TUDelft

SCALING UP HEAT GRID IMPLEMENTATION IN THE NETHERLANDS: end-user perspectives

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Management in the Built Environment



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INTRODUCTION

Rotterdam, 03 april 2024

NOS Nieuws • Woensdag 27 maart, 06:31 • Aangepast woensdag 27 maart,

Tweede Kamer komt met voorstel om warmtenetten snel goedkoper maken

Laagbouwwoningen in Overvecht-Noord niet geschikt voor betaalbaar warmtenet

Het gaat niet g warmtenetten, stoppen steed

nieuwsuur

Amsterdamse corporaties sluiten voorlopig geen woningen meer aan op stadswarmte

Dinsdag 14 mei, 23:09

Energiebedrijven: 90 procent nieuwe spoedmaatrege warmtenetaansluitingen voorlopig van de baan warmtenetten



NIEUWS

Tweede Kamer weifelt over spoedmaatregel voor warmtenetten

Het spoedplan waarmee energieminister Rob Jetten iets wil doen om volgend jaar de tarieven voor stadswarmte enigszins te beperken, kan niet direct op een meerderheid rekenen in de Tweede Kamer. Dat bleek woensdag tijdens het debat over de Wet Collectieve Warmte.

PROBLEM STATEMENT

- Not on track for reaching agreement goals in energy transition
- Electrification is not the sole solution due to net congestion >> heat networks have potential
- 90% of the heat grid projects are on hold or cancelled
- Challenges such as feasibility, disturbed stakeholder dynamics, end-user willingness to connect



RESEARCH GAP

..... this is not the only reason this study is relevant

- Most research is supply focussed
- Demand side is underrepresented
- Willingness to connect key factor in project success
- Need for tailored engagement strategies



RESEARCH QUESTIONS

Main research question:

How can different end-user groups be effectively engaged in the heat grid implementation process by project initiators to optimize their willingness to connect?

Subquestions:

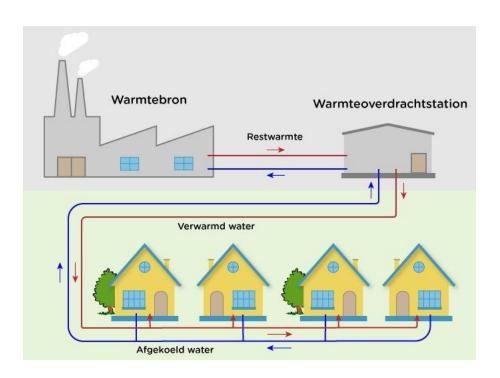
- 1. Who are the different end-user groups within suitable areas for heat grids, and what are their specific characteristics and needs?
- 2a. What barriers do different end-user groups face in their willingness to connect to heat grids?
- 2b. How do these barriers vary across user groups and phases of the decision-making and implementation process?
- 3. How can project initiators use different strategies to effectively engage different end-user groups and optimize their willingness to connect (at various stages of the heat grid implementation process)?



Heat grids in energy transition

- From fossil-based energy systems to renewable energy sources
- In The Netherlands: focus on gas-free buildings
- To meet climate goals and reduce greenhouse gas emissions
- Energy security
- Central heating using underground pipelines
- 4th & 5th generation heat networks (smart, sustainable)
- Source can be adapted relatively easy
- Potential to reduce emissions by 60%
- Current reliance on natural gas = challenge





Stakeholders in heat grid projects

Stakeholder	Housing association	Tenants/ homeowners	(Local) government	Grid operator/ energy company
Role	Initiator, coordinator, shareholder, owner	Shareholder, heat purchaser	Initiator, coordinator, facilitator, shareholder, (co)financer, owner, heat purchaser	Network owner, investor, coordinator

- Overlapping roles > need for cooperation
- Different project initiator > different approach process
- Stakeholder roles vary depending on initiator and leading organisation



Process of heat grid implementation

1 | Initiation

Idea forming
Exploring options
Announcing plans

2 | Feasibility

Technical research

Financial viability

Needed connection numbers

3 | Contracting

Making and signing agreements

Commitment

Pricing

4 | Realization

Construction

In public space

At people's house

5 | Operation

Active heat grid

Maintenance

Support



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Active heat grid

Maintenance

Support

Key decision-making moments: Feasibility & Contracting

>> commitment of end-users



End-user decision-making journey

A | Awareness

B | Consideration

C | Decision

D | Execution

E | Experiencing



End-user decision-making journey

A | Awareness

B | Consideration

C | Decision

D | Execution

E | Experiencing

Most critical stages: Awareness & Consideration

However, decision is influenced by aspects in the execution and experiencing phase



Suitable areas

- Mixed-use, older urban areas with a constant heat demand
- In new developments
 > developer has decision-making autonomy
- In existing urban areas with mixed tenure and ownership structures
 - > more complexity

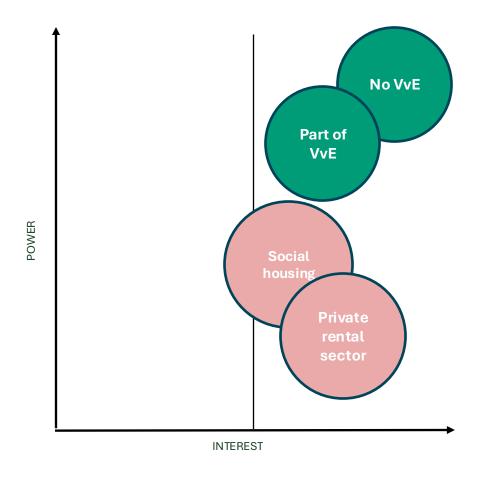


End-user typologies





- Decision making power varies
 Homeowners have higher decision-making power and interest
- Different type of home-owners have different needs





Homeowner characteristics

Building Household Behavioral Characteristics characteristics characteristics Ownership **Building** year Trust Typology Age Awareness M2 Education Interest Willing to spend on Employment status Heat demand energy transition **Previous EER** Energy label Income **Current heating** Disposable income Social norms system Savings



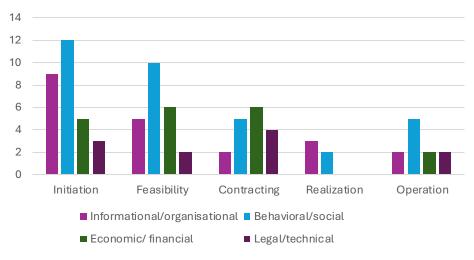
Household size

(van den Brom et al., 2018; Santin et al., 2009; Khor et al., 2023; Ebrahimigharebaghi, 2022; Brounen et al., 2012; Vaseur & Marique, 2019; Mashhoodi et al., 2020; Wahi et al., 2023)

