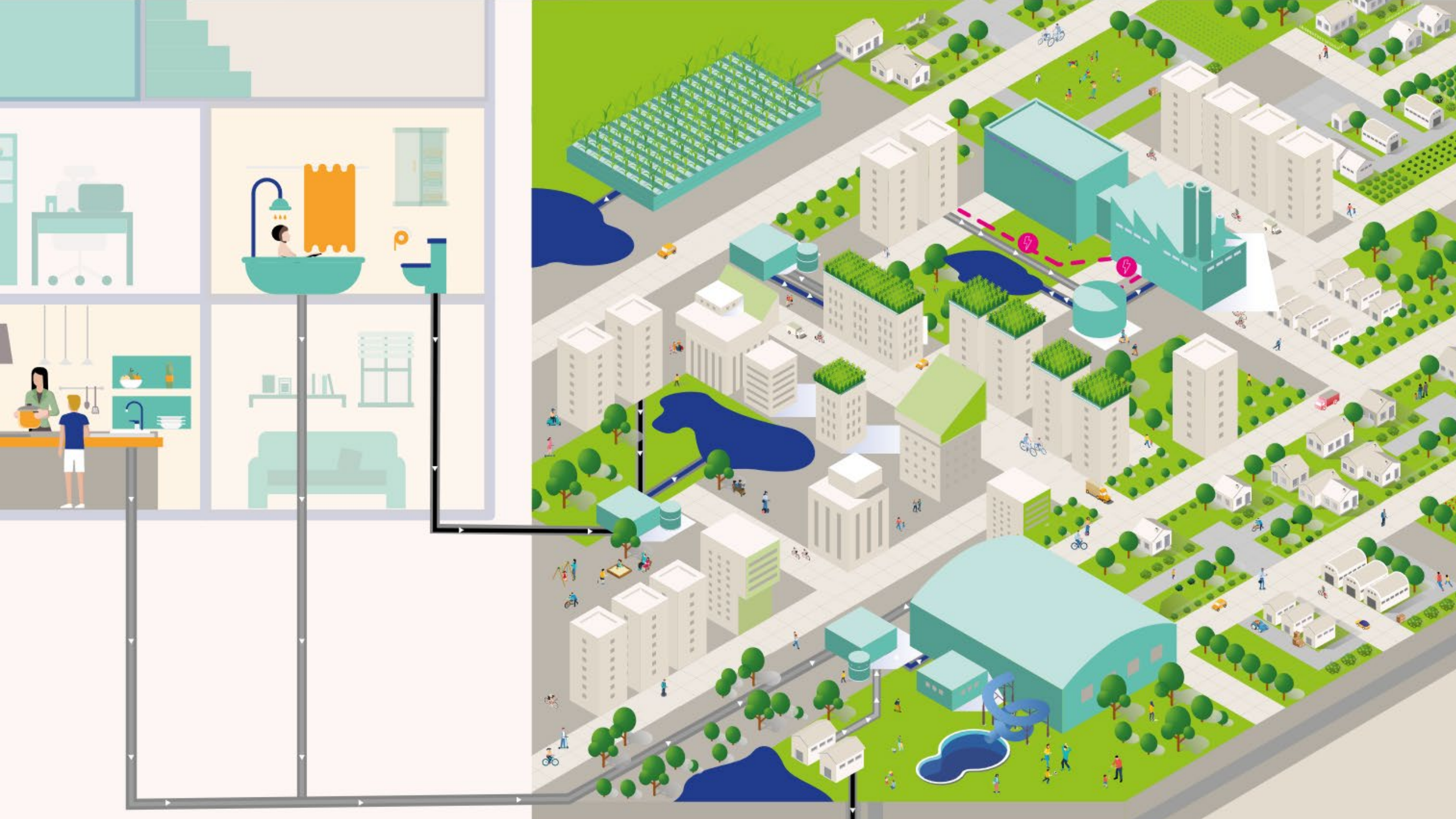

WHO?

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Anchor Lunch Talks

AGENDA

- What is the potential for grey water heat recovery?
  Ruben van den Berg and Marette Zwamborn
- Demo site reflections
  Hamse Kjerstadius and Dries Seuntjens
- Heat recovery on building level
  Jörgen Wallin

- Time for questions and reflection

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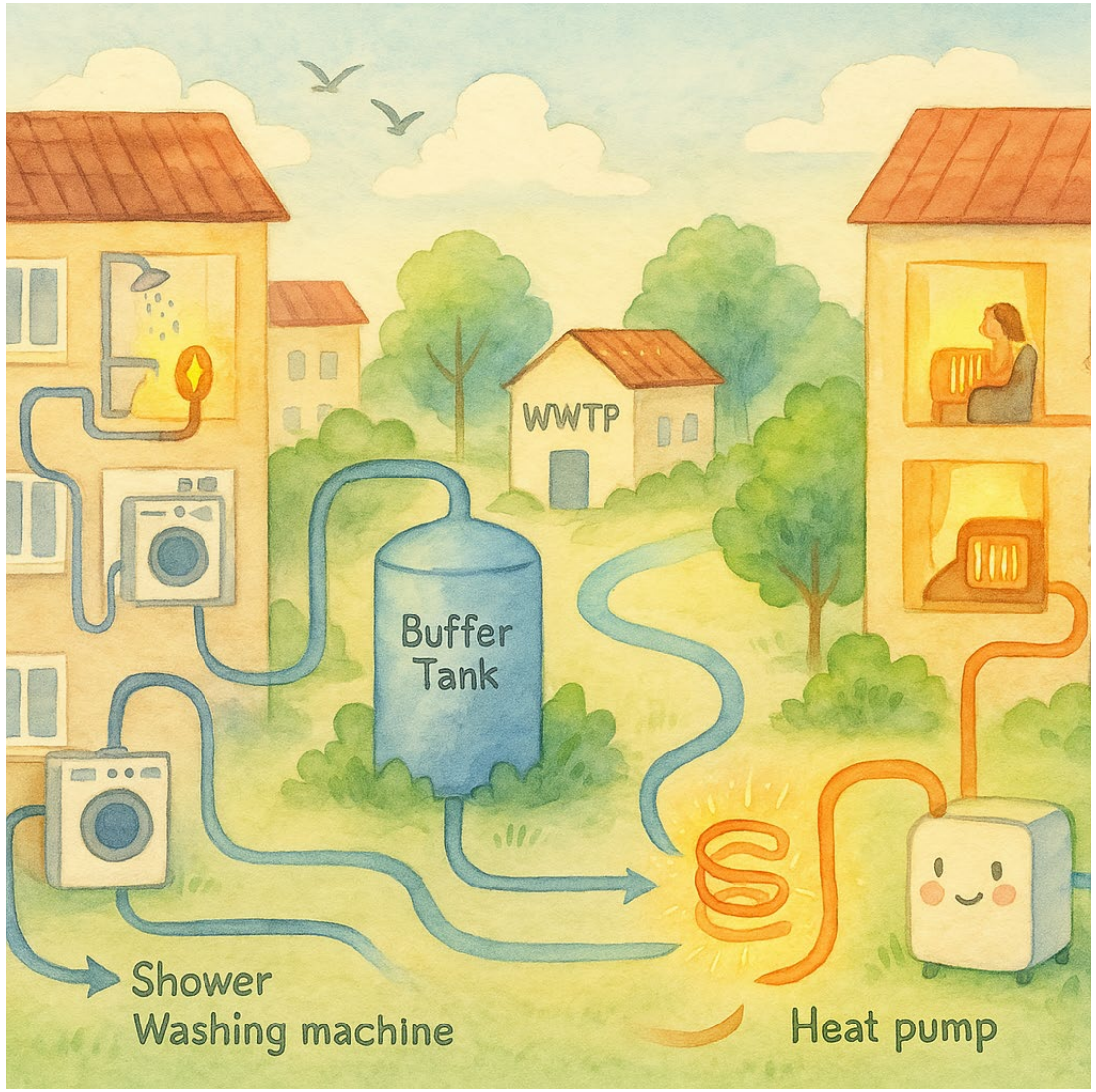
Potential for grey water heat recovery at three scale levels

Ruben van den Berg and Marette Zwamborn, KWR

Contents

- **Why grey water (GW) heat recovery?**
  - **Getting grip on the potential**
  - **Key factors for heat recovery**
- **Heat recovery at three scale levels:**
  - **Building scale**
  - **Local scale**
  - **Central scale**

  System design, pros and cons, example(s) from demo site(s)
- **Conclusions**



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Why grey water heat recovery?

From the energy perspective:

- **Towards net zero in 2050**
- **No more fossil sources for heating**
- **Heat pumps are a viable option**

Renewable heating sytems with heat pumps require a local heat source.

