

DECARBONIZATION OF HEAT SUPPLY IN BUILDINGS

Observed lessons during heat planning and
implementation by large, medium and small
municipalities in the Netherlands



Universiteit Utrecht

Copernicus Institute of Sustainable Development

TNO innovation
for life

Sara Herreras Martínez
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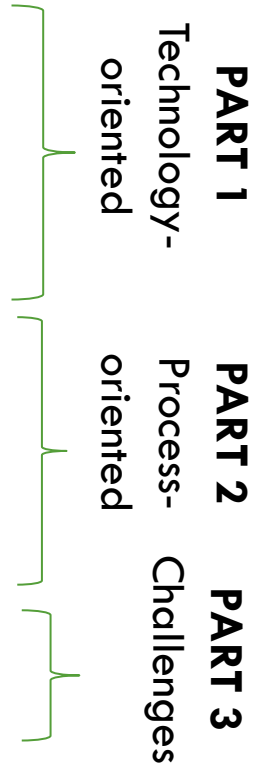
RESEARCH GOALS

- To explore the decision-making at the municipal level during the planning and (early) implementation stage of various low-carbon heat strategies in neighbourhoods
- To identify the key challenges experienced by local authorities in the process → recommendations for policymakers



RESEARCH SCOPE AND AGENDA TODAY

Timeline	
9.05 – 9.20	Data collection and analysis
	Selected technologies
	Selected priority areas
9.20 – 9.30	Discussion and Q&A
9.30 – 9.45	Decision-making key stakeholders and citizens' participation
	Organization model district heating networks
9.45 – 9.55	Discussion and Q&A
9.55 – 10.10	Key challenges
10.10 – 10.30	Discussion and Q&A and close-up



CASE STUDY SELECTION

# Case study	Size municipality	Region	Status heat plan document (at the time of interview)		Nr awarded (PAW) subsidy	Target year decarbonization
			In development	Ready (publication year)		
1	Large(>100,000 inhabitants)	Flevoland *	x			2050
2		Utrecht *		(2021)		2050
3		Noord Brabant *	x			2040
4		Gelderland *	x			2050
5		Groningen *		(2019)	2	2035
6		Noord-Holland		(2021)		2040
7		Zuid-Holland *	x			2050
8		Gelderland *		(2018)	2	2040
9		Noord Brabant *	x		1	2040
10		Utrecht *		(2021)	1	2050
11		Overijssel *		(2020)		2050
12	Medium (50,000-100,000 inhabitants)	Noord-Holland *		(2020)		2050
13		Overijssel *		(2020)		2050
14		Zuid-Holland		(2021)	1	2050
15		Utrecht	x			2040
16		Friesland		(2021)		2050
17		Zeeland	x			2050
18	Small (<50,000 inhabitants)	Drenthe	x			2040
19		Utrecht	x			2040
20		Gelderland *	x		1	2050
21		Gelderland		(2020)		2050
22		Utrecht		(2020)		2040
23		Utrecht		(2021)		2050
24		Noord Brabant	x			2050
25		Friesland	x			2040
26		Gelderland *		(2020)	1	2040
27		Gelderland *		(2021)	1	2050
28		Noord-Holland		(2020)	1	2050

* Municipalities with district heating

RESEARCH FINDINGS

PART 1: Data collection, selection heat system and prioritized areas

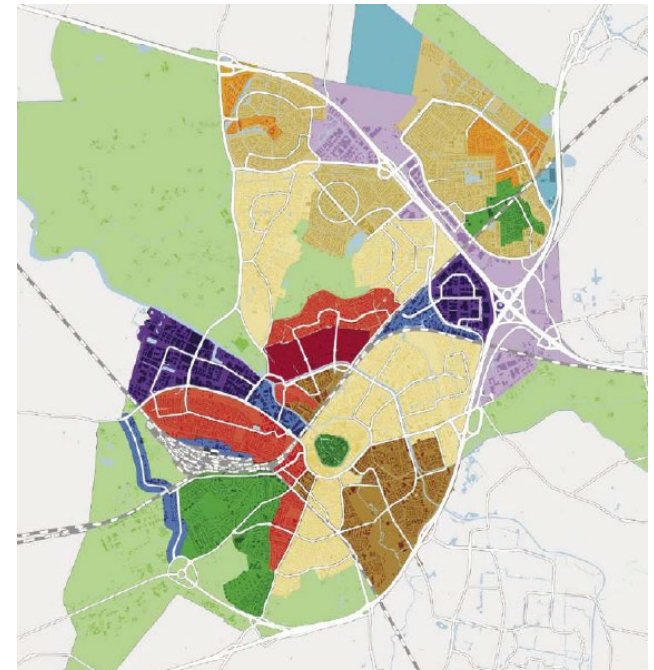
DATA COLLECTION AND ANALYSIS

To choose heat system and prioritized areas:

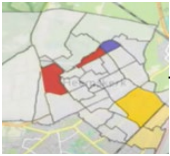
- Data-intensive process: Techno-economic-, environmental-, social aspects. Also, data from partners to identify restrictions and opportunities

E.g. Building-related, theoretical heat, energy demand, energy infrastructure, alignment with city infrastructure plans, with housing associations, data from energy cooperatives, socio-economic data...