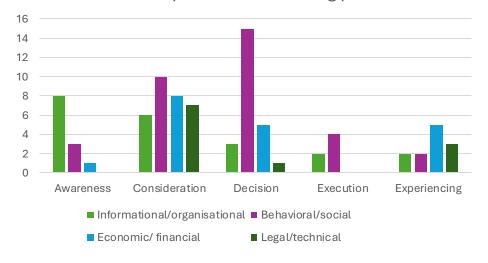
Barriers

Barrier group	Barrier
	1.Lack of information
	2.Accessibility of information
Informational & organizational	3.Information overload
illioi illatioilat & olganizatiollat	4.Lack of awareness
	5.Nuisance
	6.Lack of trust in leading party
	7.Preferring individual heating solutions over collective systems
	8.Skepticism about system performance
Behavioral & social	9.Resistance to change from existing heating system
Bellaviorat & Sociat	10.Influence of negative experiences from peers
	11.No renewable energy source
	12.Too much effort preparing for the connection
	13.High initial cost
	14.Uncertainty about long-term cost savings compared to current heating system
Economic & financial	15.Perceived risk of monopolistic pricing
Leonomic & infanciat	16.Future cost
	17. Costs of alternatives
Legal & technical	18.Changing policies

Barriers per project phase



Barriers per decision-making phase





Drivers to willingness to connect

Barrier group	Barrier
	1.Clear overview of the benefits for their household
Informational & organizational	2. Accessible and understandable information about the system
Illioithationat & organizationat	3.Transparency about project timeline and connection process
	4. Availability of user friendly support before, during and after the connection
	5. Social norm campaigns; I don't want to be left behind from my peers
	6. Positive word-of-mouth recommendations from friends/family/neighbors
Behavioral & social	7. Having trust in leading party
	8. The feeling of contributing to sustainability goals
	9. Increased level of comfort in my house
Economic & financial	10. Lower energy bills
Leonomic & infanciat	11. Increased property value
	12. Energy independence (less reliance on fossil fuels)
	13. Compatibility of heat network with existing (heating) systems
Legal & technical	14. Flexibility to combine heat network connection with other measures
	(energy efficiency measures like insulation or window replacement / aesthetic
	measures like new kitchen or bathroom)



EFFECTIVE APPROACH

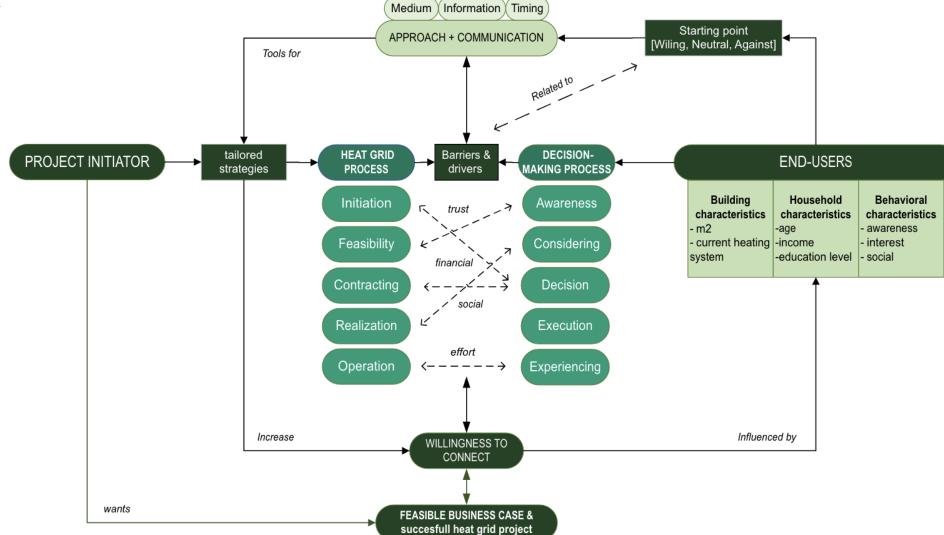
What? Information

When? Timing

How?
Source & channel

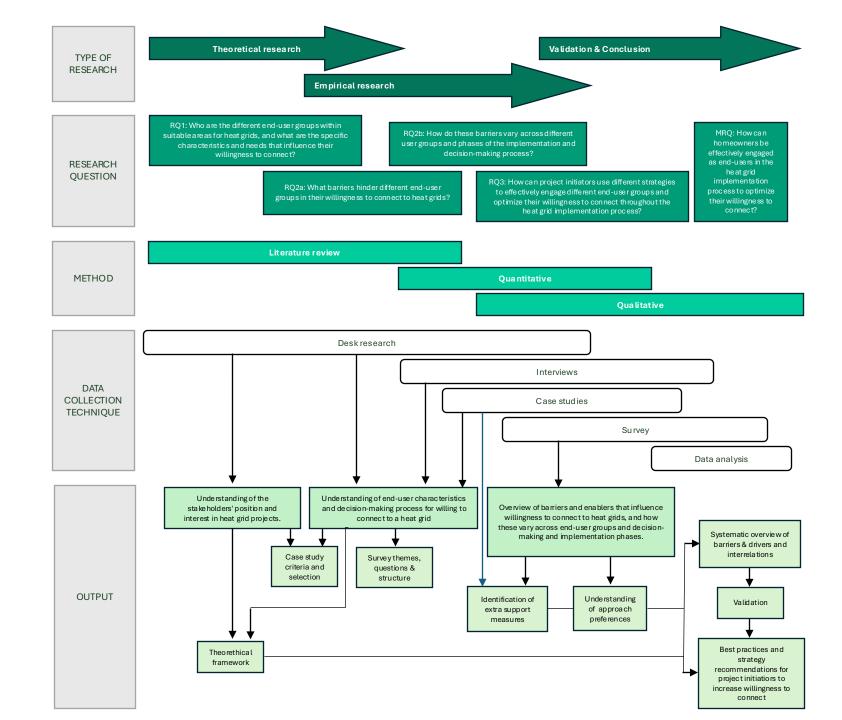








METHODOLOGY

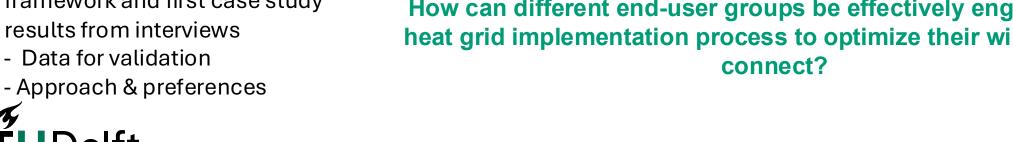


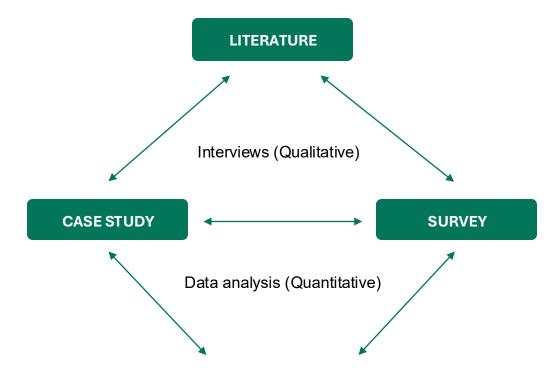


METHODOLOGY

Mixed-method research

- Literature
 - building framework & input for interviews and survey questions
 - case study selection criteria
- Case study
 - cross-case analysis
 - deeper understanding of phases
 - barriers/drivers & extra support
- Survey
 - Design based on literature framework and first case study results from interviews





