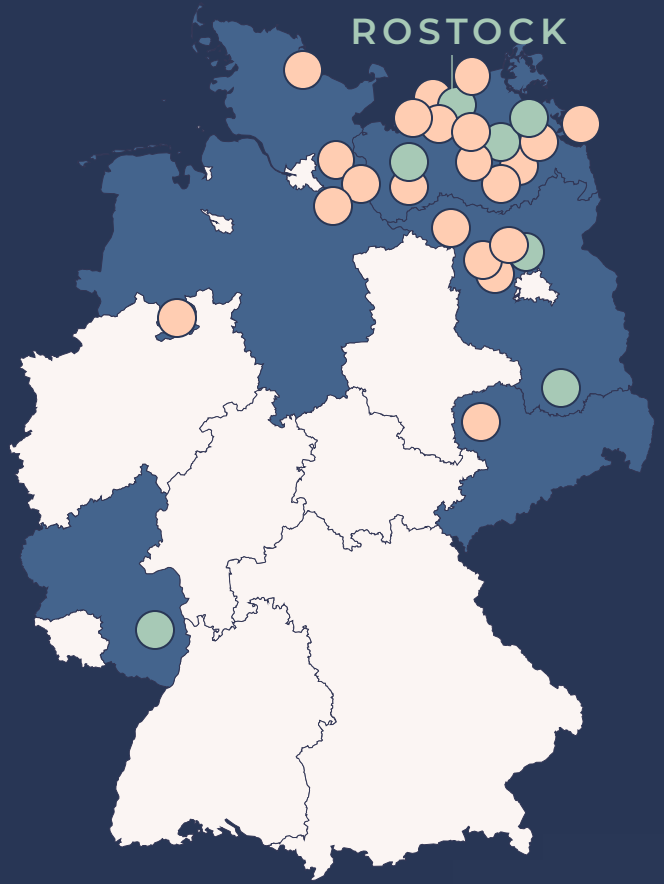
THETA
CONCEPTS GMBH

SESSION I : INTRODUCTION TO GERMANY'S HEATING PLANNING ACT – A PATHWAY FOR ONTARIO?

TORONTO | MARCH 20, 2025

AGENDA

1. Greetings / Introduction
2. Vision – climate neutral by 2045 / 2050
3. Introduction to heating planning
4. Conclusions



THETA – ENGINEERS, SPECIALIZED IN HEATING PLANNING

2022	Founding in late 2022 after accomplishing Rostock's heating planning
> 30	More than 30 projects in municipalities ranging from 1,400 to 610,000 inhabitants
1,4 M.	Involved into heating planning for more than 1,4 million people
4,230	4,230 km² project area (~ 7 times Toronto)

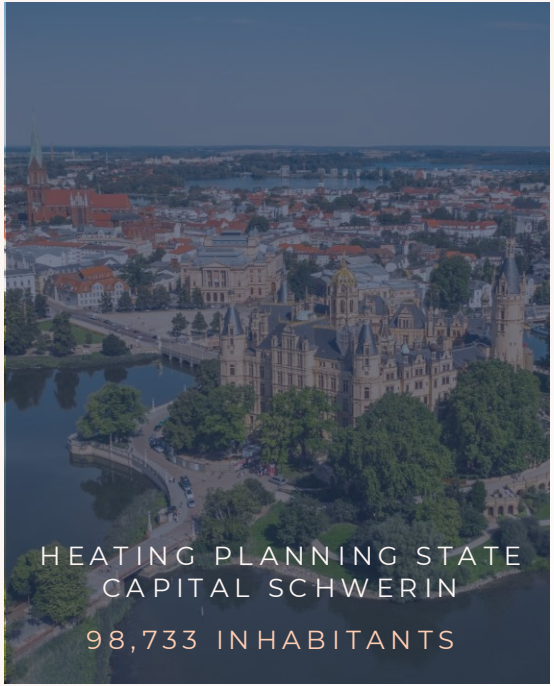

HEATING PLANNING
ROSTOCK
209,920 INHABITANTS


HEATING PLANNING
LEIPZIG
608,013 INHABITANTS


HEATING PLANNING
NEUSTADT
53,148 INHABITANTS


HEATING PLANNING AND
DISTRICT HEATING
TRANSFORMATION
NEUBRANDENBURG
63,989 INHABITANTS


HEATING PLANNING AND
DISTRICT HEATING
TRANSFORMATION
ORANIENBURG
48,492 INHABITANTS


HEATING PLANNING STATE
CAPITAL SCHWERIN
98,733 INHABITANTS

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VISION – CLIMATE NEUTRALITY IN EUROPE / GERMANY

EUROPEAN GREEN DEAL

2050

First climate-neutral continent by 2050

55 % less GHGs by 2030 compared to 1990

Climate protection as an innovation driving force (cost-efficient, affordable)

CLIMATE PROTECTION ACT

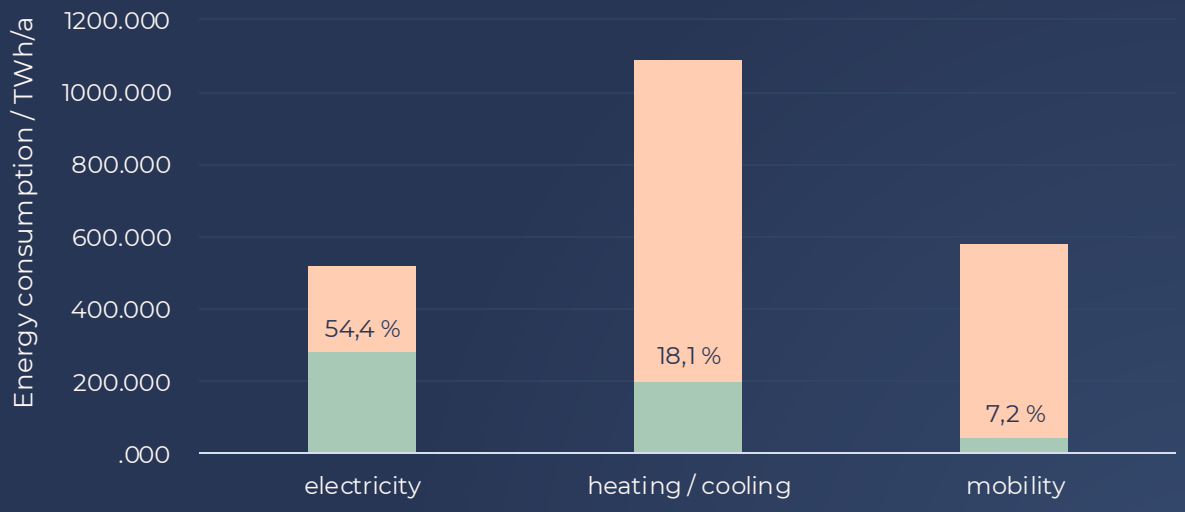
2045

Net zero by 2045

Exit nuclear and fossil energy (coal and gas) simultaneously

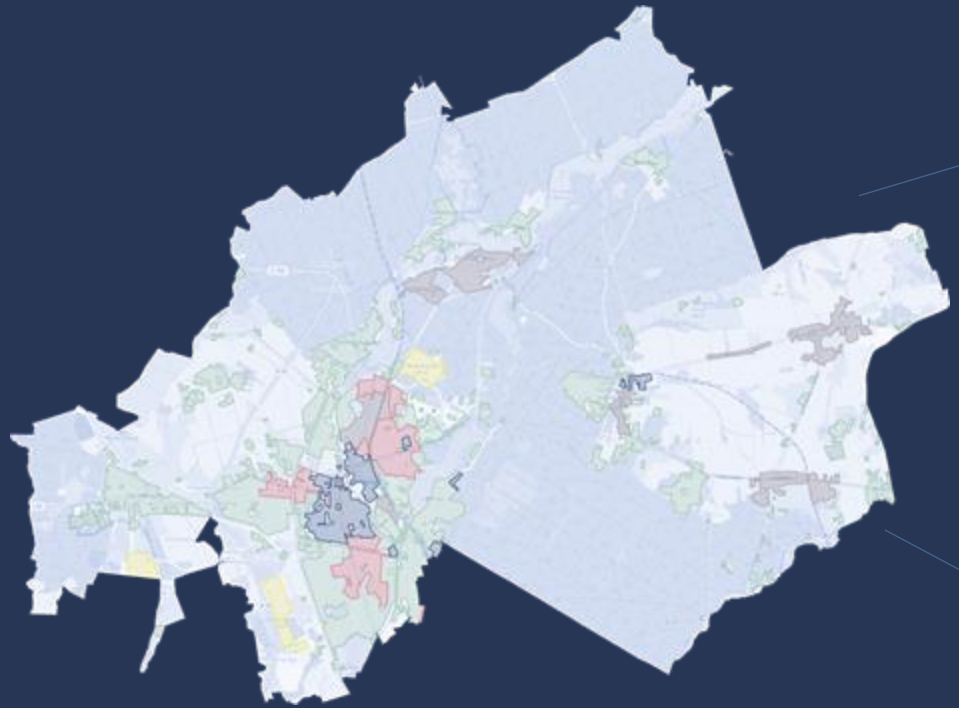
HEATING SECTOR AS DEAL BREAKER

- We made progress in terms of renewables (wind and solar)…
- Heating is the deal breaker with the largest energy consumption and a low share of renewables (mainly natural gas)
- Heating can’t be solved by wind and solar only
- Heating is a local problem in regional responsibility
- Search for local potentials



