

# High-resolution transformation strategies towards carbon-free heat supply in German municipalities

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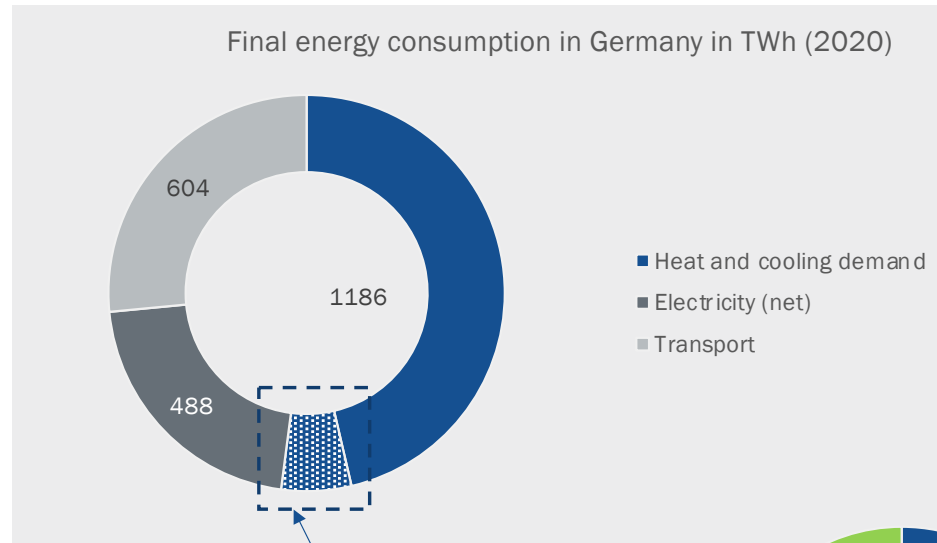
Hyères | 07/06/2022

# Heating and cooling in Marseille: efficient or inefficient?





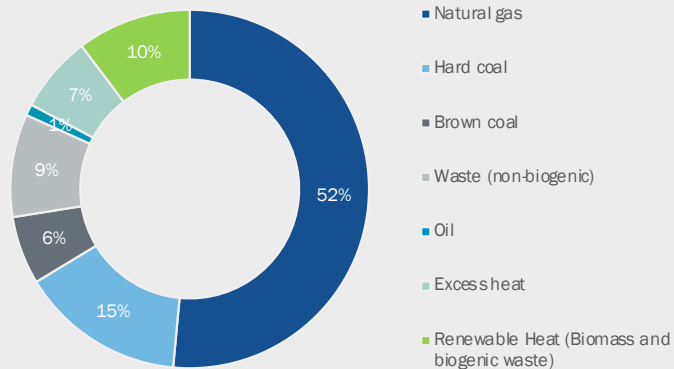
# Motivation



District Heating

- Heat and cooling demand
- Electricity (net)
- Transport

- Around 50 % of end energy in Germany = heat energy, with only 15 % share of renewable energies
- District heating:
  - Around 10 % of heat production
  - 55 % dependency on Russian Import



- Natural gas
- Hard coal
- Brown coal
- Waste (non-biogenic)
- Oil
- Excess heat
- Renewable Heat (Biomass and biogenic waste)

High-resolution transformation strategies towards **carbon-free heat supply** in German municipalities

Source: BDEW Jahresbericht 2021

# Data and Methodology

## Procedure

### I. Potential Analysis

- Heat demand
- District heating potential
- Supply potentials: Industrial excess heat, deep geothermal energy, other renewables etc.