- Development of own municipal database
- Use of various techno-economic models:
Results do not always align



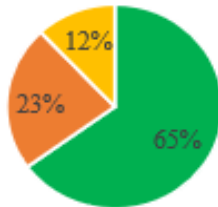
SHARE OF ROBUST HEAT SYSTEMS – MODEL COMPARISON



Geographical level: **District**

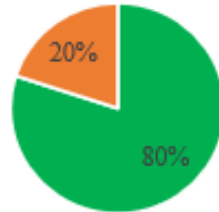
Case 10

Robust results:
9% of heq



Case 23

Robust results:
9% of heq



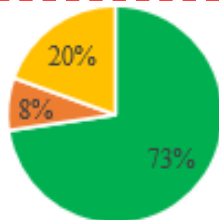
■ Individual HP ■ Boiler or hybrid HP with biomethane/hydrogen ■ MT-/HTDH



Geographical level: **Block (clustering buildings)**

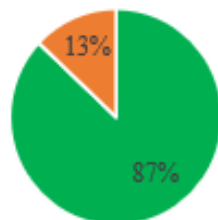
Case 10

Robust results:
24% of heq



Case 23

Robust results:
17% of heq



Energietransitiemodel
(Quintel)

Vesta MAIS
(PBL)

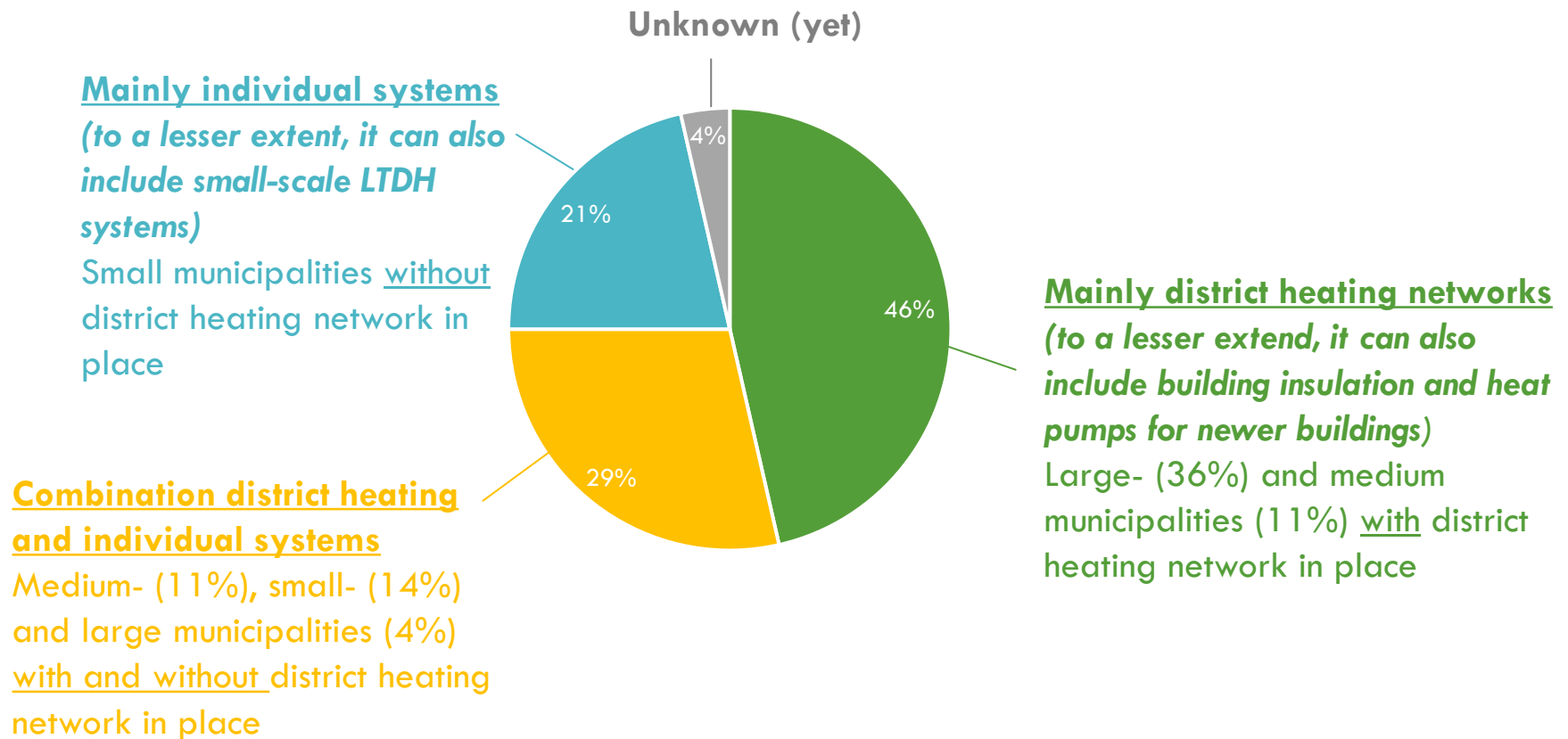
CEGOIA
(CE Delft)

Three different heat potential scenarios

Robust outcome (when outcomes aligned regardless the model and scenario used)

Robust technical pathway
(=clearly the best from a cost efficiency point of view regardless the model used and scenario) attains only 10-20% of the buildings