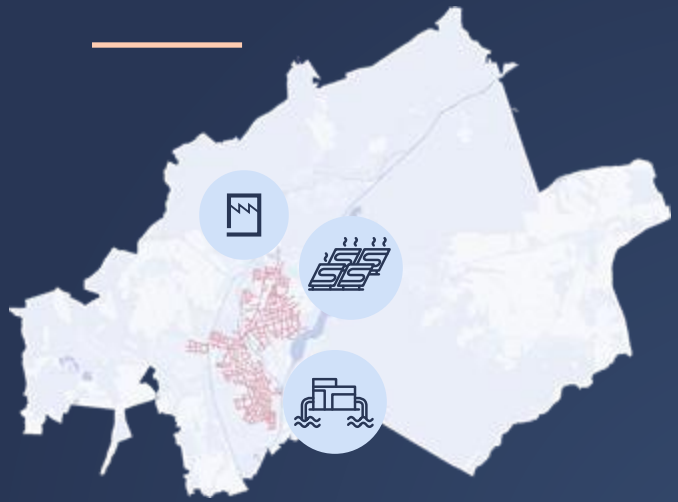
Quelle: BMWK (2024)

TARGETING THE HEATING SECTOR



HEATING PLANNING ACT

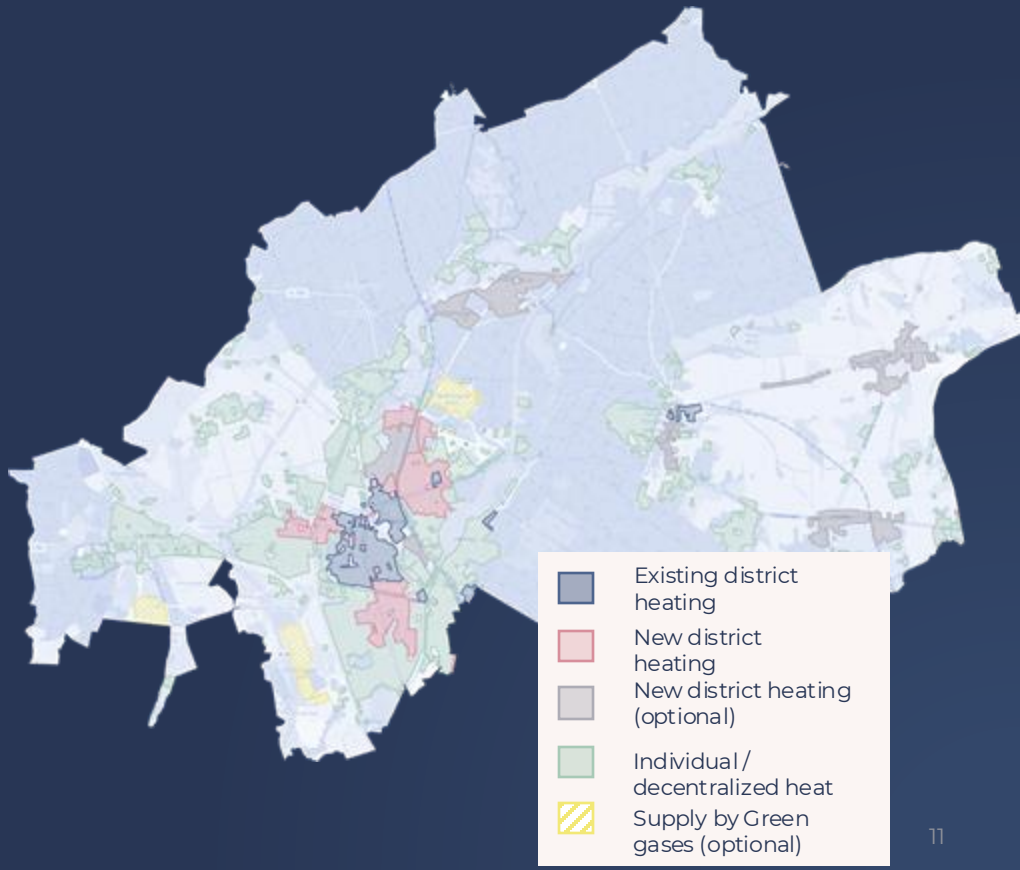
BUILDING ENERGY ACT



DISTRICT HEATING EXPANSION

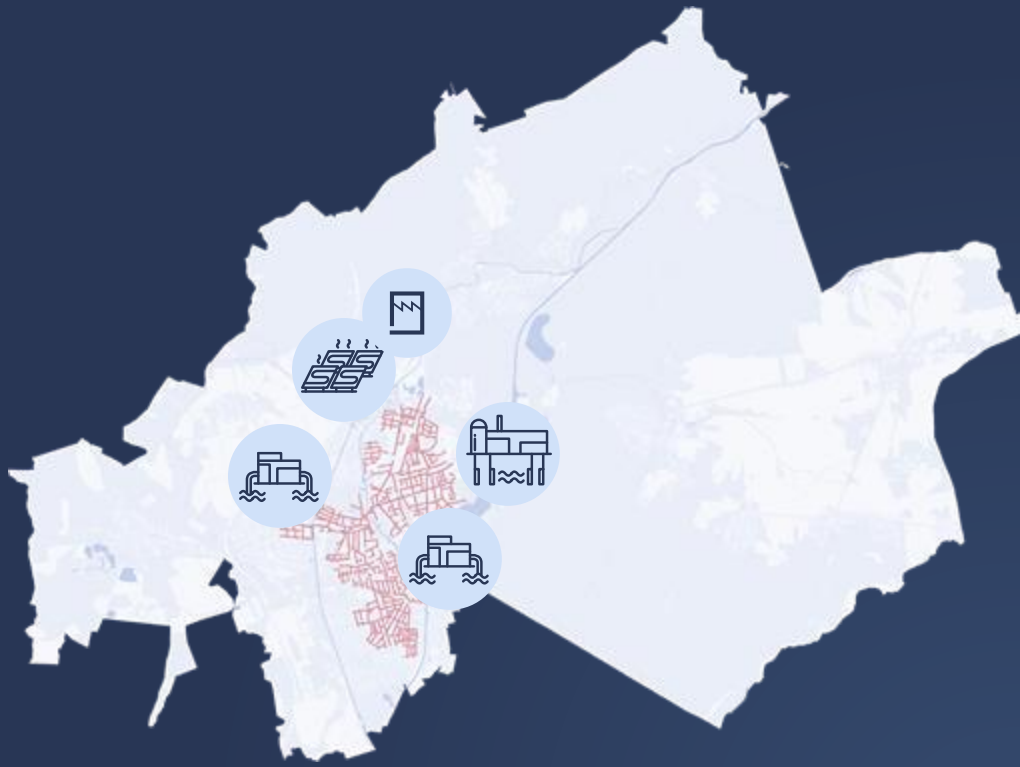
HEATING PLANNING ACT

- Independent concept to reorganize the regional heat supply towards climate neutral technologies
- A concept that is to be implemented as it has been developed
  - Finding the best suited heating approach (technically and economically)
  - Mandatory for 10,780 municipalities by federal law since 2024
  - Funded up to 100 % by federal republic or state (80 % in average)
  - Pricing varies from 0.84 € to 6.32 € per inhabitant (smaller relative prices for larger projects)



DISTRICT HEATING EXPANSION

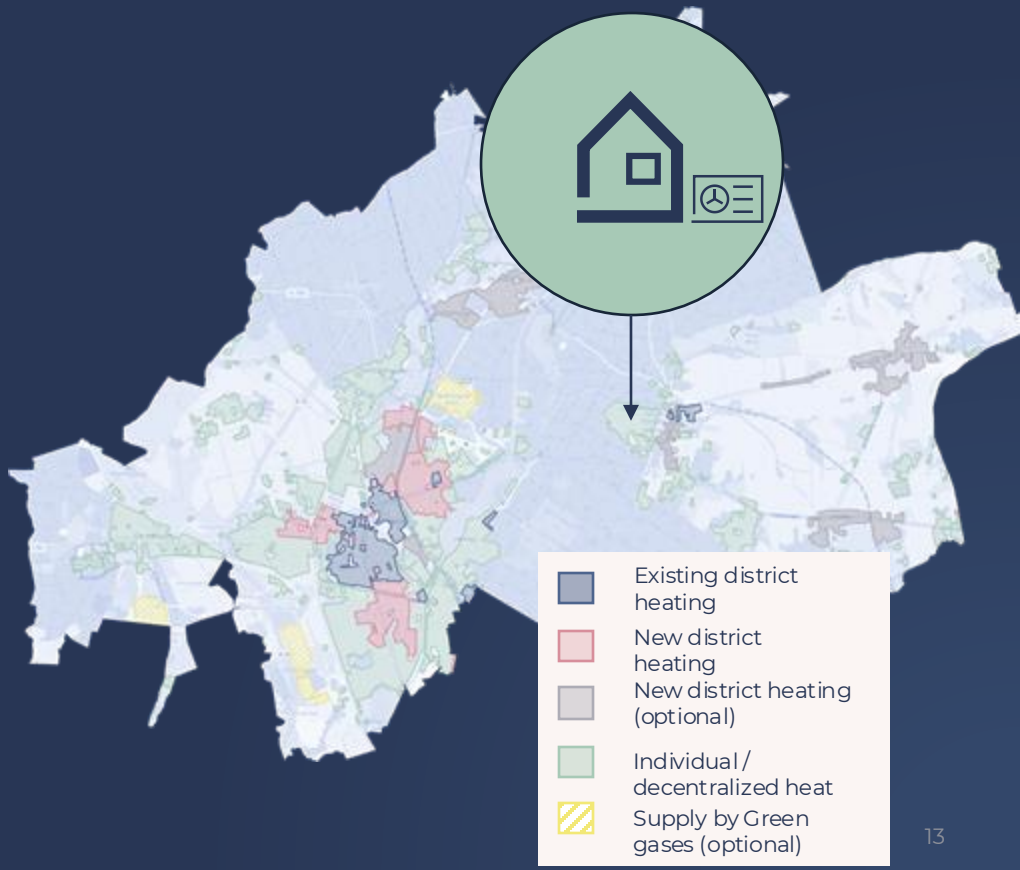
- District heating to substitute heating by gas distribution grids in densely populated areas
- Feasibility studies or transformation studies for district heating towards waste heat and renewables
  - Federal funding up to 50 %
  - Studies grant federal investment funding for district heating expansion (up to 100 m. € per proposal, 40 %)
- District heating to fulfill 30 % renewables and waste heat by 2030 (80% by 2040 and 100 % by 2045)