### II. Heat supply scenarios

### III. Cost-benefit analysis (CBA)

- LCOH
- GHG-emissions

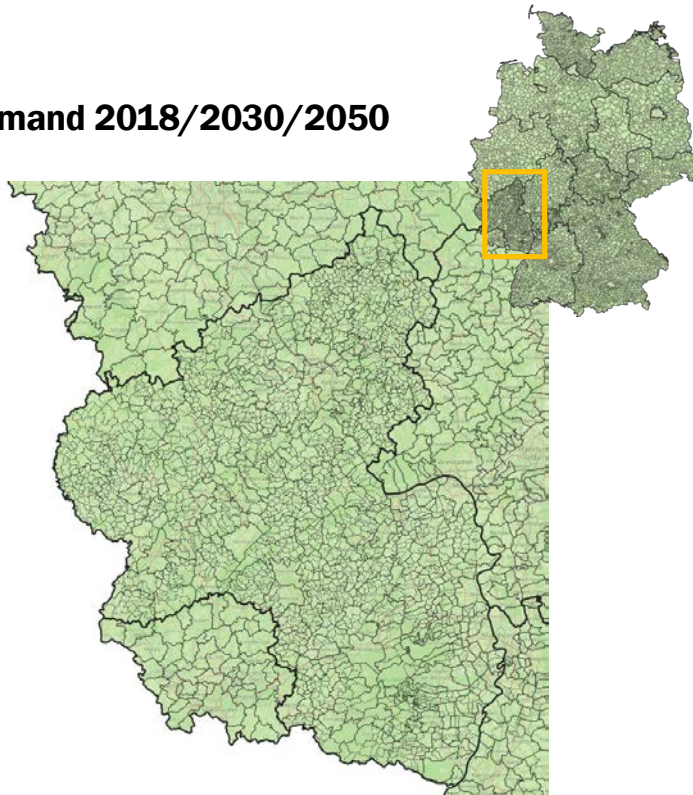
## Data source

- Energy demand based on NECP
- Potentials mainly based on EU-Hotmaps
- Disaggregation on municipality level (NUTS 3)
- Excess heat potentials from BimschV (Federal Emission Act)

# Potential analysis: Heat-Maps (GIS)

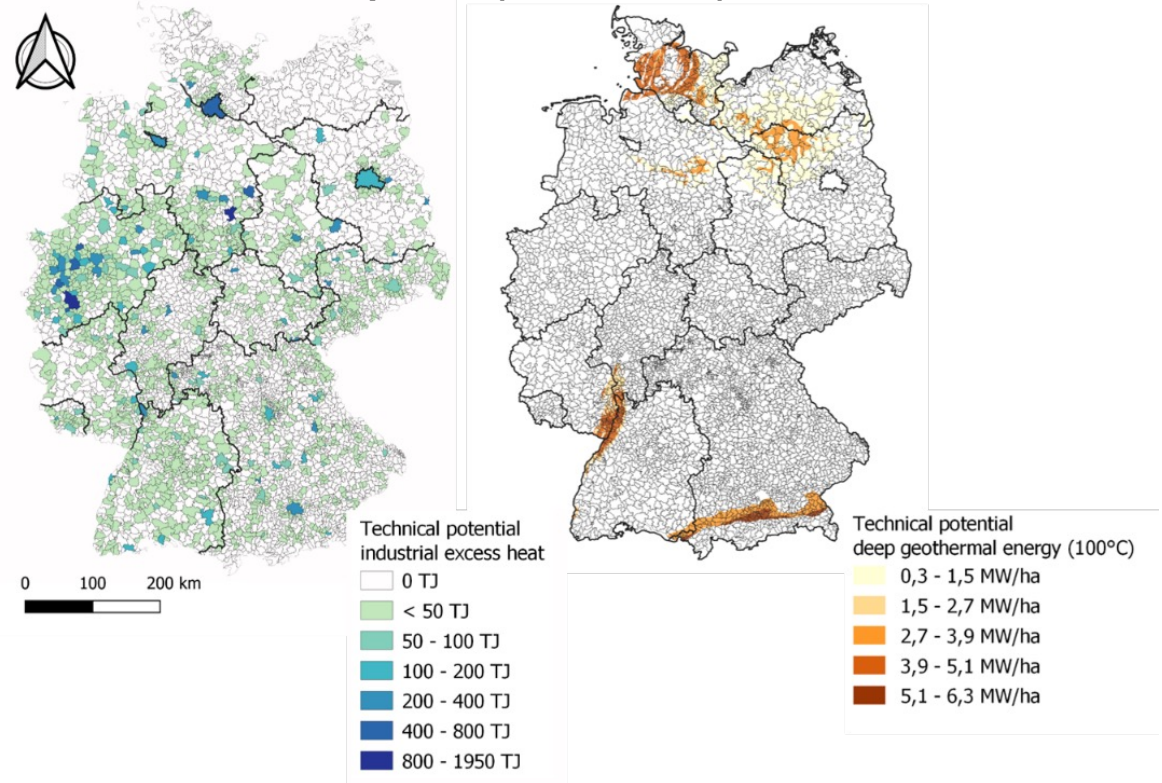
Reduced maps makes an initial and quick REHP-assessment for municipalities possible