Options:

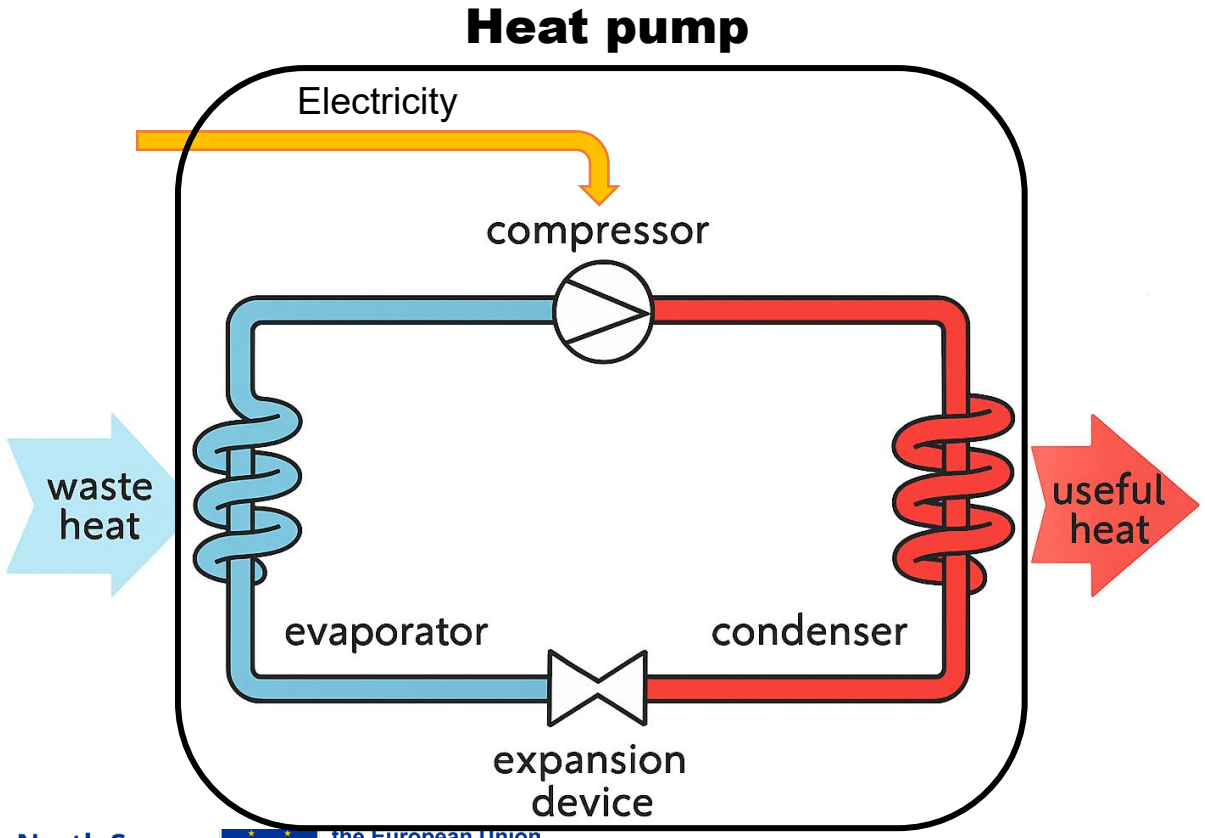
- **Air**
- **Surface water**
- **Drinking water**
- **Ground source heat**
- **Solar heat**
- **Grey water!**

PARIS2015
UN CLIMATE CHANGE CONFERENCE
COP21·CMP11

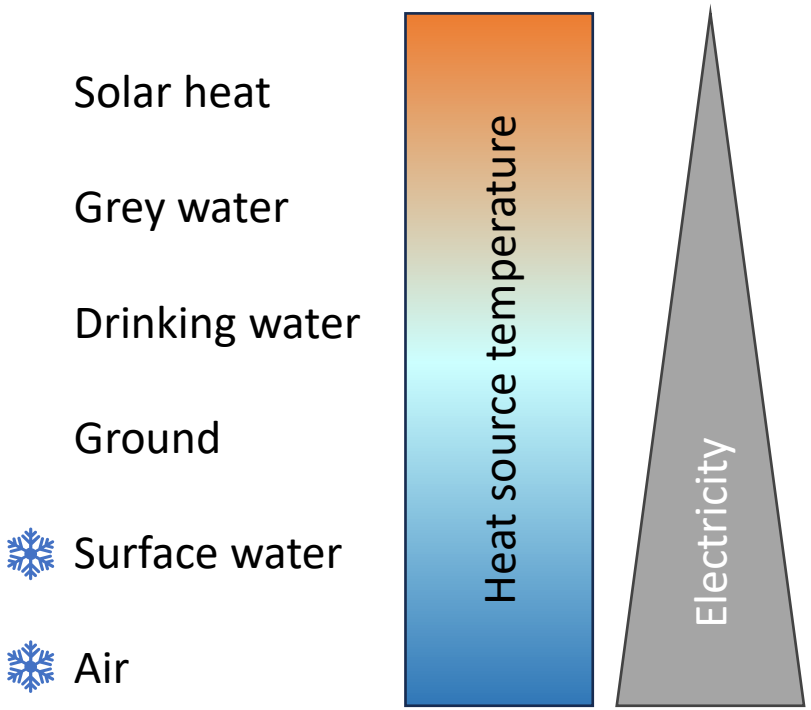
Source: Milieucentraal.nl

Grey water and heat pumps: a winning combination

A heat pump needs less electricity with a high-temperature heat source.



Grey water has a relative high temperature → high energy efficiency and cost effective.



Grey water heat recovery – getting grip on the potential

How much heat can be recovered?

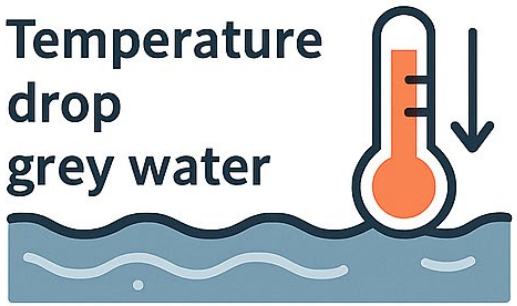
- **GW use per household in an apartment: ~ 50 m³ per year**
- **Heat recovery potential of GW: 0,3 – 0,9 MWh/apartment/year**

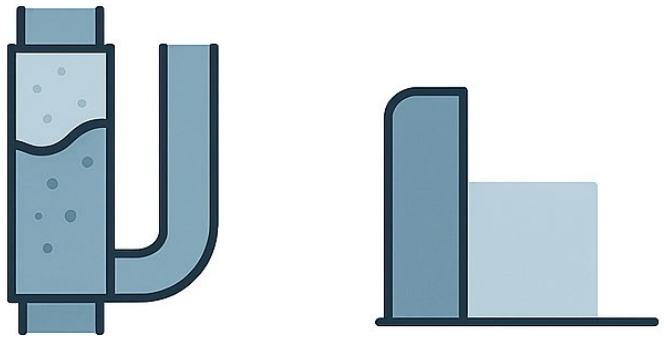
Grey water heat recovery potential versus the total heat demand?

- **Heat demand new-built apartment: ~ 6,0 MWh/apartment/year (heating ~2/3 & hot tapwater ~1/3, Dutch apartment ~80 m2)**
- **Heat recovery potential of GW: 6 – 15% of total heat demand**

Temperature drop grey water in heat exchanger (ΔT)	6 °C	8 °C	10 °C	12 °C	14 °C	16 °C
Grey water heat recovery potential [MWh/apartment/year]	0.34	0.45	0.56	0.68	0.79	0.90

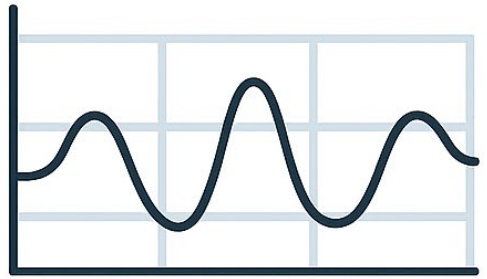
Key factors for heat recovery from grey water



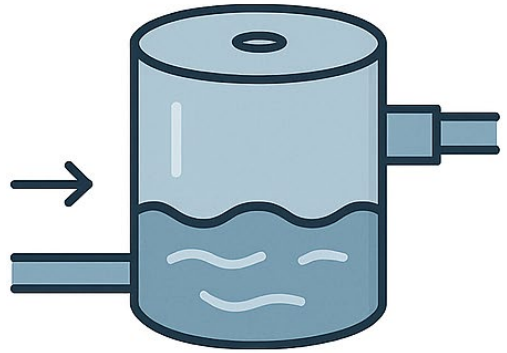


Insulation

Volume/
discharge



Temporal
fluctuations

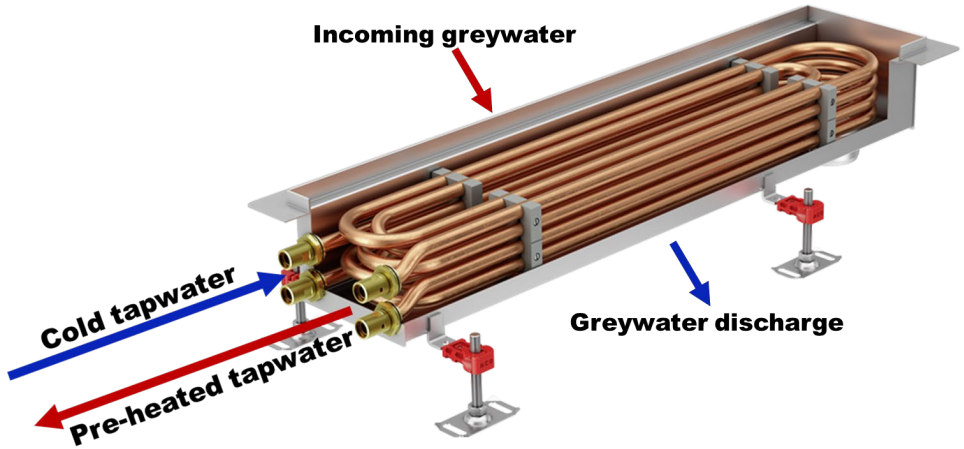


Buffering and
retention time

Heat recovery at building scale

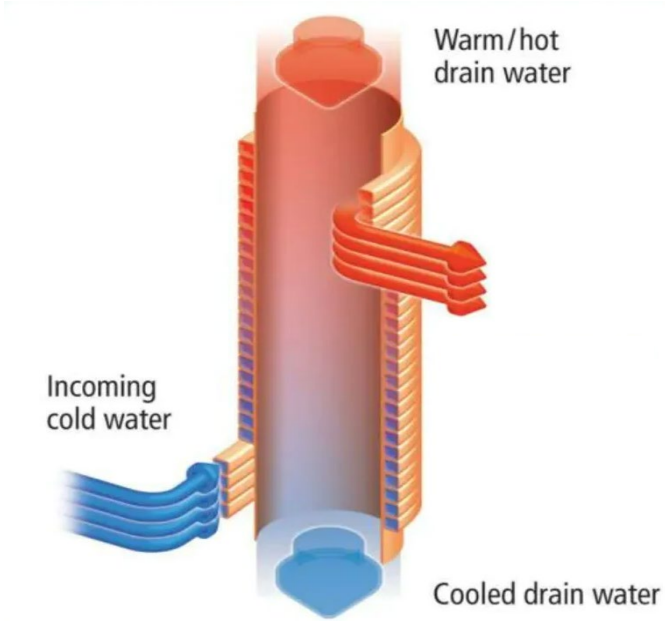
General system design:

- **Heat recovery directly in shower drain, or in-building drainage pipe**
- **Passive heat exchange with incoming flow, no heat pump involved**



Pros and cons:

+ **Heat recovery directly after use, no temperature losses due to transport**
- **Only pre-heating for hot tap water**
- **Non-continuous flow, no storage**

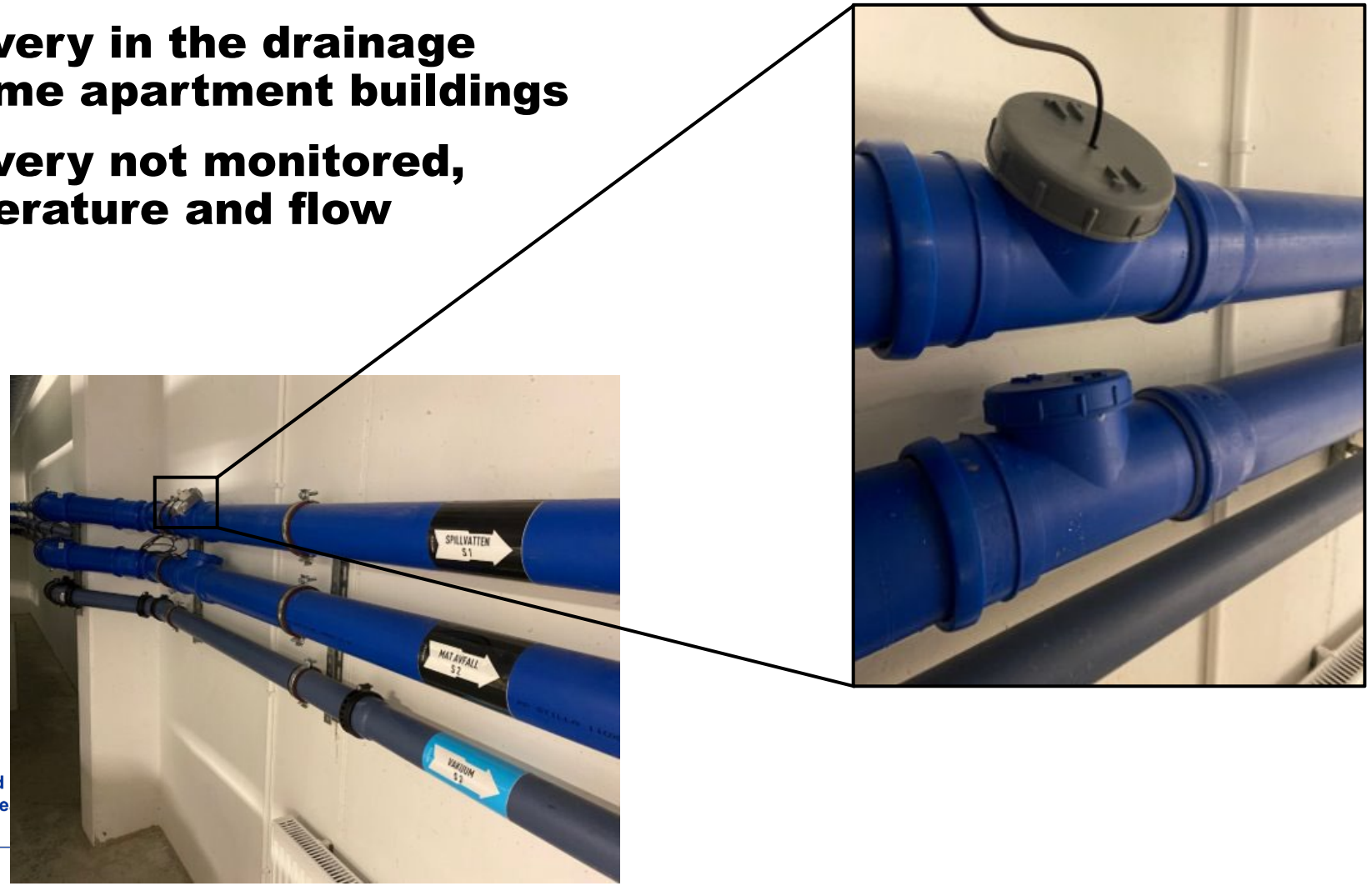


Literature: 57-64% energy recovery from shower heating with a shower heat exchanger

Heat recovery at building scale: Helsingborg (H+)

System set-up

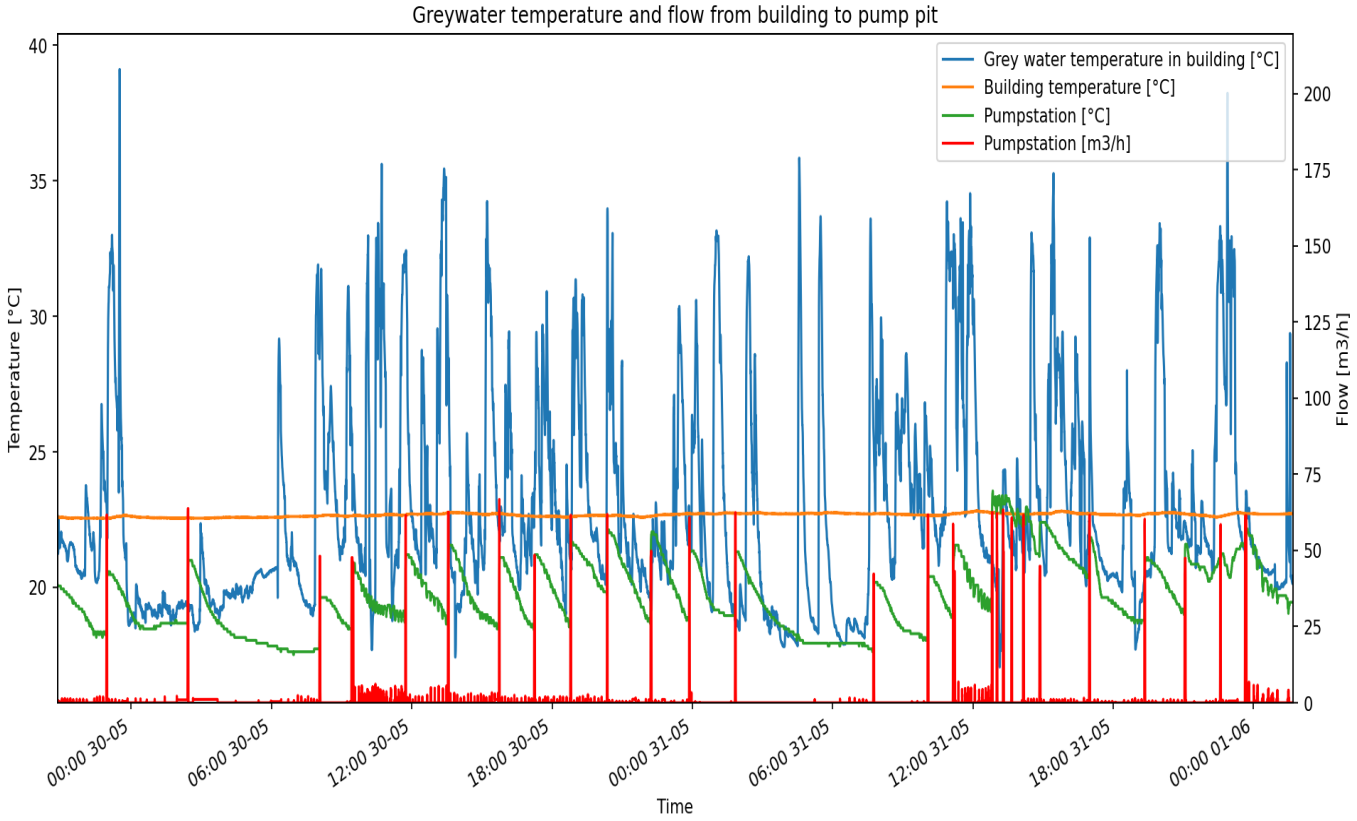
- **Heat recovery in the drainage pipe of some apartment buildings**
- **Heat recovery not monitored, only temperature and flow**



Heat recovery at building scale: Helsingborg

Measurement results (May ‘25 – June ‘25)

- **GW temperature in buildings: 16 to 39 ^{0}C**
- **Building temperature: 22 to 23 ^{0}C**
- **GW temperature after pumpstation: 17 to 26 ^{0}C**



Heat recovery at local scale

General system design

- **Heat recovery takes place at local scale, after collection, buffering and treatment**
- **Combined with heat pump**

Pros and cons:

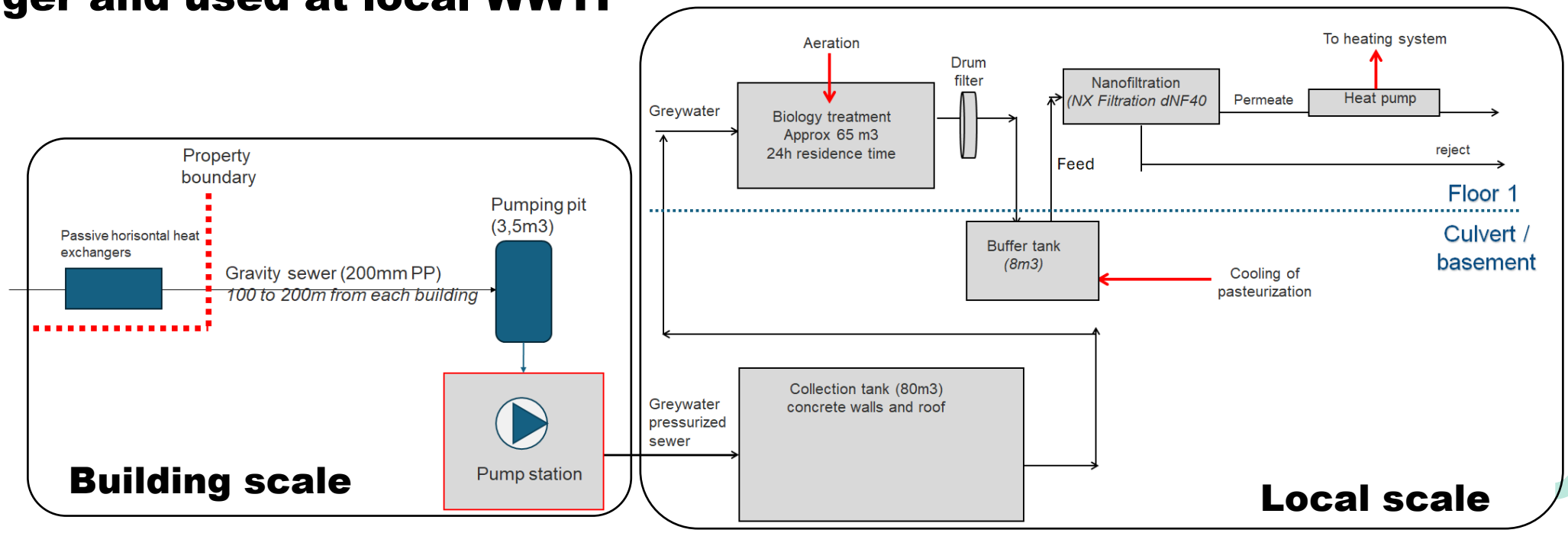
+ **Heat recovery after buffering, more continuous flow**
+ **GW treatment prevents clogging of the heat exchanger**
- **Temperature loss, lower temperature**

Recolab – Helsingborg, Sweden (source: Waterforum.net)

Heat recovery at local scale: Helsingborg (H+)

System design:

- **GW from apartments is collected in pumping pit**
- **GW is transported to collection tank at local treatment plant (Recolab)**
- **Treated GW directed to the heat exchanger and used at local WWTP**



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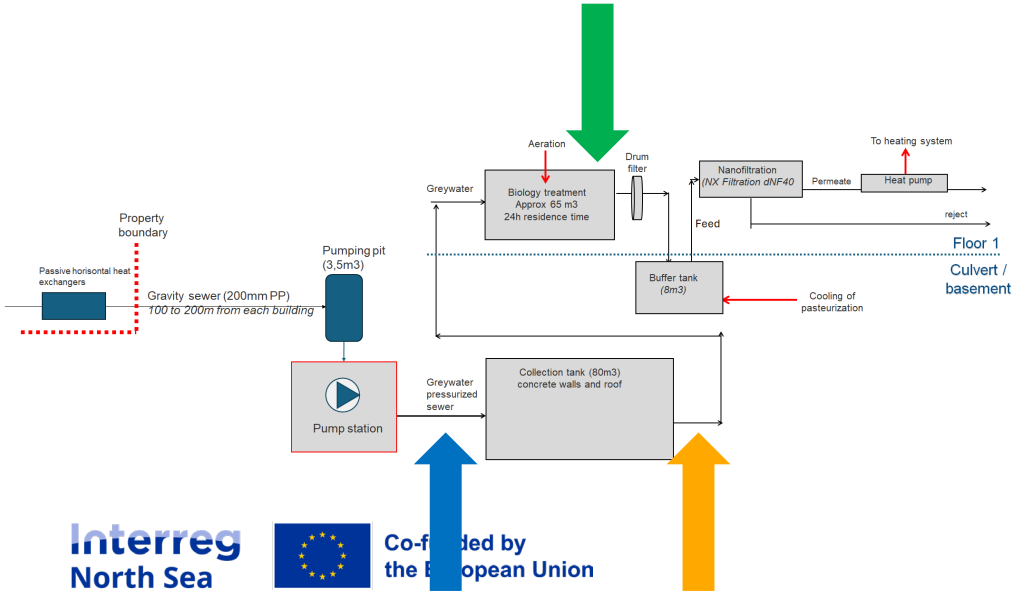
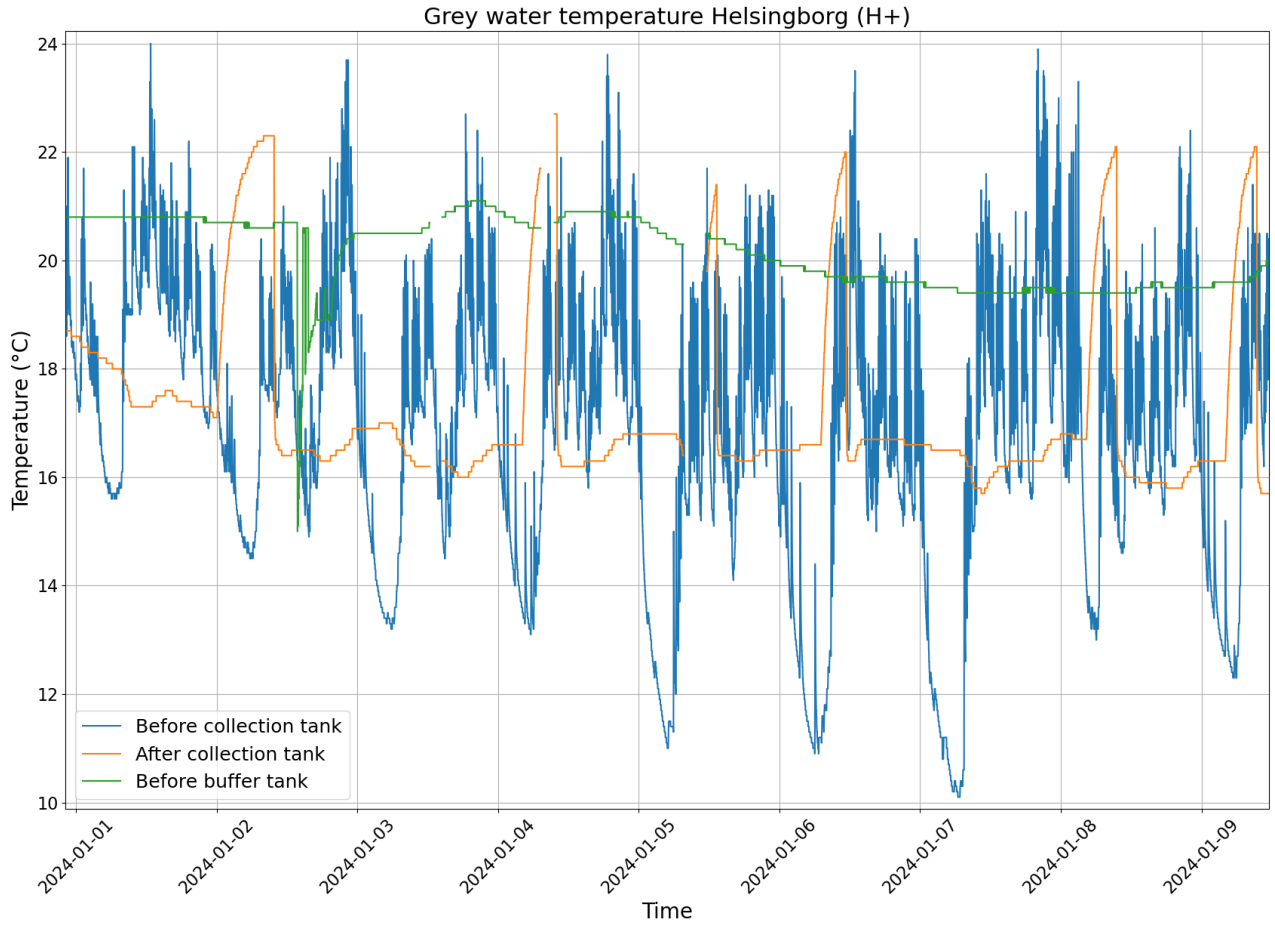
Heat recovery at local scale: Helsingborg (H+)

Average GW temperature (2023 -2024):

- **Entering collection tank: ± 21.5 ºC**
- **Leaving collection tank: ± 20.7 ºC**
- **Before buffer tank: ± 22.9 ºC**

Increase in GW temperature during treatment process!





