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# EXCESS HEAT DISTRIBUTION FOR PRIVATE HOUSEHOLDS THROUGH EXISTING SEWER NETWORKS

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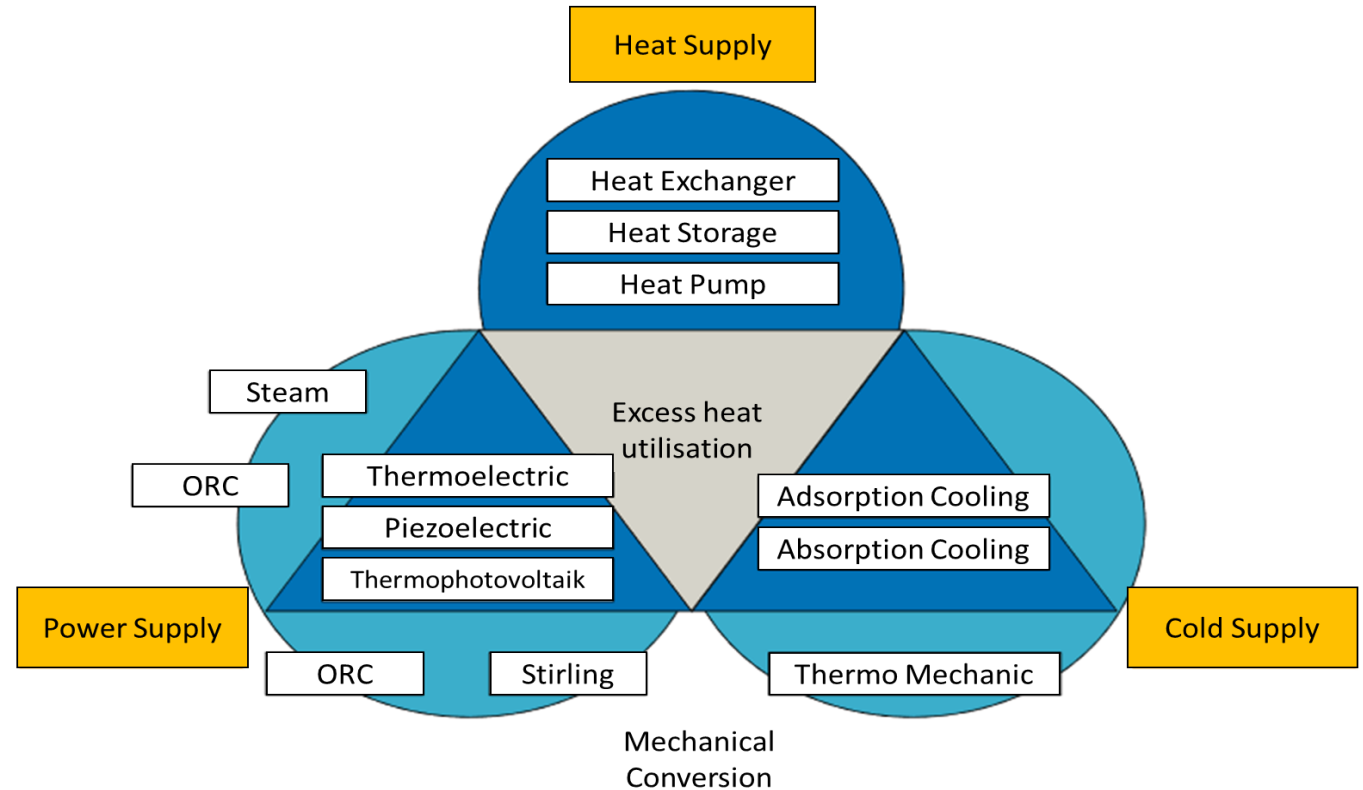
# Why is the topic of excess heat relevant?

## What is industrial excess heat ?

Unwanted by-product (unused)

