HEAT RECOVERY

STRATEGY

Residual heat in greywater or mixed wastewater, from showers, laundry and dishwashers, can be passively recovered via heat exchangers to heat a building's hot water supply. Heat can also be actively recovered via heat pumps and added to a building or district's heat network. The recovery of this residual heat can reduce the energy demand of a building or district by roughly 30%. Heat recovery can be implemented in single- and multi-family homes and residential buildings, as well as in non-residential buildings with high hot water consumption (e.g., sports complexes, commercial washing facilities, hotels). Heat recovery can be coupled to on-site water reuse. The resulting lowered water temperature also helps reduce microbial regrowth in storage tanks.

INPUT STREAMS

- Greywater
- Mixed wastewater

TARGET OUTPUTS

- Recovered heat

IN-APPLIANCE RECOVERY

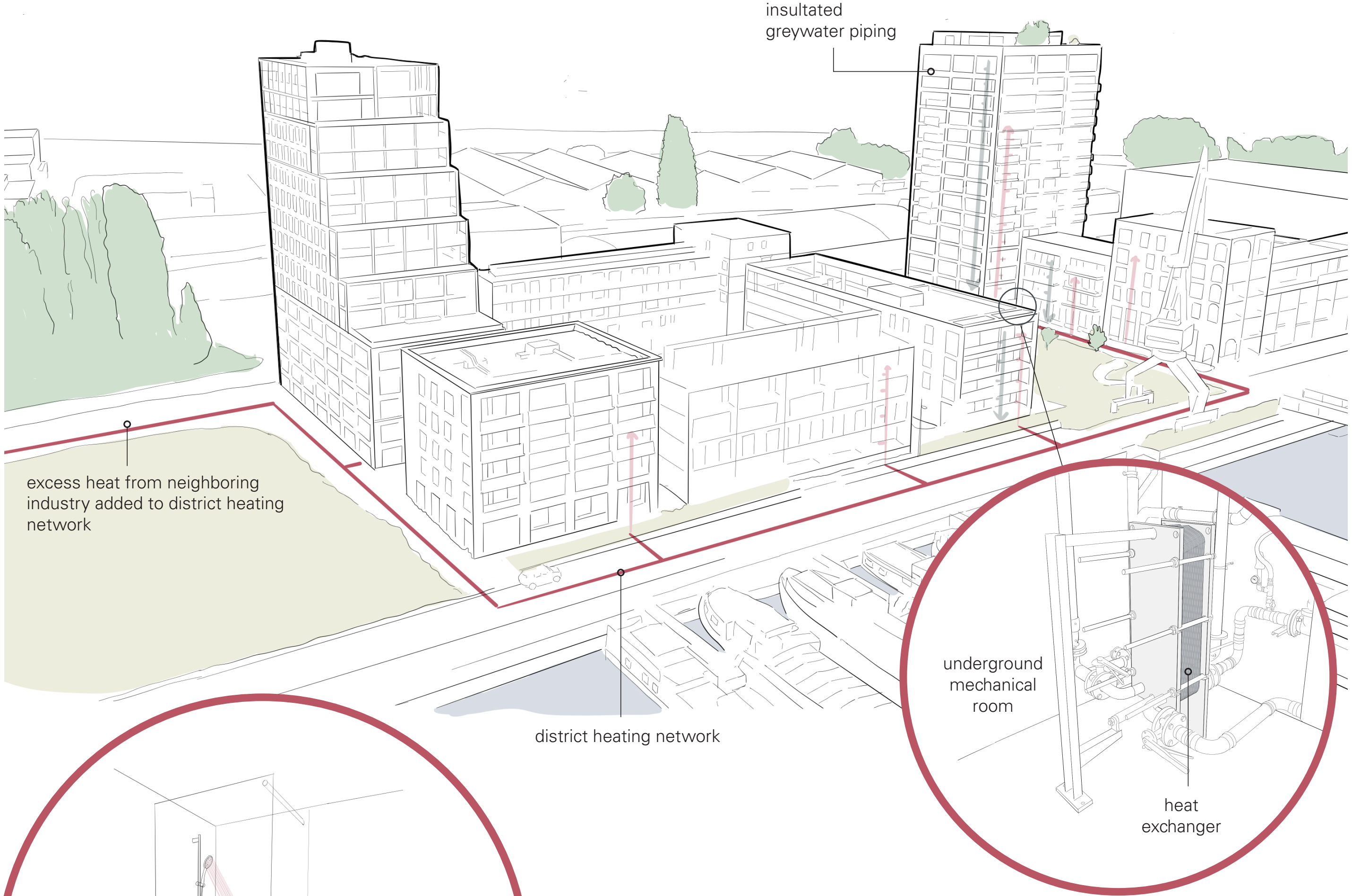
Heat exchangers implemented in or close to a shower, recover heat from the draining greywater to pre-heat the incoming water (by ~15 °C) before the mixing valve. Recirculating showers, that reuse shower water after in-appliance treatment, directly recirculate heat.