TARGETING THE HEATING SECTOR

BUILDING ENERGY ACT

- Regulates the exit of fossil heating on a building level
- 65 % renewables mandatory for new buildings since 2024 & existing buildings by 2028
  - Heat pumps, district heating, biomass, green gases valid (hybrid systems as intermediates)
- 100 % renewables for space heating and warm water by 2045
- Heating change and funding on demand, when existing heating fails irreversibly



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INTRODUCTION TO HEATING PLANNING

Stakeholder analysis & participation, data collection

01 | Status analysis (Status Quo)

Urban structures, heat demands, existing infrastructure, heating technologies, GHGs

02 | Analysis of potentials

Potential of energy savings by renovation, potentials of waste heat and renewables

03 | Target 2045

Concept for reliable energy supply in 2045 based von renewables and waste heat

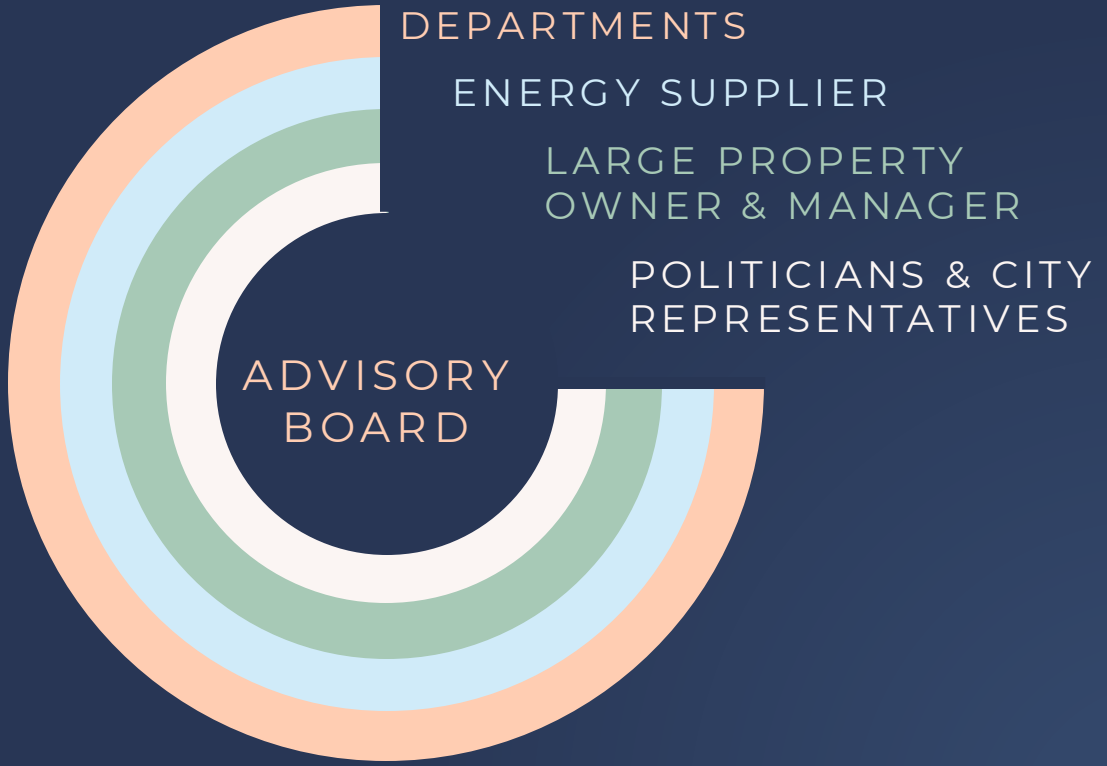
04 | Measures & obligations

Milestones, measures and obligations for stakeholders

Decision by city representatives (work has just started)

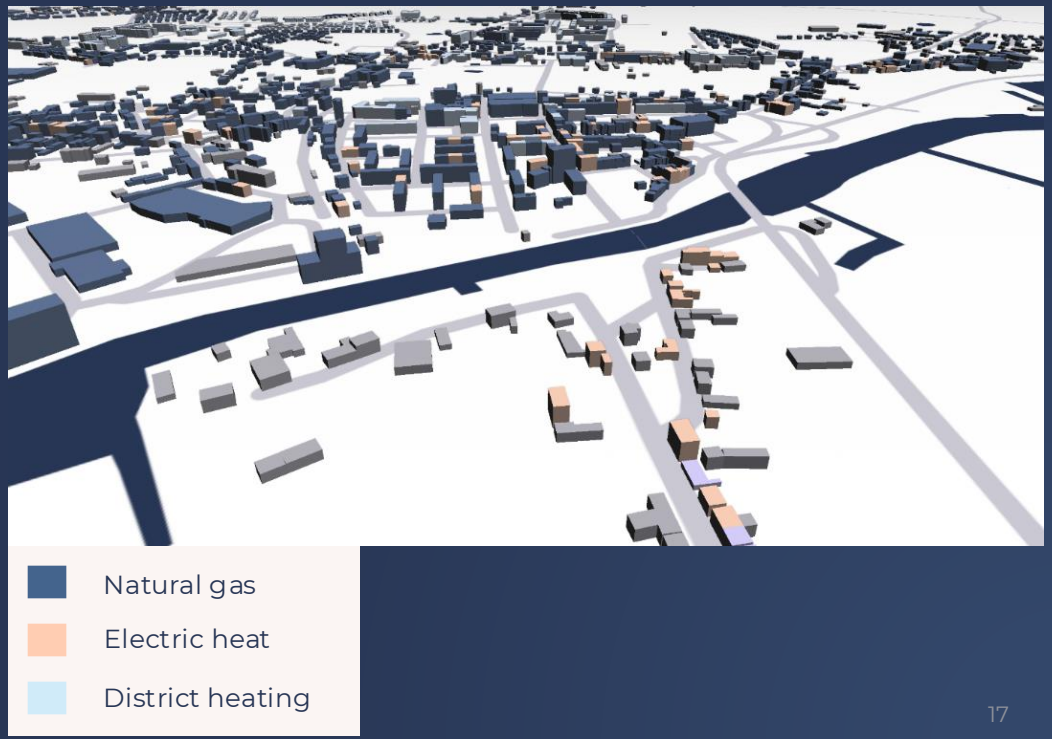
A CONSENSUAL CONCEPT

- Consensus in terms of most stakeholder's strategy is key for realization
- Early and comprising participation of central stakeholders should be aimed for (advisory board)
- Key accounts, industry, hotels, clinics to be involved on demand
- Public needs to be involved frequently (planning safety)