- Inefficiencies of processes
- Thermodynamic limitations

Use: Added value for industry and society

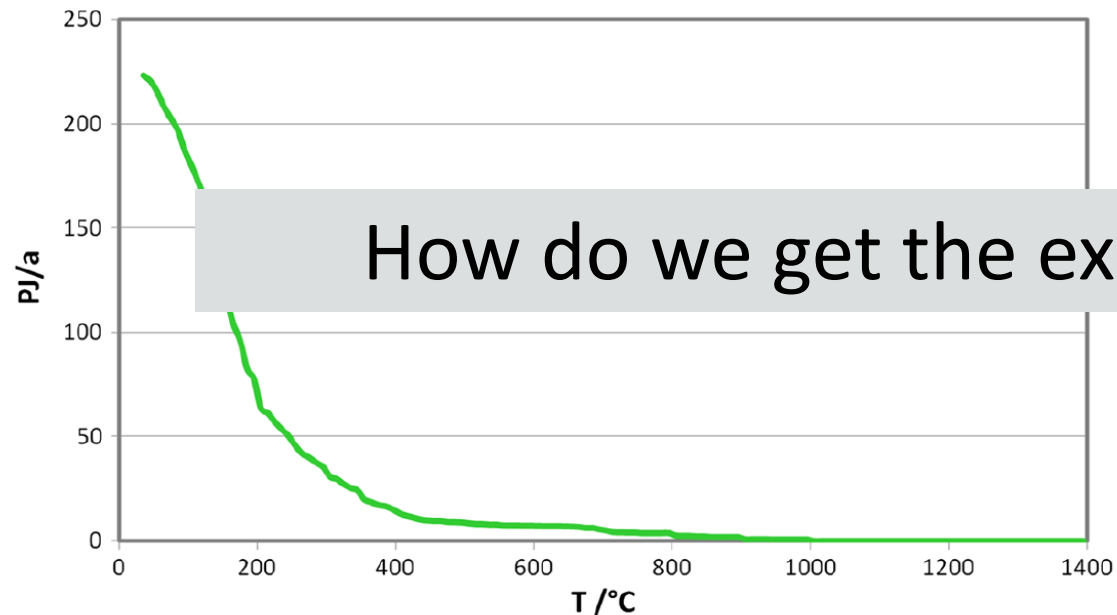


translated from Hirzel 2013

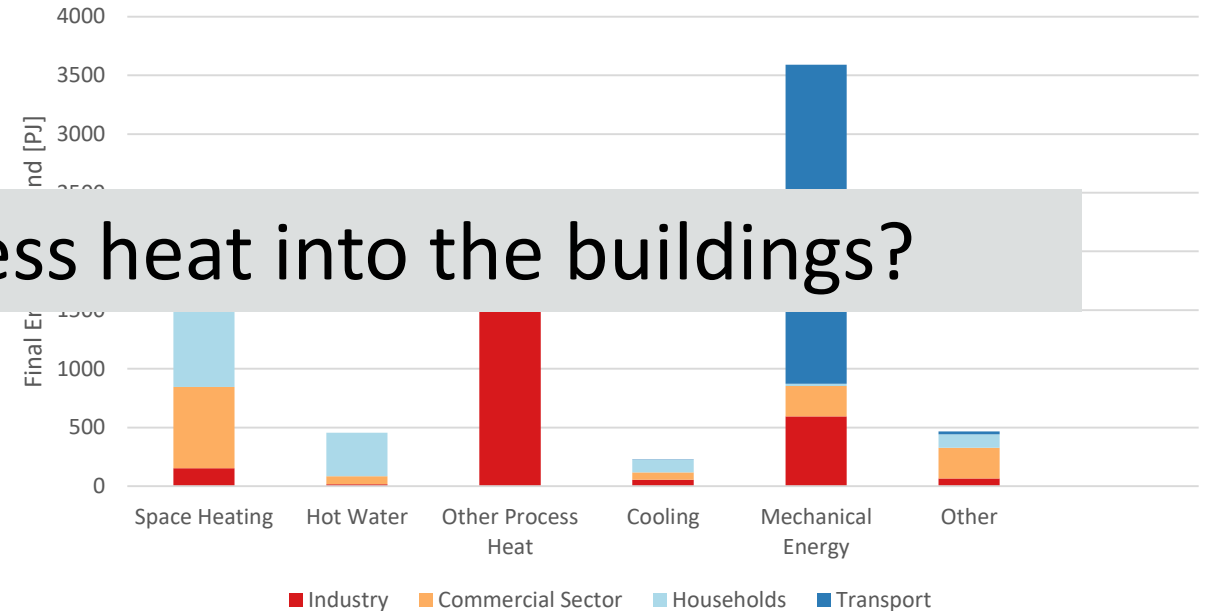
# Potential excess heat and demand of households