INSULATION

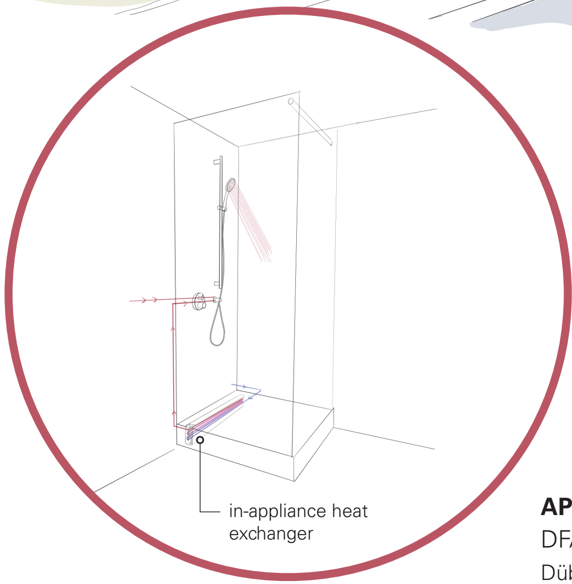
Greywater or mixed wastewater piping should ideally be insulated to avoid heat dissipation before reaching the heat exchanger or heat pump. Thermal storage tanks, also known as hot water storage tanks or buffer tanks, are commonly used to store heat between intermittent heat recovery and use. Storage tanks should also be insulated.

MECHANICAL ROOM

Heat exchangers or pumps, as well as storage/buffer tanks, are typically placed in a mechanical room, for example, in a basement. The closer the heat exchanger or pump is to the source, the lower the dissipation of heat during conveyance and the higher the heat recovery potential. Ventilation of the mechanical room is important to allow excess heat to dissipate and prevent overheating of the heat exchangers and pumps, and for humidity control.



BUILDING/DISTRICT SCALE
DE NIEUWE DOKKEN
Ghent, Belgium | 2021



APPLIANCE SCALE
DFAB HOUSE, NEST
Dübendorf, Switzerland | 2019

TO CONSIDER

COLLECTED STREAM

Most of the heat is present in streams including greywater from showers, washing machines, and dishwashers. Heat recovery is therefore implemented from greywater (if separated) or mixed wastewater. Greywater (temp. range: 25 - 38 °C) contains more thermal energy than mixed wastwater (15 - 30 °C). It is important to consider that recovering heat can impact further performance of treatment and recovery technologies.

SPACE & PLACEMENT

Unless appliance scale recovery is implemented, a mechanical room is used to house the heat exchangers and/or pumps, as well as heat storage/buffer tanks. Heat exchangers are often designed for modularity; depending on the volume of the collected stream and heat demand, the setup can expand. The insulation of pipes requires a bit more space between/behind walls. If integration in district heating network is desired, proximity to the network is essential.

RESOURCE INTENSITY

The initial investment for a heat exchanger or pump can be significant, although the long-term energy savings often justify the expenditure. Heat pumps are often most financially suitable at larger scales with high wastewater volumes. Heat recovery requires little additional resources, and minimal operation and maintenance.

NEW BUILD VS. RETROFIT

Heat recovery is suitable for both new constructions and retrofitted buildings. In existing buildings, implementing heat exchangers or pumps may require modifications to plumbing. New build contexts lend themselves for integration of onsite heat recovery into a networking heating distribution model.

HYBRID VS. DECENTRALIZED

Heat can be recovered at a centralized location, for example in conventional sewers and wastewater treatment plants. However, recovery close to the source reduces heat losses (i.e., dissipation) and increases recovery potential. Heat recovery can be part of a larger water saving strategy, however it can also be implemented for wastewater streams sent to sewer.

USER EXPERIENCE

Properly designed and maintained systems operate quietly and without odor, ensuring a positive user experiene. Lower heating bills are often a welcome result of heat recovery.

RECOVERY OPTIONS

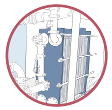
Heat recovery passively transfers (via a heat exchanger) or actively transfers (via a heat pump) residual heat, which would otherwise be lost, to either preheat or heat a cold water stream. Heat recovery reduces the energy required for heating the stream.

RECOVERY VIA HEAT EXCHANGERS

In a heat exchanger, the greywater or mixed wastewater passively transfers its thermal energy via conduction through metal plates or coils to a separate secondary stream, often colder water. This preheated water is then directed to the building's heating system or storage tank.

RECOVERY VIA HEAT PUMPS

A water-source heat pump can elevate the temperature of the cold water stream (also after heat recovery via heat exchanger) by actively extracting heat from the greywater or mixed wastewater stream via a vapor compression cycle that moves heat from one place to another.



T.61 HEAT EXCHANGERS & HEAT PUMPS

REUSE

STORAGE TO BUFFER SUPPLY & DEMAND

Heat in greywater and wastewater streams varies in depending on user behavior - of showers, dishwashers and washing machines. Not only does the volume and temperature of the flow vary, but the thermal energy in the flow is intermittent. Storing recovered heat is crucial to bridge supply (of recovered heat) and demand (for hot water or heating). Storing heat effectively ensures that it can be used when needed, such as during periods of low wastewater flow or high demand for hot water.

REUSE IN HEATING NETWORK

At scales beyond in-appliance recovery, the heat transferred to the secondary stream, can be used and distributed on site, for space heating or hot water, or into a larger heating network, via another heat exchanger. The heat can then be distributed to other users.

ENERGY SAVINGS

Energy reductions can lead to savings in utility bills over time and pay off initial investments. Calculated savings vary depending on 1) heat recovery efficiency and capacity of the heat exchanger and/or pump installed, 2) household size, 3) hot water usage, and 4) local energy rates.