How can different end-user groups be effectively engaged in the heat grid implementation process to optimize their willingness to

METHODOLOGY

Case study selection criteria & interviewees

Criteria	Required	Desired
Located in the Netherlands	X	
Renewable energy source	X	
Ongoing, planned or completed	X	
(active)Involvement of end users	X	
Public-private partnerships		X
Municipality as leading party	X	
Housing association as leading party		X
Energy company as leading party		X
Failed project (due to end-user related		X
barriers)		
Succes project	X	

#	Code	Role	Stakeholder	Times interviewed
1	M1	Project manager heat transition	Municipality	2
2	M2	Project manager participation	Municipality	2
3	HA	Project manager	Housing Association	1
4	E-U 1	Potential end user	End-users	1
5	E-U 2	Potential end user	End-users	1
6	E-U 3	Potential end user	End-users	1
7	E-U 4	Potential end user	End-users	1
8	EC1	Process manager	Energy company	1



Case studies A | Multatulibuurt Delft

- Housing associations first
- Homeowners engaged (WUP ready)
- Focus on no regret measures
- 4 alternatives
- Mostly engaged through community events & letters
- Meedenkgroep







Case studies A | Multatulibuurt Delft

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B | BoTu Rotterdam

- Municipality in lead
- Close partnership with energy company
- Integral approach focussing on existing problems and raising neighborhoods social index (Veerkrachtig Bospolder-Tussendijken 2028)
- Subsidy (Nationaal Programma Lokale Warmtetransitie) & Proeftuin Aardgrasvrije Wijken



Cross case analysis

Case B: BoTu Rotterdam	Case A: Multatulibuurt Delft	Aspect
Project manager heat transition	During initiation & feasibility	Phase of end-user engagement
Initiated by municipality, in close collaboration with energy company & housing association	Municipality & housing association involved	Leading/initiating partie(s)
Ongoing –decision phase for homeowners	Ongoing – WUP published, implementation for housing corporations, decision phase for homeowners	Project status & phase
Waste heat	Geothermal well	Heat grid type
Mainly social housing tenants, homeowners with diverse profiles	Housing association tenants (great share of students) & homeowners	Preliminary end user groups
Newsletters, key community figures, multilingual local sustainability coaches, Local community center " de Verbindings kamer"	Letters, workshops, community building in neighbourhood, compensated participation sessions, co-creation, survey, information sessions	Communication/participation
Coordination delays, planning issues, mistrust, net congestion, cost concerns, personal problems, negative newsflashes	Cost concerns among homeowners, trust issues, complex VvE dynamics, monopolistic pricing, awareness levels	Key Barriers
Financial support, trust building, key figures as coach, price stability guarantees	Financial incentives like increased property value, increased comfort, sustainability	Key Drivers
Decided	Homeowners still in consideration phase; no mandate	User decision-making phase
Mainly post-war apartments, dense social housing blocks; row houses in clusters	Mix of 1960s flats and single-family homes; outdated collective systems in some buildings	Building typology
Low-income, high diversity, many with language barriers and other problems	Mixed, modest-income households; some sustainability pioneers	Socio-economic profile
Low trust, multilingual needs, sceptical homeowners, illiteracy	Technical complexity, fragmented messages, VvE inertia	Communication challenges
Integral approach, social community building and trust gaining, language and sustainability coaches, individual approach with kitchen table conversations, Haalbaar & betaalbaar	WijkvanNu as independent participation party. Use of small-scale participatory formats with feedback loops. Key figure with open house. Meedenkgroep, trusted locals, and neighbourhood-specific guides	Unique approach

Cross case analysis: Barriers

Category	Barriers	Case A	Case B
Informational &	1. Lack of information	Χ	
Organizational	2. Accessibility of information	X	
	3. Information overload	Χ	
	4. Lack of awareness	Х	X
	5. Nuisance		X
Behavioral &	6.Lack of trust in leading party	X	X
Social	7.Preferring individual heating solutions over collective systems	Х	
	8.Skepticism about system performance		
	9.Resistance to change from existing heating system		X
	10.Influence of negative experiences from peers		
	11.No renewable energy source	Х	
	12.Too much effort preparing for the connection	X	X
Economic &	13.High initial cost	X	Χ
Financial	14.Uncertainty about long-term cost savings compared to current		X
	heating system		
	15. Perceived risk of monopolistic pricing	X	
	16. Future cost	X	X
	17.Costs of alternatives	X	
Legal & Technical	18.Changing policies		X
	19.Unclear contractual terms, leading to a lack of understanding	X	
	rights and obligations when connecting to a heat grid		
	20. Legal uncertainties around ownership and responsibilities	X	
	related to the heat network infrastructure and services		



Cross case analysis: Drivers

Category	Drivers		
Informational &	1.Clear overview of the benefits for their household		
Organizational	2.Accessible and understandable information about the system	X	X
	3.Transparency about project timeline and connection process		X
	4. Availability of user-friendly support before, during and after connection	X	X
Behavioral & Social	5. Social norm campaigns, people don't want to be left behind from their peers	X	
	6. Positive word-of-mouth recommendations from friends/family/neighbors	X	
	7.Trust in leading party	X	X
	8. The feeling of contributing to sustainability goals	X	
	9. Increased level of comfort in my house		
Economic &	10. Lower energy bills	Χ	X
Financial	11. Increased property value		X
Legal &	12. Energy independence (less reliance on fossil fuels)	X	
Technical	13. Compatibility of heat network with existing (heating) systems		X
	14. Flexibility to combine heat network connection with other measures (energy efficiency measures like insulation or window replacement / aesthetic measures like new kitchen or bathroom)	X	



Cross case analysis: Support measures

Support measures

- 1. Clear information and education about the benefits and operation of heat grid
- 2. More insights about the actual initial investment and other cost
- 3. Increased trust in leading parties
- 4. Community engagement with feedback opportunities
- 5. Customer support incl. service and maintenance
- 6. Participation opportunity about the connection process beforehand
- 7. Usage price stability guarantees
- 8. More financial incentives or subsidies
- 9. Option to use heat network for cooling
- 10. Additional legislation that makes a heat grid connection more attractive



Survey overview

- 1754 valid responses
- majority (52,8%) of respondents are aged 55 or older

	62 40% of reamendants	have completed higher	r aduaatian
•	62.4% of respondents	have completed higher	reducation