■ Excess heat potential is mainly present in low temperature ranges

■ Private households account for a quarter of the EU's final energy demand



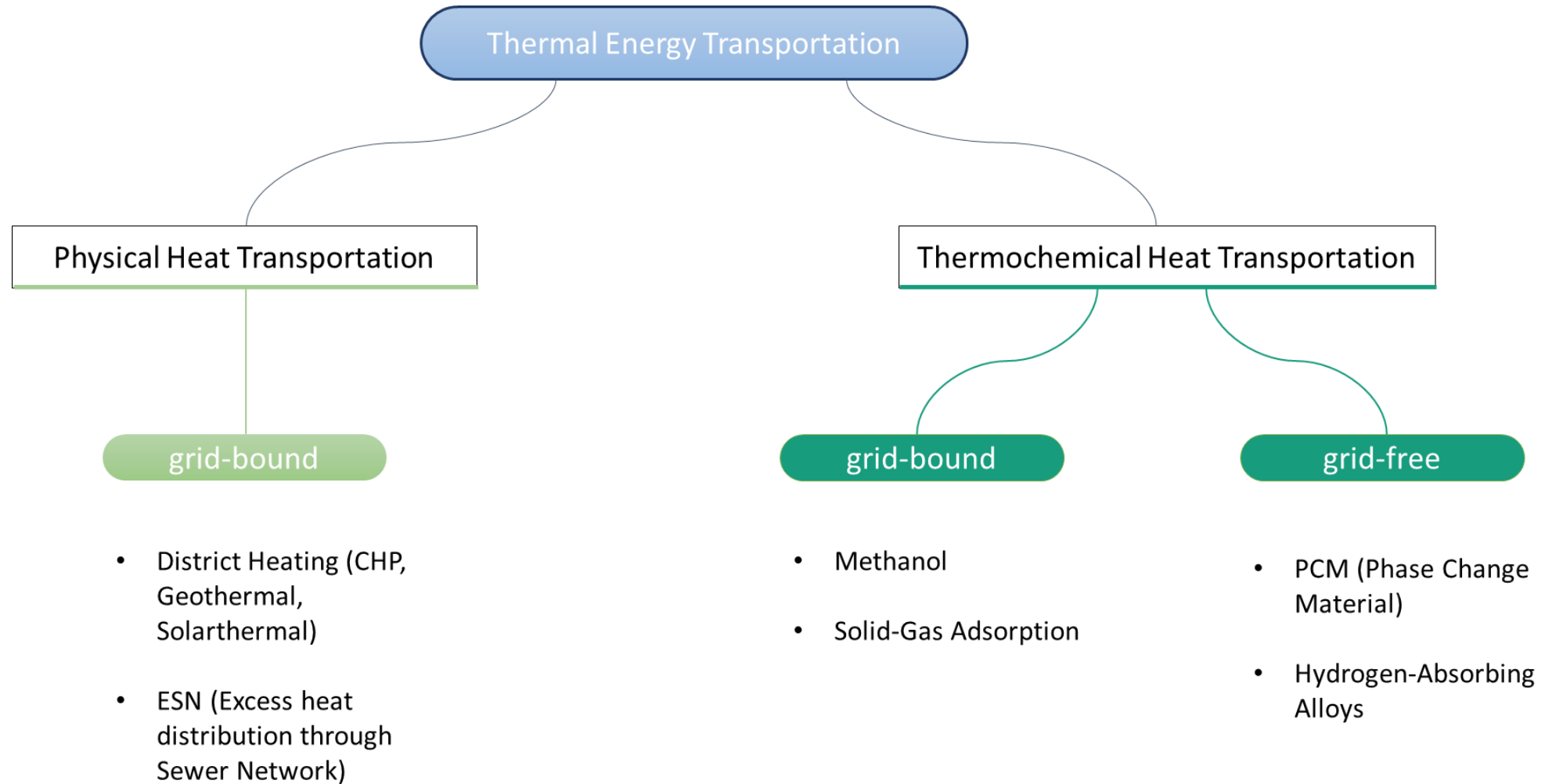
How do we get the excess heat into the buildings?



Industrial Excess heat potential for Germany (Brueckner et. al 2016)

Final energy consumption by sector for Germany (AG Energiebilanzen e.V. 2018)