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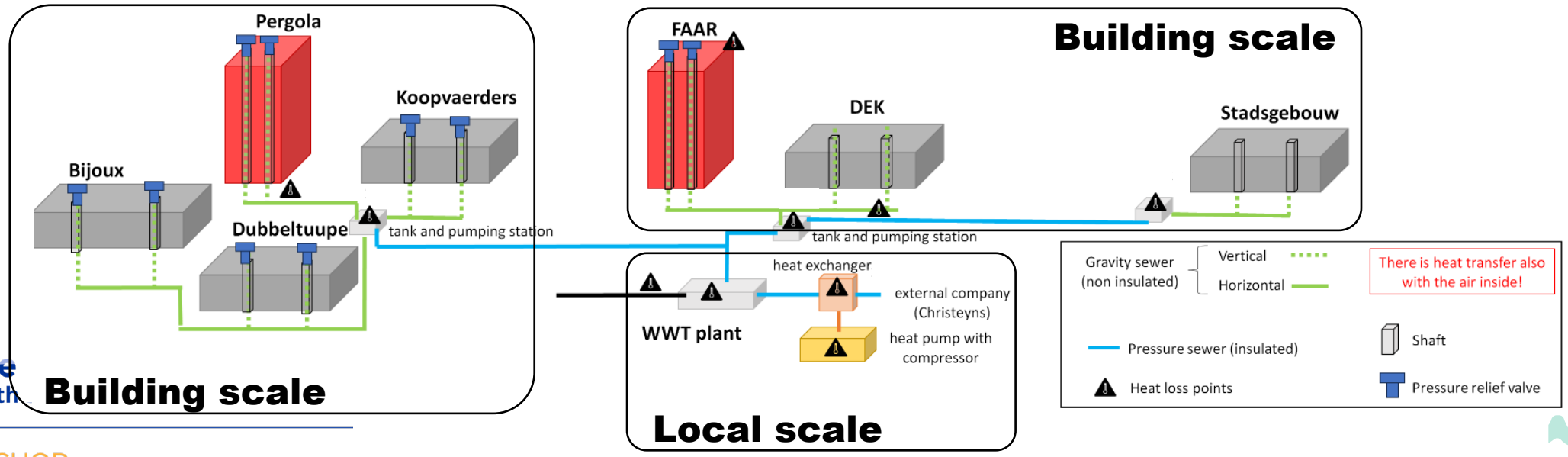
Heat recovery at local scale: Ghent (Nieuwe Dokken)

System design:

- **GW is collected from different building blocks**
- **Treatment of GW before heat recovery**
- **Recovered heat is used for local heating network**

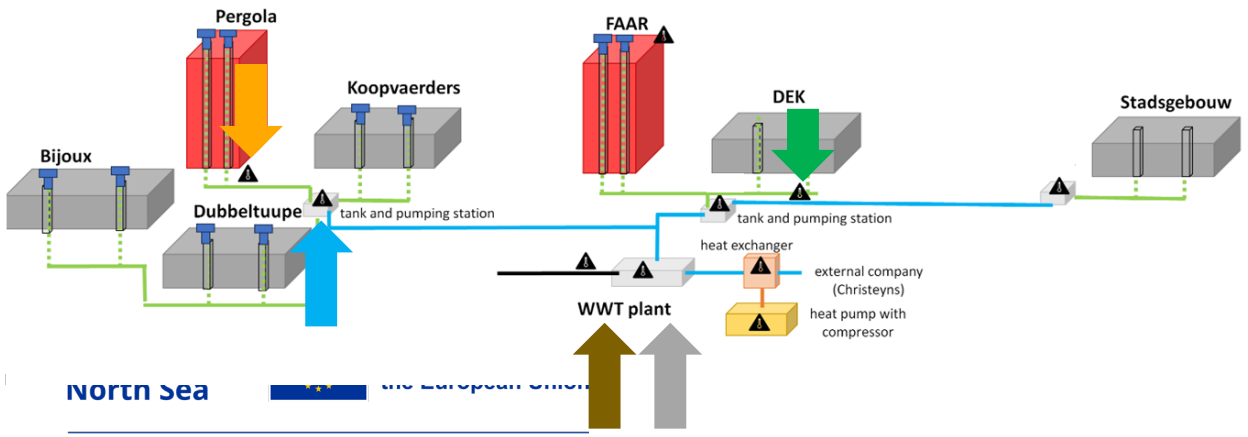


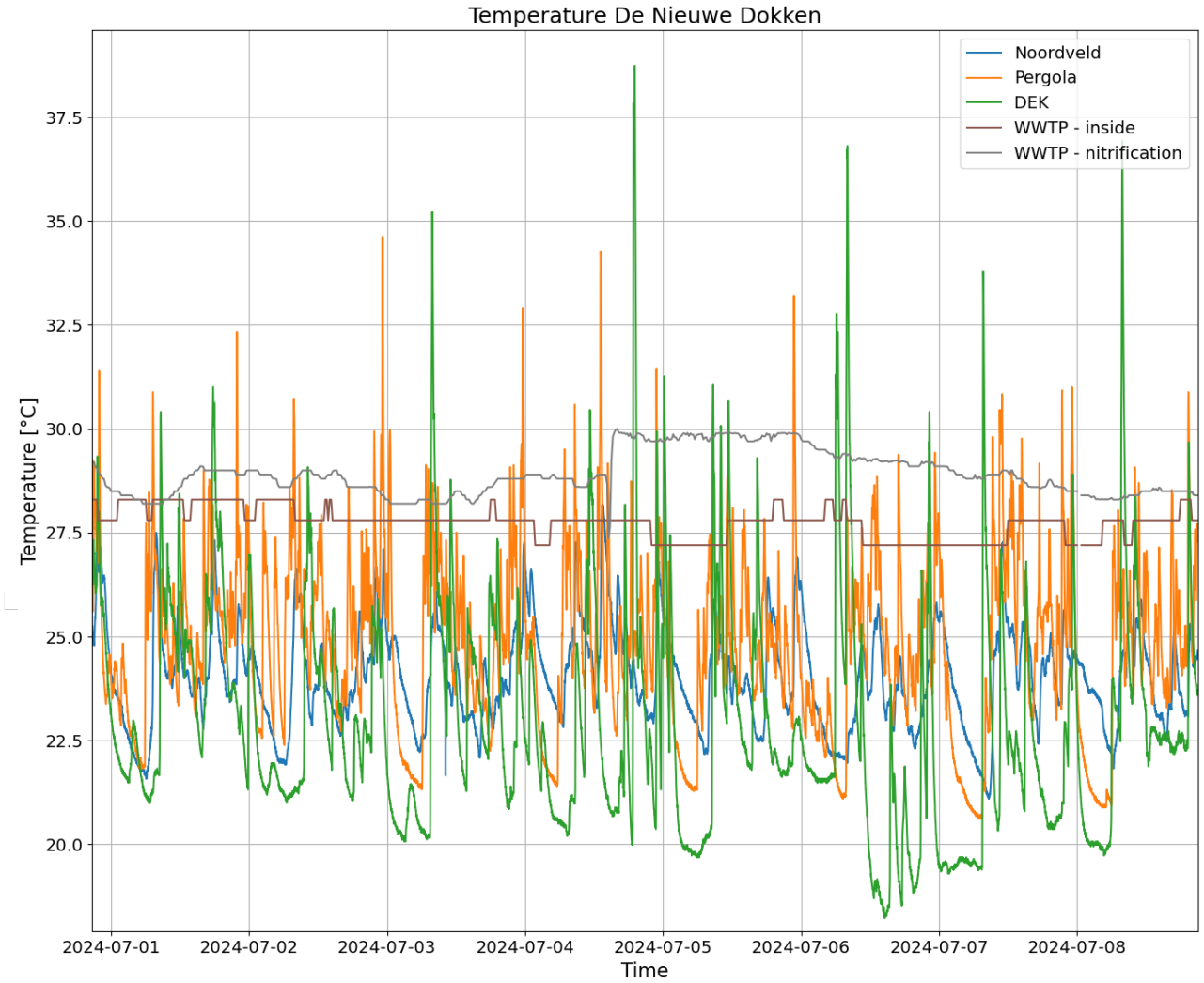
Heat recovery at local scale: Ghent (Nieuwe Dokken)

Average GW temperature (2023-2024):

- **Noordveld (building): ± 22.7 ^{0}C**
- **Pergola (building): ± 22.1 ^{0}C**
- **DEK (building): ± 20.2 ^{0}C**
- **Inside WWTP plant: ± 22.7 ^{0}C**
- **After nitrification: ± 24.5 ^{0}C**

Increase in GW temperature during treatment process!

