# INDUSTRIAL EXCESS HEAT AND DISTRICT HEATING
## POTENTIALS AND COSTS FOR THE EU-28 ON THE BASIS OF NETWORK ANALYSIS

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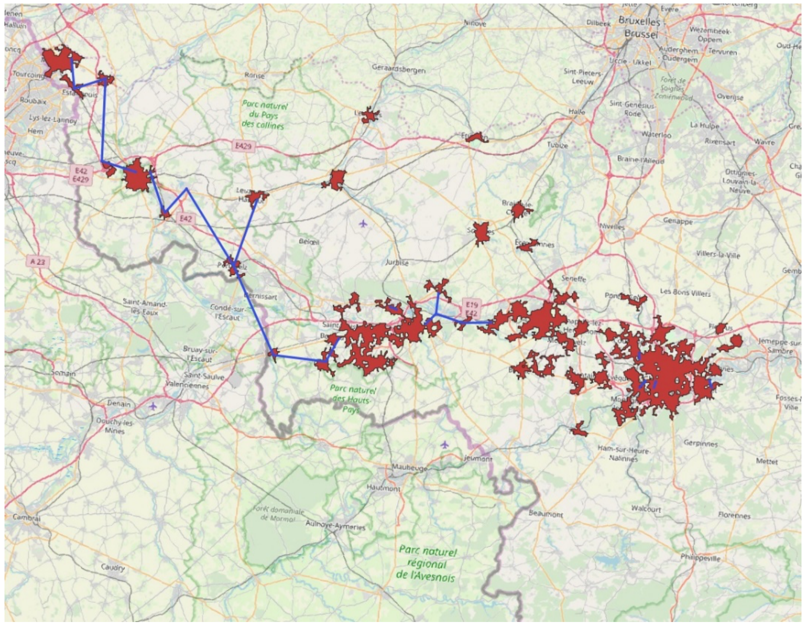



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# AGENDA

- Background
- Method
- Results
- Discussion and Conclusion

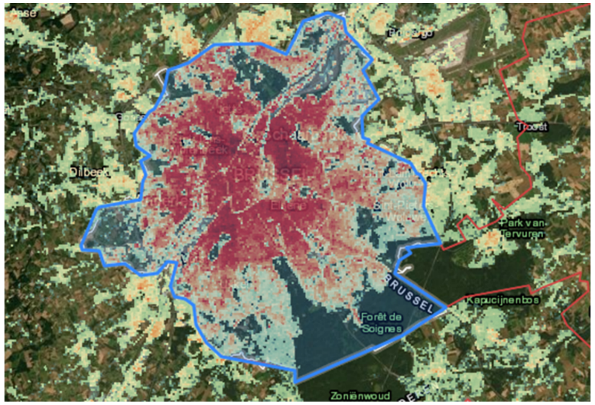
# Background (I/II)

- Heating and cooling (H&C)
  - → Half of Europe's total energy needs
  - → Dependent on fossil fuels (75%)
  - → Decarbonisation: slow, rapid change required
    - → Fragmented
    - → Many decision makers
    - → Local perspective and solutions
- District Heating
  - Countries with higher shares of DH → Higher shares of RE for H&C
  - Potential to increase the speed of transformation
  - Cheap heat as driver → Excess heat

# Background (II/II)

Hotmaps toolbox ([https://www.hotmaps.hevs.ch/](https://www.hotmaps.hevs.ch/))

- Supporting public authorities
- Strategic H&C
  - Default data
    - RES potentials
    - H&C demand (Res-/ Non-Residential)
    - ....
  - Calculation modules
    - Scenarions
    - Excess Heat
    - .....