# Excess heat distribution technologies

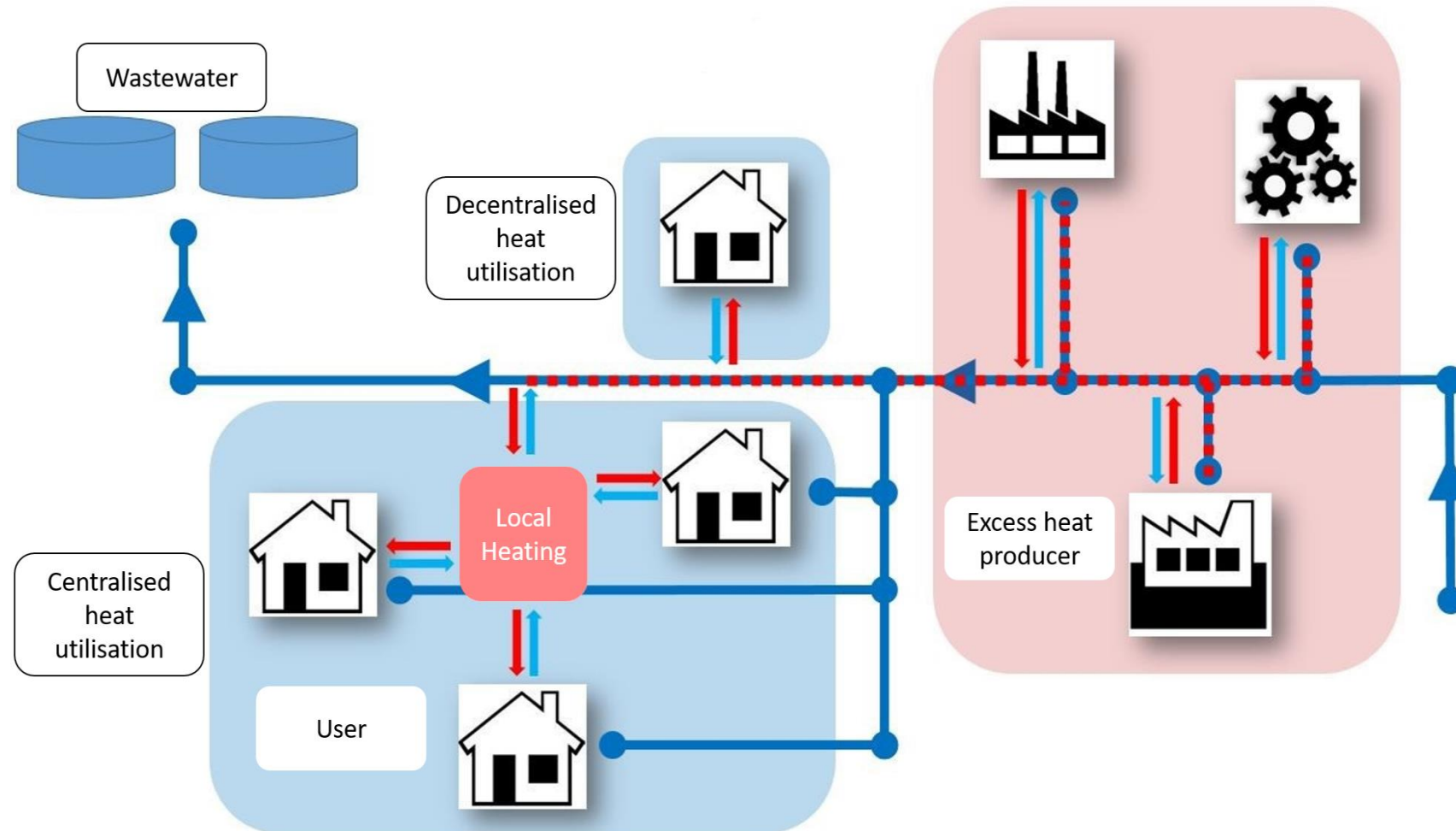


# Excess heat distribution through sewer networks

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- There is a theoretical potential of low temperature industrial excess heat
- There is a high demand for low temperature heat in households
- Classical solutions such as district heating are often too expensive or are not realized due to complicated approval procedures
- The existing sewer network offers a solution with an existing infrastructure

# Excess heat distribution through sewer networks



Schematic representation of the heat distribution over the existing wastewater network (Fritz 2019)