Heat demand 2018/2030/2050



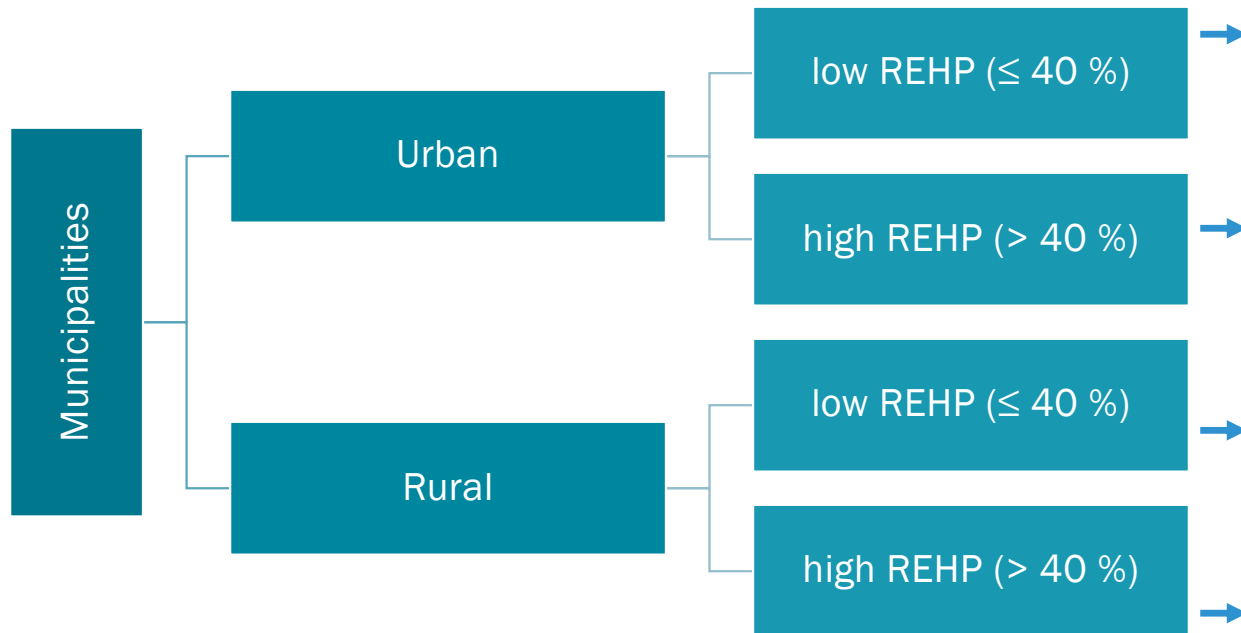
Source: Bundesamt für  
Kartographie und Geodäsie

REHP-Potentials for each “associated”  
municipalities (4670, NUTS3)



# Clustering and district heating potentials

**REHP = Renewable and Excess Heat Potentials**



Results	
Number of municipalities	District heating potential [TWh]
506	98
240	27
678	9
216	3
$\Sigma = 1640$	$\Sigma = 137$

# Urban vs. rural: from theoretical potentials to heat supply

**More potentials could be used, especially in rural areas**

	urban	rural		urban	rural		
Industrial excess heat [GW]	<div><div></div></div>	5	0	Industrial excess heat [GW]	<div><div>66%</div></div>	<div><div>79%</div></div>	
Deep geothermal [GW]	<div><div></div></div>	9	<div><div></div></div>	14	Deep geothermal [GW]	<div><div>14%</div></div>	<div><div>3%</div></div>
Solar thermal [GW]	<div><div></div></div>	25	<div><div></div></div>	14	Solar thermal [GW]	<div><div>19%</div></div>	<div><div>9%</div></div>
Waste incineration [GW]	<div><div></div></div>	5	<div><div></div></div>	1	Waste incineration [GW]	<div><div>51%</div></div>	<div><div>63%</div></div>
Excess heat from surface water [GW]	<div><div></div></div>	2	<div><div></div></div>	2	Large heat pumps [GW]	<div><div>25%</div></div>	<div><div>35%</div></div>
Wastewater treatment plants [GW]	<div><div></div></div>	5	<div><div></div></div>	1			
Total*	Σ = 50		Σ = 32				