MAIN SELECTED HEAT STRATEGIES UNTIL 2030



- Heat availability for DH unequally distributed among case studies

SELECTED SYSTEMS UNTIL 2030

Very different (new) heat sources

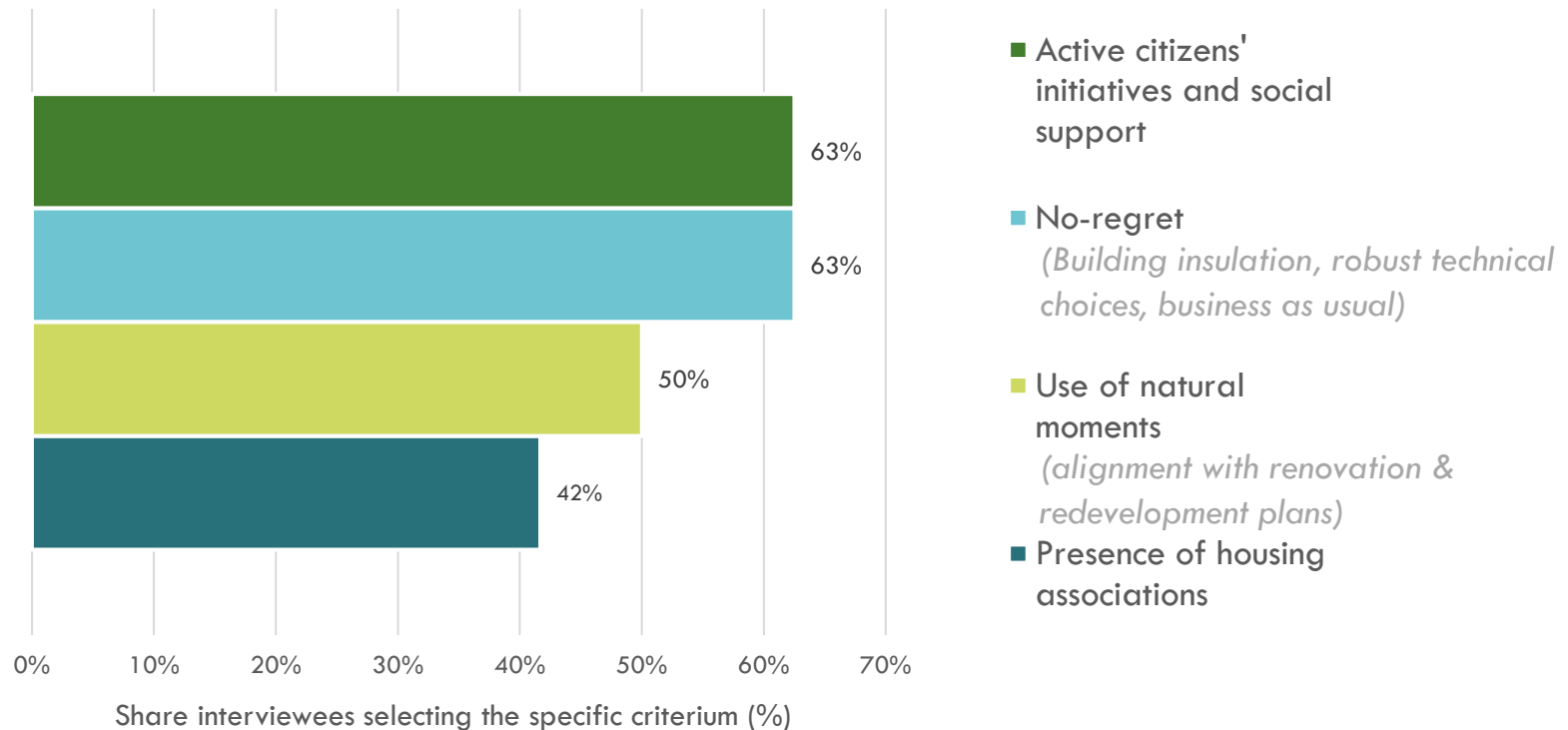
- Large role aquathermal, residual industrial heat, biomass, ATES...
- Potential for geothermal (under investigation)
- Sporadic use of hydrogen, solar-thermal, biogas

Lack of affordable solutions and high uncertainties: Eye-opener and change of strategy → Reduction temperature heat demand

Large-scale building refurbishment programs starting in areas with:

- Homogenous building typology
- Easy and high CO₂ reduction gains

MAIN UNDERLYING FACTORS TO PRIORITIZE NEIGHBORHOODS



- Start in areas where concrete steps can be taken in the short-term (enthusiast citizens, 'natural moments,' presence of housing associations, no-regret)
- Taking advantages of 'natural moments' is complex in practice

Q&A AND DISCUSSION (PART 1)

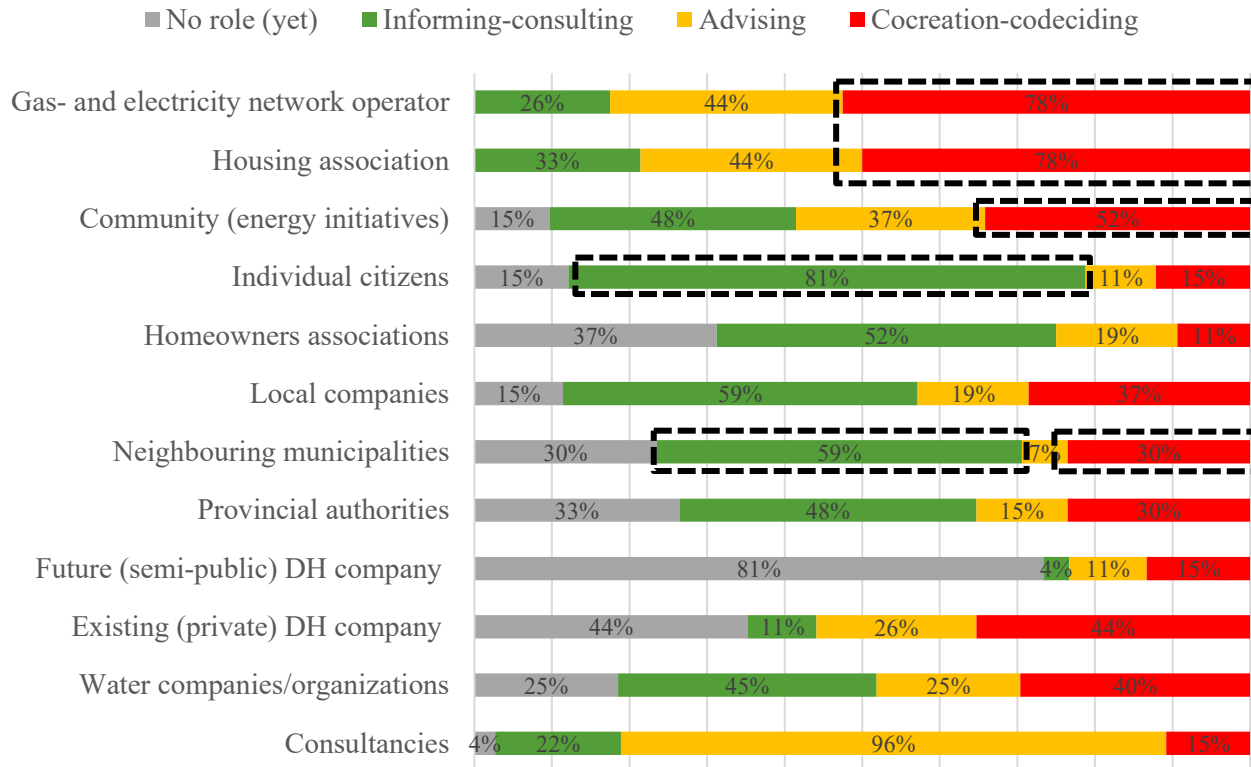
Data collection and analysis
Selected technologies
Selected priority areas