# Why excess heat distribution through sewer networks?

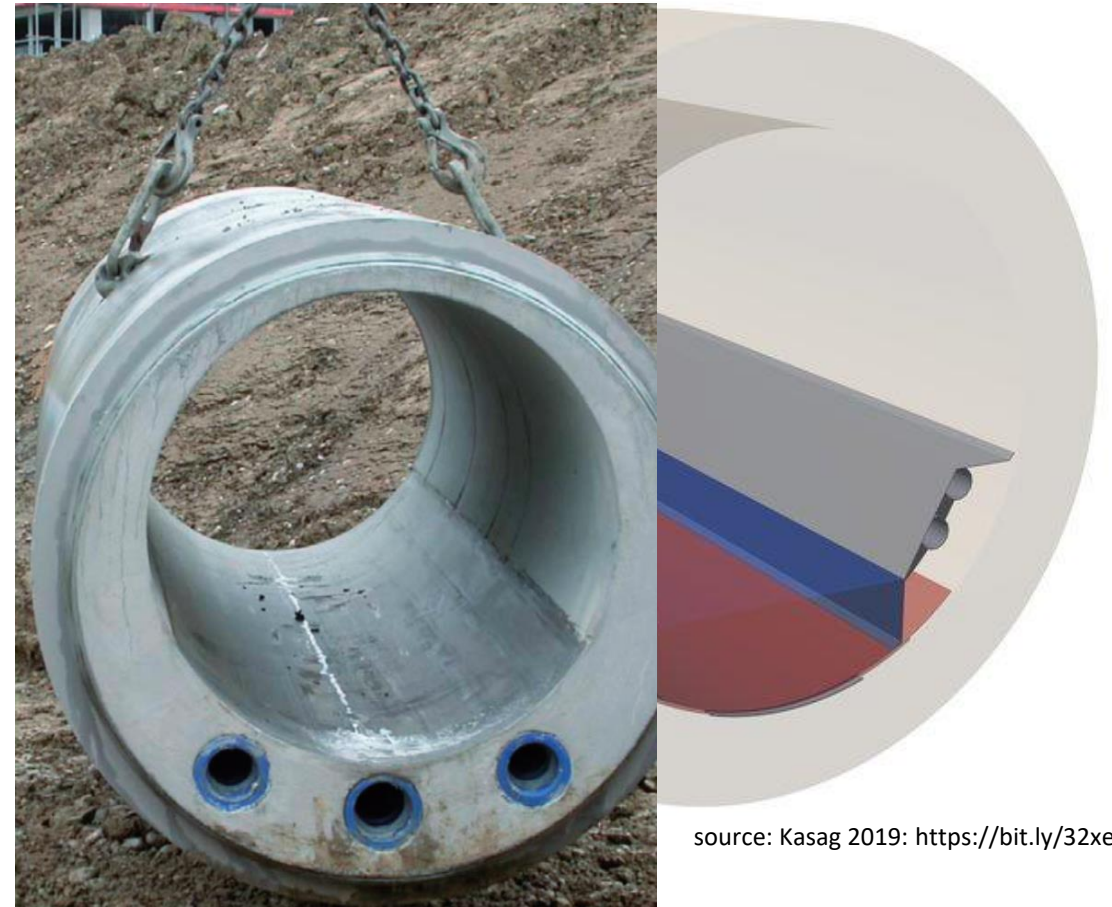
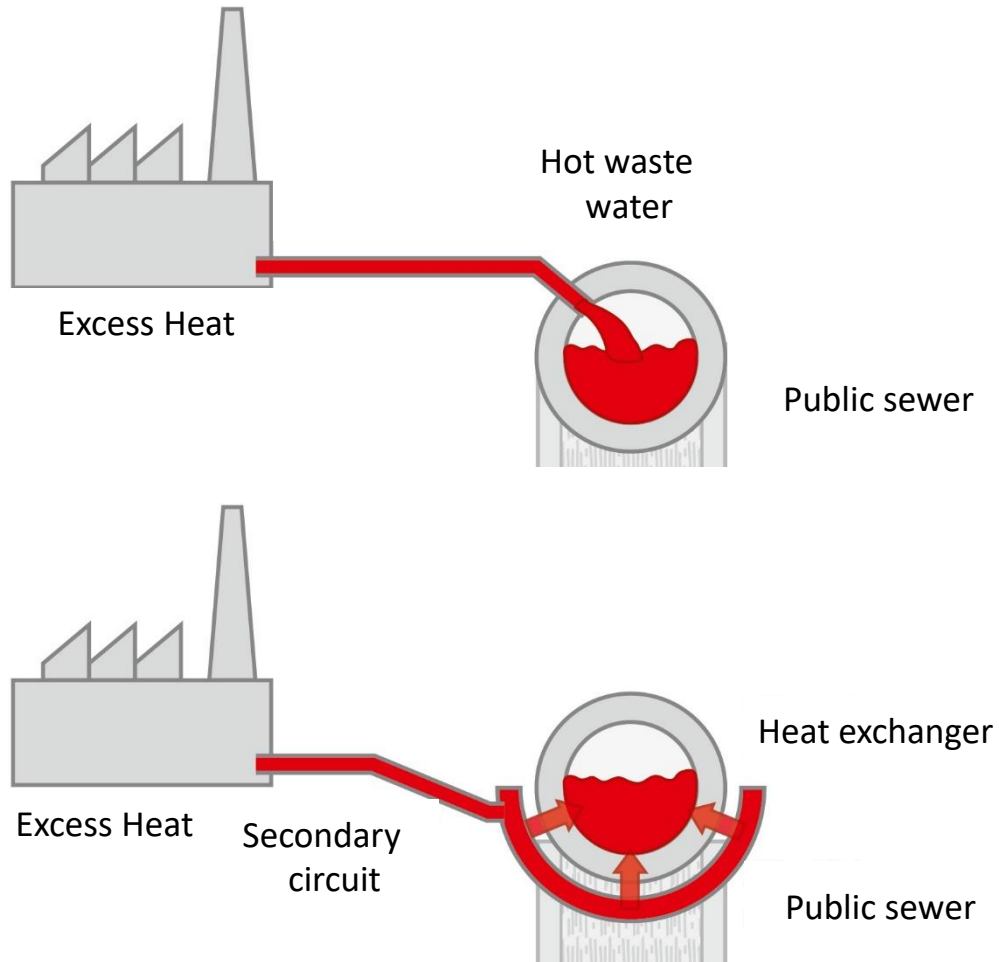
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1. Technology transfers excess heat from industrial site to wastewater stream
2. Temperature in the sewer is raised
3. Downstream, the heat can be used

## Advantages:

- Usage of established technologies (heat exchangers and heat pumps)
- Primary energy demand and GHG emissions are reduced
- High level of resource efficiency by multiple use of existing infrastructure