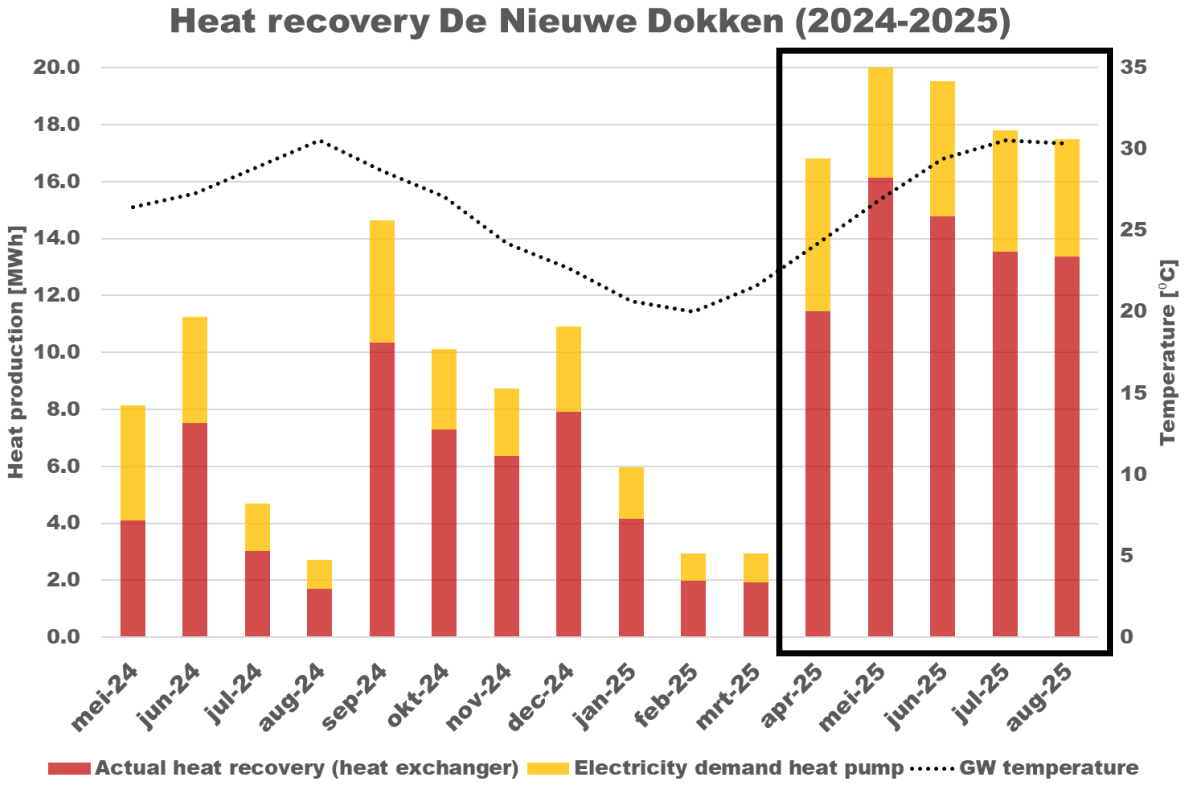




Heat recovery heat recovery at local scale: Ghent (Nieuwe Dokken)

Communal (local) scale:

- **Good performance GW heat recovery since april ’25**
- **Heat recovery potential depends on proper functioning of WWTP**
- **GW temperature entering heat exchanger ranges from 20-30 ^{0}C**
- **Temperature drop grey water in heat exchanger up to 15 ^{0}C**
- **Yearly heat recovery potential of 0.9 MWh/apartment* → 15% of total heat demand new-built apartment**



*Based on last 5 months

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Heat recovery heat recovery at central scale

General system design:

- **Heat recovery at the centralized WWTP, combined with heat pump**
- **Seasonal buffering with aquifer storage possible**

Pros and cons:

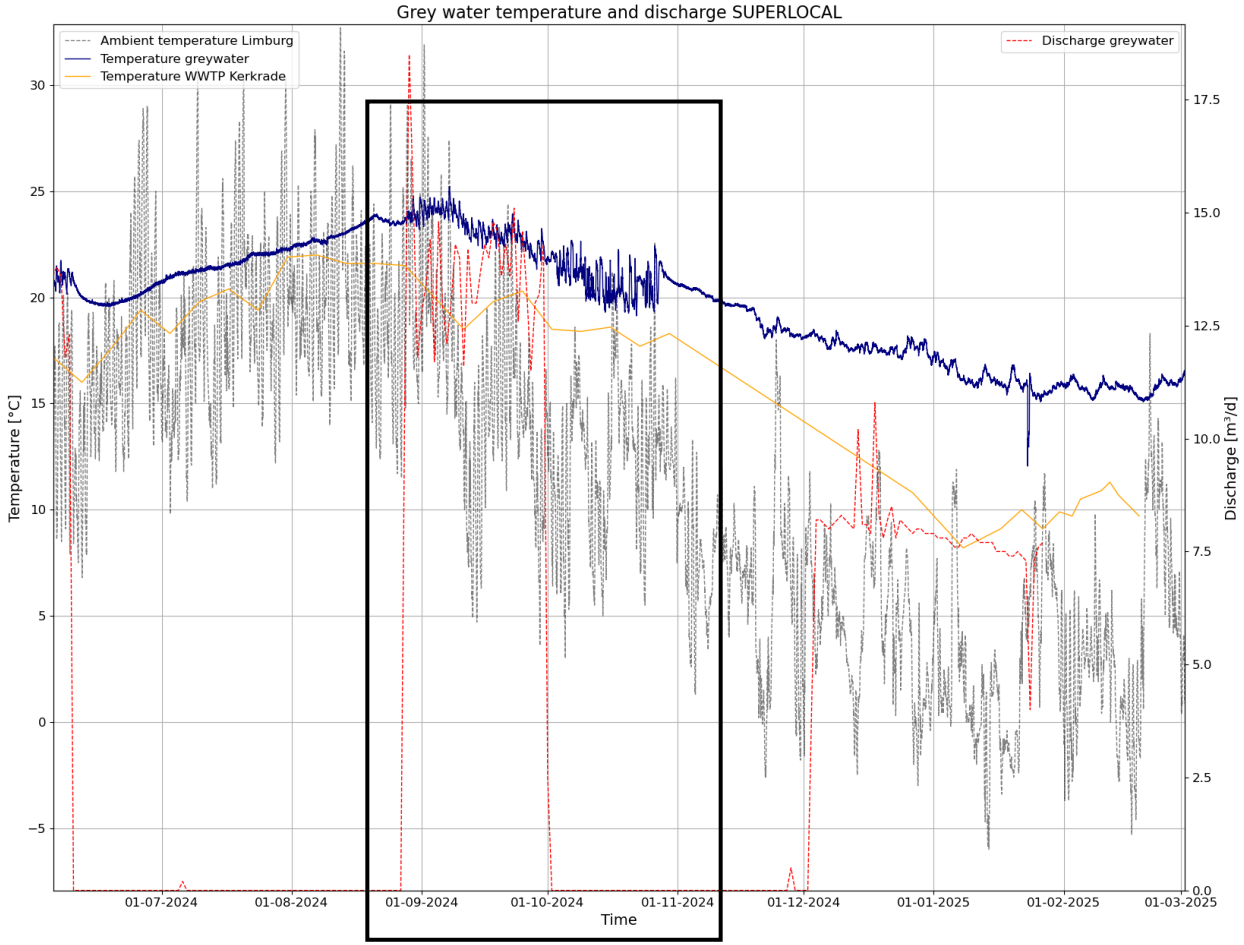
+ **High wastewater discharge**
- **Extensive wastewater treatment needed**
- **Lower temperature compared to local scale**
- **Local heat demand needed near WWTP**

Source: Eneco

Heat recovery heat recovery: local versus centralized

Comparing temperature

- **Temperature of local GW (Superlocal, Kerkrade) and centralized wastewater (WWTP Kerkrade)**
- **Average temperature September – October 2024**
- **Local GW temperature: ± 22 ^{0}C**
- **Centralized wastewater: ± 19 ^{0}C**



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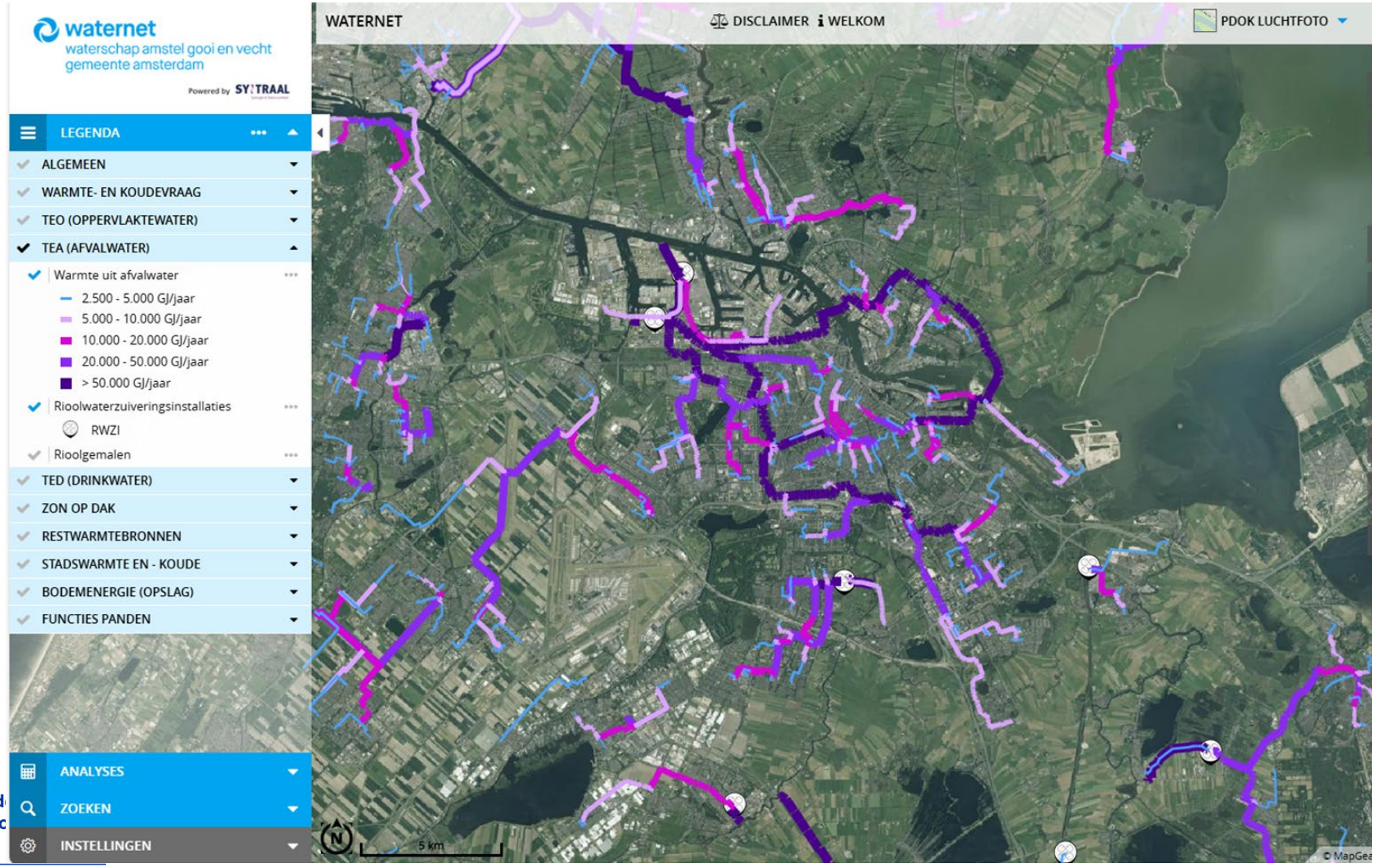
Example of heat recovery potential map of the centralized wastewater system in Amsterdam