RESEARCH FINDINGS

PART 2: Process (decision-making municipal partners, citizens' participation and organization model of district heating networks)

LEVEL OF INVOLVEMENT KEY STAKEHOLDERS



** The total shares amount to more than 100% because some partners are involved in more than one role, depending on the phase or the project*

Relative amount of municipalities reporting a specific collaboration approach during the making of the municipal strategy (until the moment of the interview)

- Role can change per project, per phase and depends on individual attitudes of the partner

COMPLEXITIES IN THE DECISION-MAKING

- Not always easy to align various interests:

Stakeholder	Some complexities reported in the decision-making
Existing heat companies	<ul style="list-style-type: none">• Existing power relations• Lack of cost's transparency and poor societal perception
Heat producers	<ul style="list-style-type: none">• Complex negotiations because changing roles/functions
City Council	<ul style="list-style-type: none">• Lack of urgency• Lack of affordability of available solutions
Network operators	<ul style="list-style-type: none">• Grid constraints hamper the momentum of projects
Housing association	<ul style="list-style-type: none">• Timeline of plans• Sustainability goals vs affordable housing

'The district heat company are not transparent about their costs and wait for the new heat law to come to know which exact requirements they have to meet. However, we need this transparency now for the decision-making and the discussions with the city council.'

'The wastewater treatment company produces green gas wanted the municipality pays more for the gas produced than other interested parties (heavy transporters) if we want to ensure availability. We do not want to enter in those type of discussions yet.'

'Our political climate is not good at the moment. The scepticism about the energy transition is quite high among some members of the city council. It is for them a left-wing hobby'

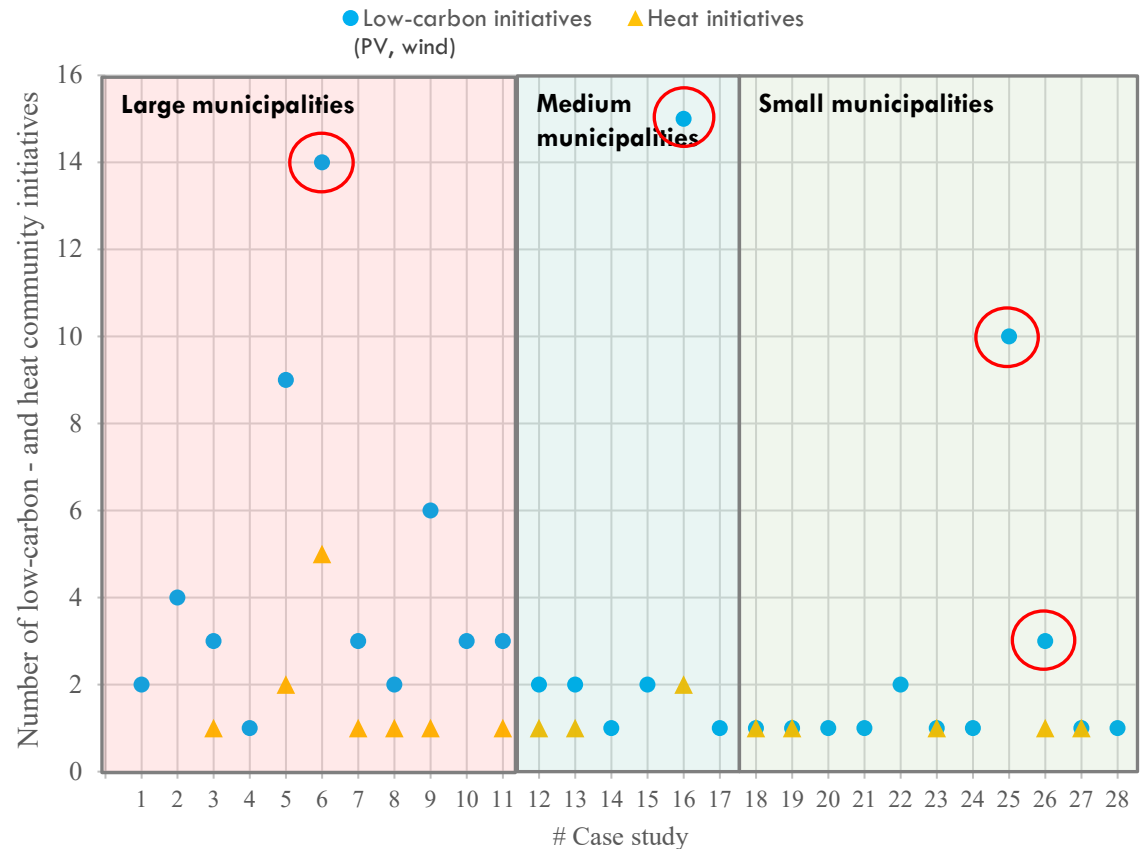
CITIZENS' PARTICIPATION

- Focus on information provision and few consultative procedures
- Interaction with citizens at higher levels difficult (abstract character planning phase)
- For now, involve them in the 'how', but not on the 'what' (technical choice) and 'where'
- Different views regarding approach, importance and impact of civic participation