• a quarter of the sample (25,3%) has less than €20.000 savings / 20,3% of respondents preferred to not share their amount of savings

Group

3

Willingness to connect

Against

Neutral

Willing

Percentage

50,8

35,3

13,9

- The majority of homes in the sample were built between 1986 and 2020 (44,3%)
- Most respondents (82,3%) are currently not connected to a heat grid and are not in the process of being connected.
- Majority of respondents (64,2%) have already taken measures in the past five years. 23% say they might act depending on subsidies or new regulation
- 81,1% still rely on a traditional natural gas boiler versus 14,9% who already use a (hybrid) heat pump.
- 44,7% of respondents are not familiar with the concept of heat grids.
- 25,8% of respondents felt more positive about connecting to a heat grid after completing



Household Characteristics

- Older respondents less willing
- Education level plays a role
- Full-time employed people less willing
- Lot of people that didn't share their income, are willing

Age 18-34 years 130 7,4 2 35-54 years 666 39,7 28 55 years or older 927 55,8 88 Composition Couple without children Family 637 36,3 37 One-person household 313 17,9 15 Single-parent household 7 0,4 0 Education level High (HBO, WO, HAVO VWO) 1.089 62,4 72 Middle(MBO, VMEO) 649 37,2 26 No diploma 7 0,4 0 Employment status Employed full-time Retired 458 26,1 18 Employed part-time 332 19 18 Self-employed 97 5,6 6 Housewife / Houseman/ full-time Care 37 4,9 2 Carer Unable to work 48 2,8 2 Unemployed 14 0,8 1 Free disposable income 0-30% 36 44,8 5 Free disposable income 0-30% 36 44,8 5 <th></th> <th></th> <th>Willing %</th>			Willing %
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Middle(MBO, VMBO)	,5 0,2	0,5 0,2	0,5
No diploma			57,9
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60-80% 172 9,8 10	3 9,8		14,3
•		•	10,6
	2 2,7	•	3,5
Total N=1.754 N= 20			N=733



Building Characteristics

- Respondents living in older buildings tend to be less willing
- Homeowners of newer buildings are more willing
- 50% of people that don't have any plans for Future EER would be willing
- Large group is still in doubt and awaits incentives like subsidies or regulations
- Respondents who just recently did EER less interested



Variables	Category	N	Total	Against	Neutral	Willing
			%	%	%	%
Dwelling age	1971 – 1985	425	24,2	30,3	27,3	23,3
	1986 – 2000	399	22,8	17,4	21,8	22,9
	1945 – 1970	268	15,3	11,4	18,2	15,4
	2001 – 2010	233	13,3	18,4	13,1	13
	before 1945	210	12	15,4	10	12,8
	2011 – 2020	143	8,2	3,5	7,5	8,2
	2020 or later	58	3,3	2,5	1,8	3,4
	l don't know	17	1	1	0,4	1
Moving plans	I do not plan to move, out of my current home	873	49,8	36,8	49,6	61,5
	I don't know	228	13	10,9	15,3	12,6
	I plan to move out of my current home, in over 5 years	181	10,3	13,9	12,4	10,2
	I plan to move out of my current home, within 5 years	308	21,3	38,3	22,7	15,6
Size	100m2 – 149m2	723	41,2	49,3	40,6	41,3
	150m2 – 200m2	303	17,3	17,4	16,1	19,8
	75m2 – 99m2	294	16,8	15,4	15,9	14,9
	50m2 – 74m2	155	8,8	6	9,4	7,2
	over 200m2	128	7,3	5,5	8,6	7,6
	I don't know	115	6,6	4	7,3	8
	30m2 – 49m2	27	1,5	2	1,4	1
	less than 30m2	8	0,5	0,5	0,8	0,1
Туре	Terraced house	552	32,2	34,3	32	30,3
	Apartment	321	18,7	12,4	18,8	21,4
	Detached house	313	18,3	12,9	16,7	17,3
	Semi-detached house	271	15,8	18,9	13,3	15,3
	Corner house	239	14	16,4	15,7	13,1
	Maisonette	17	1	2,5	1	0,1
Future EER	No, I don't have any plans	635	36,2	20,9	30,2	50,9
	Maybe, depending on subsidies or new regulations	404	23	27,9	30,2	18,7
	Yes, I am currently exploring my options	399	22,8	37,8	23,5	11,9
	I don't know / I have not thought about it yet	160	9,1	5	8,4	12
	Yes, I am already working on it or have concrete plans	153	8,7	8	7,6	6,5
Past EER	Yes, 2 years ago (2023)	373	21,3	24,9	24,1	19,2
	Yes, just recently (2024 & 2025)	370	21,1	28,9	18,4	19,4
	No, I never took any measures for a more energy efficient house	352	20,1	16,9	21	21,4
	Yes, more than 5 years ago	275	15,7	10,9	15,1	20,9
	, ,	210	13,7	•	10,1	10,2
	Yes, 3 years ago (2022) Yes, 4 years ago (2021)	210 90	ı∠ 5,1	11,4 3	5,7	4,2
	Yes, 5 years ago (2020)	83	4,7	4	5,7	4,6
			•		•	,
VvE	No, I am not	1.299	74,1	74,6	79	81,9
	Yes, I own my home as part of a VvE (Vereeniging van Eigenaars / Homeowner association)	451	25,7	24,9	21	18,1

Total 1.754

Behavioral Characteristics

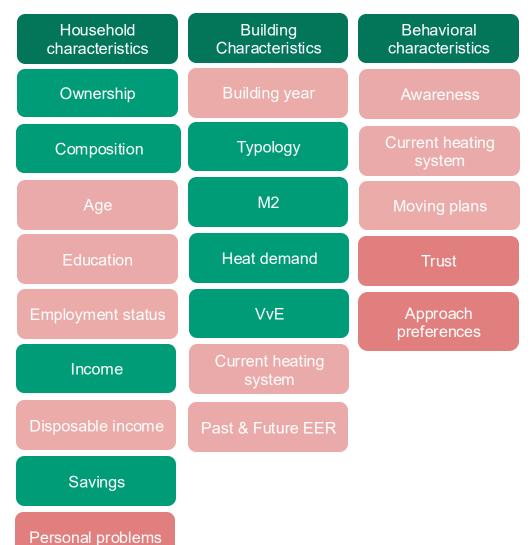
- Respondents with a heat pump are less willing
- People without moving plans are more willing
- Familiarity is a big issue
- Most people are satisfied with their current heating system
- Filling out the survey influenced people's willingness