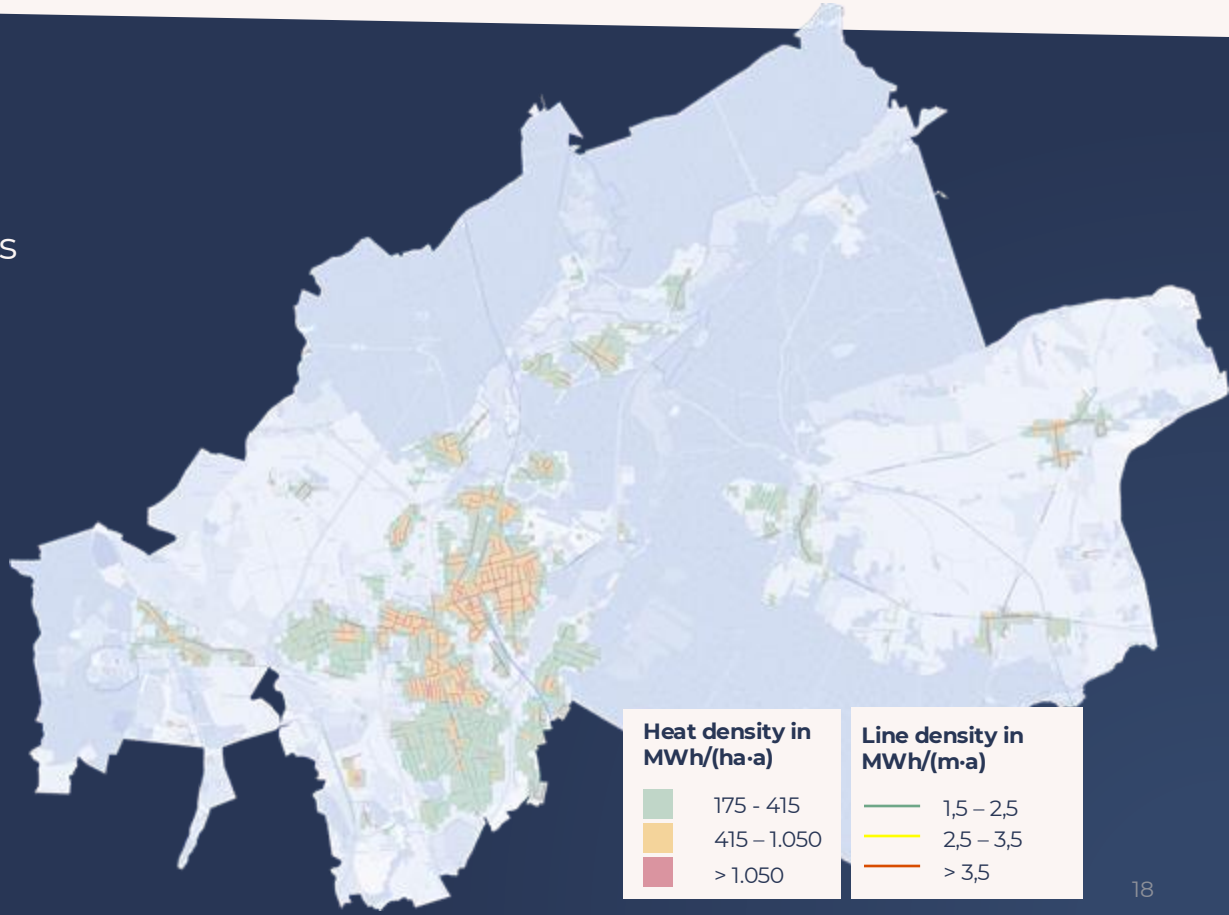
THE FIRST CHALLENGE…

- Heating planning is data driven and accessible data varies from project to project
- Exemplary Data demand:
  - GIS data of land usage, buildings, properties, airborne laser scanning…
  - Energy consumption, supply infrastructure (data from chimney sweeps)
- Data collection vs. data privacy
- Building a digital twin, based on geospatial data

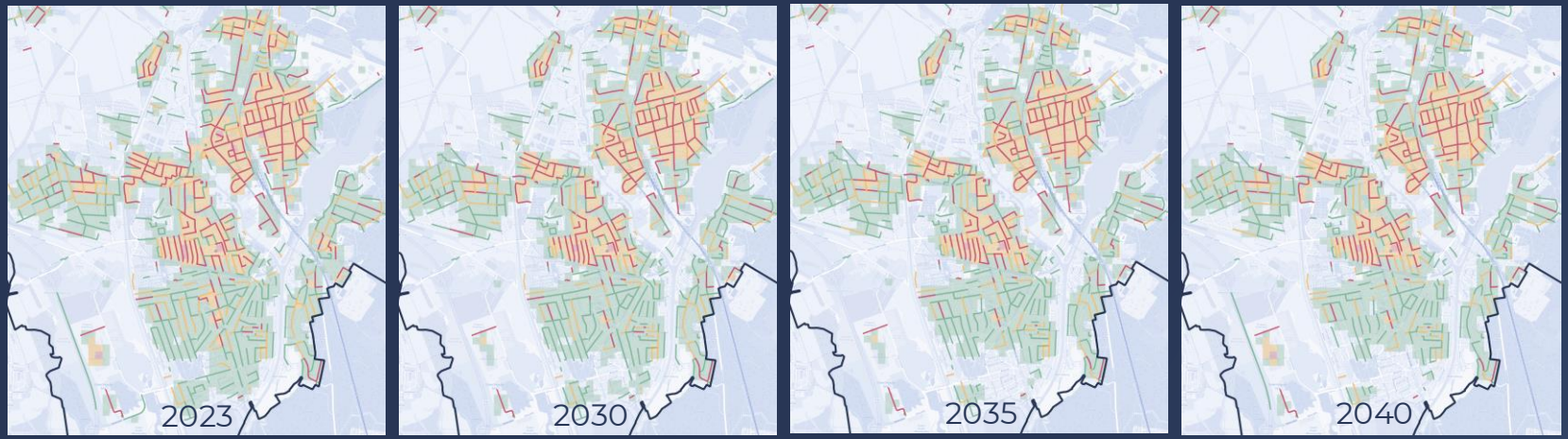


HEAT DEMAND

- Identification of blocks / quarters with high heat demand and streets with high line density
- Higher values indicating district heating suitability



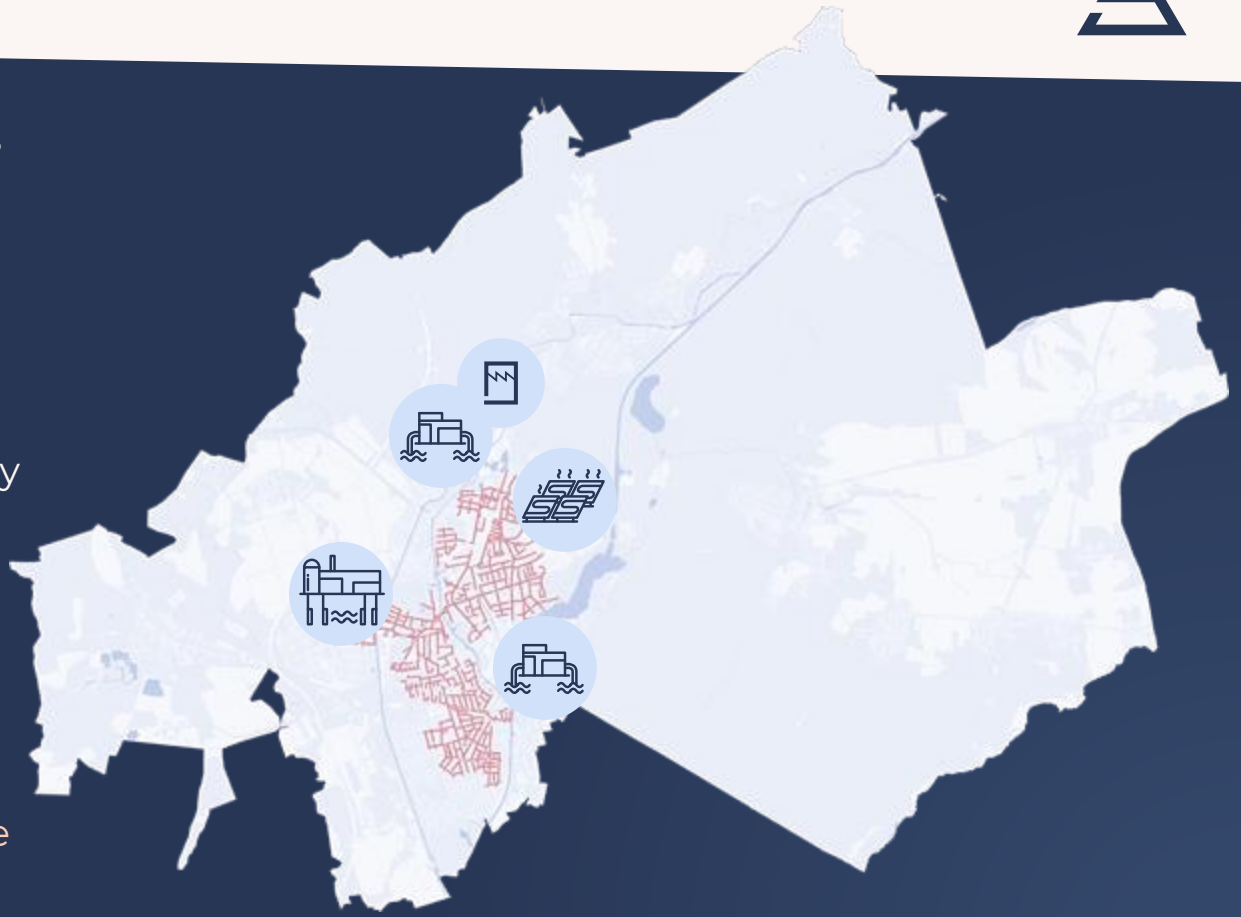
EVOLUTION OF HEAT DEMAND



- Evolution of heat demand by time due to climate change, demography, new construction, deconstruction and energetic renovation

Local potentials for networks

- Site search and potential evaluation for district heating
  - Solar thermal and geothermal energy
  - Sea and lake thermal energy
  - Waste heat potentials
  - Biomass, sewage sludge and municipal waste potential
- green gases, e.g. hydrogen, ammonia, methane for gas distribution network (minor role for buildings, often not cost-efficient)