INDICATORS GRAPHICS

| INFORMATION | VALUE |
|---|---|
| HEAT DENSITY TOTAL | |
| Heat demand total | 14 734.23 GWh/yr |
| Counted Cells | 13 328 cells |
| Heat density min | 0.03 MWh/(ha*yr) |
| Heat density max | 9 491.29 MWh/(ha*yr) |
| Average heat density | 1 105.51 MWh/(ha*yr) |

EXPORT INDICATOR



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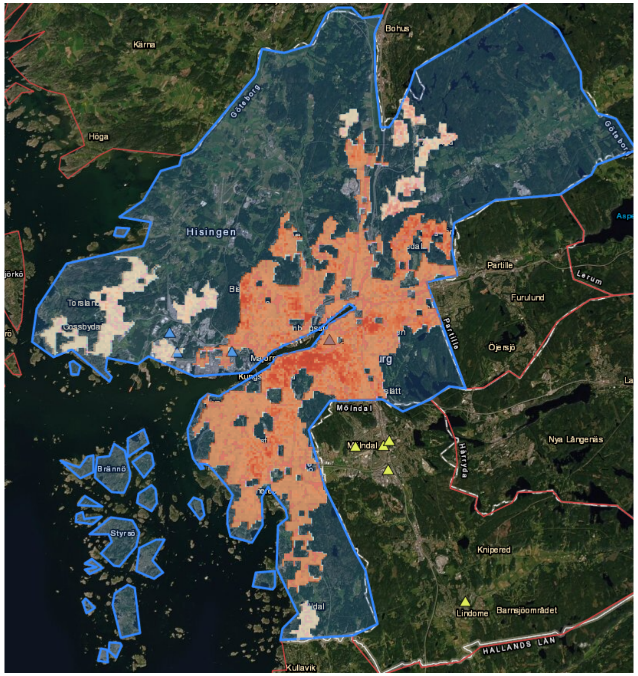
# Method (I/II)

1. Mapping areas with district heating potential

Cells ≥ 50 TJ/km²




2. Generation of networks to transport excess heat

   a. Create minimum spanning tree

   b. Cut edges (maximus distance)

   c. Calculate flow

   d. Calculate investments and costs

   e. Optimize the network





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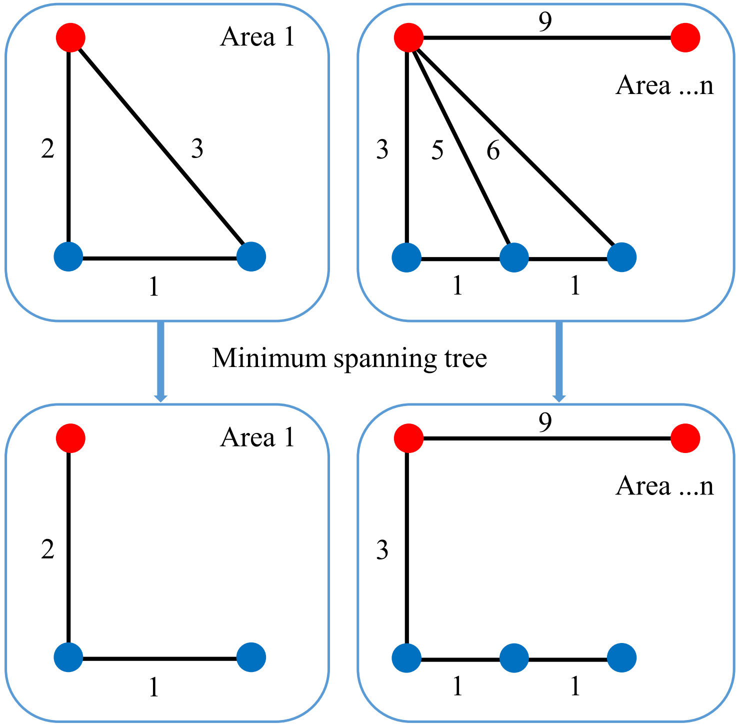
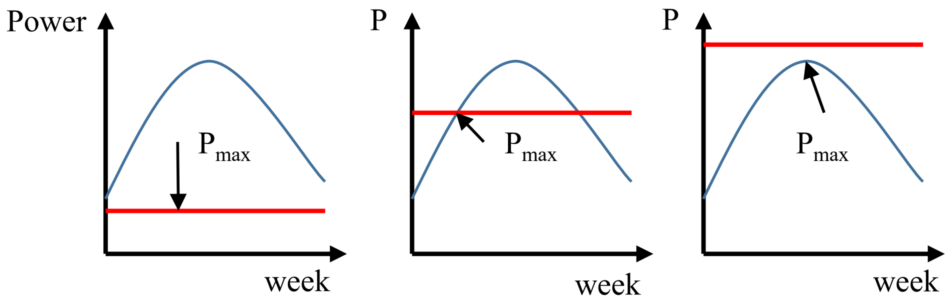
# Method (II/II)