Variables	Category	N	Total %	Against %	Neutral %	Willing %
Heat grid connection	I am not connected to a heat grid and not in the process of getting a connection	1.444	82,3	41,7	29	11,3
	I am already connected to a heat grid	201	11,5	/	/	/
	I am in the process of being connected to a heat grid	108	6.2	/	/	/
	Is your house connected to a heat grid?	1	0,1			
Current heating system	Natural gas boiler (CV ketel)	1.174	81,1	80,6	82,9	75,7
	(Hybrid) Heat pump	216	14,9	13,4	7,5	13,5
	Collective heating (blokverwarming)	48	3,3	1,5	2,7	1,5
	Solar Heater or PVT	10	0,7	1	0,6	0,5
Moving plans	I do not plan to move, out of my current home	873	49,8	36,8	49,6	61,5
	I don't know	228	13	10,9	15,3	12,6
	I plan to move out of my current home, in over 5 years (after 2030)	181	10,3	13,9	12,4	10,2
	I plan to move out of my current home, within 5 years (before 2030)	471	26,9	38,3	22,7	15,6
	(before 2030)					
Awareness about heat grids	No, I am not familiar	740	44,7	33,8	53,5	47,7
	Yes, from news & media	406	24,5	24,4	22,5	29,2
	Yes, out of own interest	224	13,5	15,4	8,2	8,5
	Yes, municipality campaign	131	7,9	7,5	6,5	4,6
	Yes, from family / friends / neighbors	96	5,8	9	5,1	5
	Yes, energy company advertisement	59	3,6	3,5	2,2	1,5
Personally approached	No	1.588	90,5	93,5	97,1	98,5
	Yes	165	9,4	6,5	2,9	1,5
Reason not willing to connect	I am satisfied with my current heating system	379	56,7	/	/	51,7
	I don't expect a heat grid connection to lower my monthly energy bill	150	22,5	/	/	20,5
	I don't consider a heat grid to be reliable	62	9,3	/	/	8,5
	I have already invested in an alternative heating system	39	5,8	/	/	5,3
	I don't have the financial means for the initial investment	37	5,5	/	/	5
Survey influence	No, not at all	1.157	66	47,3	68,6	82,9
-	Yes, I feel more positive about connecting to a heat network	453	25,8	51,2	27,1	3,8
	Yes, I feel more negative about connecting to a heat network	143	8,2	1,5	4,3	13,2
Willingness to connect	I am neither in favor nor against being connected to a heat grid	510	35,3	/	510	/
	I am totally against being connected to a heat grid	486	33,7	n=486	/	/
	I am against being connected to a heat grid	247	17,1	n= 247	/	/
	I am willing to connect to a heat grid	151	10,5	/	/	n=151
	I am very willing to connect to a heat grid	50	3,5	/	/	n=50
VvE	No, I am not	1.299	74,1	74,6	79	81,9
	Yes, I own my home as part of a VvE (Vereeniging van Eigenaars / Homeowner association)	451	25,7	24,9	21	18,1
Total		1.754				



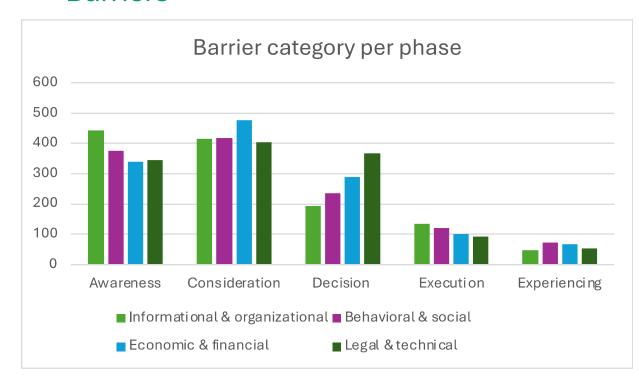
Total 1.754

Significant characteristics for willingness to connect





Barriers



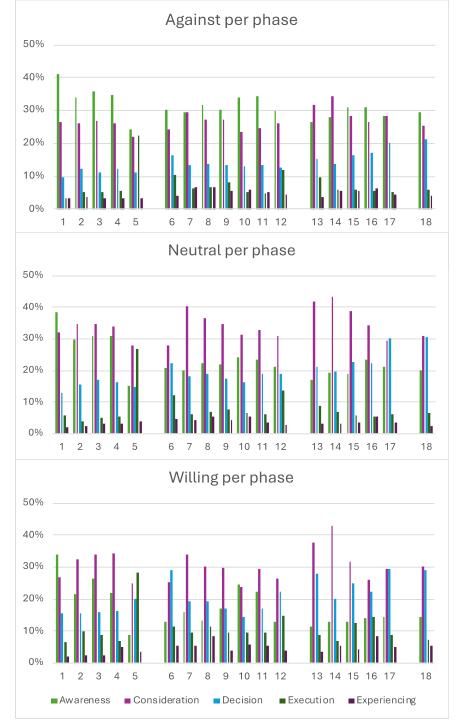




Barriers

- Most barriers in the Awareness and Consideration phase.
 Especially Against group faces most barriers in the Awareness phase
- Trust, in all phases
- Lack of information
- High initial cost
- Uncertainty about longterm cost savings compared to current system
- Perceived risk for monopolistic pricing in later phases





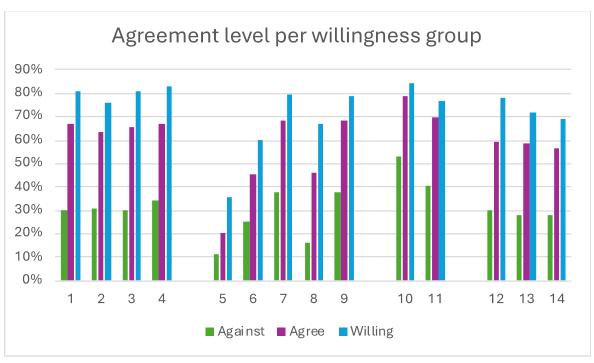
Barriers

Category	Barriers	Against	Neutral	Willing
Informational	1. Lack of information	Х		
&	2. Accessibility of information	Х		
Organizational	3. Information overload	Χ		
	4. Lack of awareness*	Х	X	
	5. Nuisance		X	
Behavioral &	6.Lack of trust in leading party*	X	Χ	
Social	7. Preferring individual heating solutions over collective systems	Χ		
	8.Skepticism about system performance			
	9.Resistance to change from existing heating system		X	
	10.Influence of negative experiences from peers			
	11.No renewable energy source	X		
	12.Too much effort preparing for the connection*	X	X	
Economic &	13.High initial cost*	X	X	
Financial	14.Uncertainty about long-term cost savings compared to current heating system		X	
	15. Perceived risk of monopolistic pricing	X		
	16. Future cost*	Х	X	
	17.Costs of alternatives	X		
Legal & Technical	18.Changing policies		X	



Drivers







Drivers

- Respondents don't agree with social norm campaigns being a driver
- The against group has overall higher disagreement levels
- Lower energy bills are most agreed upon in all groups
- Availability of user-friendly support
- Having trust in the leading party