COMMUNITY-ENERGY INITIATIVES

- Unequal number of initiatives between municipalities
- Number depends on social cohesion, environmental drivers and institutional support
- Sometimes better to involve them than hiring a consultancy → regular financing & professionalization
- Not representative for whole neighborhood



ORGANIZATION DISTRICT HEATING NETWORKS

current

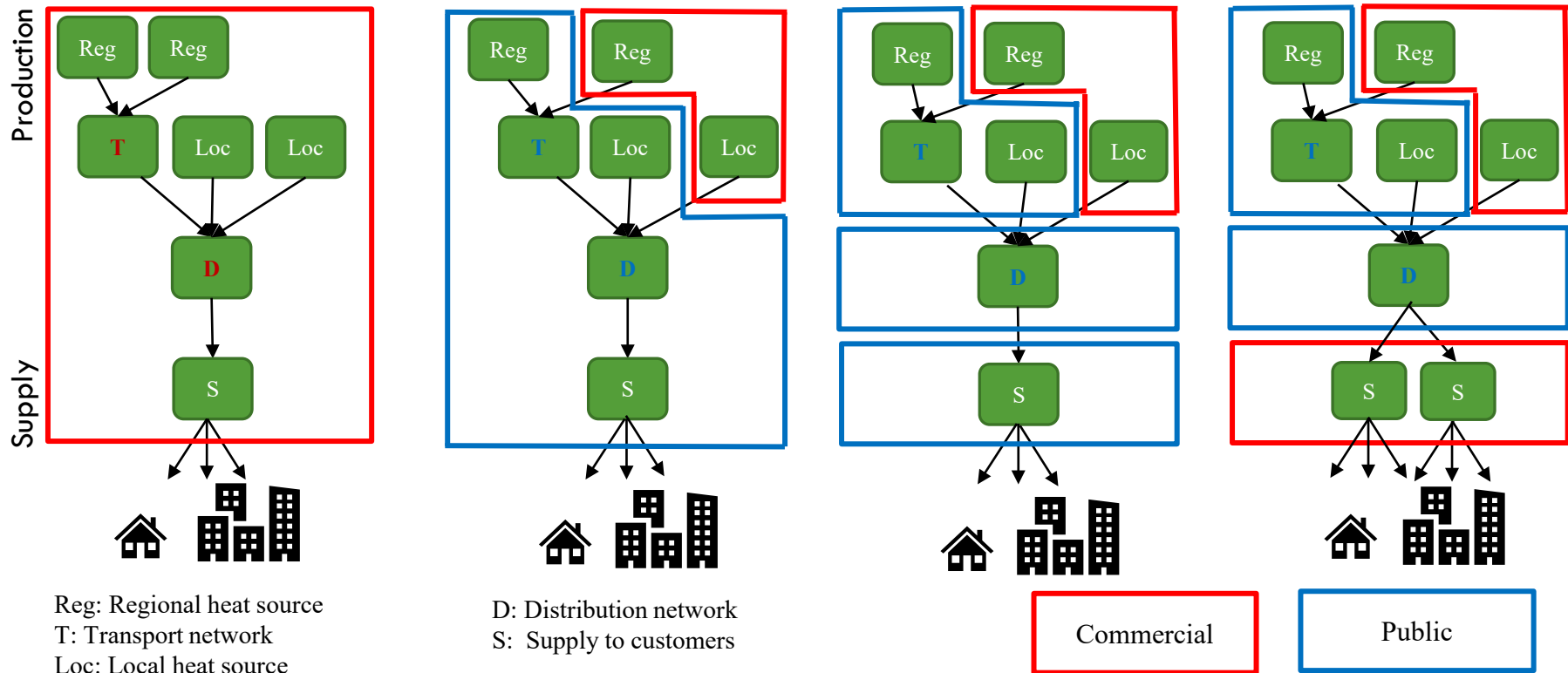
Emerging trend

Model 1 (case studies 1, 2, 3, 4, 7, 8, 9, 10, 11, 12, 13, 20, 26)
Integrated fully private

Model 2 (case study 5)
Integrated public primary network, heat sources in private or public hands

Model 3 (considered by case study 13)
Unbundled DH network, heat supply and distribution in a separate public entity, heat sources in private or public hands

Model 4 (under development by case studies 4, 8, 20, 26, 27; considered by case studies 6, 11, 14)
Unbundled DH network, transport and distribution in a separate public entity, heat supply by private company, heat sources in private or public hands



* Cooperative ownership not in the scheme, but also possible (considered in many cases studies)

SAFEGUARDING PUBLIC VALUES

- Avoid cherry picking
- Move away from monopolistic positions
- Facilitate the roll-out of district heating
- Ensure sustainability goals
- Cost-efficient and independent distribution of heat sources at regional level

*'After holding a public consultation, all parties except the existing heat company were very positive and willing to cooperate..but the existing company wanted to do it all themselves and they weren't interested because it wasn't economically viable. At that point, we decided to take the lead and set up our own heat company. But now we receive angry briefs from the heat company saying that we are doing something that is not allowed. **We are blamed for fulfilling our social role and trying to avoid cherry-picking**'*

*'The municipality would like to transport more heat via the existing district heating network to other areas, but the heat company does not allow us to do it. They are very protective of their concession area. **It is a monopoly.**'*

*'In the future a transport network which connects all the heat sources that are geographically spread throughout the city will be needed. This network **should be managed in an independent and cost-efficient manner.** If a commercial party is in charge of that, would mostly look at the profit. Thus, the network must be **in public hands or in a public-private partnership** that safeguards the public interests'*

Q&A AND DISCUSSION (PART 2)

Decision making with municipal partners
Citizens' participation
Model structure district heating networks