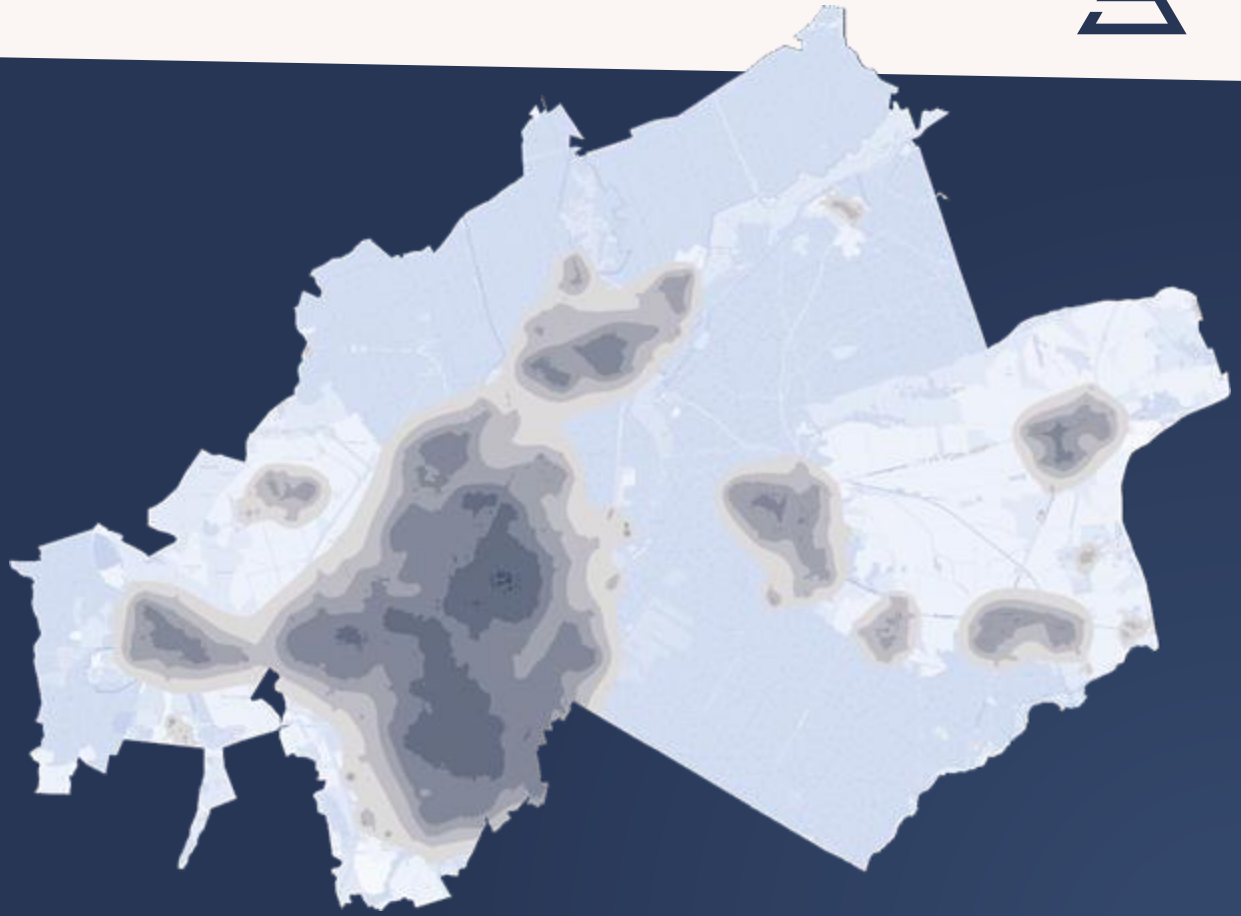


Decentralized heating

- Decentralized heating by heat pump is often a cost-efficient approach in less densely populated areas
- Heat pumps are expected to deliver up to 75 % of decentralized heat in Germany by 2045
- Area-wide evaluation for potentials for local heat pumps (air and ground)
  - Checking accessible free areas on properties
  - Determining thermal properties of the underground
  - Summarizing and mapping of data to block level

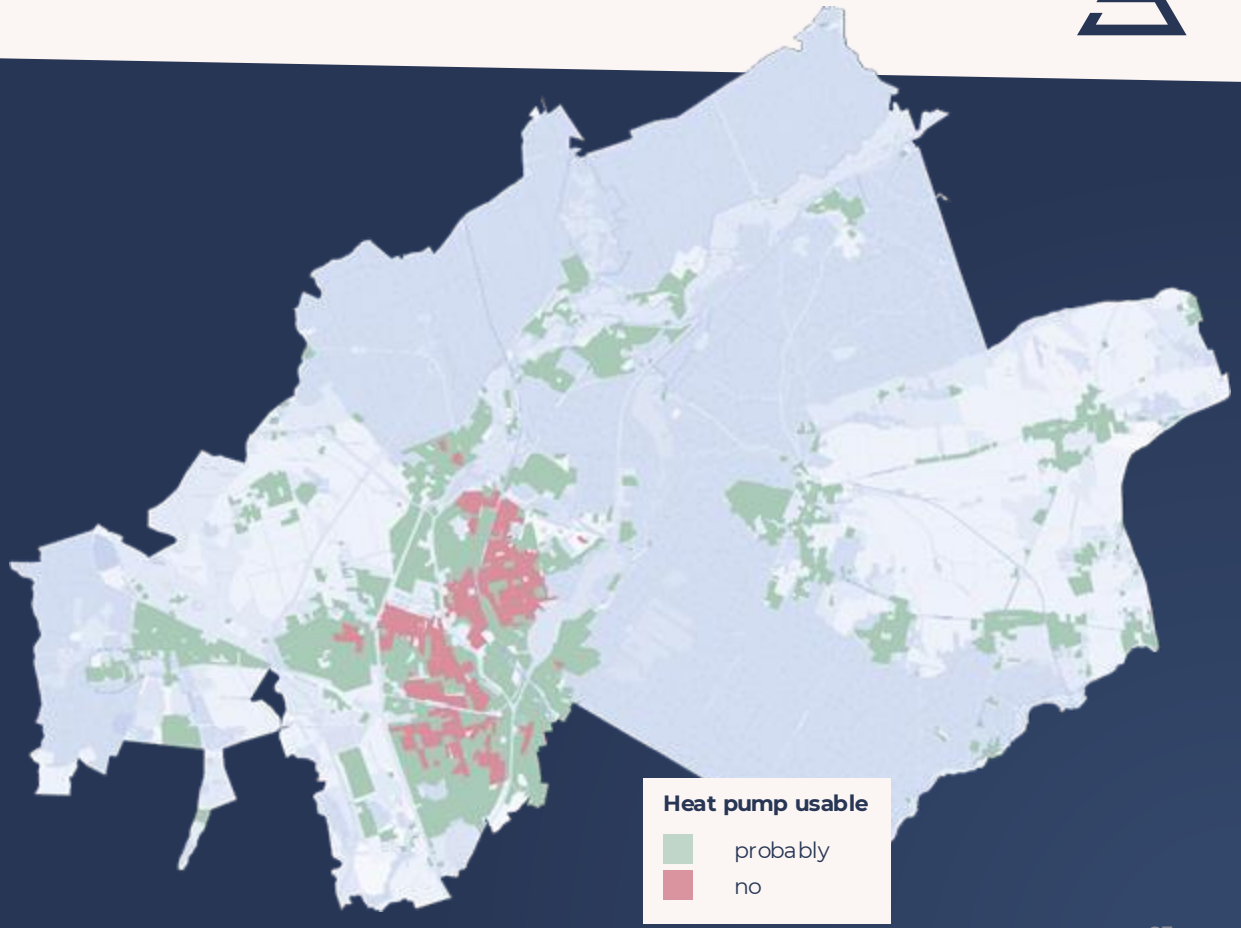
Decentralized heating

- Transition from gas boilers to heat pumps is quite a challenge
  - “new” technology
  - Functionality and economics in question
  - Reservation regarding noises limit broad acceptance
- Area-wide noise indication to prevent head wind



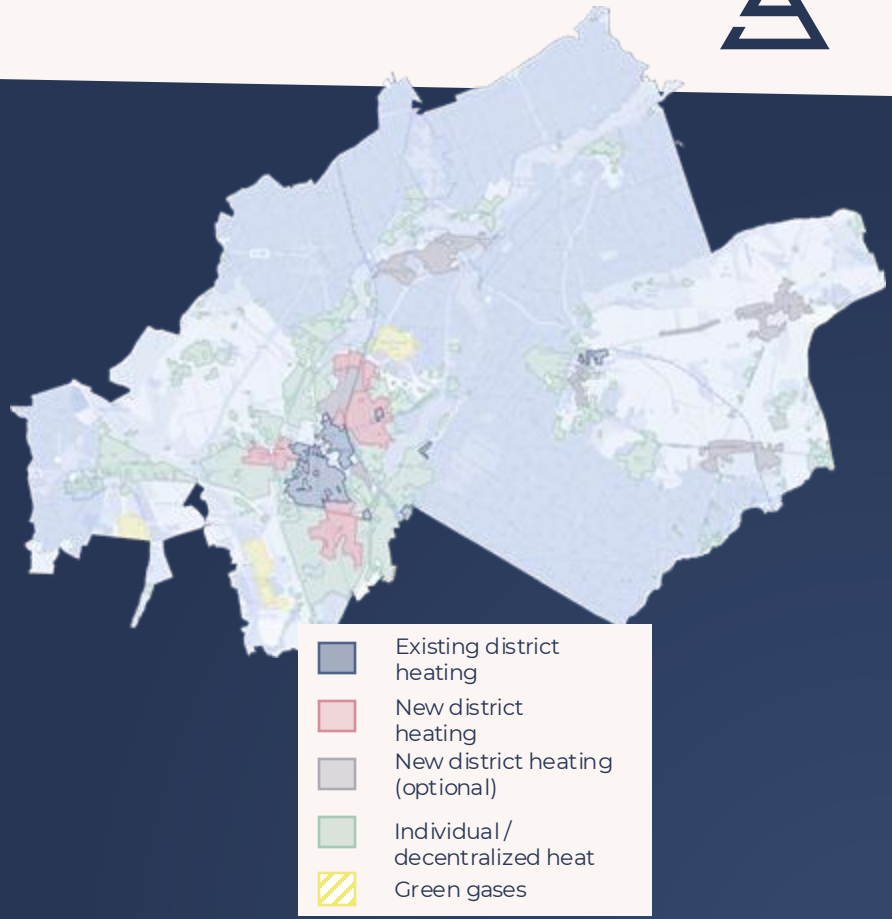
Decentralized heating

- Where are heat pumps or where is a technology mix suited for decentralized supply?



today's demand	potentials	economy
demography	energy potentials	CapEx
climate	waste heat potentials	OpEx
renovation, urban planning	district heating suitability	total costs

optimization (technically reliable and cost-efficient) in every block



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Heating planning is complex

- Transition to net zero provides various pathways
- An independent as well as (technically and economically) reliable concept is basis for necessary, controlled transition
- Mostly, there are more than enough potentials
- Electrification vs. district heating to substitute natural gas
- Transition requires central steering and incentives (economy first)
- Deriving milestones and clear measures assigned to stakeholders in order to make it happen

THANK YOU FOR YOUR ATTENTION!