# Heat exchanger



source: Schratz 2018

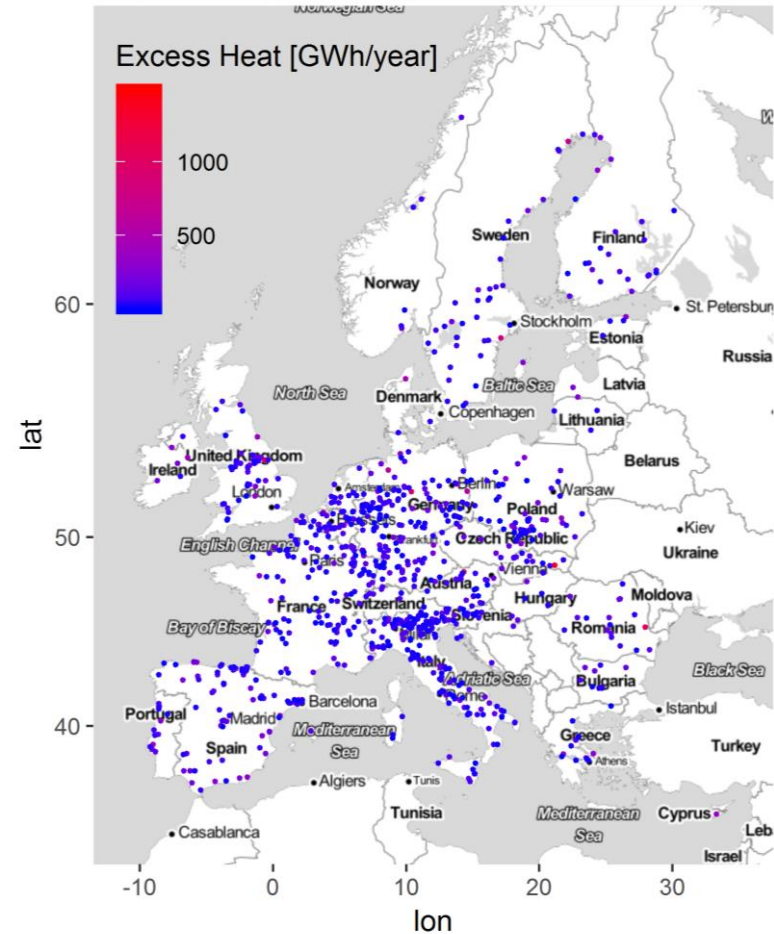
source: Badenova 2007

source: Kasag 2019: <https://bit.ly/32xeMDA>

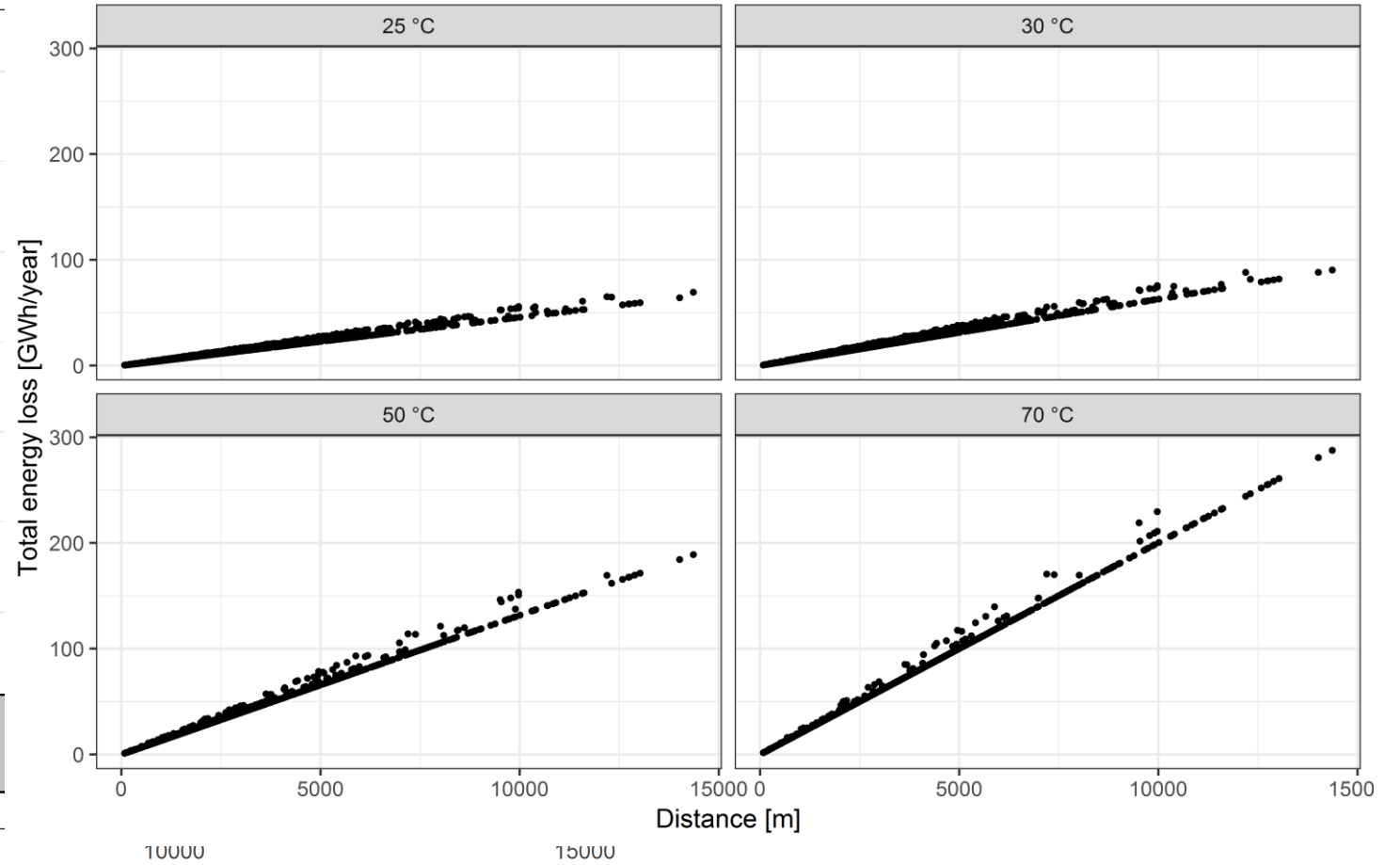
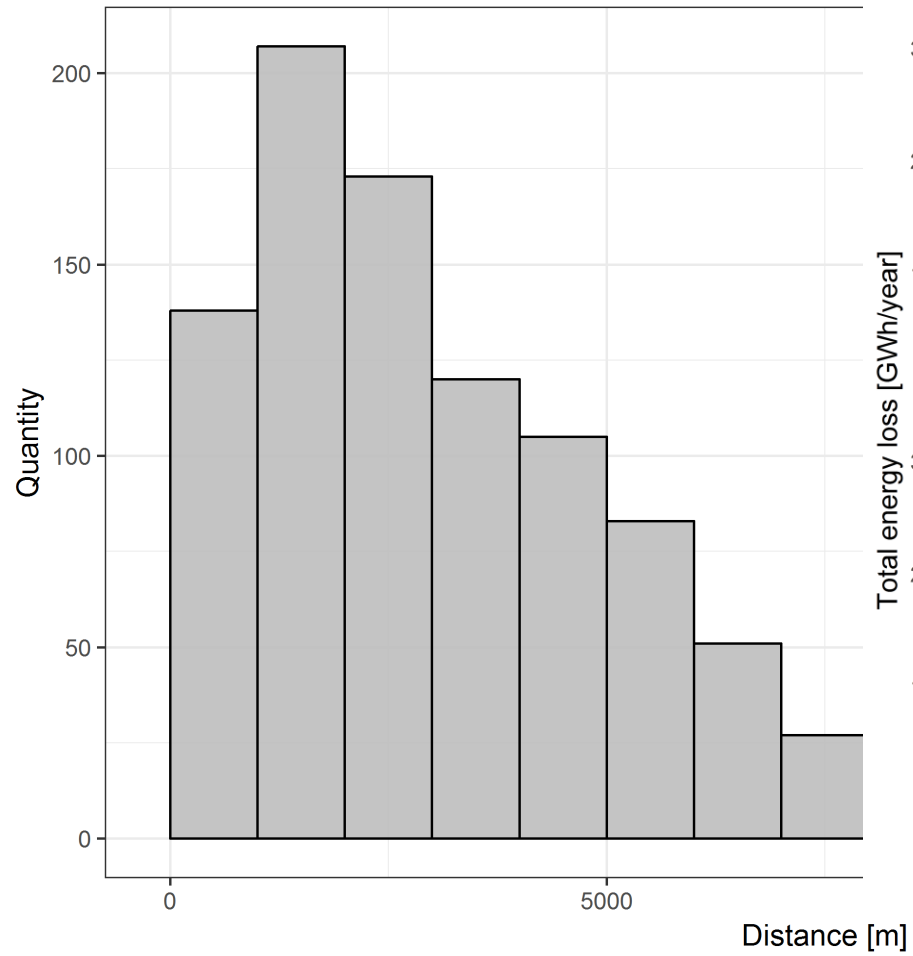


# Theoretical potential

1. We identify the nearest sewage treatment plant for every industrial site
2. We calculate the average amount of water required to dissipate the excess heat
3. We calculate the sewer parameters based on the flow rate of the water and model a sewer that leads directly from the excess heat source to the sewage treatment plant
4. We calculate the heat loss within the sewer