## 2.a & 2.b




## 2.c




## 2.d & e

d: Pumps, Pipes, Heat Exchangers

e: maximum ratio of cost to heat transport per pipeline
($CH_{max}$ → threshold → ct./kWh)
vary until all pipelins ≤ $CH_{max}$)



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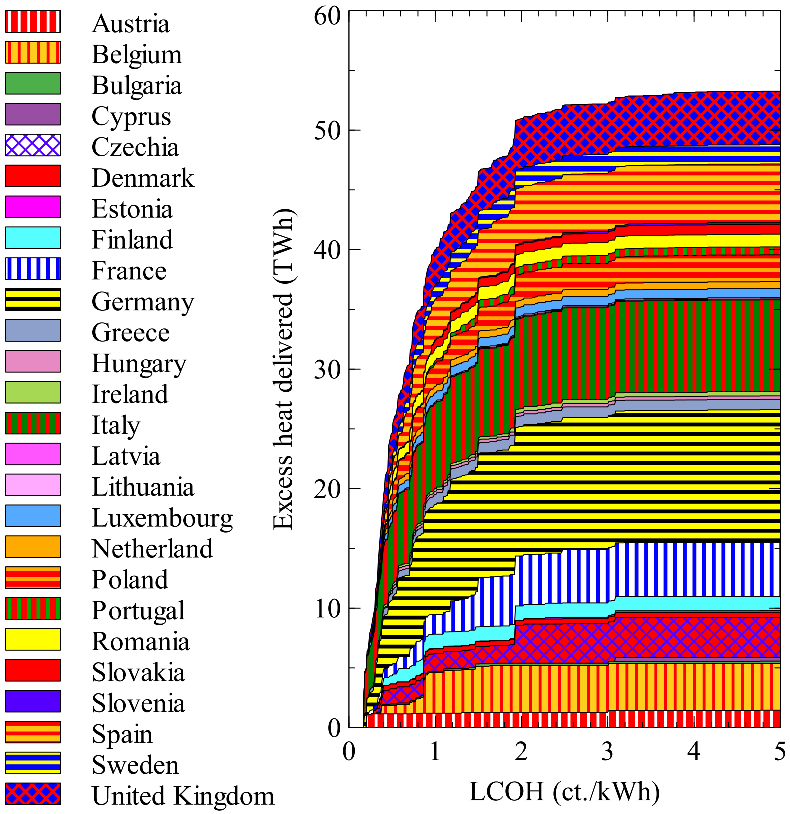
# Results (I/I)




Values

- 0.75 ct./kWh → 34 TWh → 36%
- 1.5 ct./kWh → 46 TWh → 49%
- 2.0 ct./kWh → 51 TWh → 54%.
- 5 ct./kWh → 53 TWh → 57%.
- After that, no increase → heat losses



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# Discussion and Conclusion

- No optimization
- Specific costs: uncertainty
- Comparatively little excess heat: 94 TWh
  - → Persson et al. (2014): 398 TWh
  - → Papapetrou et al. (2018): 304 TWh
- No real distribution of existing district heating networks

→ 50% of the excess heat for transport costs for up to 1.5 ct./kWh

# THANK YOU FOR LISTENING