ANY QUESTIONS?

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Dr. Dorian Holtz

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SESSION II: LESSONS LEARNED AND APPROACHES FOR HEATING PLANNING IN ONTARIO

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1. Best practice / lessons learned
2. Expansion of district heating
3. Key takeaways

BUILDING A DIGITAL TWIN

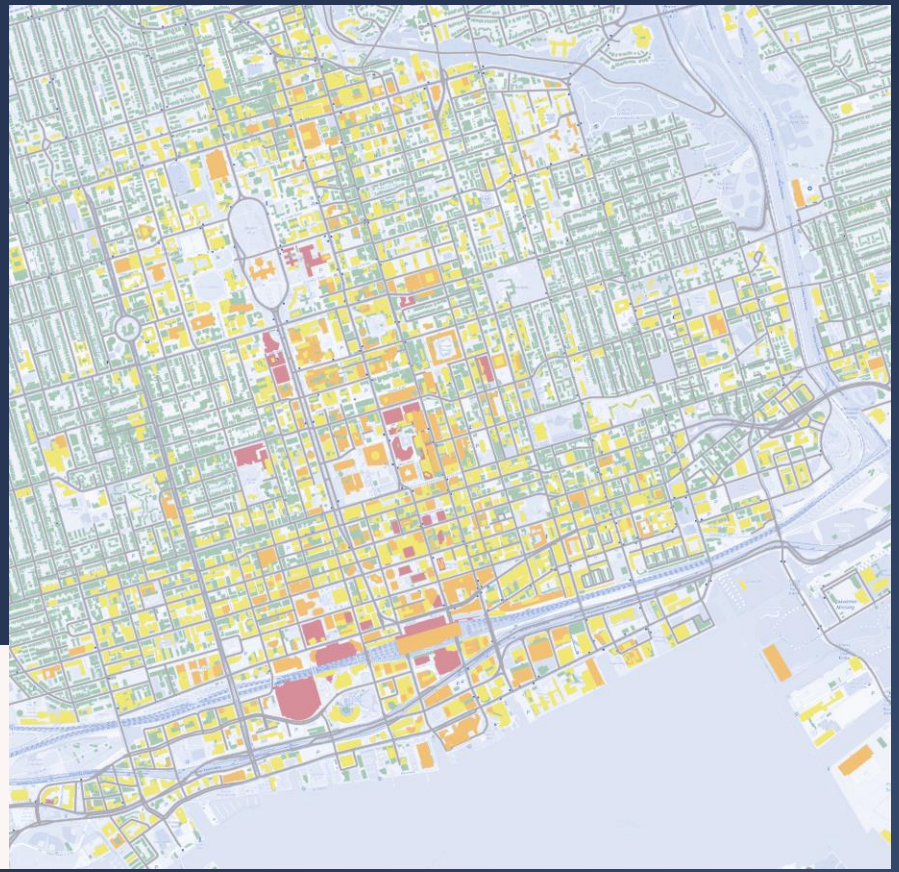
- Collecting as much data as possible
- Reliable building data is crucial
  - Use of cadastral data for information on buildings and properties (living space, plot area, year of construction)
  - Utilization of energy supplier data for heat consumption and current heating system
  - 400,000 buildings in Toronto
- Merging data to a digital twin to be maintained all over the process
- Documentation is key for long term projects

DATA HANDLING

- Data quality and accessible data vary by project
- Each municipality has its own boundary and initial conditions
- Standardization of methodology is doable and maintains the result quality
- High number of buildings requires efficient data handling to ensure efficient working

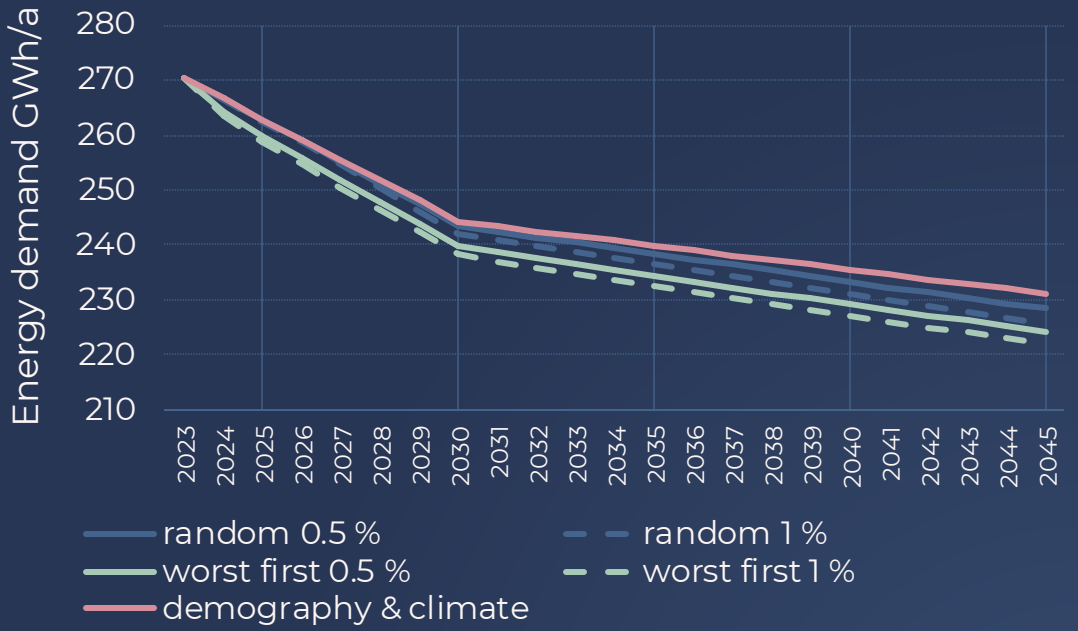
DATA HANDLING

- Heating planning normally takes 10 to 12 month (24 month for very large municipalities)
- Heating planning appears in a sequence of processes with numerous operations
  - Need for highly automated data processing in a GIS



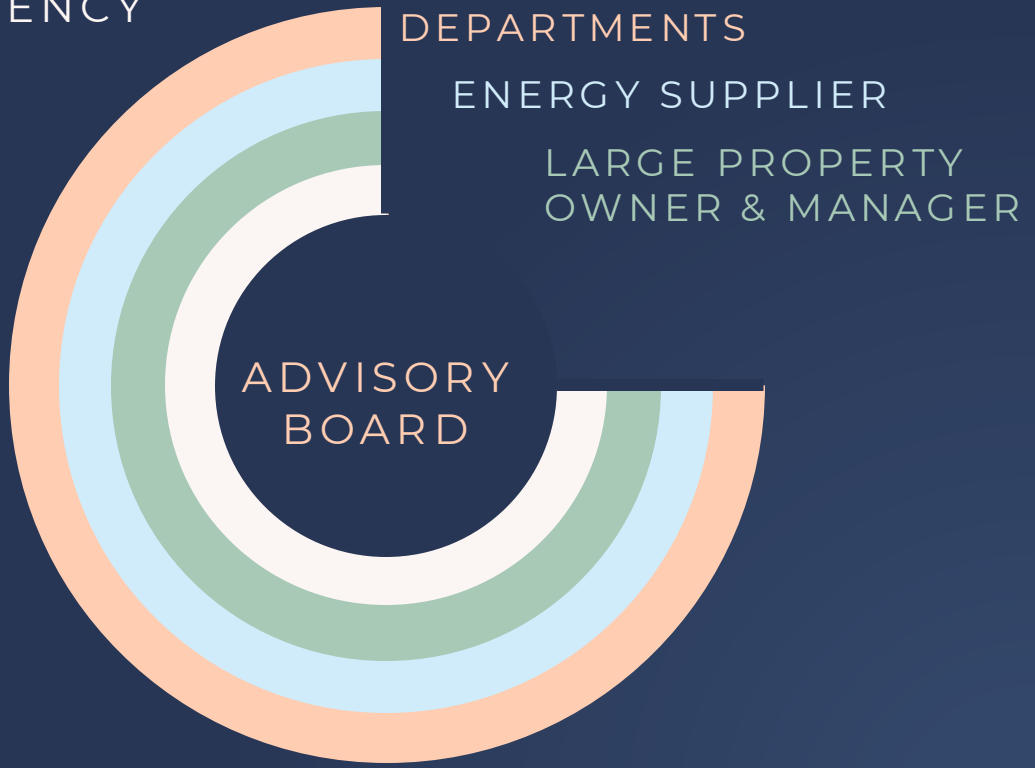
THE ROLE OF ENERGETIC RENOVATION

- Municipalities greater 45,000 inhabitants should follow efficiency first
- However, renovation is expensive
- reliable (and cost-efficient) saving potential for existing buildings is limited
- potential of new buildings is huge
- Realistic saving potential amounts to 10-20 % maximum
- Renovation rate is normally below 1-2 %/a