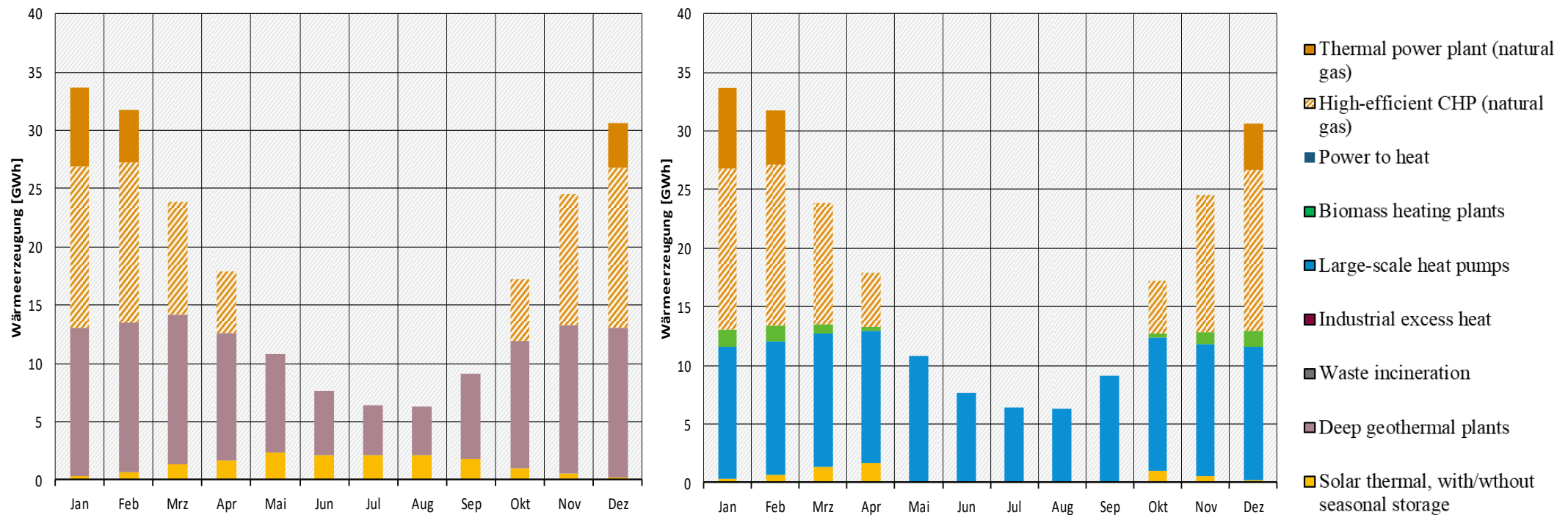
Depending on:

- Local heat demand / seasonality / distance
- Feed-in priority
- Technical conditions (power, temperature, full load hours)