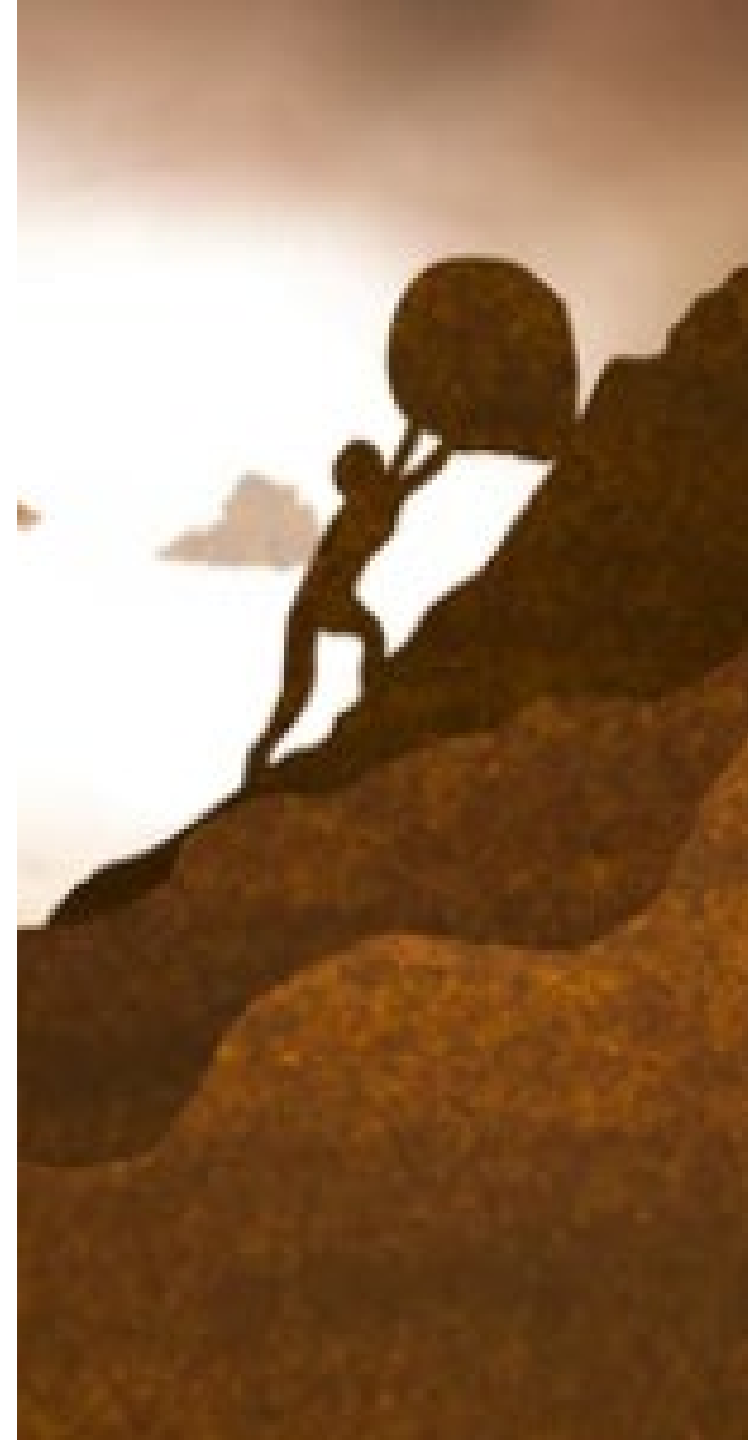


RESEARCH FINDINGS

PART 3: Key challenges

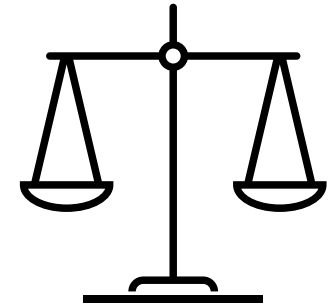
CHALLENGES

1. Regulatory
2. Economic
3. Technical
4. Municipal capacity
5. Effectivity of available national instruments
6. Citizens' participation



REGULATION

- Lack of binding policies for homeowners → hampers the momentum of ongoing projects
- All important regulatory changes under development
 - Need for homogenous legislation tackling natural gas, electricity and heat
 - Heat Act, important improvements compared to current regulation, but many open doors and confronting opinions



Market organization

Integral economic ownership of the DH network

Leading role municipality

- Establishment heat zones
- Opt-out options
- Designating heat company

Tariff regulation

- Decoupling from natural gas prices
- Cost-based prices
- Cost transparency

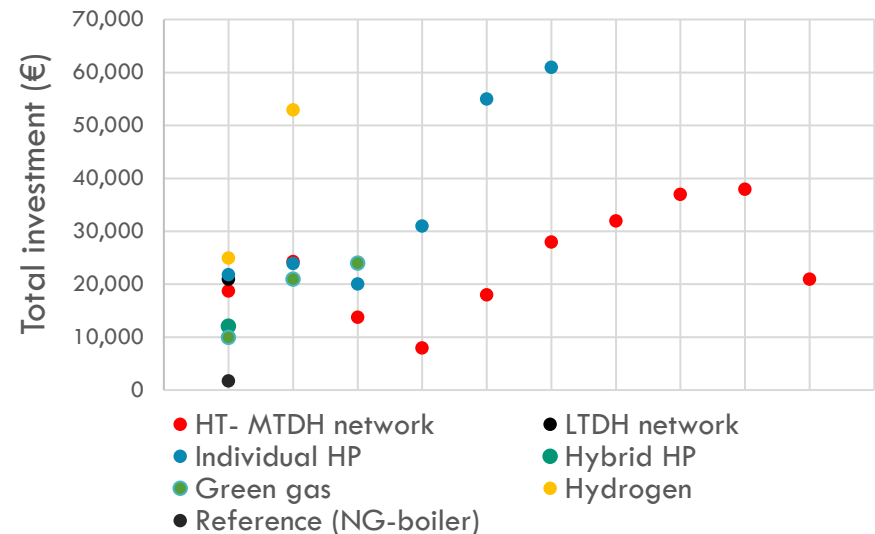
Sustainability

- Obligation for CO2 reduction standards until 2050
- Stimulation of residual heat use