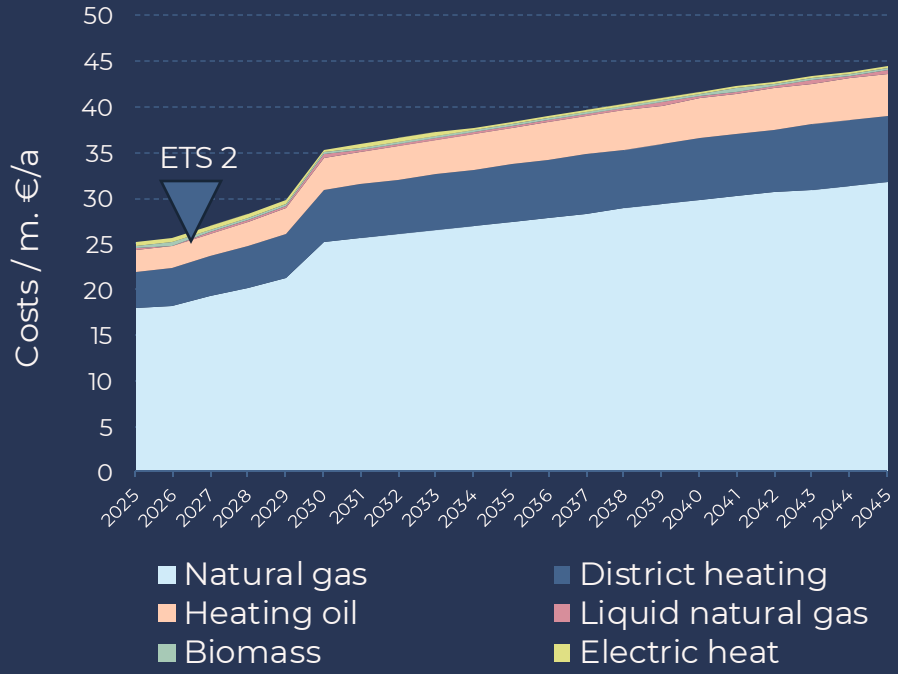


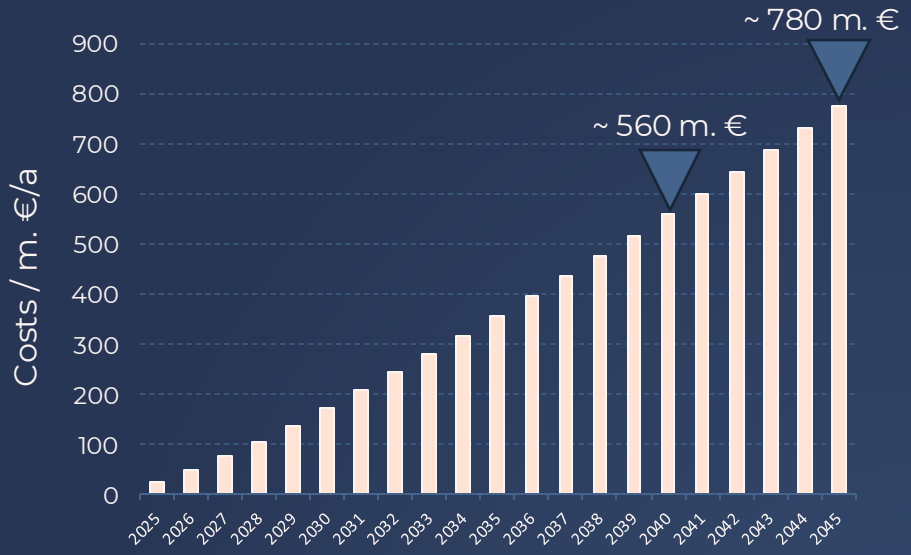
PARTICIPATION AND TRANSPARENCY OF MAJOR IMPORTANCE

- Early and frequent participation leads to acceptance, a basis for realization
- In the end, economy decides
- Different stakeholders, different business models and strategies
  - Independent heating planning supports good decision making
  - Consensus is the highest goal



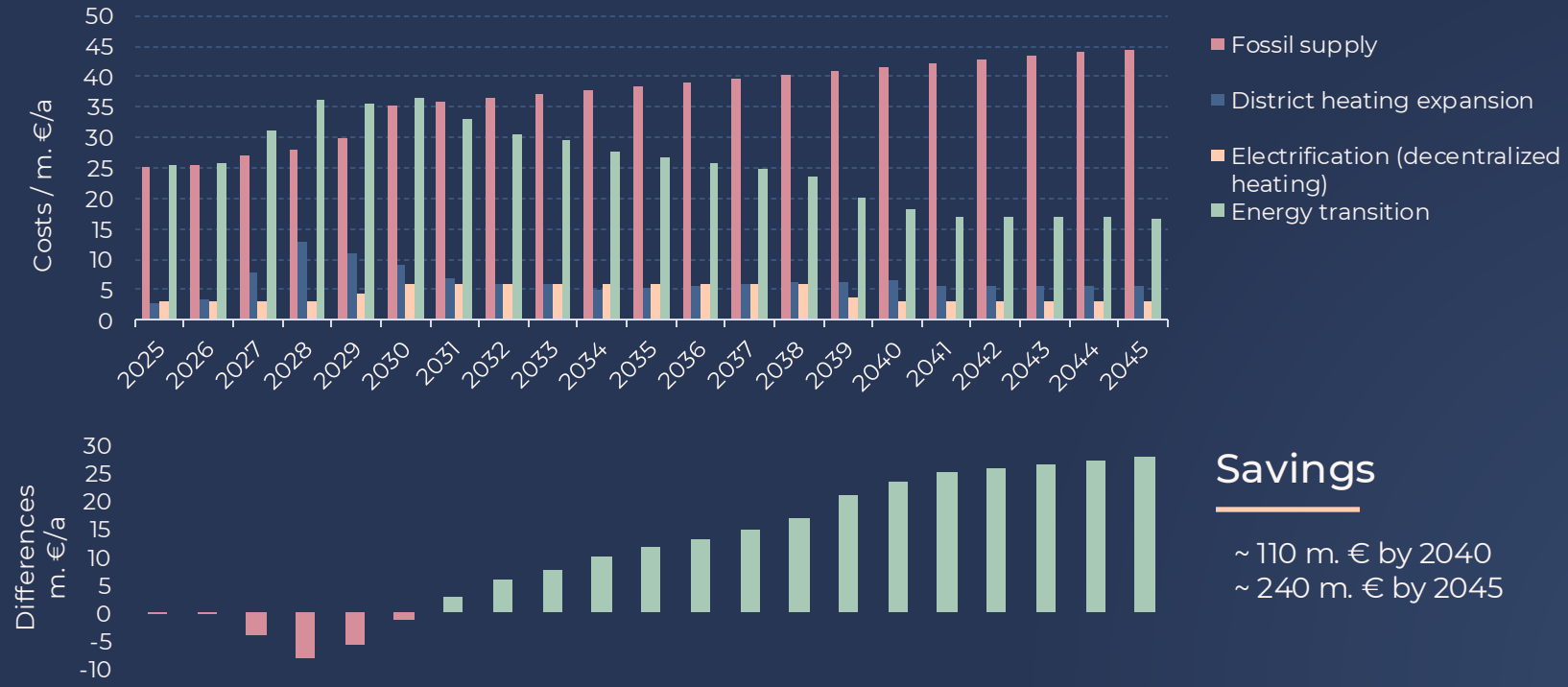
Fossil energies to become more expensive (municipality with 22,000 inhabitants)





- Mainly driven by CO_2 pricing
- Individual costs about to increase even more steep (grid charges)

Heating planning saves money in the long run



Savings

~ 110 m. € by 2040
~ 240 m. € by 2045

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NORMALLY MORE POTENTIALS THAN REQUIRED