\* locally available potentials

# Heat supply scenarios

The optimal heat supply scenario was determined for each municipality

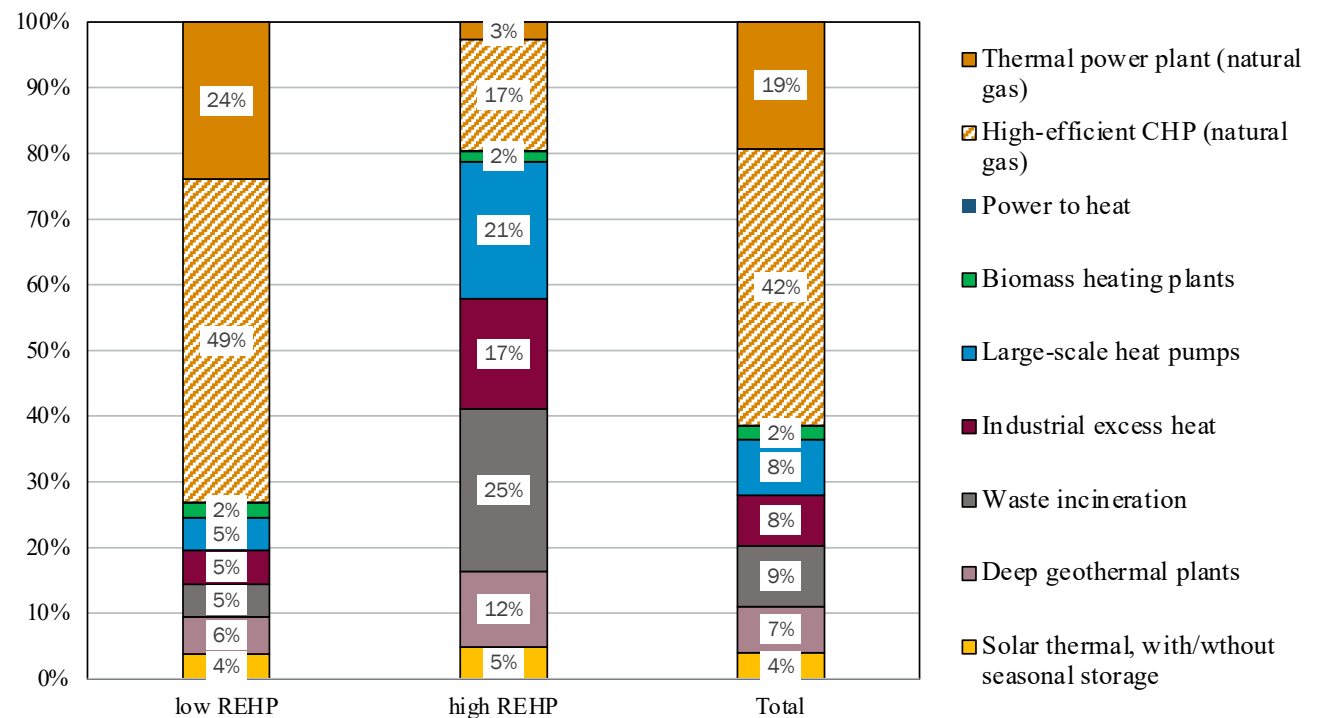




# Heat supply scenarios

- 30% of the municipalities have high REH potentials
- These reach in average a share of 80% EE & excess heat
- EED target of 40% in 2030 is reached
- Municipalities with low local REHP can use more locally independent sources