Source: https://waternet.omgevingswarmte.nl/waternet

Conclusions

- **Grey water offers relatively high temperatures, energy effective!**
- **Average values found in demos:**
  - **Inside building: ± 27 ^{0}C**
  - **Collection tank (building): ± 21 ^{0}C**
  - **After treatment (local): ± 23 ^{0}C**
  - **WWTP (centralized): ± 19 ^{0}C**

  Fluctuations in temperature decrease with increased scale
- **GW heat recovery can cover up to 15% of total heat demand new-built apartment**
- **System integration varies by scale:**
  - **Building scale: Suitable for pre-heating domestic hot water.**
  - **Local scale: Can serve as an energy source for heat pumps.**
  - **Central scale: Larger scale offers potential for seasonal thermal energy storage.**
- **Temperature and flow dynamics must be considered for optimal system design.**

“The efficiency of grey water heat recovery hinges on the trade-off between maximizing temperature and managing discharge volume.”

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Demo site reflections Helsingborg and Ghent

Hamse Kjerstadius, NSVA and Dries Seuntjens, Ducoop

“What is your main lesson learned in respect to grey water heat recovery at your demo site?”

Lessons from Helsingborg

- Greywater heat recovery has not really been investigated for the buildings before.
- Horizontal heat exchangers need maintenance flushing to avoid clogging from fat.
- It is likely easier to have a low maintenance vertical heat exchangers in buildings.
- Heat pump at WWTP demands very little maintenance.
- Heat recovery via heat pumps could be an interesting future options to shave of peaks in demand for district heating.

Lessons from Ghent

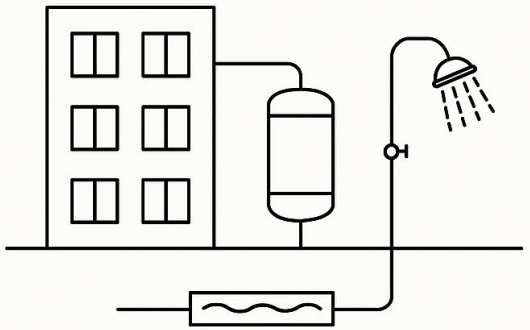
- Effluent temperatures : on average 5°C higher than central sewer systems (in Ghent, Belgium)
  - 17-30°C throughout year
- Up to 25% of local yearly heating demand can be covered by heat recovery from grey water
- Heat recovery dependent upon robust operation of water treatment plant

Greywater Heat recovery on building level in Stockholm

Jörgen Wallin, KTH

Greywater Heat Recovery in Multi-family Buildings

System choices, sizing & impact on building energy



Jörgen Wallin, KTH

25 Sep 2025

Heat recovery on building level in Stockholm

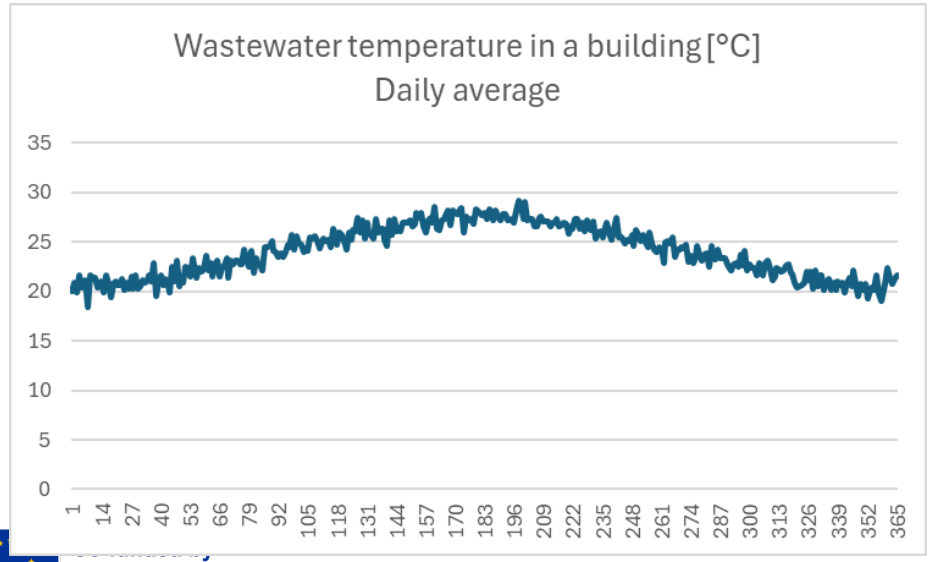
Where I'll focus (10 minutes)

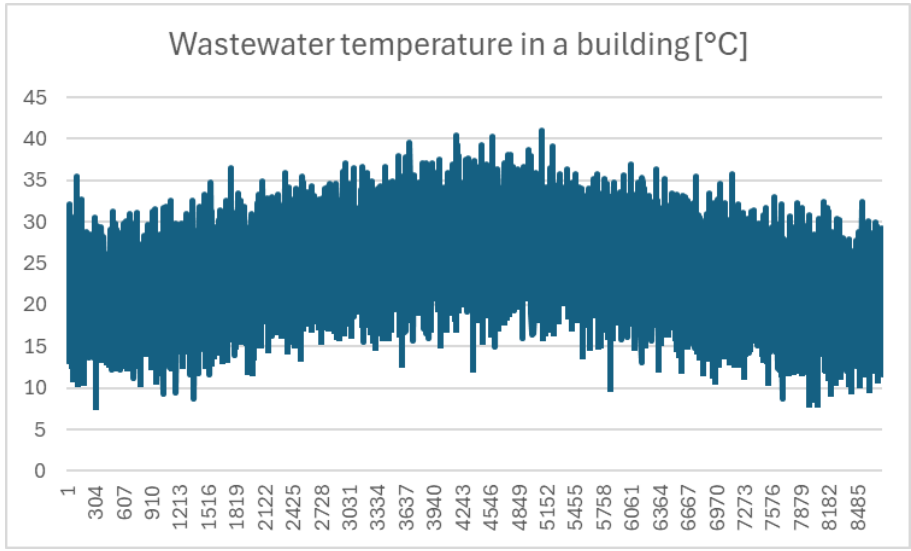
- **Build on today's overview: three scales — building, local (district/block), central (WWTP)**
- **Zoom in on building-level greywater heat recovery**
- **Connect system type ⇄ building conditions ⇄ energy impact**

Heat recovery on building level in Stockholm

Why greywater as a heat source?

- **High source temperatures inside buildings (Daily av. 18–29°C; Low/High 8–41°C in Swedish buildings).**
- **Potential for both HP and passive preheat.**



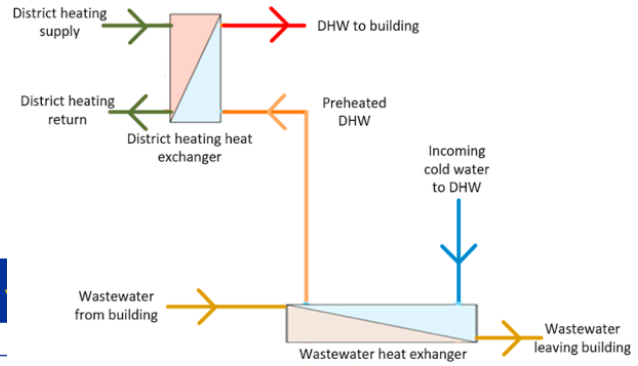


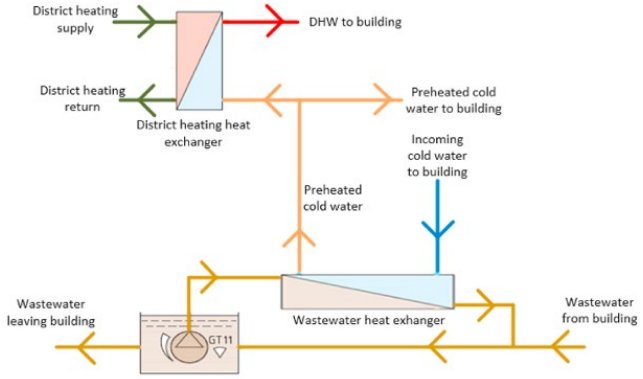
Heat recovery on building level in Stockholm

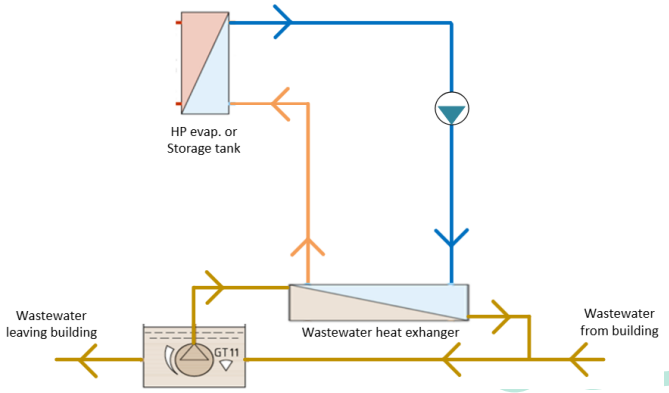
System types ⇄ when to use

- **A) Passive WWHR (vertical or horizontal inline): preheats cold feed; best with simultaneous draw (mismatch demand/availability).**
- **B) SemiActive: HX + buffer + pump on one side: smooths intermittency.**
- **C) FullActive: HX + buffer + pump on both sides: smooths intermittency, increase heat transfer**