# Theoretical potential



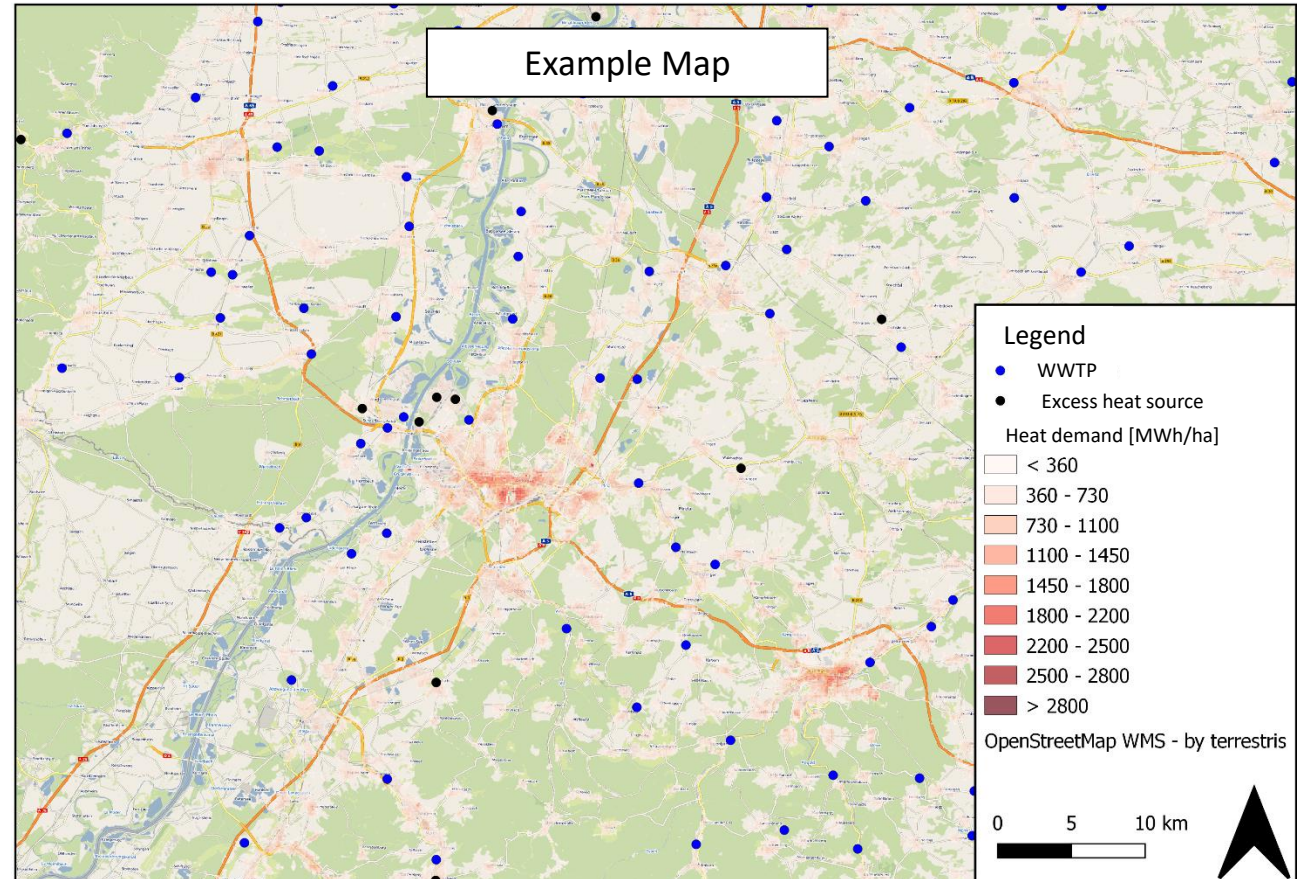
# Theoretical potential

Temperature	Potential use cases	Percentage of potential use	Quantity of excess heat
25 °C	410	42 %	61.5 TWh
30 °C	321	33 %	55 TWh
50 °C	179	18 %	39.8 TWh
70 °C	117	12 %	31.5 TWh

- Over 75 % of the maximum flow path distances are less than 5 km.
- At a wastewater temperature of 30 °C for 321 of the 978 cases investigated, it might make sense to use the existing sewer infrastructure.
- At lower temperatures the proportion of possible uses decreases faster than at higher temperatures.

# Technical potential

- Consideration of:
  - Waste Water Quantity
  - Sewer Configuration
  - Heat Demand
  - Building Structure



# Conclusions

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- Excess heat distribution through sewer networks can offer theoretical potential
- The estimation of the technical potential is difficult due to the lack of data
- There are some limitations of the technology

Thank you very much for your attention

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# References

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