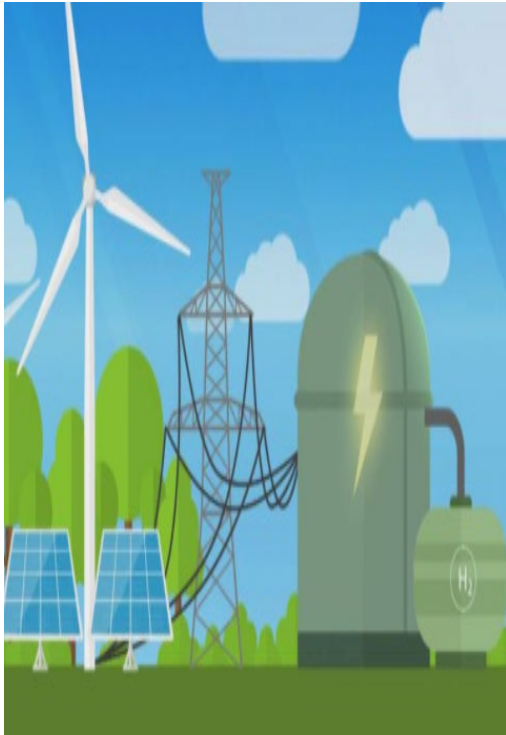
Security of heat supply

ECONOMIC BARRIERS

- Lack of competitive heat alternatives and appropriate financing instruments
 - Investments not paid back by energy savings
 - Subsidies only cover half of the financial gap
 - Investments disproportionate high compared to the value of houses
- Some positive business case when several conditions come together
- Very different investment costs figures
 - Depends on components included
 - Differences between public and private returns (up to 9,000 €/house for DH)
 - Figures more uncertain for DH (little experience, lack of costs transparency and high risks) than for all-electric



Data sources: PBL (2019), DAEB (2020), EIB (2021)



UNCERTAINTIES RELATED TO THE TECHNOLOGIES

- Market immaturity, little experience, uncertain impacts
- Polarized views (biomass, geothermal, hydrogen) → desire for a clear message from the central government about limitations and feasibility
- Requirements on:
 - Electricity grid
 - Building insulation level
 - Land needed for sustainable power production



LACK OF MUNICIPAL CAPACITY

Lack of capacity, and know-how → Strong dependency on external expertise

- *Temporary hired consultants (technical, legal, process, communication)*

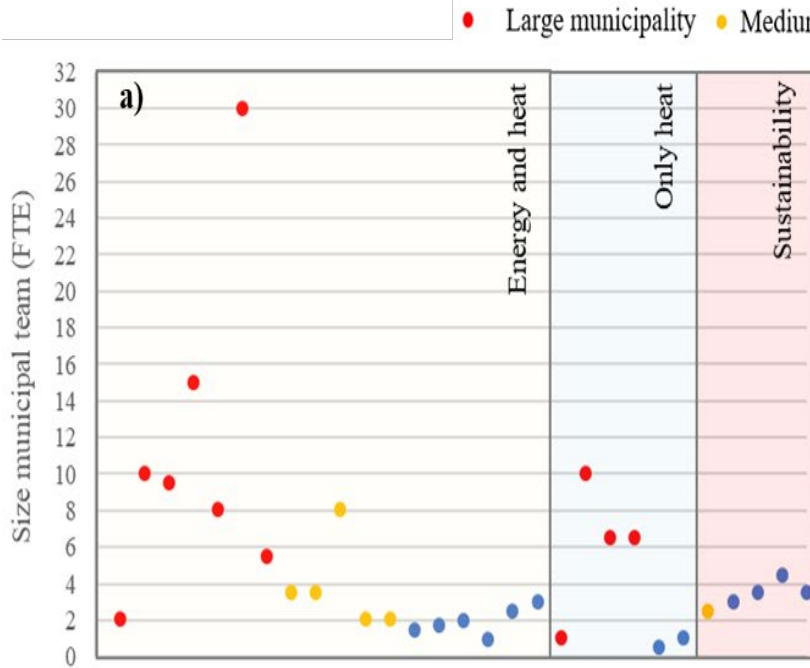
Problems:

- *Not cost-efficient for a long-term process, and does not develop local knowledge*
- *Able to assessed the delivered external expertise?*

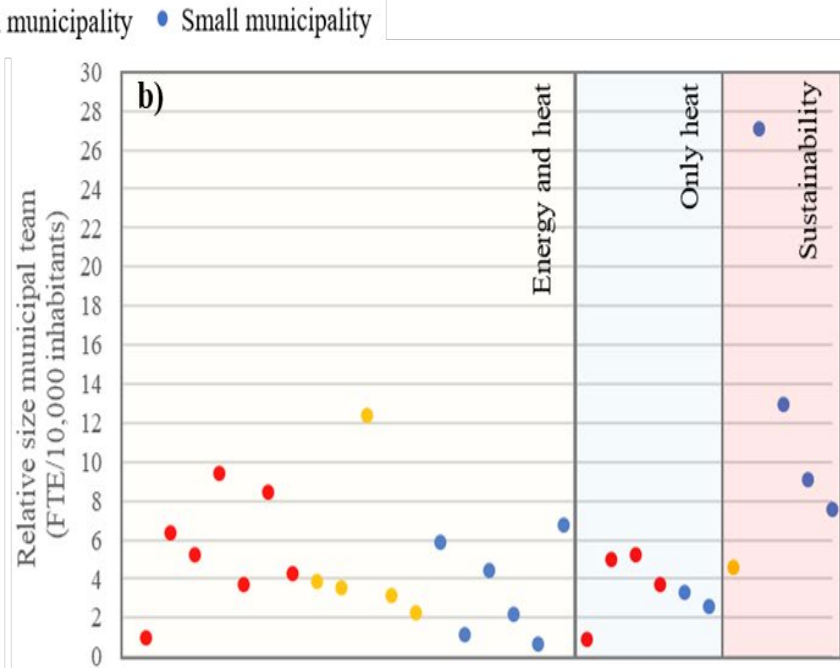
The problem of lack of capacity will become more prominent when realization starts