- **B and C systems can be used with or without heat pump**







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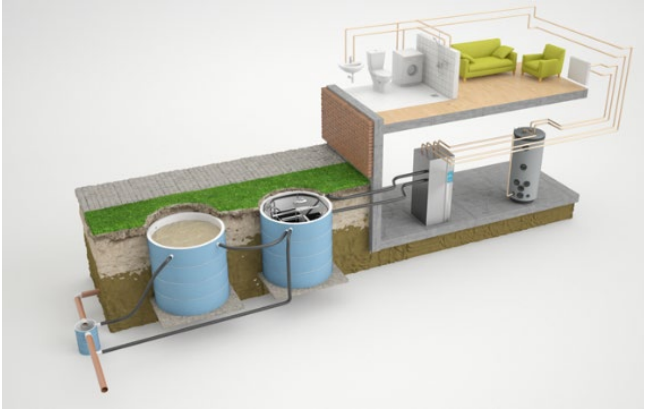
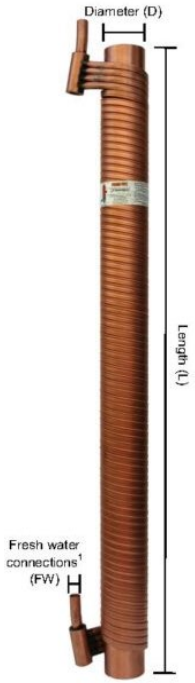
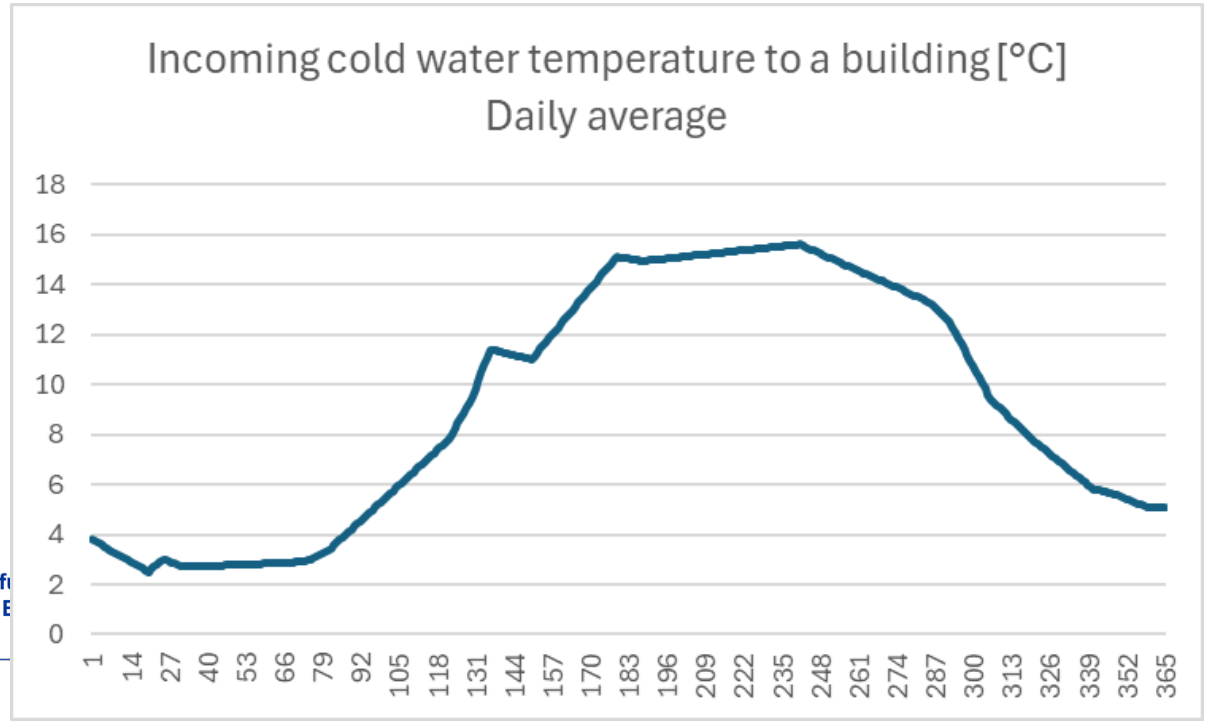
Heat recovery on building level in Stockholm



Heat exchanger types and sizing

- **Heat recovery rate depends on heat transfer area, flow and temperature**
- **Heat exchanger type depends on water quality**





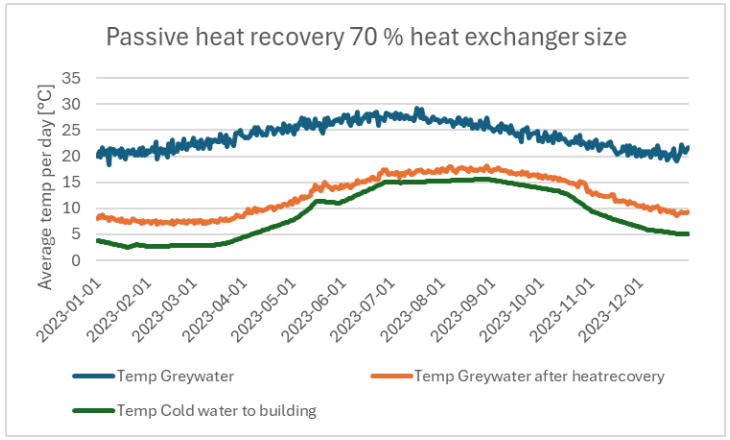
Heat recovery on building level in Stockholm

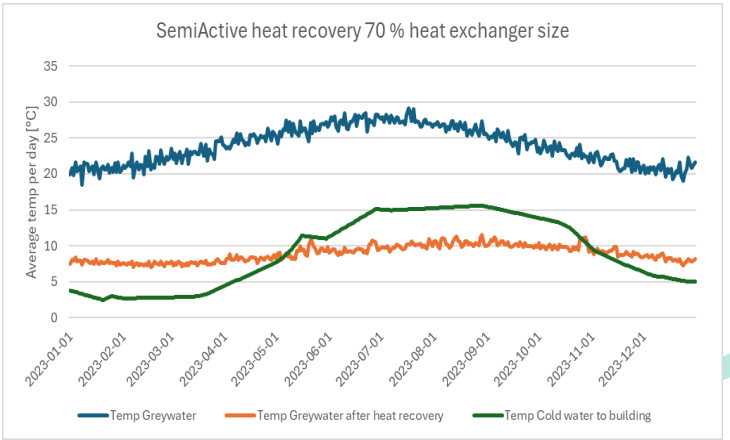
Expected impact on energy performance

- **Reference DHW need in new buildings: ~18-22 kWh/m²·y**
- **Some heat is lost from tap to drain: ~12-16 kWh/m²·y available**
- **Modelled savings (Loudden study):**
- **Passive preheat:**
  - **Case traditional ≈ 3 kWh/m²·y (floor area) - (0.32 MWh/household) – (17 % of DHW demand)**
  - **75%-sized*: ≈ 9 kWh/m²·y (floor area) – (0.94 MWh/household) – (50 % of DHW demand)**
- **SemiActive preheat (with HP):**
  - **Case traditional ≈ 5 kWh/m²·y (floor area) - (0.50 MWh/household) – (28 % of DHW demand)**
  - **75%-sized**: ≈ 12 kWh/m²·y (floor area) – (1.3 MWh/household) – (67 % of DHW demand)**

*75 % of recovery rate of available heat in drain

** 75 % of recovery rate of available heat in drain for passive case (same size as passive case)





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Heat recovery on building level in Stockholm

Design for robust operation

- **Fouling (fat, hair, lint) → choose vertical/self-cleaning HX where possible; plan periodic flushing & screens.**
- **Flow intermittency → add buffer where aiming beyond shower preheat; maintain > flow on cold side when there is greywater flow**
- **Cooling losses in pipes → insulate internal stacks/yard pipes if centralizing; keep runs short.**

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Thank you

Anchor Lunch Talks

Upcoming Lunch Meetings

- When: November 3rd
- Topic: What do users of source-separating wastewater systems think?

- When: December 4th
- Topic: Improvements in practical knowledge of vacuum systems for blackwater

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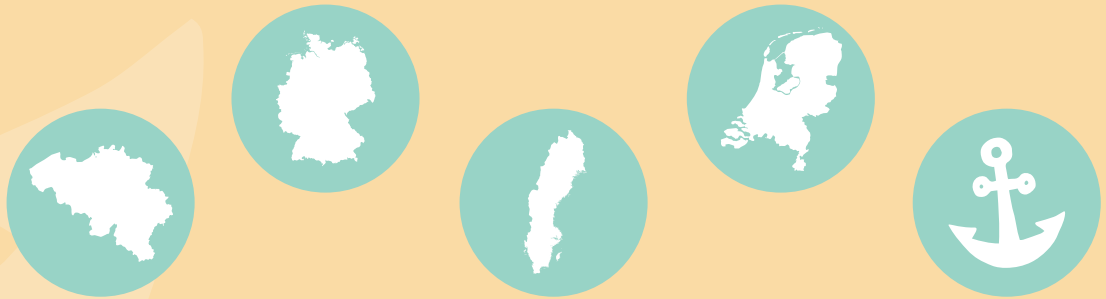
Thank you for attending!



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