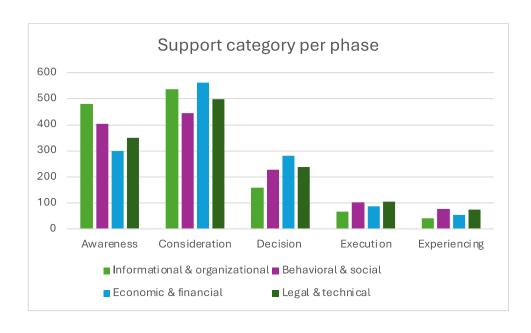


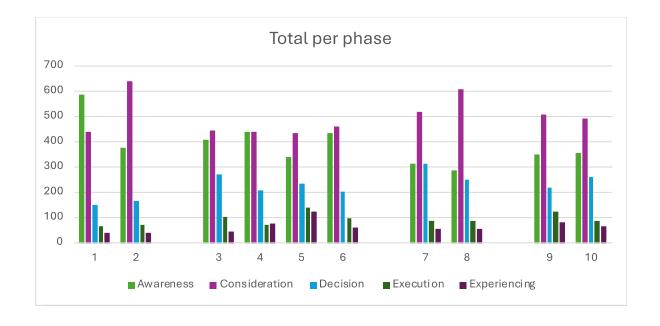
Drivers

Category	Drivers	Against	Neutral	Willing
Informational &	1.Clear overview of the benefits for their household	30%	67%	81%
Organizational	2.Accessible and understandable information	31%	63%	76%
	about the system*			
	3.Transparency about project timeline and	30%	65%	81%
	connection process			
	4. Availability of user-friendly support before, during	34%	67%	83%
	and after connection*			
	Total times mentioned category	920	1340	645
Behavioral &	5.Social norm campaigns, people don't want to be	11%	20%	35%
Social	left behind from their peers			
	6.Positive word-of-mouth recommendations from	25%	45%	60%
	friends/family/neighbors			
	7.Trust in leading party*	38%	68%	80%
	8.The feeling of contributing to sustainability goals	16%	46%	67%
	9. Increased level of comfort in my house	38%	68%	79%
	Total times mentioned category	936	1265	644
Economic &	10.Lower energy bills*	53%	79%	85%
Financial	11.Increased property value	40%	70%	77%
	Total times mentioned category	684	<i>7</i> 59	324
Legal &	12.Energy independence (less reliance on fossil	30%	60%	78%
Technical	fuels)			
	13.Compatibility of heat network with existing	28%	58%	72%
	(heating) systems			
	14.Flexibility to combine heat network connection	28%	55%	69%
	with other measures (energy efficiency measures			
	like insulation or window replacement / aesthetic			
	measures like new kitchen or bathroom)			
	Total times mentioned category	631	889	440



Support



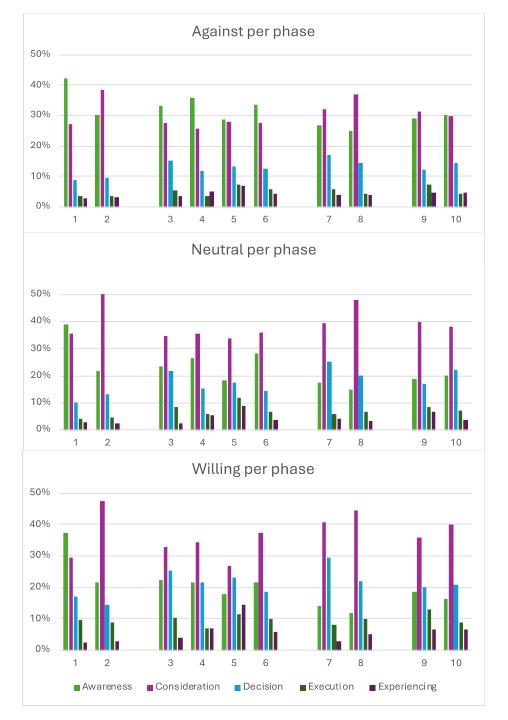




ANALYSIS & RESULTS Support

- Most support needed in the Awareness and Consideration phase.
- Against group slightly more in Awareness phase
- Against and neutral people in Consideration phase
- Financial support measures most mentioned
- Trust



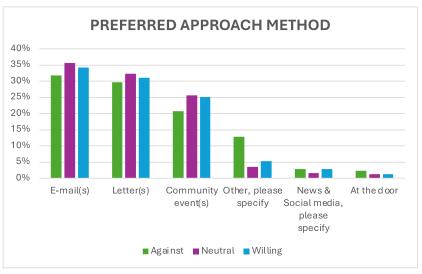


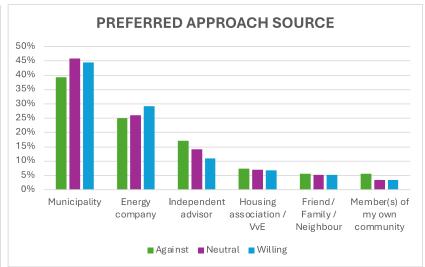
Support

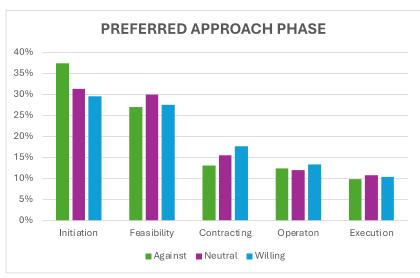
Support measures	Α	В	С	D	E
1.Clear information and education about the benefits and operation	Χ	Х			
of heat grid					
2.More insights about the actual initial investment and other cost		X			
3. Increased trust in leading parties	Χ		X	X	
4. Community engagement with feedback opportunities	Χ				X
5. Customer support incl. service and maintenance				X	X
6. Participation opportunity about the connection process beforehand		X			
7. Usage price stability guarantees		X	X		
8. More financial incentives or subsidies		X	X	X	
9.Option to use heat network for cooling					X
10.Additional legislation that makes a heat grid connection more		Χ	X	X	
attractive					



Approach preferences





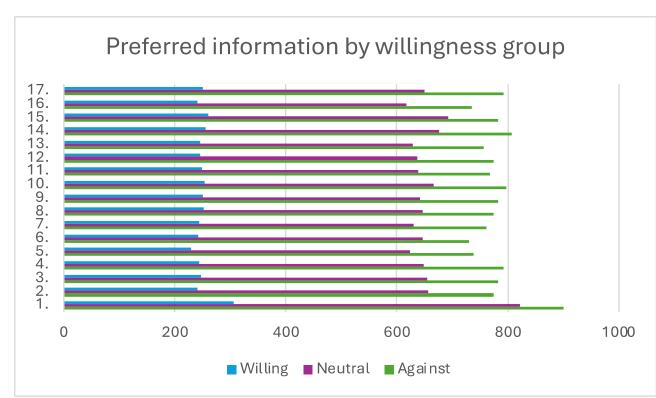




Information preferences

- The initial investment and connection fees
- 2. Explanations about potential benefits
- 3. Explanations about potential disadvantages
- 4. Estimation of potential cost savings on my energy bill
- 5. Information about the impact on my property value
- 6. Information about funding opportunities like loans and subsidies
- 7. Information about which party will lead the project
- 8. Indication about the project duration and timeline
- 9. The works that need to be done in the area prior to the connection
- 10. The work and efforts needed to prepare my house for the connection
- 11. Information about potential nuisance during installation
- 12. Information about technical working of heat grid
- 13. The heat source that will be used
- 14. Information about heat usage cost
- 15. Information about maintenance and support after connection
- 16. Information about why a heat transition would be needed in the first place
- 17. Personalized cost-benefit analysis