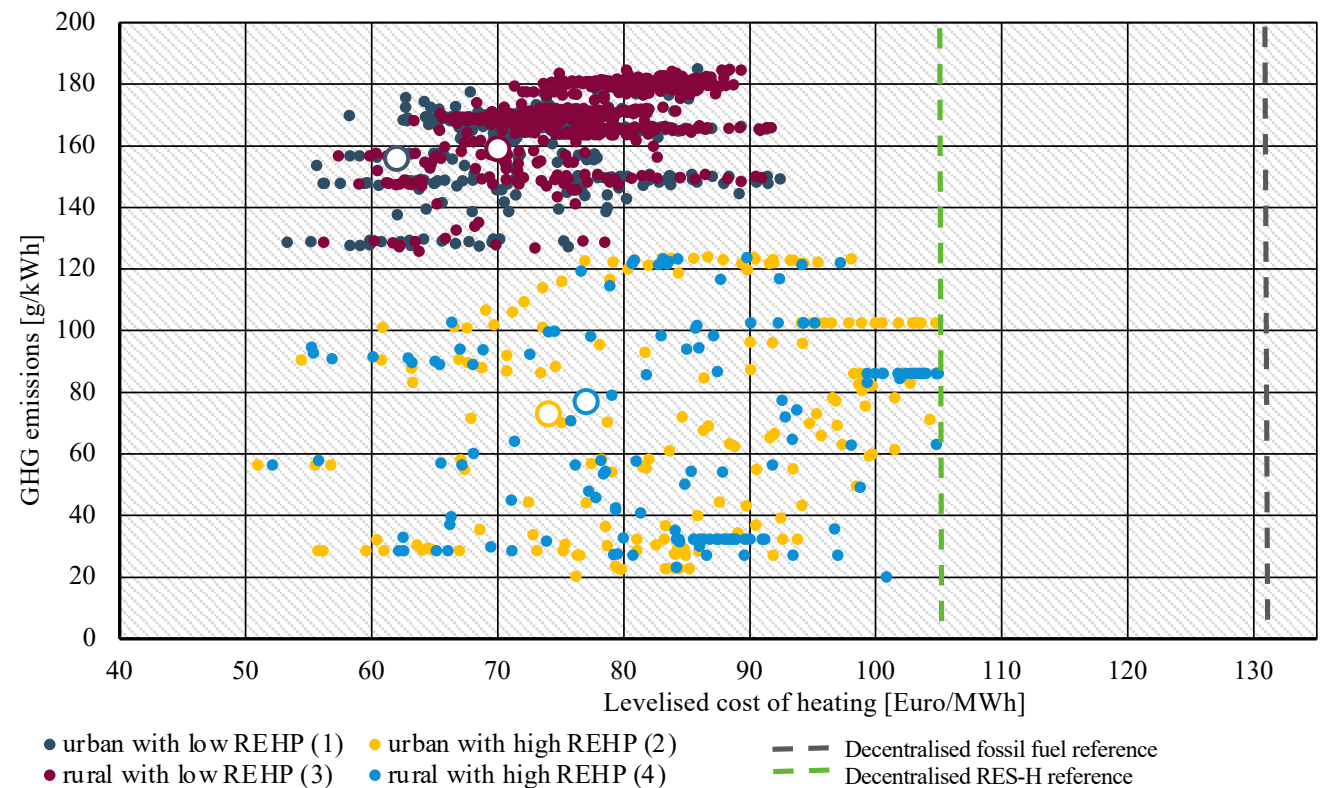
## Low vs. high potential communities



# Cost-benefit analysis

- Average LCOH average is 62 to 77 €/MWh
- Municipalities with high REHP reach low GHG emissions
- All municipalities that are suitable for district heating have lower LCOH than decentralized options

## LCOH and GHG emissions



## Relevance for policy making

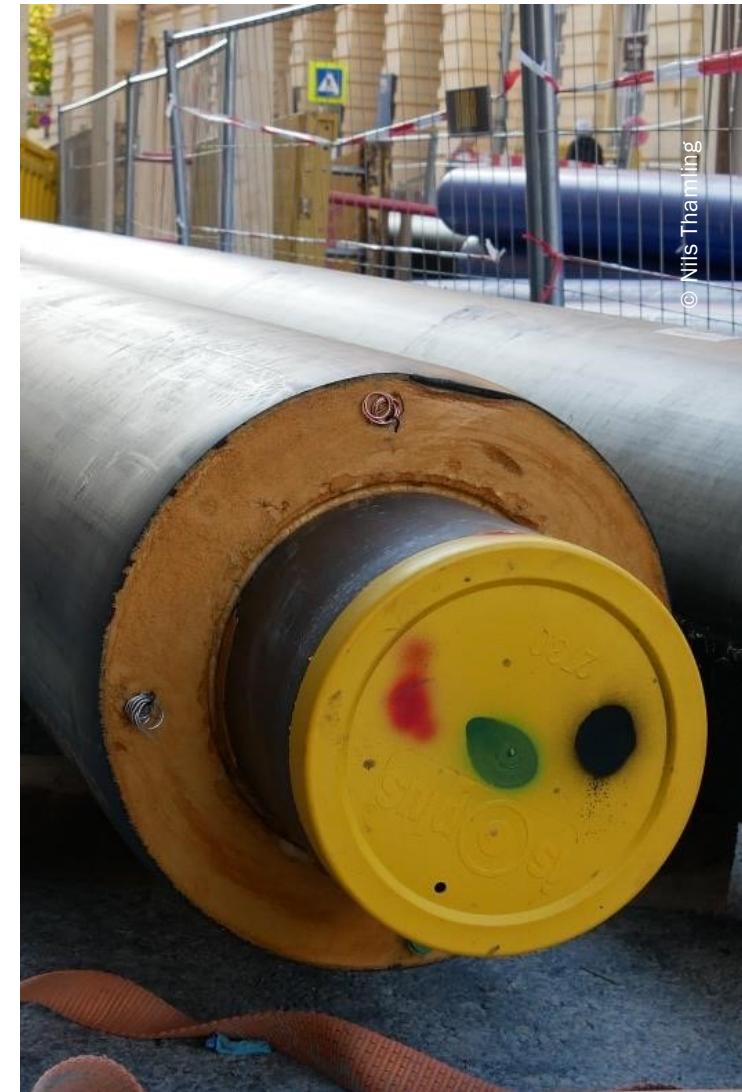
- The availability of local potentials varies greatly among municipalities
- Some reach a REH share of 25-30 % in average, others reach more than 80 %
- Small-scale analysis at municipality is necessary, → “municipal heat plans”

	Number of municipalities	Share of REH
Urban	506	24%
	240	89%
Rural	678	23%
	216	92%

High-resolution **transformation strategies** towards carbon-free heat supply in German **municipalities**

## In a nutshell

- The EED target of 40 % renewable and excess heat in 2030 on the overall heat supply in German municipalities can be reached
- Spatially available renewable and excess heat play a major role and varies greatly among municipalities
- District heating options have lower LCOH than decentralized options
- Small-scale analysis and local transformation strategies are necessary





# Questions?

Glad to tell you  
more 😊



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