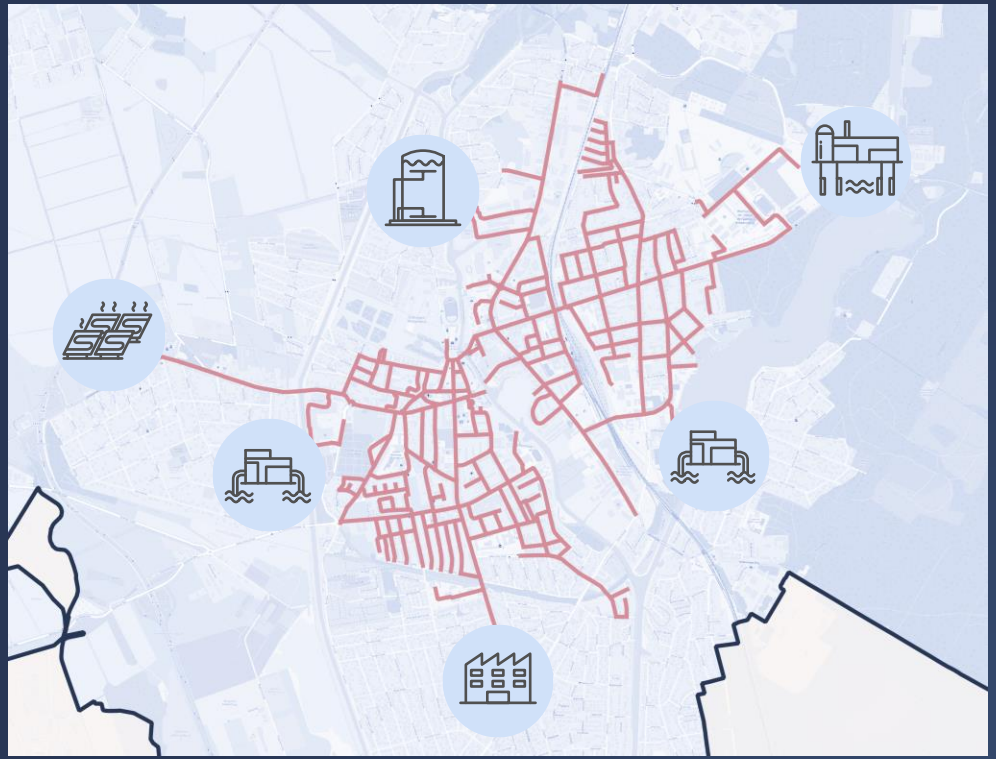
- District heating expansion comes with a shift to smaller potentials / plants
- Finding the best suited heat plant pool is a central challenge
  - Investigation of the interplay of technologies

Technology / Potential	#1	#2	#3	#4
Geothermal (deep or surface)				
Solar thermal				
Waste heat (industrial, sewage, air condition…)				
Environmental potentials (air, river, lake)				
Thermal storage system				
Power to heat				

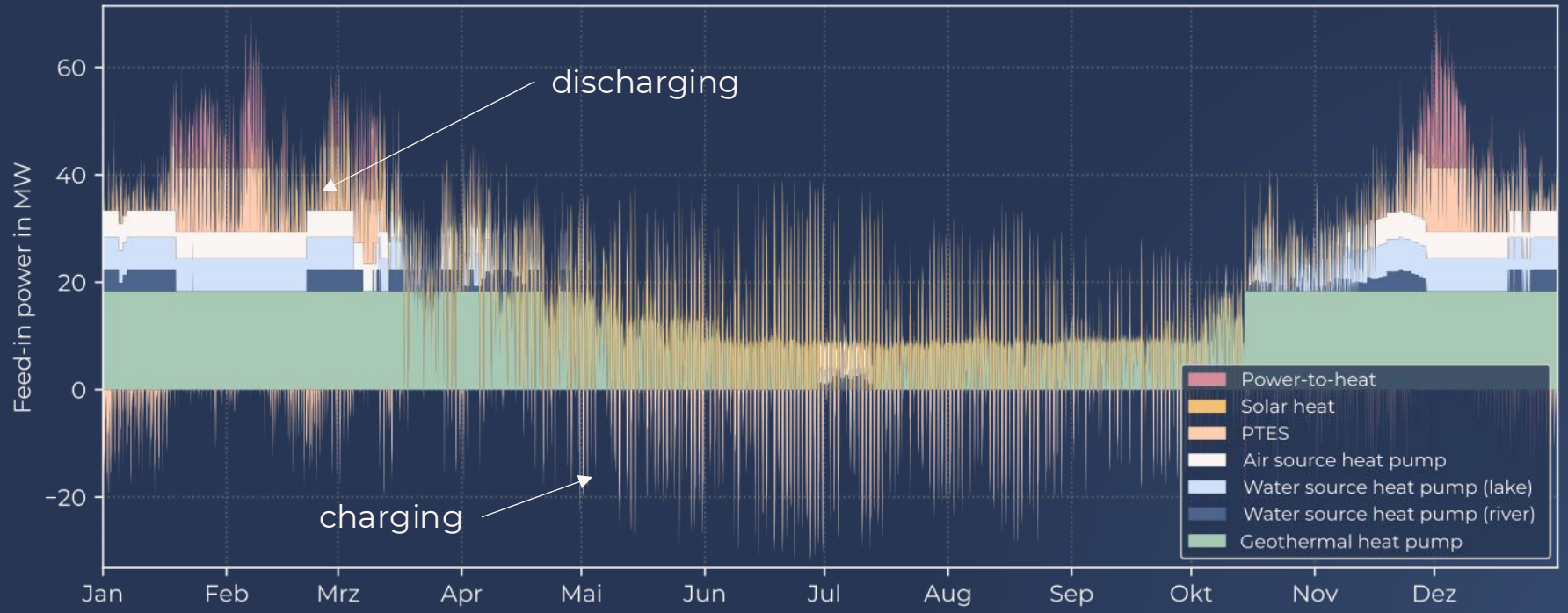
EXPANSION OF DISTRICT HEATING

INCREASE IN COMPLEXITY

- Heat sources are spread across the city
- Challenges for existing grids due to changes in grid hydraulics
- Use of different models to calculate hydraulics and optimize investment and plant dispatch

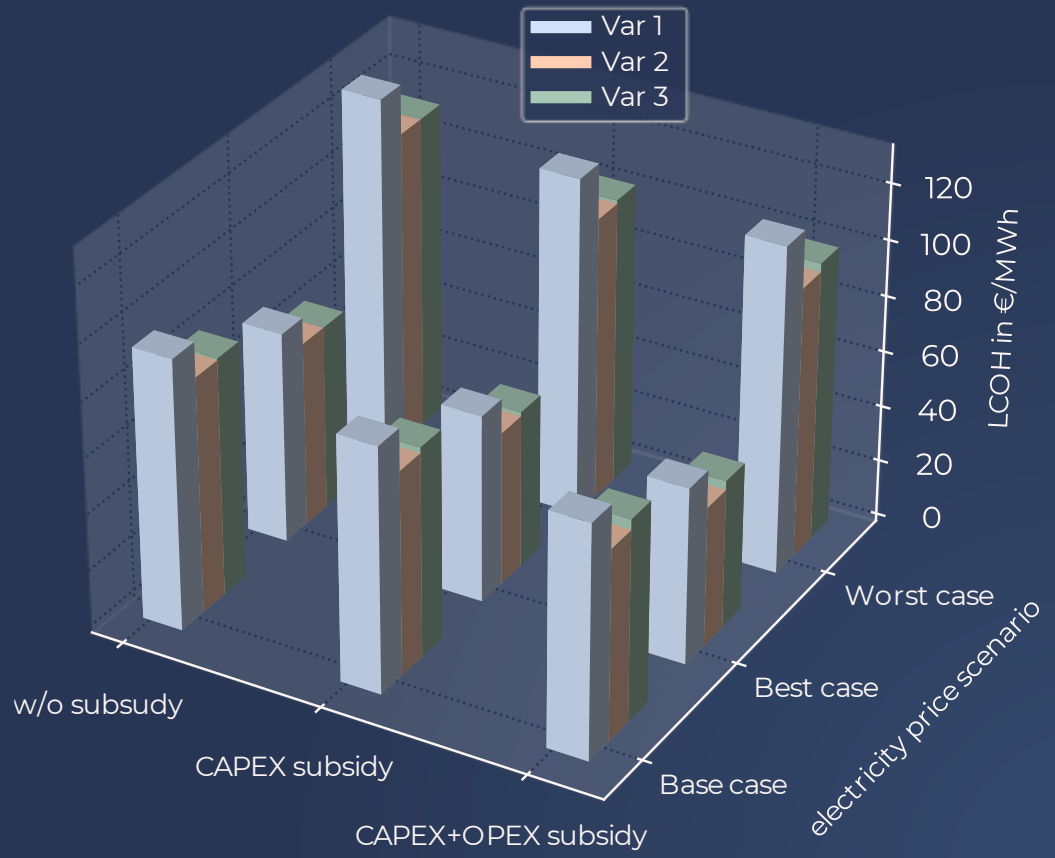


INVESTMENT AND OPERATING COST OPTIMIZATION



COST COMPARISON

- Comparison of variants and scenarios based on levelized cost of heat
- Determination of no-regret measures
- Development of a transformation path



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DATA HANDLING

- Heating planning is data driven
- Heating planning requires a certain amount of data
- Efficient data handling is key
  - Automation and standardization
  - Building a digital twin

PROCESS

- Each heating planning is unique
- Heating planning must be done independently in responsibility of the municipality / province
  - Acceptance
  - Consensus
- The involvement of key stakeholders is an advantage (advisory boards and working groups are proven)

EFFICIENCY AND ECONOMY FIRST

- Realization is driven by economy
  - Energy saving potential by renovation is limited (meaningful measures only)
  - Energy saving potential of new buildings is huge
  - Mostly, various supply routes, technologies and potentials on the table
  - Finding the best approach (technically and economically) is the idea of area-wide heating planning
- Energy transition requires investment in centralized infrastructure as well as decentralized heating
  - Heating planning is to save money in the long run

DISTRICT HEATING NETWORKS & ELECTRIFICATION

- District heating and electrification to substitute gas distribution network
- District heating for collection and supply of waste heat and environmental potentials
  - When considering environmental potentials geothermal and solar thermal are leading
  - Lake and river heat also provide great potential

THANK YOU FOR YOUR ATTENTION!

ANY QUESTIONS?

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