DISCUSION

Persona's

	End-user group	Against					Neutral					Willing				
	Phase	Awareness	Consideration	Decision	Excecution	Experiencing	Awareness	Consideration	Decision	Excecution	Experiencing	Awareness	Consideration	Decision	Excecution	Experiencing
Category	Barriers															
≪ =	1. Lack of information	41%	27%	10%	3%	3%	38%	32%	13%	6%	2%	34%	27%	15%	6%	2
nal	2. Accessibility of information	34%	26%	12%	5%	4%	30%	35%	15%	496	3%	21%	32%	15%	10%	
Information Organizatio	3. Information overload	36%	27%	1196	5%	3%	31%	35%	17%	5%	3%	26%	34%	16%	9%	
	4. Lack of awareness*	35%	26%	12%	6%	3%	31%	34%	16%	5%	3%	22%	34%			
	Nuisance	24%	22%	1196	22%	3%	15%	28%	15%	27%	496	9%	25%	20%	28%	3'
	6.Lack of trust in leading party*	30%	24%	17%	10%	4%	21%	28%	22%	12%	5%	13%	25%	29%	11%	
	7. Preferring individual heating solutions over						ı									
	collective systems	29%	29%	14%	6%	7%	20%	40%	18%	6%	496	16%	34%	19%	9%	5
Socia	8.Skepticism about system performance	32%	27%	14%	7%	7%	22%	36%	19%	7%	5%	13%	30%	19%	11%	8
	9. Resistance to change from existing heating	30%	27%	13%	8%	5%	22%	35%	17%	8%	496					
ral	system	30%	2796	1390	0%0	390	2290	33%	1/90	890	490	17%	30%	17%	9%	4
avio	10.Influence of negative experiences from	34%	23%	13%	5%	6%	24%	31%	16%	6%	596					
eh.	peers	100 (100)					2000,000					24%	24%			
I "	11.No renewable energy source	35%	25%	13%	5%	5%	24%	33%	19%	6%	4%	22%	29%	17%	9%	5
1	12.Too much effort preparing for the	30%	26%	13%	12%	4%	21%	31%	19%	14%	396	10000	12/22			
	connection*						l					1370	26%	22%		
	13.High initial cost*	27%	32%	15%	10%	4%	17%	42%	21%	9%	396	11%	38%	28%	9%	3
al co	14.Uncertainty about long-term cost savings	28%	34%	14%	6%	6%	19%	43%	20%	7%	3%					
nci nci	compared to current heating system											13%	43%	20%		
Econom	15. Perceived risk of monopolistic pricing	31%	28%	16%	6%	110000	19%		23%	6%	4%	13%	32%	25%		
n n	16. Future cost*	31%	27%	17%	6%	6%	23%	34%	22%	5%	5%	14%	26%	22%		
	17.Costs of alternatives	28%	29%	20%	5%	5%	21%	29%	30%	6%	4%	14%	29%	29%	9%	5
& cat		1					l					I				
Legal	18. Changing policies	29%	25%	21%	6%	4%	20%	31%	30%	6%	2%					
Je Le												14%	30%	29%	7%	5
	Support measures															
	1.Clear information and education about the															
1	benefits and operation of heat grid	42%	27%	9%	4%	3%	39%	35%	10%	4%	3%	37%	29%	17%	9%	2
1	2. More in sights about the actual initial					2,000,000						100000000000000000000000000000000000000				
1	investment and other cost	30%	38%	10%	4%	3%	22%	51%	13%	5%	2%	21%	47%	14%	9%	31
1	3. Increased trust in leading parties	33%	28%	15%	6%	4%	24%	35%	22%	8%	2%	22%	33%	25%	10%	
1	4. Community engagement with feedback						7.000	177.67								
1	opportunities	36%	26%	12%	4%	5%	26%	35%	15%	6%	5%	21%	34%	21%	7%	7
1	5. Customer support incl. service and															
1	maintenance	29%	28%	14%	7%	7%	18%	34%	17%	12%	9%	18%	27%	23%	11%	14
1	6. Participation opportunity about the	1.00.000														
1	connection process beforehand	34%	28%	12%	6%	4%	28%	36%	14%	6%	4%	21%	37%	18%	10%	60
1	7. Usage price stability guarantees	27%	32%	17%	6%	4%	17%	39%	25%	6%	4%	14%	41%	29%	8%	
1	8. More financial incentives or subsidies	25%	37%	14%	4%	4%	15%	48%	20%	6%	3%	12%	44%	22%		
1	9. Option to use heat network for cooling	29%	31%		7%	5%	19%	40%	17%	8%	6%	18%	36%	20%		
1	10.Additional legislation that makes a heat	25%	3170	1270	7 70	370	1370	4070	1770	070	070	1070	3070	20%	1370	0
1	grid connection more attractive	30%	30%	14%	5%	5%	20%	38%	22%	7%	4%	16%	40%	21%	9%	60
1	Drivers	5070	0070	1470	070	070	2070	5070	2270	770	470	1070	4070	2170	570	0
	Clear overview of the benefits for their household	х	Х				x					x	X	X		
Informational & Organizational	2.Accessible and understandable	 ^	^				^					^	^	*		
tor	information about the system*						1					l				
nati	3. Transparency about project timeline and						1									
forr	connection process						1						Х	Χ	х	
= 0	4. Availability of user-friendly support before,						l							100	**	
1	during and after connection*		X	X	X	х	l							x	X	X
	5. Social norm campaigns, people don't want						1									
=	to be left behind from their peers	l					l					I				
ocial							1					l				
& So	6.Positive word-of-mouth recommendations from friends/family/neighbors						1					l				
72	Inom mends/family/neignbors															
avioral	7.Trust in leading party*	Х	X					X	X	X	X	āk sa		X	X	х
Beh	8. The feeling of contributing to sustainability															
m	goals											l				
	9. Increased level of comfort in my house		X		X	Х	X	Х	X		Х					
· 80	10.Lower energy bills*															
omic	TOTAL OTTO STORY DATE	Х	X	X		X	X	X	X		X	Х	Х			X
	11.Increased property value	v				v	v				v	l				
		Х				X	X				X	l				
	12.Energy independence (less reliance on						1					l				
	fossil fuels)	l					l					I				
n S	13.Compatibility of heat network with existing	l					I					I				
& Technical	(heating) systems	l					I					I				
× T	14. Flexibility to combine heat network	l					1					l				
Legal	connection with other measures (energy	l					l					I				
Le	efficiency measures like insulation or window replacement / aesthetic measures like new	l					l					I				
1	kitchen or bathroom)	l					l					I				