SIZE MUNICIPAL TEAMS

Absolute size municipal team



Relative size municipal team per nr. inhabitants



- Large differences looking at absolute and relative values
- Only few cases where there is a dedicated team for heat projects
- Staff shifts frequent in municipal teams, but not considered in the numbers above

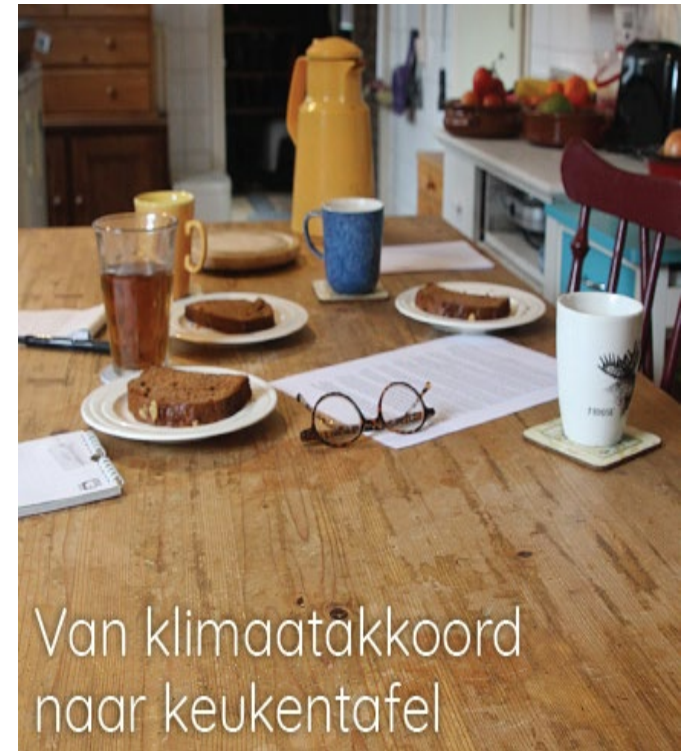
NATIONAL INSTRUMENTS/PROGRAMS

- Many instruments (Startanalyse, ECW, PAW) that have helped the municipalities to take the first steps
- BUT, do not always aligned with the local needs:
 - Critics Startanalyse
 - PAW focuses on innovation but less on ready, more business-as-usual projects
 - Overwhelming



CITIZENS' PARTICIPATION

- Right balance of participation (meeting goals vs keeping it manageable)
 - *Dealing with increasing participation and a growing number of local initiatives in the future with limited resources → Energiesamen/Klimaatverbond proposal (regional service organization). Also used in Denmark*
- Participation \neq success
 - *Opposing minorities can negatively influence citizens' support*
- Dealing with different interests
- Resistance and increasing tiredness to “aardgasvrij”



Van klimaatakkoord
naar keukentafel

CONCLUSIONS & POLICY RECOMMENDATIONS

Challenges

Data and instruments for heat planning

- Low practicality models
- Too general and diffuse data
- Intensity of data collection and analysis
- **Limited municipal capacity**

Technical pathway

- Unclear technology selection for many areas
- Low maturity alternative technologies compared to reference
- Limited availability heat sources
- Requirements for LT systems (grid, buildings, land)

Social pathway

- **Participation ≠ Success**
- **Intense processes**
- Difficult to reach majority and to address different interests
- Resistance
- **Limited municipal capacity**

Instruments at national level

- **Lack of binding policies**
- **Financial barriers**
- More public control in the management of DH systems
- Lack of realisation in pilots
- **Limited municipal capacity**

(General) Policy recommendations

- ★ For national governments
- ★ For local governments
- ★ Required combined efforts

1. Give municipalities the right basis to be able to fulfill their role: ★
 - i. *Clarity and timely establishment of adequate and consistent regulation*
 - ii. *Clarifying potential financial allocation mechanisms*
 - iii. *Policy structures to experiment AND realize ongoing projects*
2. Intra-governmental efforts to increase municipal capacity and know-how ★
3. Design flexible strategies, find the balance between: ★
 - i. *Planning and execution*
 - ii. *Between participation and the final goal → Invest in professionalisation of robust energy cooperatives*
 - iii. *Manage expectations and keep momentum → Offer regular and transparent feedback on the purpose and use of participatory processes to your citizens*

WHAT WOULD YOU RECOMMEND?

What are your recommendations for local and national authorities (in the Netherlands, and other countries)?

1. Give municipalities the right basis to be able to fulfill their role:
 - i. *Clarity and timely establishment of adequate and consistent regulation*
 - ii. *Clarifying potential financial allocation mechanisms*
 - iii. *Policy structures to experiment AND realize ongoing projects*
2. Intra-governmental efforts to increase municipal capacity and know-how
3. Design flexible strategies, find the balance between:
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 - iii. *Manage expectations and keep momentum → Offer regular and transparent feedback on the purpose and use of participatory processes to your citizens*

Q&A AND DISCUSSION (PART 3)

Key challenges
Policy recommendations



This project has been carried out as part of the Innovation Plan WarmingUP and partly received funding from the Netherlands Enterprise Agency (RVO) in the framework of the funding scheme Meerjarige Missiegedreven Innovatie Programma's (Multi-year mission-driven innovation programs, MMIP), known at RVO under the project number TEUE819001. WarmingUP contributes to MMIP-4 – Sustainable heat and cold in the built environment and contributes to Mission B – A CO₂ free built environment in 2050.