DISCUSSION

Strategies & Persona's

Jan, The Resistant Traditionalist:

- Retiree in a minimally insulated 1970s detached or rowhouse with a gas boiler
- Lives on a fixed pension, so is cautious about financial risk, but has paid off his mortgage already
- Potentially wants to move to a smaller place within 5 years
- Shows resistance to change from status quo.
- Lower / high education level

Barriers:

- Not aware of heat grids and sees no need to switch
- Fears higher costs and disruption
- Distrust in municipality or energy provider (monopoly, hidden future costs)
- Scepticism about system performance

Drivers (potential):

- Strong financial support or subsidies, like lower energy bills
- More insights about actual investment and other cost
- Boiler breaks or sharply rising gas prices
- -Trusted peer recommendations could potentially reach him
- -Availability of user-friendly support before, during and after connection
- Increased trust in leading party

Engagement style:

- Avoids promotional campaigns

Strategy:

- Inform and educate subtly through trusted local figures
- No top-down messaging
- Address fears with peer stories
- Handle installation with extreme care and respect for comfort



Sophie, The Cautious Considerer:

- -Middle aged in a 1980s semi-detached house with moderate insulation and a gas boiler
- Middle income, limited disposable budget
- Her house has some past EER like double glazing, but she is not necessarily exploring future options
- Satisfied with current gas heating and values stability
- Open but he sitant
- Higher education level

Barriers:

- Concerned about upfront costs, unclear payback period, and reliability
- Cost of alternative
- Trust issues with institutions and conflicting information
- Limited awareness (only via news & media)

Drivers:

- Interested in saving on energy bills
- More insights about actual investment and other cost
- Peer recommendations could boost confidence
- Increased trust in leading party
- Increased level of comfort
- Increased property value

Engagement style:

- Responds well to simple, relatable, non-technical information
- Prefers trusted messengers, such as independent experts or peers
- Overload of complex details could demotivate

Strategy:

- Us e relatable personal examples & trusted messengers
- Tackle financial and reliability concerns with calculation tools and peer examples
- Provide guarantees and support & maintenance after connection
- Minimize nuisance and disruption with good planning

Currently in phase: Awareness/Consideration

Mark, The Enthusiastic adopter:

- Middle-aged, high educated homeowner
- Lives in a well-insulated semi-detached house (1990s) with stable, high income and savings
- Environmentally conscious: proactively informed himself via news and research
- No moving plans and has just taken other EER measures like extra insulation and is currently exploring future options

Barriers:

- Information overload
- Uncertainty about long-term cost saving compared to current heating system
- Too much effort preparing for the system

Drivers:

- Clear overview of the benefits for his household
- More insights about actual investment and other cost
- Transparency about the project
- Availability of user-friendly support
- Trust in leading party
- Energy savings, future-proofing home, sustainability goals
- relatively strong trust in public institutions and project initiators

Engagement style:

- Actively participates in community meetings and reads municipal updates
- Responds well to clear, detailed information like cost calculators

Strategy:

- Maintain momentum with clear, timely, and personalized communication
- Keep informed through early project updates and be transparent
- Offer cost-benefit tools and legal clarity to confirm decision
- Make sign-up process simple and supportive
- Ensure smooth installation and responsive support
- Train them as grid coach to motivate others

Currently in phase: Consideration / Decision

DISCUSSION

Strategies & themes

Awareness & Lack of information

- Launch coordinated publicinfo campaigns (local media, peer sessions, coaches)
- Use visual and simple language to explain heat grid concepts
- Tailor information to different literacy levels and demographics
- Create 1 access point for FAQs, helpdesk, or guided explanations

Trust & Engagement

- Involve local community members and homeowner associations
- Use independent experts to validate technical and financial plans
- Co-create and maintain two-way dialogue
- Publish updates on budget, pricing, and decision-making transparently
- Be present and visible for people to address concerns and have someone to talk to

Financial Support

- Offer upfront subsidies and collective discounts
- Partner with involved stakeholders to provide transparency and best price
- Guarantee fixed or predictable pricing to reduce uncertainty
- Provide personalized cost-saving estimates and property value insights

Technical & Practical Support

- Provide a one-stop-shop model for home prep and upgrades
- Offer personal assessments and clear installation timelines
- Reduce nuisance: coordinate works, offer temporary solutions
- Ensure smooth handover and ongoing support after connection



CONCLUSION

How can different end-user groups be effectively engaged in the heat grid implementation process by project initiators to optimize their willingness to connect?

- The Enthusiastic Adopter

- 1. Identify: Classify potential end-users using observable characteristics (ownership type, building type, income level, etc.)
- 2. Predict: Map these user profiles to one of the three personas to understand likely barriers and drivers.
- 3. Engage Early: Build trust and awareness in the Initiation and Consideration phases using appropriate channels (Like municipality-led approach, personalized home visits, peer ambassadors).
- 4. Tailor: Customize the approach method and information based on the persona's needs, ranging from low-effort, personal situation-based communication to participatory co-creation. OR Customize the approach method and strategy based on the key barriers that need to be addressed in the specific project context



Building Characteristics - Current heating system End-users' influence Willingness to Household characteristics connect - Age Education Income - Other personal problems **Behavioral characteristics** increase - Trust - Awareness - Previous EER Mitigate barriers with **CHOOSE PERSONA STARTING** extra support & tailored **POINT** approach per phase or The Resistant Traditionalist barrier theme The Cautious Considerer

LIMITATIONS

- Phases are subjective and hard to define, especially during interviews
- Since survey conducted among end-users> in the answers more focus on the end-user decision making journey. The project phases have been included, but outcome could be questionable
- The persona-based approach offers valuable insights, but reallife households often show hybrid characteristics. Therefore, they should function as flexible starting points rather than fixed categories.
- Self-reported data and social desirability bias
- Attitudes, willingness to connect, or trust in stakeholders could evolve as the heat grid develops or as national policies change
- Stakeholders interviewed were primarily already involved in the projects, which might have skewed perspectives toward more informed or favorable views

- Longitudinal studies on behavior over time Follow households throughout a heat grid project to understand their decision-making process on a deeper level
- Effectiveness of engagement strategies test different engagement strategies on a group of participants to see what actually works
- Evaluate satisfaction, regret, comfort, cost perception, and recommendation likelihood after connection
- Include more underrepresented groups: young people for example. It can be useful to already develop strategies for future homeowners
- More statistical evidence
- Changing policy influences (like Wet Collectieve Warmte)

FUTURE RESEARCH



THANK YOU FOR LISTENING

QUESTIONS???

